System Dynamic Framework for Analyzing Organizational Stress: United States Postal Service Case Study

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I would like to thank my beloved friends from SDM cohorts of 2012 and 2013, all of whom I miss dearly. Being in the same classroom with you and learning from you was a pleasure, and an honor.

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LIST OF FIGURES

ABSTRACT

Stress, both individual and organizational, appears to be an increasing problem in any society, and more so in organizations. It already is taking a significant toll on corporate and national levels. Slow recovering economy and pressures on bottom lines, especially for financially constrained organizations, further emphasize the problem and call for new solutions. This paper explores two aspects of stress – individual and organizational. Our goal was to provide a systems dynamic framework that organizations, as well as individuals, can use to improve the understanding of the physiological and psychological stress loads, as well as understand their relationship to organizational key performance indicators. Like many natural systems, human body is the ultimate limited system. The main benefit of the proposed framework will be the ability to monitor cumulative variables of the functional capacity of human body to process stressors, and the mental and emotional capacity of employees to carry out their duties.

INTRODUCTION

Why is it important to build a systems framework for understanding organizational stress? According to recent studies (1) (2), recovering economy and declining unemployment rate are yet to show their effect on the rising work stress levels. Furthermore, work stress is established to be the leading cause of stress for American adults in general (3), and is closely associated with workplace violence. Understandably, the survey discovered that poor pay, unreasonable working loads and rather negative work environment and management attitude issues were the leading stressors. We commonly come across numerous "least" and "most" stressful jobs (4) (5) (6), however we must also remember that often the decisive factor is not the nature of job, but many factors of perceptive nature (7) (8) and the complicated set of factors that comprise the working environment.

As a subject of our study, we have chosen one of the biggest and most important organizations in the United States – the United States Postal Service (USPS). Over the past two decades, there were a number of violent incidents occurred in USPS offices, and the statistics of non-violent work environment assessments are alarming (9). The extensive media coverage of these unfortunate events earned them the slang name of "going postal". While it was established that "*Postal employees are no more likely than those in the national workforce to physically assault, sexually harass, or verbally abuse their coworkers.*" (9), it is important to take a system perspective on the issue of work stress, considering the planned job cuts, revenue driving transaction volumes decline and the general atmosphere of uncertainty associated with these events.

In the this paper, we begin, in Chapter 1, by reviewing USPS history including the history of workplace violence within USPS. In Chapter 2, we explore individual and organization stress. In Chapter 3, we summarize the fundamentals of Systems Dynamics to provide the reader an overview to the field. Chapter 4 and Chapter 5 use the concepts of Systems Dynamics to provide a systems framework for understanding both individual and organizational stress, respectively.

In Chapter 6, an integrative framework, using Systems Dynamics, is presented for exploring the interaction of individual and organizational stress. This chapter devises a conceptual framework for understanding employees' capacity to process stress, and its relationships both with organizational key performance indicators and variables of personal nature. Our proposed framework will likely be useful if coupled with the "big data" approach: harvesting the significant volumes of employee information within large organizations.

Our intention is to build a system dynamic conceptual framework that will focus not on measuring stress levels, but on measuring the capacity of an individual to process stressor inputs and maintain equilibrium (the ability to recover from stress). This paper builds on research on stress on individual, group and organizational levels, as well as on researches on USPS in an effort to understand how system dynamic can help to gain better understanding of the nature and relationships of processes throughout USPS workforce.

The important contributions of this thesis are:

1. Two separate system dynamic frameworks for individual and organizational stress. While the latter is an extension of the former, in each case we have considered factors and structure that can be expanded into full standalone models;

2. A joint framework that recognizes the cumulative nature of a number of stress related variables, most importantly - individuals' limited capacity to process stressor inputs, both objective physical and perceptive.

3. A basis for a comprehensive algorithm that, if applied to large datasets like those of corporate HR departments, can provide interesting insights into employee well – being, existing stressors and will allow the establishment of tangible relationship between perceptive factors and organizational key performance indicators.

4. The capacity to allow for stress management in a significantly better (or perhaps efficient) manner: We know that shorts bursts of stress have a beneficial outcome – increase in performance, arousal, etc. We also know that extended exposure to stressors can have rather negative outcomes in the forms and apathy, burnout and various diseases. The framework enables individuals and organizations manage personal and group efforts (resources) in a more efficient manner.

CHAPTER 1

UNITED STATES POSTAL SERVICE

ABSTRACT

The major aspects of USPS, relative its recent history, are reviewed. The USPS is understood as an organization through the lens of its recent fiscal difficulties. Structure, operations and prospects under current environmental factors are considered.

1.0 Introduction

In this chapter, we explore one of the most important organizations in the United States – the United States Postal Service. We dissect various aspects of USPS as an entity. In section one we reflect on USPS history, giving a brief overview of its history, current legislative standing and financial status. In section two, we look at USPS operations from perspective of efforts to maintain service standards and resources that USPS has carry out its duties. We also look at proposed infrastructure and staff cuts. In chapter 3, we look at the serious issues USPS employees have had over the years – the issue of workplace violence and negative attitudes towards management and workplace environment. In chapter 4, we summarize our research of USPS as a complex socio technical system.

1.1 Overview of the USPS

United States Postal Service (USPS) is an independent agency of the Federal Government and is almost as old as the USA itself: the cabinet level Postal Service was created in 1792 and its establishment was stipulated by the Constitution of the United States. Today USPS mission is defined by Section 101(a) of Title 39 of the U.S. Code (Postal Reorganization Act): "... *the obligation to provide postal services to bind the Nation together through the personal, educational, literary, and business correspondence of the people. It shall provide prompt, reliable, and efficient services to patrons in all areas and shall render postal services to all communities*".

This legal burden to provide baseline post services to every resident in the country is commonly referred to as United Service Obligation (USO). As of today, USPS is the only carrier with legal obligation

to provide entire range and scope (geography, facilities, service frequency, etc.) to every household and business in US. With $ 65 billion in revenues in 2012, it delivered more than 40 % of worldwide mail (USPS Facts, 2013). In 2013, USPS was ranked as the 4th most trusted company in US and 'Most Trusted Government Agency for the 7th year in a row (10).

Two milestone events have shaped USPS throughout its history – **1)** the Postal Reorganization Act of 1970, and **2)** the Postal Enactment and Accountability Act (PAEA) of 2006. Both of these were major reforms, and were conducted to address pressing social and financial issues that Postal Service was facing at the respective times. We will examine those in further detail in below.

In terms of its organizational and high-level management structure, USPS is governed by the Congress, as it sets the legal framework USPS operates in. Title 39 of US Code (Postal Code) is entirely dedicated to USPS.

The policy setting body of the USPS is The **Board of Governors**, which is an eleven-member body. Nine members are appointed by the President of United States, and are approved by the Congress. These nine members choose the Postmaster General, whose role is similar to that of the CEO in a corporation and who is a member of the Board. These 10 members then elect the Deputy to the Postmaster General, and hence the 11-member board is formed.

The **Postal Regulatory Commission** oversees USPS. The Postal Regulatory Commission is an independent establishment of the executive branch of the Government of the United States. This PRC body was created by the Postal Reorganization Act of 1970 as a "countermeasure" to balance with the new liberties given to USPS. The PRC was further reorganized by the 2006 PAEA. More freedoms given to USPS were designed to be balanced by stronger overseeing powers given to the PRC.

As in the case of Governors, the President, with the approval of the Congress, appoints members of the PRC (the Commissioners). Members of the PRC are professionals with experience in economics, accounting, law, or public administration. Every 5 years the PRC submits a report to the President and the

Congress, which is a list of recommendations of legal amendments that could improve USPS effectiveness and efficiency of operations.

Looking at the history of USPS, two milestone events stand up as having the most effect in the way USPS functions today:

1. **1970 Postal Reorganization Act (PRA)**, which marked the establishment of the USPS as we know it today;
2. **2006 Postal Accountability and Enhancement Act (PAEA)**, which introduced significant changes to USPS structure and how it operates. Namely, it introduced the requirement for USPS to prefund its future health care benefit payments to retirees for the next 75 years over a 10-year time span.

We will look with more detail into both of these milestones.

1970 Postal Reorganization Act

Unlike other government agencies, today USPS is a self-funded entity and does not rely on taxpayers' money to fund its operations. This was not the case before 1970. Before reorganization, the Postal Service was a cabinet level Department, and was called the Post Office Department (POD). The POD existed in that form 1792 to 1971 and throughout this time it functioned much like other government agencies – its operations were tax-supported. However, today USPS solely relies on the sales of its services (postage, mail products and services) to fund its operations. Having been an institution with over 170 years of history, it is interesting to understand what where the driving factors for the change.

The change did not come easy and was a result of significant events, namely – one of the largest strikes in US history. This even was interesting in that

a. It was against the Federal Government, and
b. This was one of the biggest wildcat strikes in US history (i.e. strikes not approved by work unions).

Several important factors contributed to the strike, mainly wages, working conditions, the treatment of black workers (since many white workers left for jobs with discriminatory hiring), and the general up rise of civil rights movement in the 50s and 60s (11). Years of underfinancing and vague management structure had brought the POD staff and facilities to the state where they could no longer adequately function. Interestingly, in many cases mail handling has not changed significantly since the beginning of the century (12). At that time, postal workers were amongst the lowest paid employees in US. Some consider the trigger for these events to be the decision of the Congress to increase its wages by 41%, while increasing postal workers' wage only by 4%. However, the reasons span further and included the fact that in addition to lower wages, POD was overwhelmed by increased post-World War 2 mail volumes (13).

The strike had a devastating effect on US economy, and the range of affected entities span from the stock markets to the National Guard. The stock markets nearly stopped functioning (14), while the latter were called into action by President Nixon to distribute mail.

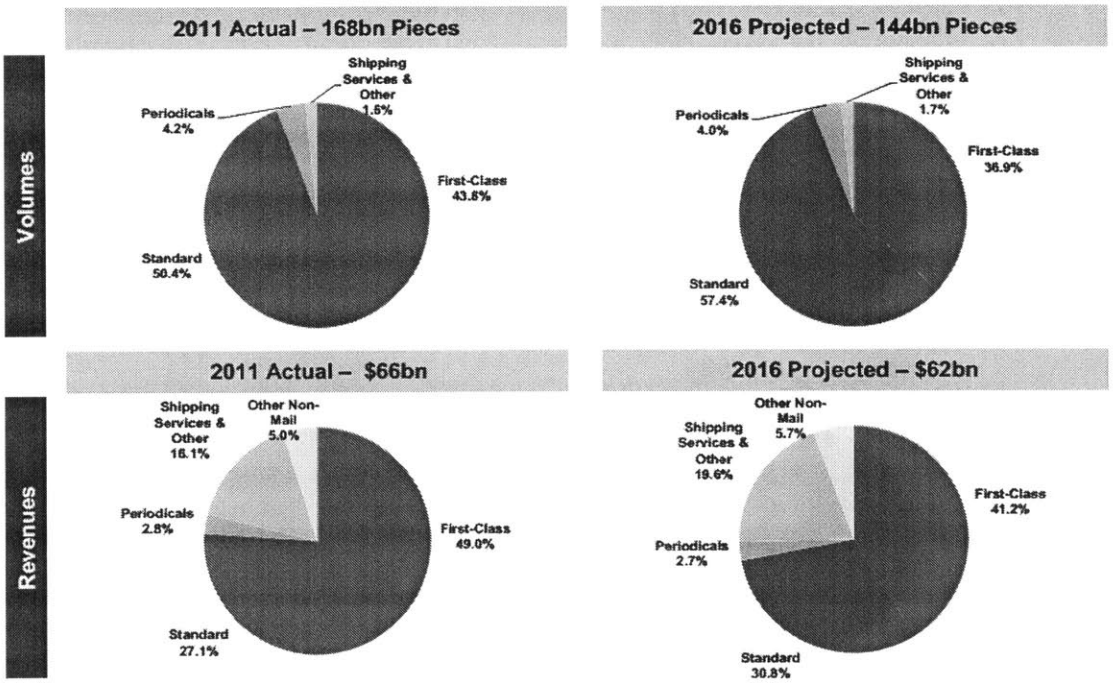
It took President Nixon's immediate intervention to end the strike and alleviate the consequences. The strike had several important outcomes, which took legal shape in the Postal Service Reorganization Act. In effect, the Act laid the foundation of the USPS as we know it today - an independent agency with an official monopoly on the delivery of mail in the United States. The first paragraph of the act mentions, "*The costs of establishing and maintaining the Postal Service shall not be apportioned to impair the overall value of such service to the people.*"

To ensure that the newly established USPS is financially self-sustainable and efficient, several improvement programs were initiated. A system for establishing mail classification and respective mailing rates was created. To make the pricing and mail classification processes (and other significant decisions made by the Postmaster General) transparent, a separate independent entity – The Postal Rate Commission (**PRC**) was established.

This decision making two-fold structure remains until today. While under the PAEA the PRC was also reorganized, still key policy decisions have to be processed by both entities (USPS and the PRC). As we will see further, this management structure inherently introduces delays into the system, and is likely to be one of the reasons for system oscillations (15).

Since USPS was not required to make profit, with the flexibility in the rate setting issue, it was able to decide how to reflect changes in mail volumes in rate policies mail categories (16). Hence, USPS could assign different cost contributions to different mail categories. This was financially and operationally a sound strategy, since mail classes differed in their features, prices and sorting requirements. These mail classes also differed (and still differ) significantly in their volumes and revenue contributions.

For example, "*Four main product lines — First-Class Single Piece, First-Class Workshare, Standard Regular, and Standard Enhanced Carrier Route (ECR) — provided 75 % of revenue, 94 % of volume, and 86 % of contribution in FY 2010.*" (17)



Source: Volume includes total mail only. Revenue includes mail and ancillary and special services revenue

Source: Plan to Profitability, 5 Year Business Plan, February 16, 2012

Another important outcome of the strike was the right of ***collective bargaining***: USPS employees were granted the right to negotiate wages, benefits and working conditions. It should be noted that the Act **did not** give postal employees the right to strike. In addition, these events brought about the creation of the largest postal workers union in the world –The American Postal Workers Union (APWU) (18).

From job stress and environment point of view, we can make interesting observations: while the PRA provided financial and some work environment improvements over previous condition, it is not necessarily true that psychologically, and from the viewpoint of fairness perception, these improvements were significant. There is empirical evidence to suggest that employees' perception of fairness is correlated with their well-being (19). There is also research to suggest that uncertainty in the context of workplace reorganization cased increase in stress and in systolic blood pressure among employees (20). There is research to support the idea that it is not union membership, but rather the perception of involvement and consultative management that have positive effect on worker well-being (21).

It is safe to assume that the prohibition to use strikes to enforce their rights put USPS employees in a stressful environment: employees had the right to bargain, but they were deprived of the right to actively defend their rights, which we believe is a significant uncertainty. The conditions stipulated by the PRA of 1970 remained virtually unchanged up to recently.

Postal Accountability and Enhancement Act (PAEA) of 2006

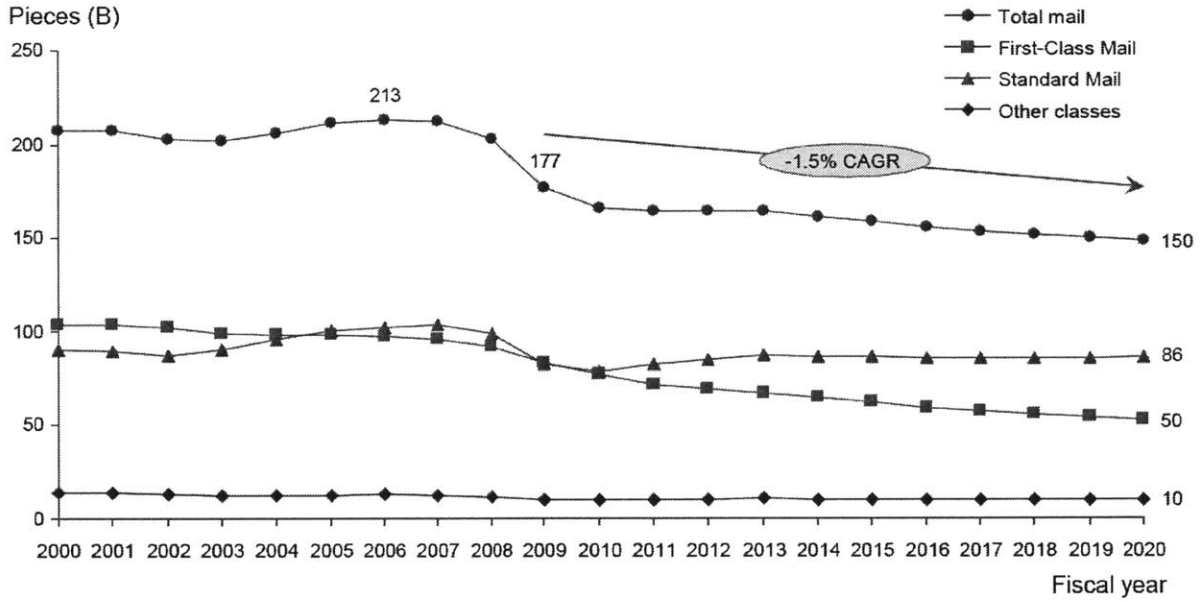
Another major USPS restructuring took place in 2006 and was stipulated by the Postal Accountability and Enhancement Act (PAEA). This act was introduced in an effort to address several important challenges presented by internal and external environmental factors, however as we will see, it also was the reason for current fiscal problems of the USPS.

While PRA of 1970 created a system that allowed for the functioning of USPS for almost 3 decades, the then newly created USPS was a rather rigid system and could not quickly respond to changing realities and market needs (22): and the environment was changing quickly indeed.

Several important technological and ecosystem events provided grounds for this document. Two factors stood out as the main change agents in USPS ecosystem: **1)** loss of high margin products to competition and **2)** new market realities (more specifically, electronic means of communication, the Internet).

Mail volumes: These changes were predicted as early as in 1982 in the report by the Office of Technology Assessment ("Implications of Electronic Mail and Message Systems for the U.S. Postal Service", August 1982). Today IT systems and the Internet have enabled the virtualization of entire business processes, effectively changing how businesses and individuals interact: letters, catalogues, periodicals and many other previously printed media are communicated via electronic means.

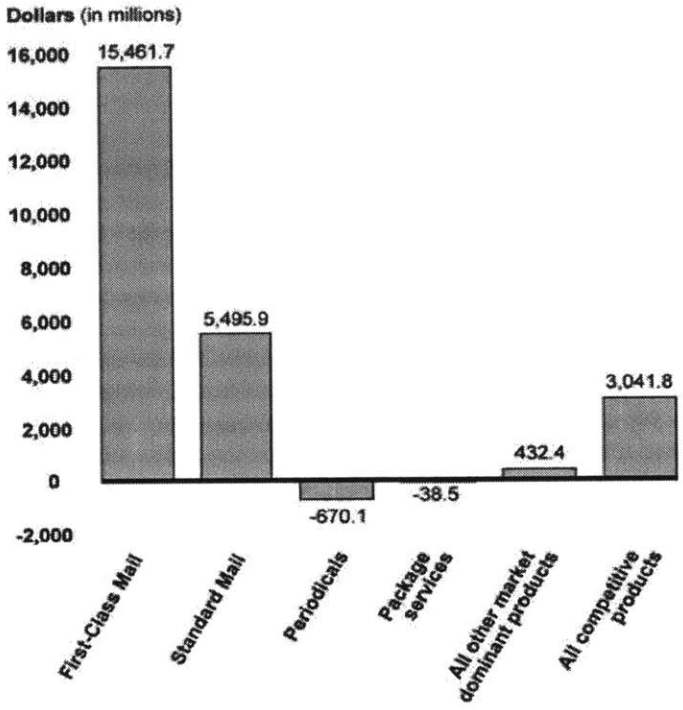
In 2010, the Boston Consulting Group published a report in which it projected anticipated mail volumes.



Source: the Boston Consulting Group, Projecting USPS Mail Volumes to 2020

While the study was sensitive to assumptions like strength of the economy, however it demonstrated that "*robust economic growth will not salvage declining volumes*". The same study concluded that the declining mail volumes are ***unlikely to reverse***.

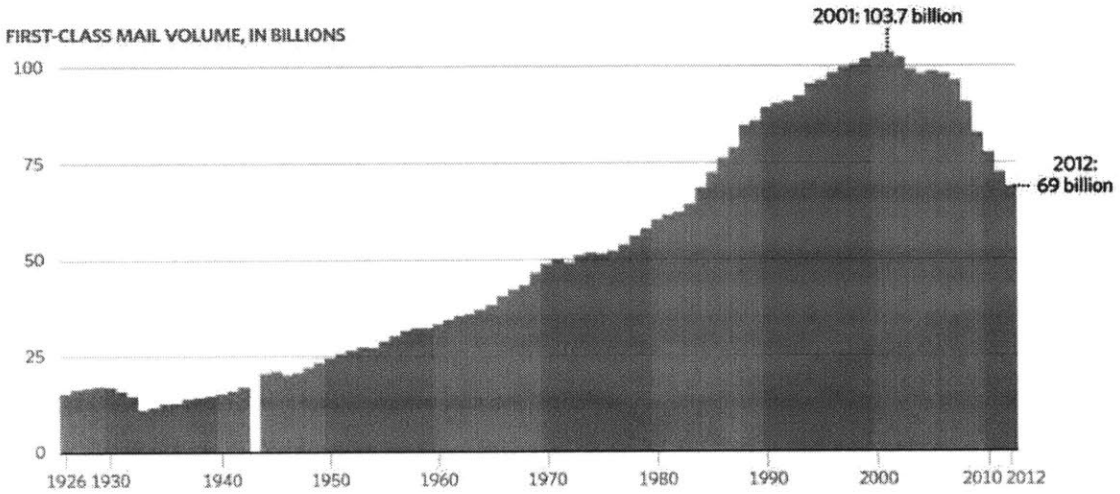
Competition: As mentioned before, while USPS offers a number of mail products, not all make the same contribution to its profits. The highest revenue driving mail class fro USPS has always been the First Class mail. Below is the Profit from Market Dominant Products and All Competitive Products, Fiscal Year 2012:



Source: United States Government Accountability Office, Report to Congressional Requesters, USPS: Opportunities to Increase Revenue Exist with Competitive Products; Reviewing Long-Term Results Could Better Inform Promotions Decisions, GAO-13-578, June 2013

As of early 2000's, USPS's express mail market is continuously declining. According to research, USPS handled circa 45 % of the total market in the mid-1970s to around 6 % in 1999. To put this into perspective, FedEx had circa 50% of that market at the same time (23). Data that is more recent indicates

that First Class mail volumes peaked in 2001 and have since been declining since, leaving USPS with significant redundant capacity.



Source: USPS, "First Class Mail Volume Since 1926"

It was due to these concerns that US General Accounting Office (GAO) placed USPS on the High Risk entities list in 2001. Other than declining mail volumes and revenues, GAO mentioned the following reasons:

- Continuing increase of borrowing to fund its operations
- Deferral of capital investments and hence, inability to update infrastructure
- Increasing competition
- Organizational rigidity enforced by statutory requirements that does not allow for timely response to changing market realities
- Continuous conflicts with PRC on pricing issues and with unions on labor agreements

Other USPS internal issues further aggravated these largely external factors, which were mentioned in GAO 2006 report on mail delivery standards (24). Some findings are mentioned below:

- USPS mail delivery standards and performance for several types of mail have not been updated in a number of years. As a result, these could not be used to for setting realistic expectations for timely mail delivery, measuring delivery performance, or improving service, oversight, and accountability.
- USPS's measurement and reporting gaps are an impediment to diagnosing delivery problems and assessing the extent to which USPS is meeting its statutory requirements to provide prompt and reliable service to patrons in all areas of the United States.
- USPS's rate of progress in developing a set of delivery performance measures for all major types of mail has been slow and inadequate
- USPS has failed to implement several key recommendations that have been made since the early 1990s to improve its delivery standards and measure delivery performance. Committees consisting of representatives of USPS and the mailing industry made these recommendations in 1992, 1997, 1999, and 2004.

All these factors combined called for immediate action. Supported by market evidence of declining mail volumes (Annual Reports to Congress, Postmaster General), the Postal Accountability and Enhancement Act was signed on December 20, 2006.

The act introduced circa 150 changes to postal law, with most important being the following (25):

- Establishment of new system for mail classification and rate setting. Namely, the categories of competitive and market-dominant mail products were established. This was done in an effort to provide USPS with more decision-making flexibility;
- As a balancing mechanism to the added flexibility, PRC was also replaced with a more powerful Postal Regulatory Commission;

- ***Requiring the USPS to prefund its future retiree health benefits by establishing the Postal Service Retiree Health Benefits Fund***. This is a rather unique requirement to which no other federal entity is subject to.

While there is much debated about the latter issue, some analysts have come to conclude that "*the prefunding requirement coupled with the restrictions on raising postage rates were a deliberate attempt to undermine the fiscal solvency of the agency and promote the privatization of mail and package delivery*" (26) and have referred to it as "*the manufactured crisis*" (27). Today, the requirement to prefund employee health benefits is considered to be the heart of USPS's fiscal problems and is subject of an on-going heated debate.

1.2 USPS Operations

USPS operations and capacity-planning decisions today are driven by its increasing financial difficulties. Both the number of facilities and employees have been scheduled to reduce further.

USPS operates a sophisticated network of offices, processing and distribution centers and other facilities that enable it to carry out its mission of providing services to every US household and business. One of the important outcomes of the 2006 PAEA were the service standards, which represent service levels USPS aims to provide to its customers. USPS is required to publish and update these standards every quarter. They are officially defined as "A stated goal for service achievement for each mail class." These standards are the primary operational goals, and hence define the operational and organizational fidelity of USPS. In essence, they define the time a certain type of mail will take to reach form an origin ZIP code to a destination ZIP code.

Today USPS categorizes mail in 6 classes, based on their features, service levels, prices and other requirements, as shown in the table below:

Class of Mail	Speed	Low Cost	Free Forwarding and Return	Extra Services	Incentives
Priority Mail Express	Yes	No	Yes	Yes	Yes
Priority Mail	Yes	Some options, yes	Yes	Yes	Yes
First-Class Mail	Yes	Yes	Yes	Yes	Yes
Standard Mail	No	Yes	No	Only for parcels	Yes
Periodicals	Yes	Yes, for In-Country	Free Forwarding for 60 days	No	Yes
Package Services/Standard Post	No	Yes	No	Yes	Yes

Source: USPS

Under PAEA, two product classes were established:

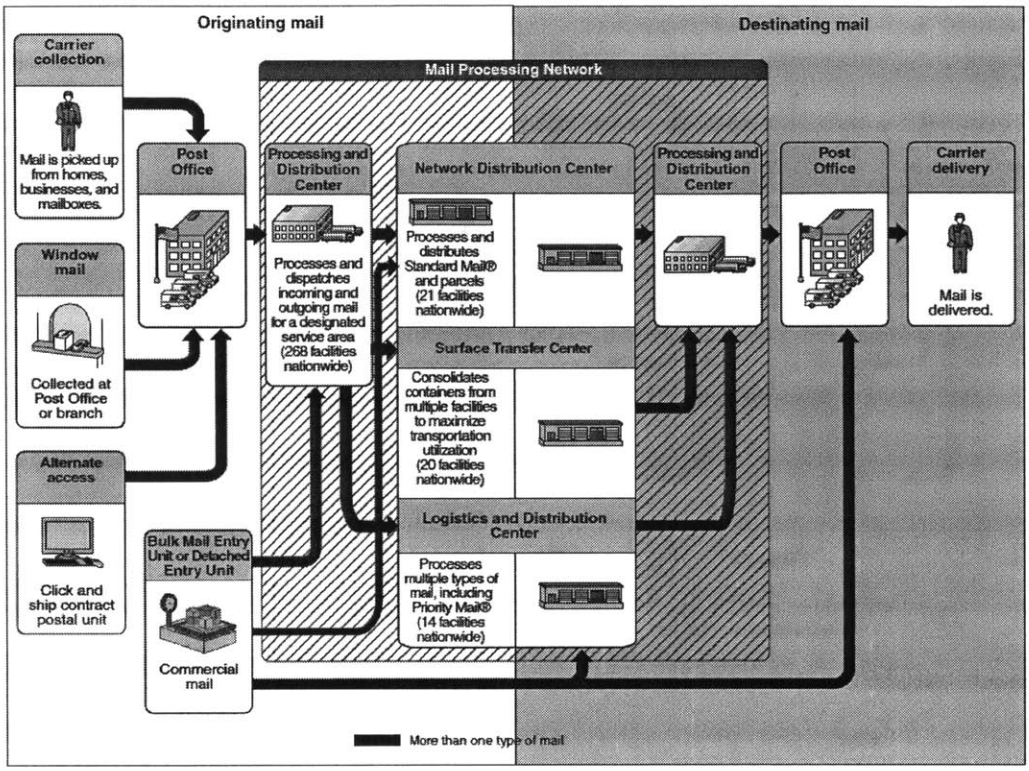
1. **Market Dominant Mail** - products for which USPS has a monopoly or would be able to exercise substantial market power (i.e. First-Class Mail and Standard Mail).
2. **Competitive Mail** - all other types of mail (i.e. primarily shipping services such as Priority Mail, Express Mail, and Parcel Select).

This list is subject to change by the PRC upon request from USPS. Products are designed to be moved in and out of respective classes to provide USPS with more flexibility in addressing market dynamics.

A letter (package, box, etc.) goes through the following basic steps when in the USPS system:

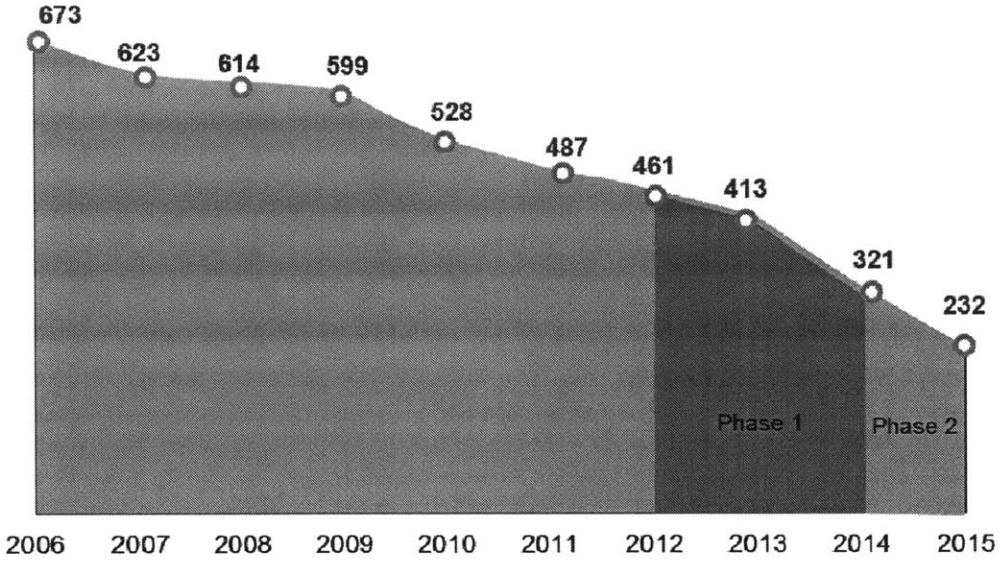
- **Collection** – done by postal workers at mailboxes or post office locations. All collected mail is delivered and accumulated at the local Post Office (PO).
- **Transportation** – Collected mails are transported to the processing plant (PP).
- **Processing / sorting** – several tasks are accomplished at processing plants:
    - ***Culling and arranging*** – sorting mail by type (boxes, large and small envelopes, packages). All mail is sorted to have addresses face the same way,
    - ***Postmarking*** – a postmark with the date and place where the letter was sorted is applied,
    - ***Bar coding and address reading*** - letters get identified by a code (a bar code) and hand written addresses are identified by an optical reader,
    - ***Sorting for transportation*** - All letters are placed with respective destination ZIP codes. After this step, trays and bins are taken to airport for long distance transportation,
- **Transportation** – local addresses are transported by USPS vehicles, air transportation is used for long distance mails. All mail is delivered to processing plants in the vicinity of destination.
- **Delivery processing** – similar sorting processes are carried out at the delivery PP, with the aim of sorting delivery mails by specific ZIP codes and assigning delivery couriers to letters that will deliver them to final destinations,
- **Final Delivery**.

Simplified mail flow through USPS system is shown below:



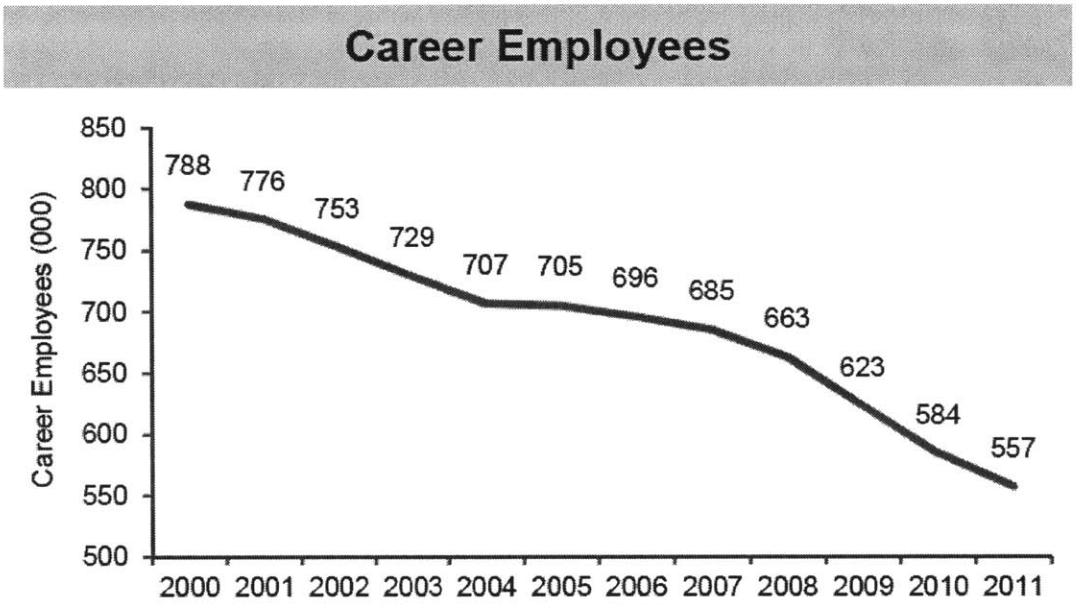
Source: GAO report 10-731 and USPS

USPS operations network consists of nearly 450 facilities and operation centers nationwide. The continuous decline in the USPS's biggest revenue driving category (single-piece First-Class Mail) and increasing operational expenses have driven USPS facilities' reduction decisions. To improve its financial standing, USPS has launched consolidation efforts. This initiative aims at increasing operations efficiency without harming its service standards. Starting 2006, USPS has continuously decreased the number of facilities:



Source: USPS factsheet, Modified Network Realignment Plan

USPS aims to save circa $ 20 billion by 2015. In addition, USPS intends to proceed with further capacity reduction with minimal impact on its workforce: reductions have been conducted mostly through attritions and incentivized leaves (Postal Service has reduced its workforce by 244,000 since 2000 without layoffs) (28) .



Source: USPS: Plan to Profitability, 5-year Business Plan

USPS Assets

The issue of decreasing mail traffic, increasing costs and redundant capacity affects other important component of the USPS system – the vehicle fleet. USPS is the operator of the largest vehicle fleet in the world, with over 215.000 cars, trucks and vans that drive circa 4 million miles a day. In FY 2010, the USPS fuel bill for all postal-owned and contracted transportation (street, highway and air) comprised $1.7 billion for more than 650 million gallons (29). Majority of USPS vehicles (192.000) are delivery trucks – custom-built right-hand drive cars. Purchase from 1987 to 1994, they are approaching the end of their expected operational lives and the costs for vehicle replacement or refurbishment (in 2005 values) were estimated at $ 5.8 billion or $ 3.5 billion respectively (30). USPS is subject to certain legal requirements concerning fleet refurbishment/purchase. For instance, under the EPA act of 1992 (Pub. L. No. 102-486, § 303, 106 Stat. 2766 (Oct. 24, 1992), at least 75 % of vehicles must be capable of using alternative fuel.

According to 2012 USPS Sustainability report, where the Postal Service measures its progress comparing indicators to 2008 base line data, it was unable to reduce to the committed levels of:

- Reduce total postal-vehicle petroleum fuel use 20% by FY 2015
- Reduce total contract transportation petroleum fuel use 20% by FY 2020

Partially, this was because each year USPS has to service more addresses, as residential and business communities continue to grow. For instance, in 2011 there were more than 650.000 new delivery addresses added to USPS network (USPS Fact Sheet 2013). This issue is especially relevant in the light of rising fuel prices, and aging fleet of vehicles.

Clearly, the procurement of new vehicle fleet will require significant financial resources, and will take circa 5-6 years. Considering USPS fiscal issues, there is little potential to involve resources from federal and non-federal partnerships or grants.

For now, USPS was able to maintain its operations by **1)** maintaining its current fleet, **2)** buying a limited number of regular minivans, and **3)** making other tradeoffs (unscheduled maintenance, higher maintenance costs, and some operational difficulties).

Other Efficiency Increase Efforts

Schedule: USPS financial difficulties are having their effect on everyday operations. The recent most noticeable one is the Saturday delivery issue. In early February 2013, USPS issued a statement announcing that it would conduct package delivery Monday through Saturday; however, mail delivery will be done only Monday through Friday. This measure was estimated to save USPS circa 2 billion annually (USPS, February 06, 2013, Release No. 13-019). However, this schedule was not implemented due to Congressional intervention.

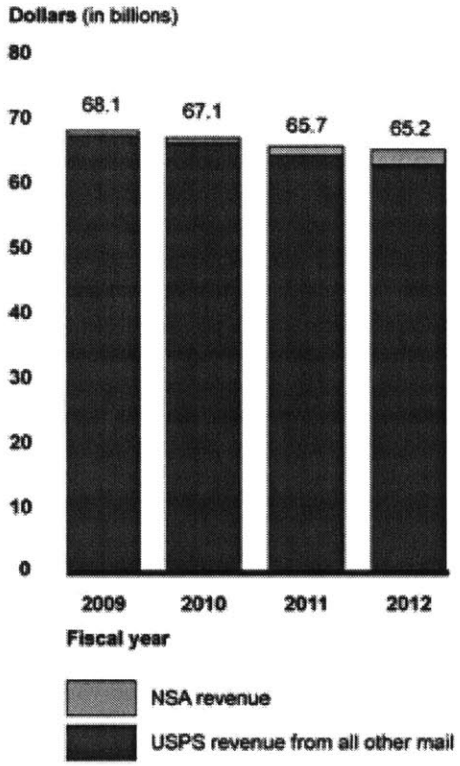
Mail Processing: USPS is actively looking into opportunities to increase efficiency by consolidating mail processing operations. Other than staff cuts and processing center decrease, GAO points out several steps USPS has undertaken:

1. Shutdown of Airport Mail Centers,
2. Transformation of Bulk Mail Centers, and

3. The Area Mail Processing (AMP) program

Some of this programs were completed, however the GAO report also points out several inefficiencies concerning decision making and implementation in USPS.

Promotional Campaigns: USPS is actively looking to increase revenue. There are two feasible ways to do that: 1) increase prices, and 2) increase revenue-generating traffic. The Negotiated Service Agreements (NSA) serves the second purpose. NSA is a contractual agreement between USPS and a company to carry out services at customized prices. This was possible due to new powers granted to USPS by the PAEA. Data indicates that this has largely been a successful program – despite overall revenue decrease - revenues generated by NSAs have been steadily increasing since its introduction.



Source: United States Government Accountability Office, USPS Opportunities to Increase Revenue Exist with Competitive Products; Reviewing Long-Term Results Could Better Inform Promotions Decisions

1.3 History of workplace violence in USPS

Workplace violence has been established to be the second largest cause of occupational injury (31). In the case of USPS, this is particularly important, since it was established that some professions are susceptible to workplace violence more than others are. The list of such professions includes nurses, utility workers, taxi drivers, ***letter carriers***, and people who work at night (32).

USPS today employs over 520.000 workers, of which 108.000 are career military veterans. In line with optimization of its operations, USPS has been constantly decreasing its staff: according to 2012 data, hiring has been completely frozen for the past five years (33). As we mentioned earlier, the uncertainty towards job security can be a significant factor in creating stressful work environment.

A comprehensive report provided the following in-depth look and statistics into the history of violent activities at USPS (9). While non-employees committed some of the homicides and acts of violence at USPS, we will focus only on those committed by employees. Below is the relevant statistics from

- From 1992 through 1998, 9 of 16 postal victims were killed by current or former coworkers;
- In nearly half of the cases (46 %), the perpetrator's status could not be identified;
- Of the homicides committed by USPS employees, motives ranged from robbery and actual or desired intimate relationships to workplace disputes.
- Most perpetrators (14 of 15) had troubled histories of prior violence, mental health problems, substance abuse, and/or criminal convictions. Five exhibited behavior prior to employment that should have excluded them from being hired.
- All victims had positions within USPS that exposed them to public – couriers, postmasters, vehicle operator;

Chart 5: Workplace Homicides by Current or Former Postal Employees, 1986-1999

Location	Date	No. of Perpetrators	No. of Victims	No. of Postal Victims	Motive	Method	Suicide by Perpetrator	Known Substance Abuse	Postal Victim Job Type	Perpetrator Job Type
Dallas, TX	4/17/98	1	1	1	Personal	Firearm	No	No	Clerk	Transitional Carrier
Milwaukee, WI	12/19/97	1	1	1	Personal/ Work	Firearm	Yes	Yes	Clerk	Clerk
Miami Beach, FL	9/2/97	1	1	0	Personal	Firearm	Yes	No	N/A	Clerk
Las Vegas, NV	12/19/96	1	1	1	Work	Firearm	No	Yes	Labor Relations Specialist	Mail Handler
City of Industry, CA	7/9/95	1	1	1	Unknown	Firearm	No	No	Supervisor	Clerk
Montclair, NJ	3/21/95	1	4	2	Robbery	Firearm	No	Yes	2 Clerks	Casual Clerk
Cedar Rapids, IA	1/14/94	1	1	1	Personal	Firearm	No	No	City Carrier	City Carrier
Dana Point, CA	5/6/93	1	2	1	Personal/ Work	Firearm and Knife	No	Yes	City Carrier	City Carrier
Dearborn, MI	5/6/93	1	1	1	Work	Firearm	Yes	No	Mechanic	Vehicle Maintenance
Royal Oak, MI	11/14/91	1	4	4	Work	Firearm	Yes	Yes	4 Managers	City Carrier
Ridgewood, NJ	10/10/91	1	4	3	Personal/ Work	Firearm and Sword	No	No	1 Supervisor 2 Mailhandlers	Clerk
Atlanta, GA	9/17/89	1	1	1	Personal	Firearm	No	No	Clerk	Clerk
Escondido, CA	8/10/89	1	3	2	Personal	Firearm	Yes	No	2 City Carriers	City Carrier
Chelsea, MA	6/29/88	1	1	1	Personal	Firearm	Yes	Yes	Clerk	Clerk
Edmond, OK	8/20/86	1	14	14	Work	Firearm	Yes	No	7 Clerks 1 City Carrier 4 Rural Carriers 2 Supervisors	City Carrier
Total	***15***	***15***	***40***	***34***			***7***	***6***		

Source: Commission on safe workplace.

The report established that in general, USPS employees are **no more likely** to be subjected to nonfatal violence than workers in America are. Furthermore, compared to other employees in USA, USPS employees are **equally likely** to be victims of physical assault, sexual harassment, and verbal abuse by coworkers, and **less likely** to be victims of physical assault, sexual harassment, and verbal abuse at work by non-employees. An important outcome of the report was the establishment of the fact that despite equal or lower probability of unfortunate events, USPS employees are significantly more fearful of those (9). As the report mentions:

- *"Postal employees are six times likelier to believe they are at greater risk than the average worker to be a victim of workplace violence from co-workers";*
- *"Postal workers are more likely to agree that "many managers and supervisors try to provoke employees to violence"*
- *"Postal employees are more likely to say they fear being robbed or attacked at work"*

Clearly, this indicates that there is a peculiar situation concerning work environment perception by USPS employees. We believe these perceptive inputs have an important relationship with the ability of individuals to process stressor inputs and to carry out their work duties. We will elaborate more on this specific example in the later section of this paper, when we devise the work and joint stress frameworks. The notably perceptive nature of work stress, as well as the cumulative nature of variables from a dynamic perspective will later drive our focus not on reported stress levels, but on the ability of an individual to recover and maintain emotional and psychological equilibrium.

USPS, being the third largest employer in United States, it is a complex socio-technical system (STS) and as such, all aspects of its performance, including the physical and psychological well-being of employees, must be analyzed through the prism of interrelationships between social and technical components of the system.

While there is significant research about USPS, and the most recent reports (9) comprehensively cover its activities and issues, contemporary research methods are able to provide decision makers with tools to reveal the dynamic nature of relationship between the structure of complex systems and their behavior (15). We will look at these issues not as static datasets, but as dynamic systems.

1.4 Conclusions

USPS is an organization that has and still is serving its purpose. Throughout United States history, it has been the inherent part of the social and political fabric, binding Americans together regardless of their location and economic status. Despite a number of reforms, the idea USPS has been based on remains simple – universally affordable transportation of a piece of mail (letter, package, etc.) mainly within US from one location to another – initially with tax subsidies, and now with enough profit to cover its operational expenses.

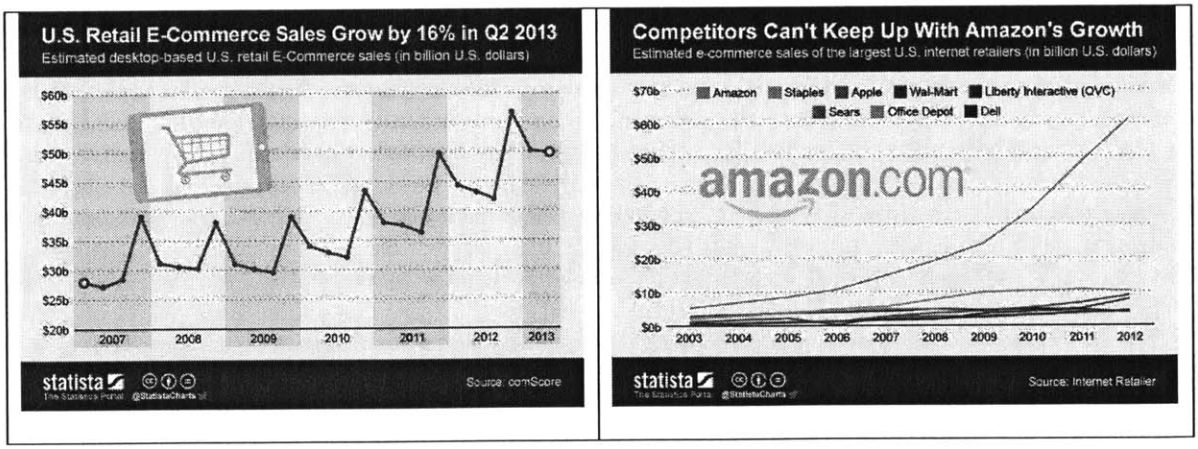
The end of the 20th century and the mass proliferation of IT and communication technologies has drastically changed the way business and individuals interact. Today we are witnessing almost entire elimination of some social norms (like writing snail mails) and the emergence of new ones (buying groceries

on Amazon). The turbulent times have affected many organizations, but USPS, being nation's biggest mail network operator, has understandably taken a significant toll.

Both of key categories – overall mail volume, and the largest revenue driver mail volume are sharply declining, giving momentum to the ***decreased mail volume - losses – borrowings – staff cuts - no capital investments – decreasing irreplaceable capacity – more losses*** vicious cycle. It seems that recent policy decisions (i.e. PEAE of 2006) have contributed to the amplitude of the events by making USPS fiscal insolvency obvious. However, the nature of events is clear –regular mail is going to decrease further and this trend is irreversible. With fixed based costs of universal service obligation, this issue should be in the limelight of not only USPS executives, but also Congresses undivided attention.

In another words – the pie of USPS's business-as-usual is shrinking. While USPS has made remarkable effort towards increasing efficiencies and squeezing more out of the struggling organization, no matter how bigger of a piece USPS manages to secure through planned reforms, it will only delay the fiscal dead-end.

The opportunity lies in exploring new lines of businesses, not only in US, but also globally. Despite the challenges that new technologies bring – they also bring new prospects. For instance, while a lot of mail has been diverted to electronic means of communication, rapidly increasing online shopping will only positively affect package delivery business.



Source: www.statista.com

Furthermore, USPS by law is uniquely positioned to provide safe and secure email services to Americans (34), an opportunity that was only briefly (and successfully) explored in the 1980s. There are also significant opportunities in international shipping and International Small Business Commerce (35).

The importance of USPS for US Government, businesses and Americans in general cannot be undermined. USPS delivers to above 150 million households, businesses and Post Office Boxes in all states, cities, towns and townships in this America, providing universal access to mail services to everyone living in the U.S. at the same postage regardless of location (USPS facts 2012).

It is clear that due to USPS scale, investments towards its sustainable future are but significant. It would only be wise to invest in the businesses and opportunities that are bound to grow and that have not been explored yet, rather than in existing (historical, traditional) product lines that are declining.

At the same time, monetary investments are necessary, but not sufficient. The dawn of the era of globally interconnected people of things will further facilitate the ever-increasing pace of life and business. This environment will not tolerate a slow-reacting organization. Hence, in order for monetary investments to have a chance at turning USPS in a financial sustainable organization, flexible and dynamic organizational structure and decision-making systems must be designed by US lawmakers.

As discussed earlier, USPS is planning to continue its operating efficiency increase efforts. This will mostly include consolidation of processing centers (shutdown of some) and further staff reduction. Currently no significant financial resources are available to invest in USPS's sustainable future, and while USPS has mentioned that staff will be reduced through planned attritions, all this factors are likely to contribute to the already stressful work environment (32). In the light of these circumstances, it is important to reconsider at the issues of individual and organizational stress. Clearly, these are rather interconnected, and there is evidence that both, in a reinforcing cycle, are significant factors in both physiological and psychological well-being, as well as employee performance.

As practice shows, organizations are becoming more and more aware of stress issues, and surveys remain but the most common tool in stress investigations. However, while being rather useful in uncovering information, surveys provide only a static view. It is important that organizations use dynamic systems for modeling and understanding stress profile of an organization. Having said this, first of all one needs to understand the history of stress research, its roots and the line of thought that has brought us to its current understanding. Insights gained from this exercise will be valuable in proposing future steps.

CHATPER 2

INDIVIDUAL AND ORGANIZATIONAL STRESS

ABSTRACT

Definitions, histories and research on individual and organizational (or work-related) stress are reviewed. The history of general stress research from its purely physics and engineering roots to modern-day inclusion of complex, feedback driven cognitive mechanisms, recognition of positive stress (eustress) and the appreciation of stress exposure duration, are traced. Similarities between definitions of individual and organizational stress and their development philosophy are identified. Contents of this chapter will be used for designing dynamic framework for individual and organizational stresses further in this paper.

2.0 Introduction

In this chapter, and in the light of the previous chapter's findings, we review the issues of individual and organizational stress. In section one, we look at the alarming statistics of stress in US, and the toll it is taking on Americans and the American economy. In section two, we review the history of individual stress research to uncover common patterns in stress and stress response in humans. We also seek so far systematized knowledge about all aspects of human stress. In section three, we review the history of organizational stress research. While these are extensions of general stress theories, we explore the peculiarities of organizational stress in the light of the facts that statistics shows the work related matters are amongst the most common stressors in many societies. In section four, we summarize by proposing new tools and approaches for understanding different dimensions of human stress.

2.1 Individual Stress: Statistics

According to American Psychological Association (American Institute of Stress, NY), job pressure and workloads were the top causes of stress in America in 2013.

Top Causes of Stress in the U.S.

	Cause	Factors
1	Job Pressure	Co-Worker Tension, Bosses, Work Overload
2	Money	Loss of Job, Reduced Retirement, Medical Expenses

3	Health	Health Crisis, Terminal or Chronic Illness
4	Relationships	Divorce, Death of Spouse, Arguments with Friends, Loneliness
5	Poor Nutrition	Inadequate Nutrition, Caffeine, Processed Foods, Refined Sugars
6	Media Overload	Television, Radio, Internet, E-Mail, Social Networking
7	Sleep Deprivation	Inability to release adrenaline and other stress hormones

Source: American Psychological Association, American Institute of Stress, NY, 7.28.2013

This statistics is even more alarming, if we consider the effects that these stress factors and levels thereof are having on individuals. The same survey yielded the following results:

U.S Stress Statistics	Data
Percent of people who regularly experience physical symptoms caused by stress	77 %
Regularly experience psychological symptoms caused by stress	73 %
Feel they are living with extreme stress	33 %
Feel their stress has increased over the past five years	48 %
Cited money and work as the leading cause of their stress	76 %
Reported lying awake at night due to stress	48 %

Source: American Psychological Association, American Institute of Stress, NY, 7.28.2013

Information from other sources (36) confirms that stress levels for the majority of Americans have increased over the past five years. American Top sources of stress include:

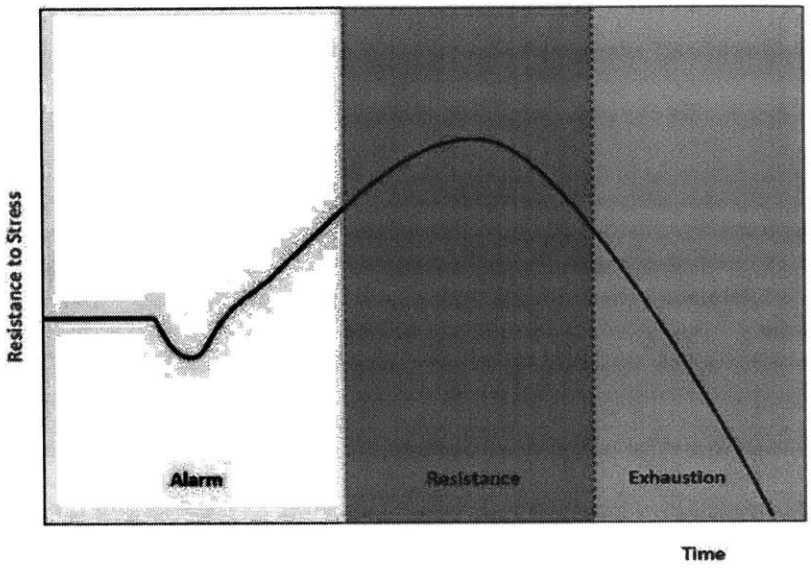
1. money (69 percent),
2. work (65 percent),
3. the economy (61 percent),
4. family responsibilities (57 percent),
5. relationships (56 percent),
6. family health problems (52 percent) and
7. personal health concerns (51 percent)

While scientists have long observed correlation between stress and physical wellbeing, even today there is not unanimously acceptable definition of stress. We will provide a brief summary into the history of stress research and some schools of thought about it.

2.2 History of Individual Stress Research

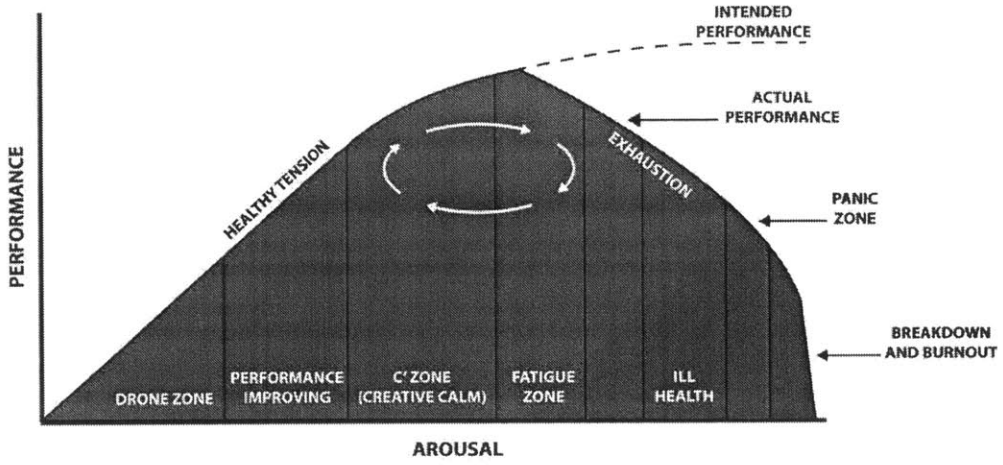
Throughout the history of stress research, there have been a number of definitions of what constitutes stress. Interestingly, first observations about stress have been derived from early physics and engineering applications. For many years, physicists and engineers have used the word and notion of stress to describe the effect of force application to bodies and the strains that these forces cause. Similarly, initially the term "stress" was used to describe physiological or psychological strains. In 1929, W.B. Cannon in his seminal work proposed that stress is what causes a disruption in our body's capacity to restore itself (homeostasis) (37). While a rather broad definition, since it did not define stress from a psychological or physiological perspective, this was an important step forward as it tied together two concepts crucial for analyzing any human-involving system – stressors (inputs) and the idea of homeostasis (we will refer to this further in the text).

Dr. Hans Selye initially defined the concept of psychological stress. Noticing during his experiments that people subjected to different negative stimulants (the word stressor has not been invented yet) exhibit same symptoms, he named these stimulants "noxious agents". Later this term was substituted with stress. In 1936, he defined stress as "*the non-specific response of the body to any demand for change*". In this context, the word "stressor" was used to define the demands placed on the system that actuated stress response. In his laboratory experiments he noted that subjects, when exposed to harmful stimulants (loud noise, extreme heat/cold, etc.) all exhibited similar physical changes – i.e. stomach ulcerations and enlargement of adrenal glands. Furthermore, he proved that extended exposure to these stressors resulted in the development of diseases similar to those in humans (heart attacks, stroke, kidney failure, arthritis). He grouped these stress responses into what he called a General Adaptation Syndrome into three categories – Alarm, Resistance and Exhaustion.



Source: Exploring Psychology 7th ed. (Worth) page 398.

Being one of the earliest stress researchers, Selye made another important contribution to stress research by differentiating between stress with positive consequences (i.e. *eustress*) and that with negative outcomes (i.e. *distress*) in 1975 (38). Again, an interesting observation about eustress is less dependent on the type of stressor, but rather on its perception (39). Later research further ascertained this concept by introducing the "human function curve". According to this concept, some "amounts" of stress are actually useful for our performance, and stress becomes detrimental only after we have exceeded certain level of exposure.



Source: *Nixon, P. G. "The human function curve. With special reference to cardiovascular disorders: part I." The Practitioner*

An interesting attempt to redefine and measure stress was done by Thomas Holmes and Richard Rahe (40). Based on their study of 5000 medical records, they developed a stress measurement scale with 43 life stressor events. The criteria for measuring the stressor was defined as "*how stress affects health*". This was another step towards supporting the perceptive nature of stress.

An important milestone in stress research were the views of Richard S. Lazarus. His research focused on the dynamics of stress, emotion and cognition. The backbone of his theory on human stress focused on the importance of cognitive processes and appraisal (41). He argued that it is based on our conscious and/or unconscious appraisal of any situation (a stressor input, for instance) that we choose a coping mechanism for stress. Selection of coping mechanisms were proved to be related to pleasant or unpleasant experiences (42). Hence Lazarus's definition of stress: "***Stress*** *occurs when an individual* ***perceives*** *that the demands of an external situation are beyond his or her* ***perceived ability*** *to* ***cope*** *with them*" (43).

Today stress researchers find themselves in a position where there is no unanimous agreement about definition of stress, but many agree that it is about the imbalance between demands and our capacities to cope with them. From biological perspective, we know that stressor inputs, regardless of their nature,

cause our bodies to respond with secretion of various hormones (such as insulin, cortisol, etc.) and hence, cause disruption in natural dynamic equilibrium (homeostasis). We will base many of our thoughts on this notion of disruption of homeostasis.

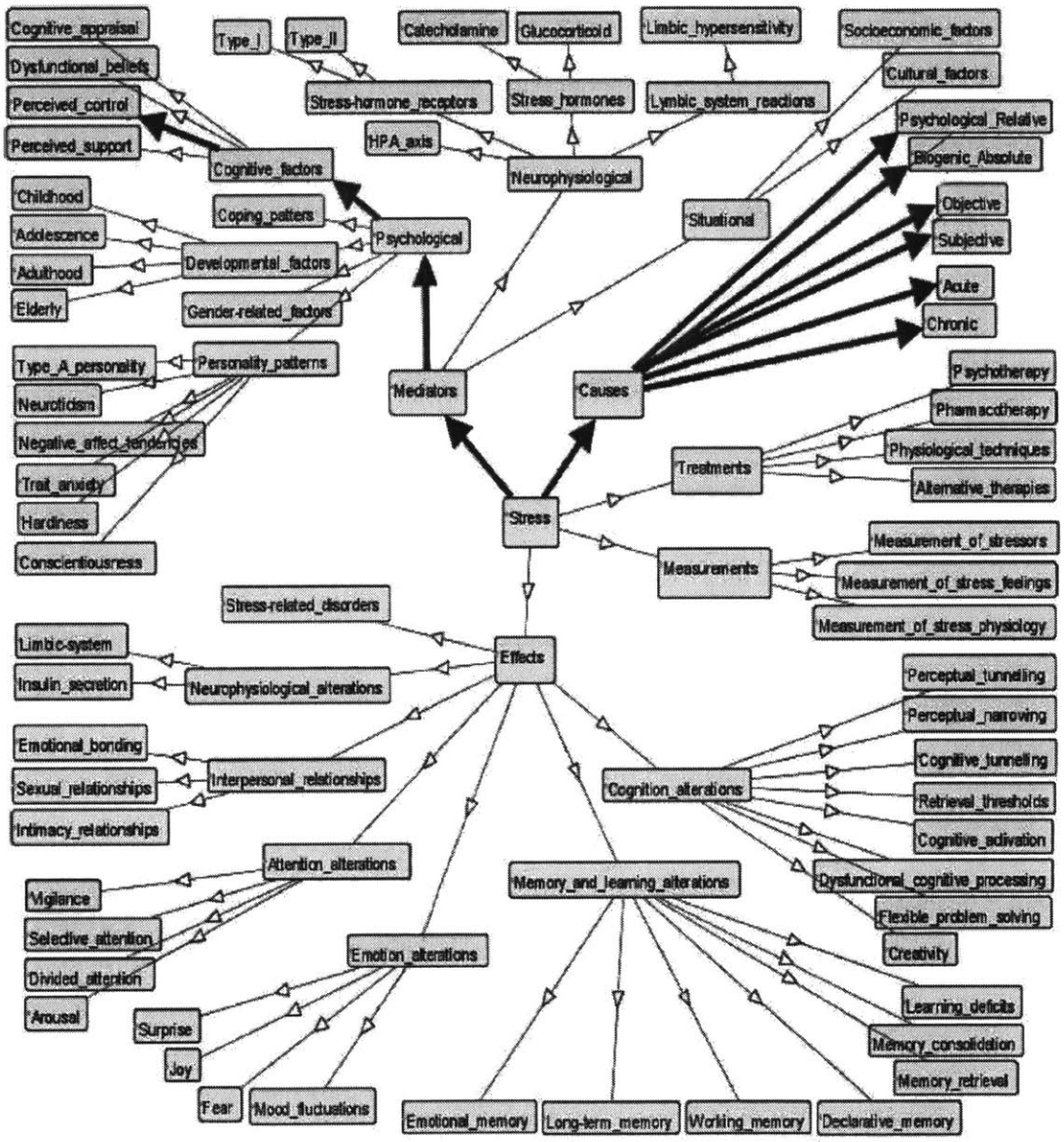
Like many complex systems, human physiology and phycology are systems comprised of components, which are engaged in complex dynamic relationships, the nature of which is very often unclear and is subject to ongoing research. Due to importance of individual stress in nearly all aspects of human life, many science branches have undertaken a somewhat silo-like approach to stress study. For instance, biologists analyze stress from the perspective of adrenaline and cortisol levels in human body and the dynamics of the hypothalamic-pituitary-adrenal-axis (HPA) (44). Behavioral scientists have long correlated stress with specific behavioral patterns (distorted eating habits, substance abuse, social withdrawal, etc.). Physiologists analyze the responses of body's nervous, endocrine, and immune systems to the disruption of equilibrium caused by stressors. Computer scientists approach the issue of stress from the perspective of image recognition – specific patterns in facial muscle, eye and other body party movements and responses that can be acquired through machine vision. Even after decades of research, there are various definitions of stress, depending on researchers' background and focus (45). Merriam-Webster dictionary defines stress as "a state of mental tension and worry caused by problems in your life, work, etc."

While there is extensive research on human stress, few researchers have undertaken the task of organizing and categorizing prior research in an effort to consolidate and systematize stress research. One of the most interesting works we came across is the paper done by E.H. Nasiri and M. Hadzic of the Australian Digital Ecosystems and Business Intelligence Institute (46). With their work, they proposed a framework for capturing knowledge about stress, a stress ontology, as they called it. This framework is rather useful for our work, as it combines known stress "components" in a single comprehensive diagram. Namely, the authors have combined five sub-ontologies into a single high-level ontology:

1. stress causes,
2. stress mediators,

3. stress effects,
4. stress treatments,
5. stress measurements.

Below is the full representation of the human stress ontology.



Source: Designing the human stress ontology: A formal framework to capture and represent knowledge about human stress, Digital Ecosystems and Business Intelligence Institute, Curtin University of Technology, Perth, Western Australia, Australia

This is one of the most comprehensive and systematized representations of knowledge about stress that we came across during our research. We will base out future exploration of individuals tress research framework on ontologies and sub ontologies of knowledge suggested by the authors. Having said this, we will also contribute to our framework by adding certain "nodes" or variables we deem reasonable and that are backed by research findings.

We believe at this stage, it will be beneficial to understand peculiarities with regards to work related stress. This will be the next logical step in understanding the relationship between individual stress and organizational stress.

2.3 History of Organizational Stress Research

Similar to the situation with general stress definition, there is little agreement among researchers as to what exactly is organizational stress. There is even ambiguity with regards to name of the phenomenon, the range spanning from "work-related stress" to "organizational" and/or "occupational" stress. For the purpose of this work, we will use these terms interchangeably. A definition accepted by both the World Health Organization and the Center for Disease Control (47)) was rather similar to that of the individual stress: "*Work-related stress is the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope.*"

We believe that while implied, a notion that work-related stress can have detrimental effects not only for an individual (physical disorders), but also for an organization (lower productivity and efficiency) is not emphasized in this definition.

For the purpose of this work, we will consider the organizational stress to be the stress originated in the workplace of an individual, which can have adverse effects on organizational performance as well.

Literature review has showed that occupational health during the past 15 years has continued to be dominated by stress and stress-related topics such as burnout, job control and demands, social support, and

coping (48). We also know that work related stress and money related problems were mentioned as the leading causes of stress among American adults. If we look at the statistics of workplace stress, according to The 7th Annual Labor Day Survey:

- 80% of workers feel stress on the job, nearly half say they need help in learning how to manage stress and 42% say their coworkers need such help;
- 14% of respondents had felt like striking a coworker in the past year, but didn't;
- 25% have felt like screaming or shouting because of job stress, 10% are concerned about an individual at work they fear could become violent;
- 9% are aware of an assault or violent act in their workplace and 18% had experienced some sort of threat or verbal intimidation in the past year

Understanding the reasons and mechanisms involved in these is crucial not only from an organizational level, but also on the national level. This statistics is even more alarming if we add the layer of associated violence. According to research (49):

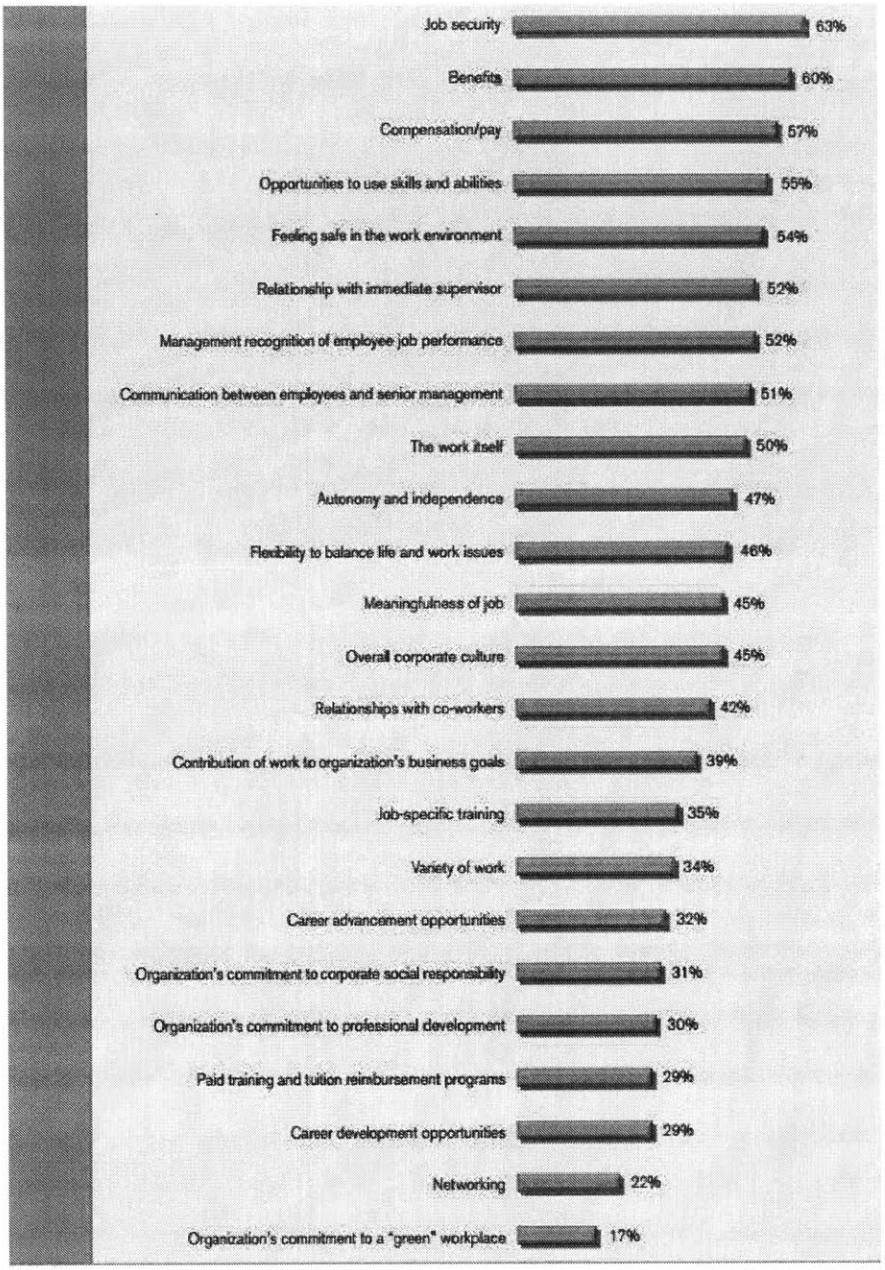
> *"An average of 20 workers are murdered each week in the U. S. making homicide the second highest cause of workplace deaths and the leading one for females. 18,000 non-fatal violent crimes such as sexual and other assaults also occur each week while the victim is working, or about a million a year. The figures are probably higher since many are not reported. Certain dangerous occupations like police officers and cab drivers understandably have higher rates of homicide and non-fatal assaults. Nevertheless,* ***postal workers who work in a safe environment have experienced so many fatalities due to job stress that "going postal" has crept into our language.*** *"Desk rage" and "phone rage" have also become increasingly common terms."*
>
> *Job Stress carries a price tag for U.S. industry estimated at over* ***$300 billion annually*** *as a result of Accidents, Absenteeism, Employee turnover (Diminished productivity, ·Direct medical, legal, and insurance costs).*

While researching for the factors affecting organizational stress we compiled a list of most commonly mentioned ones. These included support from colleagues and managers, involvement in decision making process, job satisfaction, workload and burnout, attrition, salary and benefits, job security, flexibility, physical work environment (comforts such as HVAC system, lighting, etc.), career advancement and

interesting opportunities, investment and updating of the technology, training and education, interpersonal challenges, recognition. One of the reports (50) grouped 24 factors into 5 major categories:

1. Career Development
2. Relationship With Management
3. Compensation and Benefits
4. Work Environment

The researched has also ranked the items by the order of their importance. This information will be valuable in understanding the extent of influence of each factor on organizational stress.



(n = 601)

Note: Percentages reflect respondents who answered "very important" from a scale where 1 = "very unimportant" and 4 = "very important."

Source: 2009 Employee Job Satisfaction: A survey report by SHRM

***Source**: 2009 Employee Job Satisfaction Survey, A survey report by SHRM*

The list of detailed factors is almost as numerous and diverse as the various theories of stress. We will look into these factors in more detail in the following chapters, at the moment, to have a more complete understanding of schools of thought about organizational stress, we will look at the summary table of some

of the key theories below. Based on advances in the theories of general stress, work-related stress was gaining scientific ground to build its specific theories. A recent study has categorized major theories of work stress, which will be useful for our research.

Author	Theory name	Details
Lewin (1935) and Murray (1938)	Person-Environment Fit	• Optimal fit between the person and his/her environment is needed for effective human functioning • based on the idea of employee adjustment in the work setting, which is critical for well-being o the degree of match between the demands people confront at work and their abilities to meet those demands (referred to as demands–ability fit); o the match between the person's needs and the resources available to him/her (needs–supplies fit) • In summary - there needs to be a match between what people want and what they receive, as well as a match between their abilities (knowledge, skills) and the demands placed upon them.
Holroyd, K., & Lazarus, R. (1982).	Transactional Model of Stress	• Stress is a product of the transaction between the individual and the environment. • The authority and power of the transaction lies in the process of appraisal that binds the person and the environment
Stevan Hobfoll (1989)	Conservation of Resources Theory	• Examines the interaction of the person and the environment, and the degree of correspondence between demands in the environment and the individual's resources to deal with those demands. • Stressful circumstances lead to resource losses. Favorable conditions will lead to resource gains; • Two other principles of COR theory are important to note: (a) resource spirals and (b) resource caravans job resources (namely autonomy, social support, supervisory coaching, performance feedback, and opportunities for professional development), personal resources (self-efficacy, organization-based self-esteem and optimism)
Karasek, R. A., & Theorell, T. (1990). Healthy work: Stress, productivity and the reconstruction of working life. New York: Basic Books.	The Job Demands–Control–Support Model of Work Design	• Excessive job demands or pressures (both physical and psychosocial) can have an impact on stress levels (especially psychological strain), by themselves these demands are not the most important contributors to strain experiences. • The amount of strain people experience in their work will be determined by whether or not they have any control over the demands they have to deal with: there will be interactive effects of Demands × Control (or discretion) on stress levels, meaning control will buffer (moderate) the impact of demands (pressures) on strain.

Source: Theories of Psychological Stress at Work Philip J. Dewe, Michael P. O'Driscoll, and Cary L. Cooper

We will later see that each of these, and a number of other work stress theories, while different in their approaches, revolve around the ideas we commonly find in another field – System Dynamics discipline. For instance, the concepts of resource spirals and resource caravans are similar to those of feedback loops, the concepts of actual versus perceptive strain, correlations between ideas of "fit", "strain"

can be described by various individual mental models, notions of buffering of stress with control (delays) - these all are the concepts and methods that are used in system dynamics. We will refer to this further in later chapters of this work.

Although originated in different times and under influences of various general stress theories and schools of thought, we believe these approaches complete, rather than contradict each other. Furthermore, they have a number of similarities. First of all, work related stress originates from the interaction of an employee and the work environment. Second, work environment is defined by a number of factors: while individual differences in mental models and perceptive influences should not be undermined, research has continuously indicated that some common work related stressors exist (as discussed earlier). Work stress theories, being extensions of individual (general) stress theories, have also followed a similar path from early person-environment fit theories (the match between what people want and what they get), to the understanding that demands are not the most important stress generator, and that control over stressors is able to alleviate their negative effects.

Due to the fact that work related stress is the biggest contributor of individual stress, we will attempt to build on existing research on the dynamic relationships that these two stress areas have.

2.4 Conclusion

In this chapter, we reviewed theories that were most significant for general stress and organizational stress research. General human stress research, the way we know it today, has originated in early 20th century from observations of disruptions in natural flow of things in human body and the similar effects these disruptions have. Later research confirming these findings, also emphasized perceptive and cognitive aspects of stress peculiar to each individual, as well as the duration of exposure. The connection between individual and work related stress cannot be undermined, since researchers continuously confirm that the biggest contributor of stress is work related (organizational) stress.

As we mentioned before, a number of (if not most) researches are done through static surveys, which provide a snapshot of a certain situation. While valuable, this approach lacks continuity and insight

into the overall behavior of the system and the intricate relationships between key variables. We believe that application of system dynamic approaches and models to datasets acquired by these surveys can be extremely valuable. Through SD, we are able to combine sets of different otherwise unrelated variables (or so it might seem at the first glance) into a single model that considers not momentary values, but is built around the notion of continuity and "memory" of the scrutinized system. In this regard, it is important to understand the concepts and structures of system dynamics field. In the next chapter, we will explore the theory of system dynamics modeling and look at relevant model and system behavior reference modes particularly fit for analyzing limited systems, such as the human phycology and physiology is.

CHAPTER 3

FUNDAMENTALS OF SYSTEM DYNAMICS

ABSTRACT

History and fundamental concepts underlying the field of System Dynamics (SD) were reviewed. Structures, concepts and system behavior reference modes (more specifically – overshoot and collapse) fit for modeling stress responses were analyzed and considered for application later in this paper as building blocks for compiling proposed frameworks of individual and work related stress.

3.0 Introduction

In this chapter, to further develop the idea of new tools and approaches for the research of stress phenomena, we explore the interesting field of System Dynamics. In section one we review its brief history. For a comprehensive overview, in section 2 we introduce the elements of System Dynamics. In sections 3 to 6 we focus on concepts of system dynamics, the necessary building blocks we will later use for formulating our frameworks. In section 7, we conclude by proposing that considering a number of concepts and elements resonate very well with our previous research on stress, system dynamics would be an ideal tool for modeling stress and stress responses in humans.

3.1 System Dynamics History

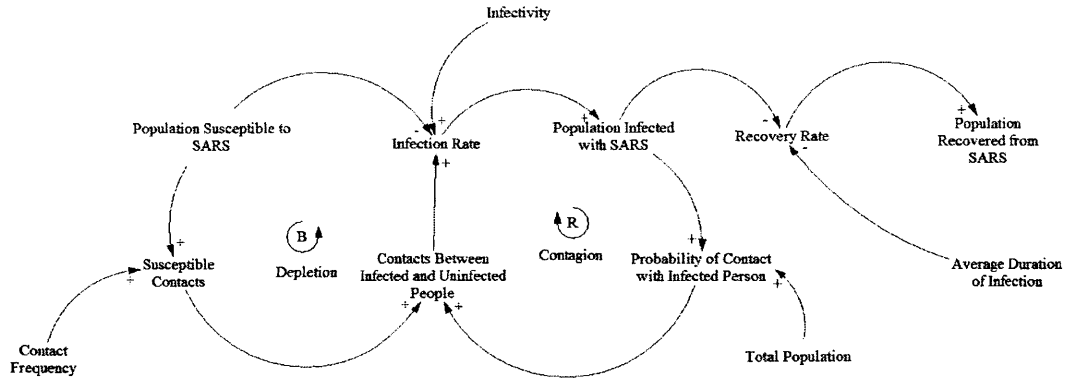
System dynamics (SD) is a relatively new (having originated in 1950s) and a rather powerful branch of science, and a tool in the arsenal of scientist that allows the modeling of and understanding the behavior of complex systems. Having its roots in control theory, engineering and mathematics, it uses the concepts of "stocks" (cumulative values over time), "flows" (rates of accumulation or dissipation), delays and feedback mechanism to model the behavior of complex systems in a user friendly, comprehensive way. Pioneered by MIT professor Jay Forrester, the discipline of SD was born while investigating from an engineering perspective the reasons for employee pool regular 3-year fluctuating cycles at the GE appliance plant. With the application of stock and flow tools to depict the decision-making policies at GE, Forrester was able to show that the fluctuations were caused by GE internal structure and factors, rather by external forces. The successful implementation of this approach led to the creation of several programming

languages (SIMPLE, DYNAMO, etc.) and for many years, SD was applied to analyzing corporate and managerial problems. Today SD is a mature discipline used not only for corporate modeling, but also it has turned into a powerful system thinking education. It is widely used by a number of consulting companies for policy and business strategy modeling (Forrester Consulting, PA consulting, Homer Consulting, etc.). Let us briefly describe the "building blocks" of System Dynamics.

3.2 Elements of System Dynamics

Causal Loop Diagrams (CLD). The first lesson novice SD modelers are taught is that "all models are wrong, but some are useful". The second lesson is that one should frame and model the problem, and avoid attempting to describe an entire system. Causal loop diagrams are the first step in building a model in SD, a simple system map really, which can later be developed into a more complete, mathematically accurate system. These simple maps of the system show the relationships of its components and the nature of these relationships. These relationships allow us to portray the path from cause to effect in two ways – negative or positive causation (and NOT correlation). Eventually this enables us to capture the causal map and structure of the system, and understand its dynamic behavior.

Below is an example of a CLD, which describes the causal relationship of major variables in modeling the spread of an infection disease:

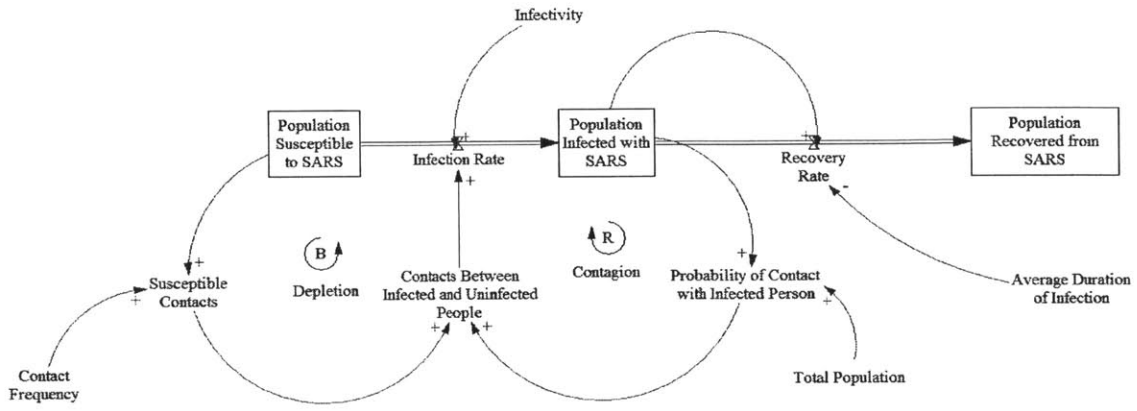


Source: Bradley Morrison, System Dynamics for Engineers ESD.74 Coursework, Assignment #1

A positive indication means that both variables change in the same direction, while the negative link means they move in opposite directions. It is important to note that link polarities only describe the dynamic behavior of the variables, and not the variables themselves. As we see, variable connections are just links, but in some cases causation of a number of variables eventually creates a closed loop (hence the name - causal loop). These might be reinforcing (**R**), or balancing (**B**). As J. Sterman describes "*A positive link means that if the cause increases, the effect increases above what it would otherwise have been, and if the cause decreases, the effect decreases below what it would otherwise have been. A negative link means that if the cause increases, the effect decreases below what it would otherwise have been, and if the cause decreases, the effect increases above what it would otherwise have been*" (15). Creation of comprehensive CLDs is an essential first step in SD modeling, it is not a model per se. While an important building block, another layer of sophistication must be added to arrive at comprehensive and mathematical models. That second step or the second SD building block are the Stock and Flow diagrams.

Stocks and Flows. While CLDs provide a good overview of the system, to conduct accurate mathematical analysis we need to be able to capture subtle, but important aspects of certain system components. The Stock and Flow diagrams allow us to capture important properties of system variables. The Stocks and Flows diagrams allow us to differentiate and capture variables that are cumulative over a time interval. Stocks represent the accumulations of resources of the system, and create delays in the system. In the words of Sterman, "*Stocks give systems inertia and provide them with memory. Stocks decouple rates of flow and create disequilibrium dynamics.*" For instance, company's employees (staff) are a stock, a value that at each given point in time reflects the size of the company. The **stock** of **staff** is defined by at least two **flows** – hiring rate (number of employees hired ***per period of time***) and attrition rate (number of people leaving the company ***per period of time***).

Below is the Stock and Flow diagram of the infectious disease CLD depicted above.



Source: Bradley Morrison, System Dynamics for Engineers, MIT ESD.74 Coursework, Assignment #1

As we see, this model has three stock variables – the "Population Susceptible to SARS", "Population Infected with SARS", and the "Population Recovered from SARS". With this model we can already conduct some mathematical analysis, as it is a much more accurate description of the system. The dynamics of these variables allows us to actually evaluate the system performance. An important observation we can make is that Stocks are governed by flows only, and that these flows are governed by different variables. Hence the unequal nature of their dynamics (and the major contributing factor in dynamic complexity). From a mathematical perspective, Stocks are integrated values of differences between flows (with consideration of initial value, of course).

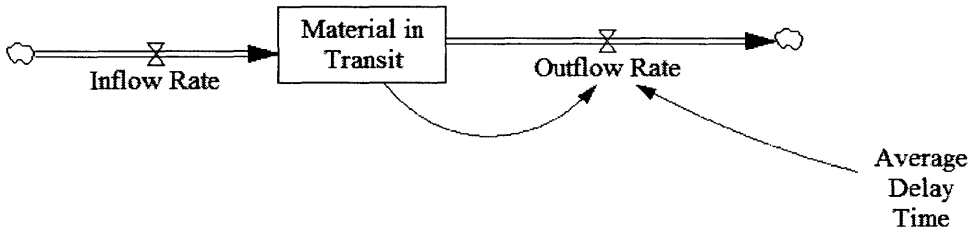
$$\text{Stock}(t) = \int_{t_0}^{t} [\text{Inflow}(s) - \text{Outflow}(s)]ds + \text{Stock}(t_0)$$

Identifying Stocks might be a challenging task, since in some cases these are counterintuitive. In his book Sterman, when talking about identifying stocks, proposes a snapshot test:

> *"To identify key stocks in a system, imagine freezing the scene with a snapshot. Stocks would be those things you could count or measure in the picture, including* ***psychological states*** *and other intangible variables."*

The defining parameter is that **Stocks** are system *states* during different times and are changed by **Flows**, which represent changes *per period of time.*

Delays are another important concept in SD. We see the influence of delays in nearly all aspects of human activity. Examples are countless: for instance, we take time to learn and analyze new information, and it takes time for this learning experience to reflect on our actions. It takes time for the data to aggregate into a valuable dataset, which we might use for some analysis. All the while the system continues to evolve without intervention. Put into words of Sterman: "*A delay is a process whose output lags behind its input in some fashion*". In many cases, due to similarity in the way delays affect the system, they are modeled as stocks. It is important to note that there are delays of **material** kind (tangible assets and materials), and perceptive, or **information** delays. The latter usually represent the change in our perceptions and understanding of the situation around us. Material delays are usually modeled as follows:



The literature about delays is elaborate and extensive. One formalized and interesting implication of first-order delays in systems is the **Little's law**. This law describes the relationship of inflow, delay and stock in a simple equation, stating that volume of stock is directly proportional to the inflow rate and inversely proportional to the delay time (this is true for stable systems, where the inflow has come to equal its outflow, meaning that its stock will also be stabilized around an equilibrium).

If we take mail for example, let us assume we receive 10 letters per hour, and it takes on average 3 hours to process these letters. This means once this system has reached its stable state (no significant

fluctuations in flow rate or delay), on average there are 3.3 letters in a post office waiting to be processed. Putting this into formula,

$L = \lambda / W$, where

- λ = arrival rate
- W = the delay (average time spent in the system)
- L = Stock size

Applications of Little's law are vast, from queue analysis to business processes, energy consumption and environmental analysis.

3.3 System Dynamics Concepts

A particularly valuable aspect of SD is that it is interdisciplinary in nature, and can be applied to problems that span through human and social studies to hard sciences. Hence, this method is understandable to all stakeholders of a scrutinized system. Earlier we have touched upon the fact that many of the concepts we came across in stress research (both organizational and individual) correlate very well with the concepts we know from System Dynamics. Below we will list several that we believe are instrumental in understanding the stress dynamics.

3.4 Concept # 1 - Dynamic Complexity

Traditional understanding of complexity revolves around the idea of the number of parts, or nodes or components of a system. This is also known as ***detail*** complexity. However, there is another type of complexity, which is more subtle, yet can have significant consequences if unaccounted for. The complexity that arises from the interaction of even a limited number of components over time is called ***dynamic*** complexity.

Amongst the reasons that give rise to dynamic complexity are the delays between introduction of a change or intervention into the system, and learning and understanding its result. The ***beer game***, which SDM students had the pleasure of playing under the supervision of Professor Bradley Morrison, is a good illustration of this phenomenon. The goal of this game is to understand the dynamic complexity that can arise form seemingly simple setup (single item distribution) and situations (simple linear process flow).

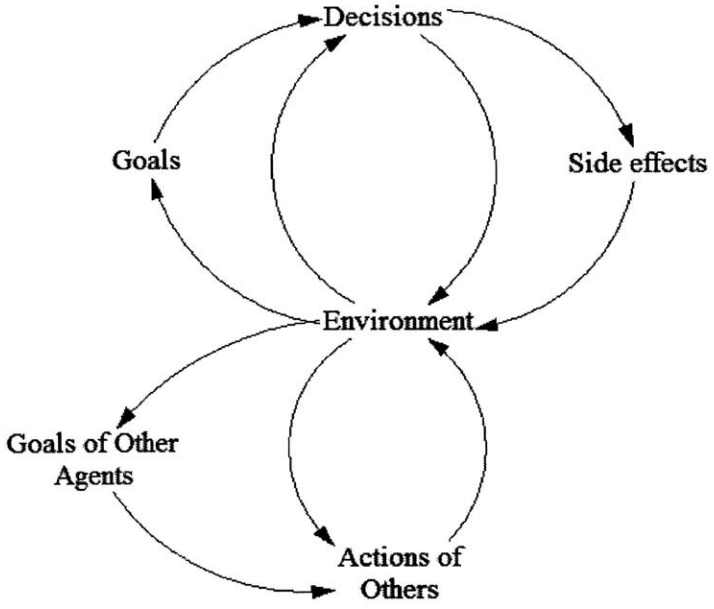
This game correlates with stress in another interesting way as it prohibits spoken communication: we know how crucial verbal communication (and sometimes – its absence) is for the aggravation of stressful situations. Essentially players learn to appreciate the notions of delays in information exchange, and the complexities associated even with a relatively simple learning curve.

Jumping slightly ahead, in the case of USPS (much like in many other large government regulated entities), delays are built into the decision-making system by definition and are required by law (i.e. financial and policy decision have to be approved by the PRC). While a necessary step, this introduces delays into the system. The beer game makes it obvious that delays in information transfer and processing cause significant oscillations, phase shifts, and general system instability.

3.5 Concept # 2 - Policy Resistance

Policy resistance is a term used to describe the unintended, delayed, and diluted or even diametrically opposite outcomes of actions within the system (15). This phenomenon has been observed throughout history in various areas of human activities – from state regulatory to economic policies, healthcare regulations and environmental control issues. An impressive list of policy resistance examples is provided by John D. Sterman in book (15). The reason our actions have unpredictable consequences lies within the nature of the systems we deal with, the complexities of which, however, we fail to understand. It is impossible to change only one variable of the system, or put another way "*there is no such thing as a small change*". This phenomenon has rendered many efforts of policy makers useless, and in some cases has rendered corrective efforts to even worsen the situation: Brook's law of adding more programmers to a late project is a good example. (*adding manpower to a late software project makes it later*)

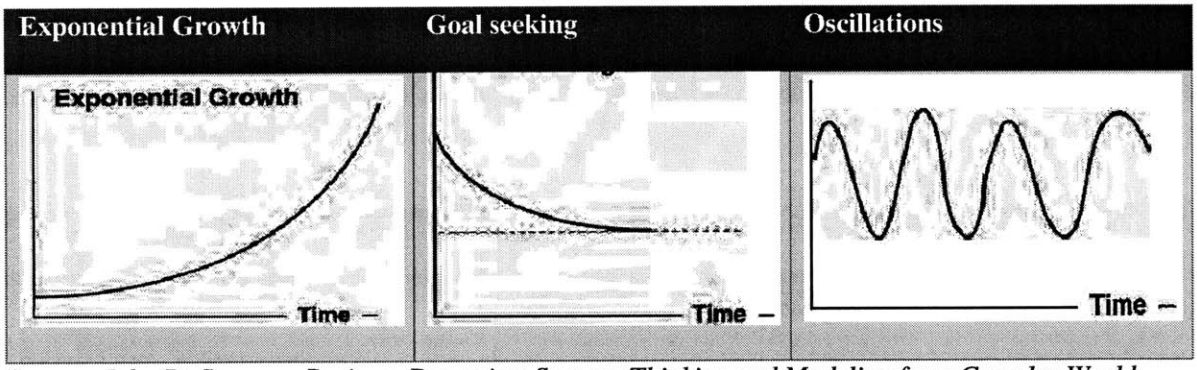
A simplistic intervention, without system wide understanding of the problem and implications of corrective actions will most likely yield undesired results. A good causal-loop diagram below is a simple, but good depiction of a more complete cycle a single decision goes through once:



Source: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

3.6 Concept # 3: System Behavior – Reference Modes

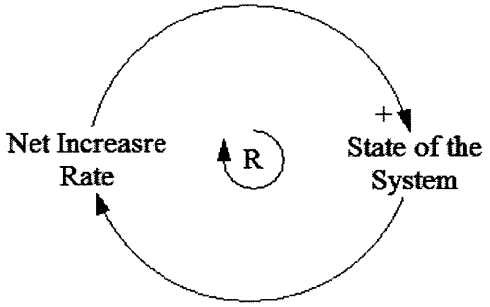
All systems have peculiar behavior models, and these are dependent on their structures, or their dominant feedback loops. SD theory has identified few basic modes of behavior and respective stock-and-flow structures. Basic system behavior reference modes are:



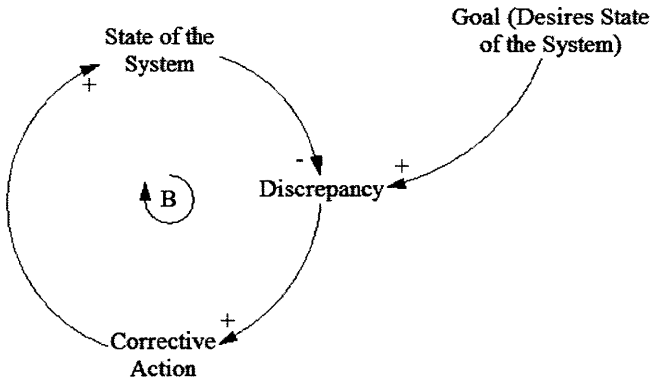
Source: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

Underlying concepts behind each of these modes are rather simple feedback structures.

For instance, the **exponential growth** is based on ***positive feedback*** structure (also known as reinforcing feedback loops). The bigger the stock, the bigger the net increase rate, which contributes to further greater stock increase, so on and so forth. It should be noted that when speaking of positive feedback, the word positive does not imply growth, or the direction of change. It rather means that the stock and flow structures illustrate the same dynamics. Positive feedback loops only ***amplify*** system behavior, be that growth, decline, or oscillations.

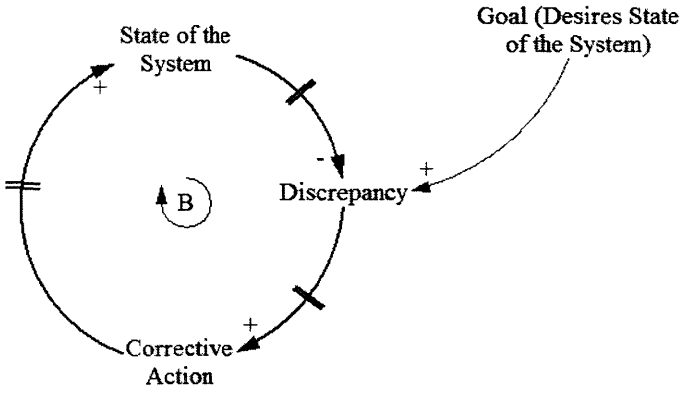


Goal seeking system behavior is a result of ***negative feedback*** structures. These, over time, bring the state of the system to the desired (specified) condition. They have the following feedback structure:



This basic structure underlies all decision making and control systems in socio-technical systems. In this absolute (perfect) case, as presented above, there are no delays and distortions between system states, measurements and control actions. This system is also exponential in its nature (exponential decay), since the smaller the discrepancy, the lesser the corrective action is.

Oscillation type system behaviors are similar to goal seeking system behavior as in both of these there is a goal, a target level of system performance that is set. However, unlike the goal seeking system, where the actual state asymptotically approaches the goal, in oscillatory system the actual state constantly fluctuates around the goal. These fluctuations are called overshoot and undershoot. These fluctuations are the results of delays (depicted by II notation below):

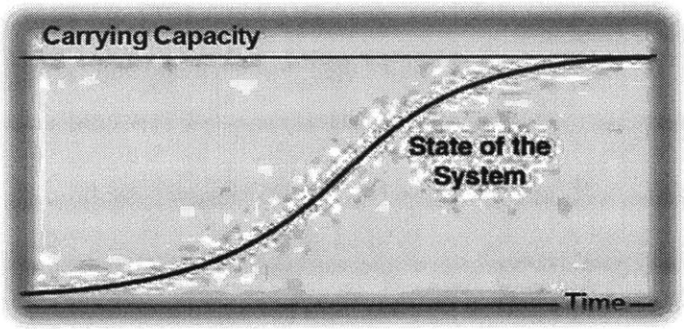


Time delays are various in nature – form perceptive (actual understanding of the state of the system) and administrative (like in case of USPS, or any other large organization).

More complex behavior modes arise from the interaction of the modes above. We will discuss two of more complex system-behavior types, as in essence they differ in one, but important assumption, and are relevant to stress dynamics in humans.

1. S-Shaped Growth

This form of system behavior is a combination of positive and negative feedback loops in a single system. The initial exponential growth is smoothed and gradually it reaches a steady state (equilibrium). A key concept underlying this type of system behavior is the notion of "*carrying capacity*". Sterman in his book uses the notion of ecological carrying capacity, when a system has limits as to how much life it can support with the given amount of resources. With life (population, bacteria, animals in certain isolated habitat, etc.) reaches the carrying capacity, per capita resources start to diminish, and the growth slows (15).

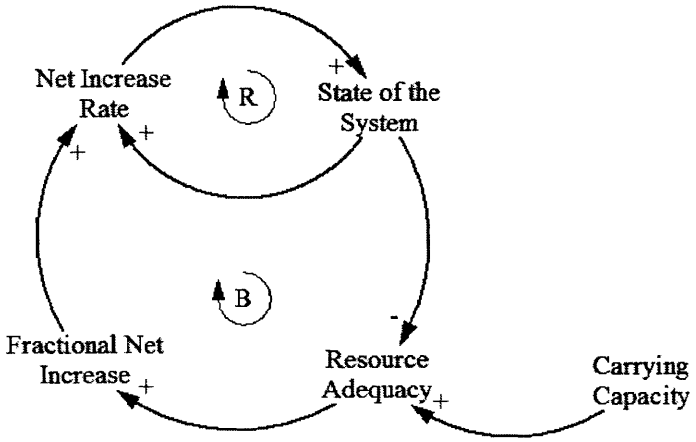


Source: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

The two critical conditions for the S-shaped growth to occur are:

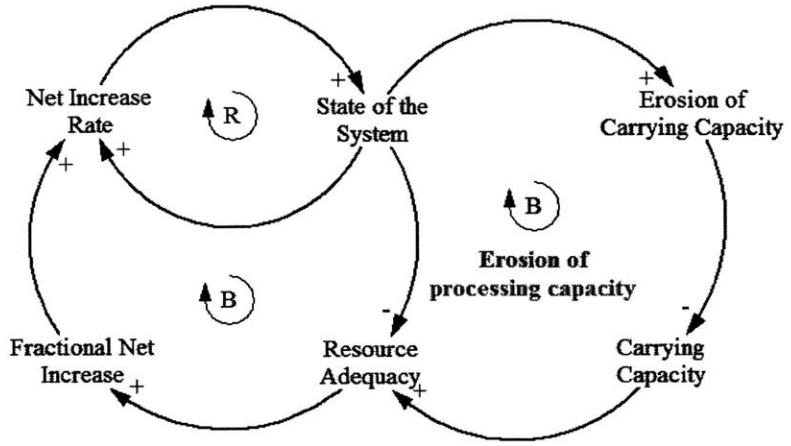
1. Negative feedback loops must not have any delays, since these would cause overshoots and subsequent oscillations;
2. Carrying capacity is fixed, and cannot change over time

Underlying structure of the S-shaped growth is as follows:

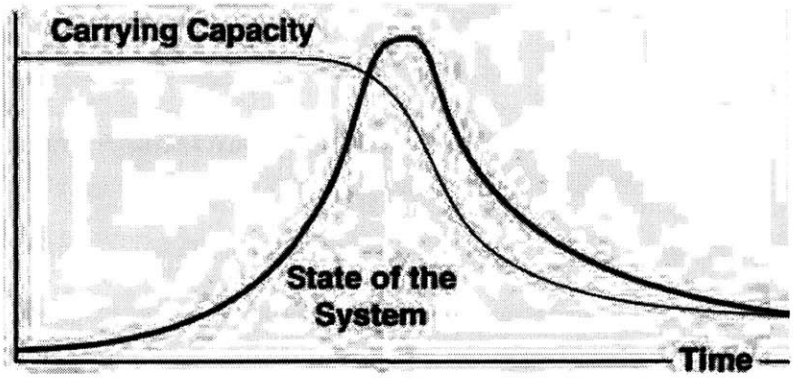


2. Overshoot and Collapse

As we discussed, for the S-shaped growth to occur, the two critical assumption mentioned above must hold true. However, what happens when these assumptions do not hold true? In the case of delays, intuitively we can deduce that much like the in the basic scenario, delays will cause oscillations around the equilibrium, and the length of delays will identify the amplitude of oscillations. What would the system behavior be if the second assumption (the carrying capacity = constant) is dismissed? Like in the case of environment, population growth and a number of examples, carrying capacity is a function of the state of the system itself. There are many examples of this in real life – hazardous waste not only contaminates the environment, but it also damages the ability of the environment to regenerate (put another way, it lowers the "processing capacity" of the environment). The feedback structure of this mode of system behavior is as follows:



The erosion of the environments "processing capacity" creates the second negative feedback loop. There are numerous real life examples for this type of system behavior. Amongst the most prominent examples are earth deforestation, carbon gas emissions, Earth population growth, etc. The ***overshoot and collapse*** system behavior graph is presented below:



Sorce: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

It is this type of system-behavior that we think strongly correlates with stress among humans. Our system dynamic conceptual framework will be built around the notion of limited, age-decaying physical and psychological "processing power" of human beings.

3.7 Conclusion

System dynamics, being a truly interdisciplinary method, has been long used in managerial problem solving and business strategy analysis. Our research indicates that System Dynamics has also been used for individual (44) and social (51) stress modeling, as well as PTSD analysis (52). We reviewed the building blocks of System Dynamics and most common reference modes, and noted the similarities between the overshoot and collapse behavior, and that of the human function curve. The latter fact has been documented in a number of researches (53) (54).

We will use the notion of limited human "processing capacity" as a cornerstone for our conceptual framework in the next chapters. Another notion we will be using will based on the key concept present in nearly all biological systems, and well explained by SD basic system - the concept of homeostasis. The idea of a system maintaining its state around a set equilibrium is one of the common reference modes in system dynamics, and is known as the goal-seeking behavior. It is modeled as a negative feedback loop.

There are several dynamic models focused on understanding of common work-related problem (burnout, work quality, etc.). In the next chapter, we will utilize system dynamic concepts and our research on common patterns uncovered during stress research to create a comprehensive framework that can be applied to better understanding of individual stress within organizations. This dynamic framework, if developed further into a system dynamics model, can help company management to devise better preventative stress management measures so as to use stress related brief efficiency increase and at the same time avoid episodes of workplace violence.

CHAPTER 4

A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING INDIVIDUAL STRESS

ABSTRACT

A conceptual framework for understanding individual stress was constructed. This was done by drawing parallels between patterns of our bodies' behavior during stressor inputs and that of the overshoot and collapse system behavior reference mode. The patterns indicated a short performance increase, followed by a sharp decline in the case of continuous stressor input. This notion was modeled according to a system dynamic "overshoot and collapse" reference behavior, with a negative feedback loop and a stock variable for representing the limited capacity of our bodies' resource. Other important dynamic related factors were incorporated to elaborate on crucial stress aspects. The framework allows for understanding of major feedback loops that constitute the basis for this dynamics. The implication of a more detailed model is likely to allow for trends analysis and increase individual's awareness of his/her acceptable stress levels and the dynamics of various factors. The framework relies on significant data entry form users, however considering the ever-increasing trend for small wearable smart devices capable of recording biometric data, this issue does not present a significant challenge.

4.0 Introduction

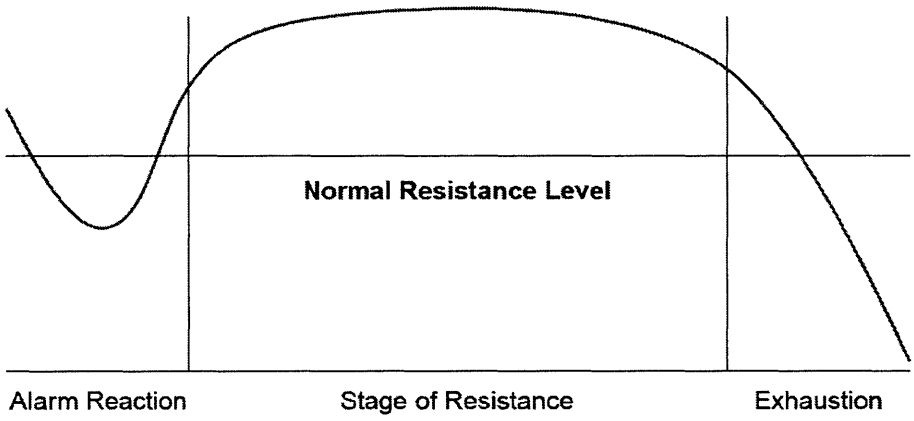
In this chapter, pursuant to introduction of system dynamics and we developed a system dynamics framework for understanding individual stress. We did this by hypothesizing that there are significant similarities between the human function curve and an "overshoot and collapse" system behavior mode. Combined with the idea of limited processing capacity of human body, were able to devise the conceptual model of individual stress. The model considers both physical and perceptive psychological factors and accommodates for the stocks for monitoring stress levels, perceptive stress levels and most importantly – individual's capacity to process stressor inputs.

4.1 Individual Stress Patterns and Systems Overview

Stress is a ubiquitous problem with significant implications on personal, corporate and nationwide levels. The complex nature of human stress and the entanglement of various cause / effect relationships indicates the non-linear, dynamic nature of the system of human stress response. One of the way to analyze complex dynamic systems is by modeling their behavior. Stress modeling has been a subject for numerous

studies and researches, and the approaches to those have changed along with changes in our understanding of stress.

In her book (55), Virginia Hill summarizes the theories of stress. The trend that patients, regardless of the nature of their sickness, exhibit similar behavior (fresh air, light, quiet, etc.) were recorded even before Hans Selye's observations. Selye, in his works, went further and with experiments on rats confirmed the theory of what he initially called "non-specific stress response". At this point, it was clear the effects of different stressors are remarkably similar. From the physiology perspective, Selye summarized previous research around the notion that the "systems" of human body that were affected by stress were adrenal, thymicolymphatic, and intestinal changes. Selye called the process stress response the General Adaptation Syndrome (GAS). The three phases of stress response were identified *alarm, resistance* and *exhaustion.*



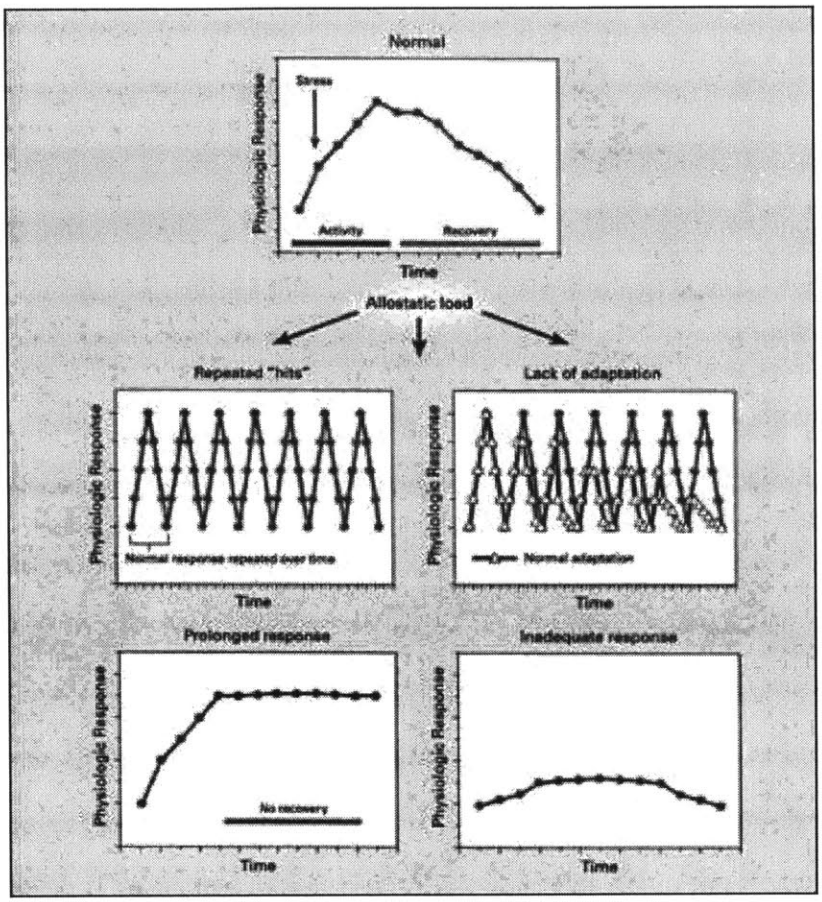
Source: Health News Network, http://www.healthnewsnet.com/gap.html

Overall, the GAS indicates that, depending on the duration of stress input, stress can have both positive results (by briefly condensing and directing body's resources), and also significant negative health outcomes (in case of a prolonged exposure). Stress essentially changes the way that our internal systems function, a process that is known as **homeostasis**. Homeostasis is the ability of the system to restore its state, recover after various inputs. All living organisms maintain some level of stability, be that blood oxygen levels, hear rate, temperature, blood pressure, etc. (56). From this perspective, stress has been

defined as conditions that disrupt homeostasis. Form physiology perspective, it is mainly the "duty" of hypothalamic-pituitary-adrenal (HPA) axis (44) to carry out homeostasis, but certainly all systems are affected and take part in homeostasis and stress response.

The disruption in homeostasis has been proved to have significant health implications. Prolonged stress exposure (because of high cortisol levels), just like in the case of Selye's lab experiments, depletes our body's stress coping resources and decreases our capacity to fight back diseases. Our stress model will be based around several central notions - the concept of homeostasis (negative feedback loop), that of the perceptive nature of some stressors (i.e. subjective stressors) and the duration of input.

Allostasis and Allostatic Load Theories: Another stress framework useful from the SD system the concepts called the allostatic (or allostasis) theory, proposed by McEwen, Sterling, Eyer and Wingfiled more recently. The basic concept underlying this theory is that as opposed to the single point system response and management to restore initial parameters (homeostasis), the system changes an entire set of parameters in an effort to restore and redefine the normal "set" parameters. In essence, allostasis is the process through which homeostasis is achieved. Allostatic load is the degree of deprivation of system's resources to maintain equilibrium. While these system-wide response reactions are essential in maintaining homeostasis, in the long run the stresses placed on the system are likely to facilitate the appearance of diseases (57). Researchers have identified several types of allostatic loads based on stressor input and duration (57):



***Source**: Bruce McEwen and Teresa Seeman in collaboration with the Allostatic Load Working Group. Last revised August, 2009*

1. High frequency similar stressor input;
2. Inability to adapt to the same stressor;
3. Continued and non-regulated hormonal stress response;
4. Insufficient levels of stress response leading other systems to engage in compensatory actions.

These four allostatic loads illustrate some key variables within stress response system – the duration of the stressor and the frequency of its application. The latter two types are both germane to the lack of control of the stress response system in that it is either has significant inertia, or is just not sensitive enough.

Virginia Hill's research (55) lists a number of other stress frameworks (such as Roy's Adaptation Model RAM, Psychophysiological Stress Model PSM, etc.), as well as some approaches to actual stress

measurement. Most of the approaches are based on taking objective measurements (blood pressure, heart rate, oxygen consumption), as well as subjective measurements, such as interviewing patients. For instance, the PSM stress measurement interview would be comprised of a series of 5-poin questions with the range of answers from "strongly agree" to "strongly disagree". Taking subjective measurements is crucial in understanding the state of a stress system. In addition to wide spread personality tests, organizations may consider conducting regular surveys and reviews in order to have timely and dynamic understanding of employee perceptions of the work environment and its stressfulness. In time, these datasets are likely to provide valuable information to for data mining and establishing patterns with regards personal and group stress dynamics.

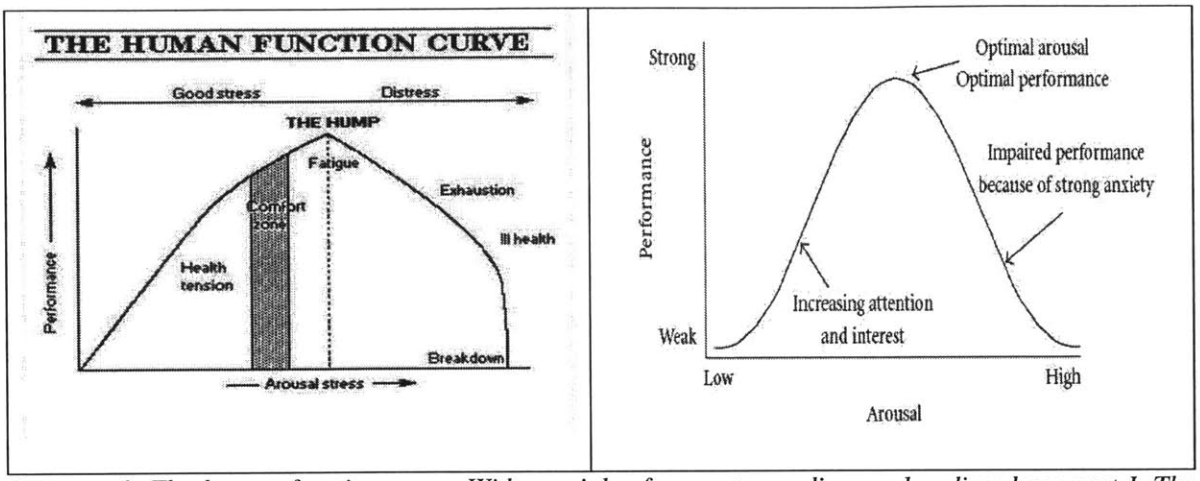
When building our framework, we considered pathways for both perceptive inputs, as well as objectively inputs. Objective inputs can be acquired through general screenings, HR databases, and existing significant body of research on human stress response physiological system. Our goal was to create a framework explaining the well-observed and repetitive pattern of human body and system behavior concerning initial increased performance, but a rapid decline and crises in the longer run. We have constructed our framework based on feedback structures, what we have called building blocks.

4.2 Method

We applied the systems dynamics modeling method for constructing a framework for understanding individual stress. Our building blocks for the reference framework were based on system behavior reference modes taken from SD. Since human body is a complex system with various interacting components, delays and cause-effect relationships, the inputs into the system (stressors, factors of personal, natural and organizational nature) are likely to cause non-trivial outcomes. We believe system dynamics is precisely the tool to use for analyzing a system like this and for conceptualizing the underlying "physics" of the stress response processes.

Interestingly, there is a lot of empirical research that coincides on similar stress system performance. Scientists have long known the term "human function curve" and research has correlated

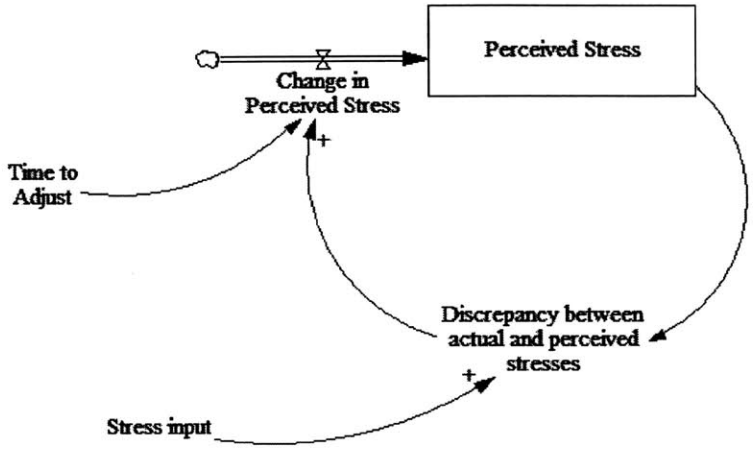
human performance with stress. From System Dynamics perspective, this is a classic *overshoot and collapse* system behavior. Below is the human function curve relationship between stress (good and bad) and performance (physical and mental).



Sources: ***1.*** *The human function curve. With special reference to cardiovascular disorders: part I, The Practitioner 217.1301 (1976).* ***2.*** *Yerkes RM, Dodson JD (1908). "The relation of strength of stimulus to rapidity of habit-formation". Journal of Comparative Neurology and Psychology 18: 459–482.*

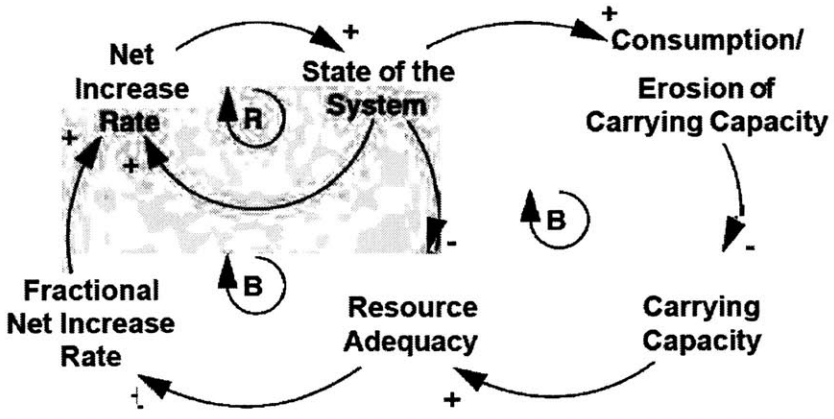
This type of human "system" behavior has been documented in a number of researches (53) (54). As we see, it is a replication of the overshoot and collapse system behavior, as we discussed in Chapter 3. These studies, as we can deduce from the human-function curve, conclude that continuous stressor influence will result in breach of **homeostasis** and, consequently, in exhaustion and sharp productivity decline. From System Dynamic perspective, homeostasis is a negative feedback loop with a goal of bringing all the externally caused fluctuations to a point of balance. We will consider this negative feedback loop as one of the building blocks of our framework.

As we have learned, some stressors (substances, diseases, and physical violence) are objective, and might somewhat be easy to account for. At the same time, a number of stressors (time pressure, co-worker support, etc.) are rather perceptive, and would be challenging to acquire (46). In this regard, the second building block we will consider is the first-order perceptive delays proposed by Sterman (15):



Source: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

Another SD building block we have used again has to do with the "overshoot and collapse" reference system behavior. The reason for this is that human body capacity to support stress recovery efforts are similar to those mentioned by Sterman (15): *"the ability of the environment to support a growing population is eroded or consumed by the population itself".*

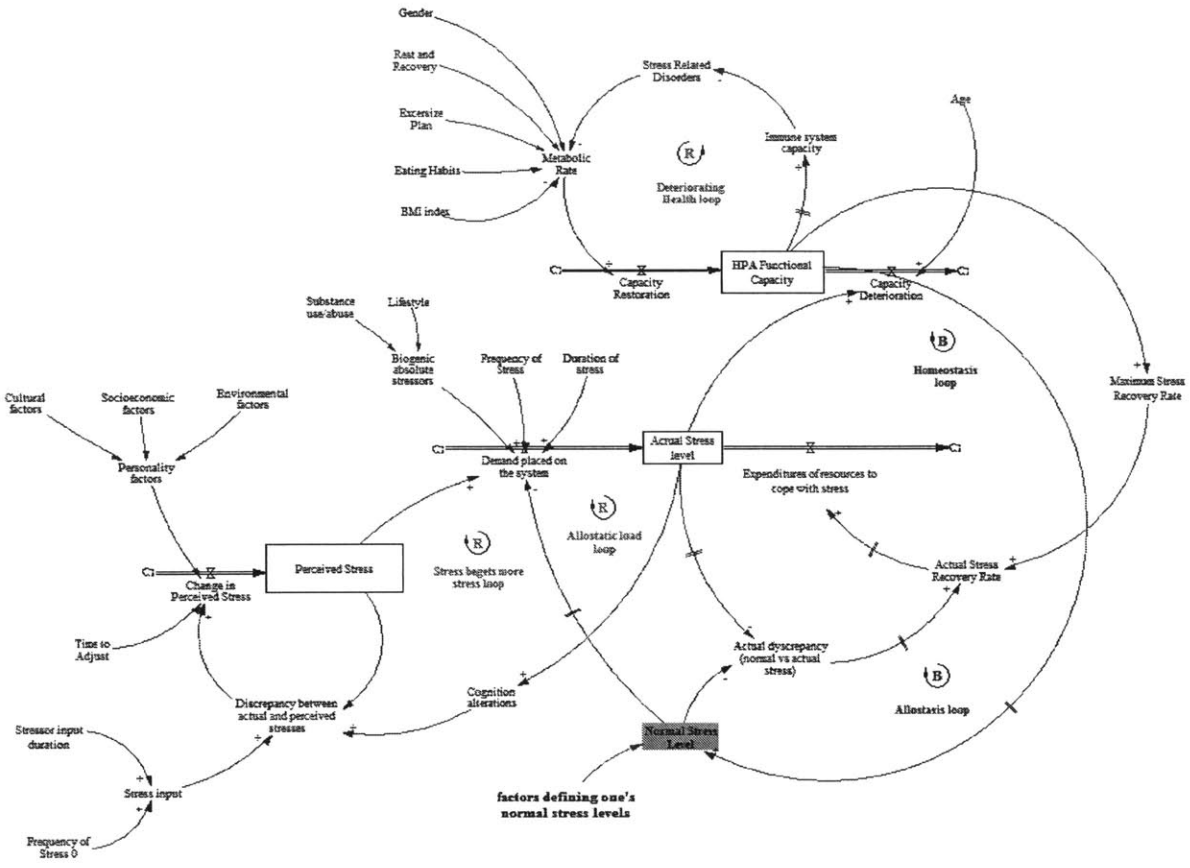


Source: John D. Sterman, Business Dynamics: Systems Thinking and Modeling for a Complex World

For building our conceptual framework, we will use the abovementioned building blocks, in addition to the stress ontology research mentioned earlier in this paper (46). Please refer to Chapter 2 for a graphical representation of human stress ontology.

4.3 The Proposed Framework

Below is the Homeostasis System Dynamic framework:



In our framework, we have combined the objectivity/subjectivity group of stressors, as many of them are of perceptive nature and must pass through a cognitive filter. Perceptive stressors are crucial, and research indicates that work related stresses are among the top two in US. We have incorporated perceptive stressor input in this framework; however, we will elaborate more on this in our organizational stress framework.

One of the major assumptions in our framework is that it constantly and certainly deteriorates due to natural aging processes happening in our bodies. In essence, aging is inversely correlated with metabolism. We have presented metabolism as a part of HPA capacity restoration for the purpose of emphasizing activities and decision under our control that can be undertaken.

4.4 Results

The apparent feedback loops responsible for the overshoot and collapse (or human function curve) behavior are as follows:

Deteriorating Health loop – reinforcing feedback loop

As we know, no quantity can grow forever, more so for the limited and constantly deteriorating system as a human body is. If the "HPA functional capacity" stock is in a fully recovered state, we are in a position to mobilize our body's resources to fully process the stress loads. This is the reason of initial incline in our performance under stress. However, these compensatory actions consume our resources - extended stress inputs contiguously deplete HPA functional capacity. As our body reaches a certain limit through various mechanisms these deteriorated capacity starts having other effects: As we know, the HPA axis is mainly responsible for stress reaction, but it is also responsible for controlling a number of other important processes in our bodies (for instance the immune system, energy storage and expenditure, etc.). In our framework, we have demonstrated the fact that extended depletion of HPA functional capacity will, with some delay, inevitably decrease immune system efficiency. On its turn, this will lead to a number of stress related disorders, negatively affecting the metabolic rate. As our overall well-being declines, our capacity to process stress at increased levels deteriorates further. It is important to note the delay between "Immune system capacity" and "Stress related disorders" - this delay is the depiction of the fact that most damage to our health is done by the chronic stress. Without adequate attention and system restoration effort, excessive or extended abuse of our stress response system will result in fatigue and a collapse with significant physiological and psychological consequences.

There are a number of ways, in which we can control and improve our metabolic rate and hence – HPA functional capacity, but we must always remember that aging processes are constantly depleting our capacity (deteriorating metabolic rate). With the aging comes the change in metabolic rate, which we have considered directly affecting the HPA axis functional capacity. The individual metabolic rate is determined by age, gender, height and weight (perhaps can be condensed into the Body Mass Index BMI), and other genetic factors (58). The takeaway here is that due to its natural tendency to decline, this is a very powerful reinforcing feedback loop, and without conscious and devoted efforts to sustaining our capacity to "fight" stress, over time it is only losing its strength.

Homeostasis loop – balancing feedback loop

This is the actual recovery loop, body's response to stressor inputs. Stress response is carried out at the expense of ""HPA functional capacity", hence the causal relationship between its outflow rate and the stock of "Actual Stress level". We have modeled this response to be proportional to the difference between two factors – the normal stress level for an individual and the actual stress level. The former is a sophisticated factor. It is likely to be formed by a combination of rather individual factors reflecting our overall wellness (including the HPA axis functional capacity), however further research is required to understand what constitutes a normal stress level for an individual. We have already assumed the "HPA functional capacity" to define the maximum rate at which our body can process stress (the maximum rate at which our body can "process" hormones and chemical reactions of stressor input). The discrepancy on its turn affects the level of actual recovery efforts actuated by our body.

In line with one of the SD building blocks (the negative feedback loop), the "Maximum Stress Recovery Rate" and the "Actual Discrepancy" define the magnitude of body's stress recovery effort.

Allostasis loop – balancing feedback loop

This is an interesting "side-effect" of body's stress response system activation. The concept of allostasis is a relatively new research topic. It was defined in the end of 80's as "*the ability to achieve*

stability through change" (59). While allostatic processes contribute to the same outcome (achievement of stability), the pathways through which they act are different. Allostatic processes alter the functions of a number of other systems to achieve stability. This is an important dynamic defining loop, and further research is required to depict with acceptable accuracy the sophisticated interrelationships in this part of the system. In our framework, we have demonstrated allostatic processes by a causal relationship through "Normal stress level" variable. This sophisticated variable is chosen to represent the acceptable level of stress that our body possesses (cumulative state of the system). As we see, the "HPA functional capacity" is one of the components of the "Normal Stress Level" variable, but we believe there are other important factors yet to be uncovered. This loop contributes to the balancing cycle not by expending our resources to process stress, but by change – i.e. decreasing the discrepancy between actual and normal stress levels. With the decrease of this gap, our body spends fewer resources to cope with stress. Research indicates that if these adaptive mechanisms are properly used (i.e activated and deactivated with adequate frequency and duration), then "*body is able to cope effectively with challenges that it might not otherwise survive*" (59). But what happens if allostatic systems are abused?

Allostatic load loop – reinforcing feedback loop

This is an extension of the previous loop, but due to its importance we have designated it into a separate loop. While allostasis loop mobilizes the systems of our body to decrease the gap, this mobilization, if extended or frequent, is nothing but another demand on the processing capacity of the system – our body. Initially this loop mobilizes other resources of our bodies and is responsible for the "adaptation" to the new, increased stress levels. However, research has proved that extended stressor inputs (chronic stress) cause significant health problems in many body systems (ranging from loss of appetite, anxiety and depression to high blood pressure, cardiovascular diseases, strokes and memory and concentration disruptions, to name a few). In essence, Allostatic load loop represents the inversely correlated relationship that normal stress levels have with the demands placed on our system. The delay indicates that the demands onto the system increase only after continuous abuse of the allostasis system.

Stress begets more stress loop – reinforcing feedback loop

This is perhaps the most difficult to measure, yet one of the more important loops in our framework. We have placed significant emphasis on this loop in our next chapter; however, a principal explanation of this loop is presented here as well. From stress ontology, we know a vast array of factors and patterns that are associated with stress causes. In our model, we assumed all perceptive and subjective factors passing through a cognitive filter. Differences in human nature imply that individuals can have rather opposite perceptions of similar stressors – a good example of this being work under pressure (some individuals strive under these conditions, and some find those rather stressful). At the same time, research has shown (the stress ontology) that stress can cause cognitive alterations and emotional exhaustion, which may in turn aggravate our perception of stress (hence increasing demands placed on the system).

These individual and subjective factors might appear to be difficult to measure, but simple Likert questionnaires (as discussed earlier) have been proved to be effective tools for acquiring valuable information. Furthermore, common personality tests that corporations often conduct for employees are also a useful information source and can be incorporated into this model with further research.

From the perspective of our framework, an important aspect of perceptive stressors is that in contrast to many physical and physiological variables, they can have both positive and negative values. An enjoyable stressor (excitement, joy, happiness, job satisfaction, etc.), while presented to be causally related to the demands of the system, can actually abate other demands.

4.5 Conclusion

In the above diagram, we believe to have captured principal relationships that exist between key variables defining dynamics of individual stress. We have created a framework that views stress as a balance between demands (various stressors: perceptive, objective and subjective) and resources to process it. We

have built our framework of self-regulating stress response using the notion of negative feedback loops from system dynamics discipline. We also used the notion of limited processing capacity of our bodies, depicted by the "HPA functional capacity" stock variable. For the purpose of this thesis and in line with good modeling practices, we consider mainly endogenous resources – the HPA axis, which is the responsible mechanism for stress response. The HPA is a system comprised of three endocrine glands; hence, one of the main factors defining its work efficiency is the overall metabolic rate of our body. Natural aging processes happening in our bodies continuously and naturally deteriorate the latter. We summarized exogenous factors that influence metabolic rate in the variable of the same name.

After creating the stock and flow SD structure, interesting observations can be made. There are two main balancing feedback loops that "process" stressor inputs, and both of these loops, while being essential in recovery process, can be the very reasons for the eventual collapse of the system ("overshoot and collapse" behavior). In the case of the "homeostasis loop", the decline is the result of HPA axis functional capacity abuse. In the case of the "Allostasis loop", the decline is the result of additional latent demands placed on our body and consequent cumulative "*wear and tear*" of the body. The framework also indicates what factors can be used to control our stress processing capacity restoration. Their relationship with the system is presented through a measurable "metabolic rate" variable. Even without precise modeling, it is clear that the maintenance of a healthy balance is not a trivial question. Perhaps the safe approach here will be similar to an approach engineers take for designing fail safe systems – either design a system with significantly more capacity than anticipated, or keep performance parameters well below critical limits.

Some of the inputs into the system are objective and obvious (like age, rest and recover time, BMI, etc.) and impacts thereof have been rather well researched. Other inputs are more subjective and challenging to acquire and assess. However, perhaps the application of qualitative analysis will be the better option in this case: if this approach is applied to a large organization with thousands of employees (like in the case of USPS), it is feasible that over time the system comes up with some "baseline" reading for each parameter (we can call this the "big data reading"). This might allow us to assess which individuals and organizational

units in have indicators significantly above or below these "baselines. Once this system is mature and in the stable state, it will provide dynamic information about individual stress levels and provide us with ability to cross-reference large volumes of data. This big data approach to is likely to generate interesting results, since as researches point out "*simple algorithms applied to big datasets yield better results than sophisticated algorithms applied to small datasets*" (60).

We think that this approach applied within USPS, certainly with employee approval and "buy-in", is precisely the location to apply this framework. The proposed framework will provide the assessment of employees' overall health, perceptive stress loads and, most importantly, big datasets are able to provide with decent understanding of key variable such as the normal stress level for an individual. Implications of this information is hard to overestimate, since a good understanding of normal stress levels is key to understanding both pathways (homeostasis and allostasis) of stress response.

We believe this framework is a solid basis for allowing mid to top-level managers, and individuals themselves, to be more aware of one's capacity to fight stress. The framework considers the impact and dynamics thereof that various objective and subjective inputs have on the "system" of human stress response. For enhanced accuracy, this framework could be incorporated with already existing system dynamics stress models (44).

It is not uncommon today for stress to be often referred to as the epidemic of our time. Demands placed on our systems, especially work-related loads, continue to increase. As we mentioned earlier in our work, work-related stress has been cited as a top stressor in a number of studies. This is especially relevant today, when in the times of crises increased pressure on employees seems to be the first choice for many organizations. Using concepts of limited stress processing capacity, we will explore the system of organizational stress and variables that comprise it. More specifically, we are interested in understanding and perhaps monitoring the relationship of stress, productivity, work quality and organizational key performance indicators.

CHAPTER 5

A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING ORGANIZATIONAL STRESS

ABSTRACT

Existing literature on work related / organizational stress was reviewed. A system dynamics conceptual framework for understanding work stress was constructed. Potential implications for organizations and relationships with key performance indicators were considered. The proposed framework was built using existing research on the topic, as well as existing USPS employee survey data for the purpose of making it more practical and applicable in this specific case.

5.0 Introduction

In this chapter, we adopt the same approach as in the chapter above to devise the system dynamic framework (a stock for limited stress processing capacity and a stock for perceptive variables). Due to its inherently perceptive nature, and for the purpose of adopting the model for specifically USPS, we incorporated variables taken from an extensive USPS employee survey results. Based on the notion that work stress is an extension of individuals stress, we assumed a single joint variable as "employee energy" to model the cumulative capacity of employee to carry out his/her duties. This allowed us to join in a single model the perceptive stress variables and organizational key performance indicators.

5.1 Organizational Stress Statistics

As we have already seen, work stress is amongst the top reasons for stress. There is significant research on the issue of overall stress effect on individual health, but we will review researches covering the effect that work stress carries on indicators of corporate, organizational and, of course, individual nature.

Ultimately, for companies the impact of stress is measured by financial losses incurred, and the numbers are alarming. For instance, according to a research done in 2013, only in UK annual stress-related losses comprised almost 6.5 billion pounds, with the number of "lost" days topping 10 million (61). World Health Organization estimates stress related losses in US to be a staggering 300 billion dollars annually

(!).Clearly, these numbers are concerning not only on the national level, but also on employer level. Just as individual stress causes numerous health problems, works tress carries severe consequences for organizations and their key performance indicators. More specifically – increase in costs and decrease in productivity. Furthermore, only some the reasons why stress issues should be of utmost interest to organizations are:

1. Stress is responsible for as much as 40% of employee turnover (62)
2. Replacing an average employee costs 120-200% of the salary of the position affected. (63)

Much like in general stress research, the definitions about work stress vary over time as well. However considering that for the overwhelming majority of adults work is the most regular activity of their lives; it's significant impact on quality of life has been appreciated since the times of early works of Walter Cannon. Today, with the research proven stress induced healthcare costs, it is hard to underestimate further understanding of this phenomenon. In Chapter 2, we reviewed individual and organizational stress researches, noting that these two ideas have undergone similar changes, since largely the notion of organizational stress is an extension of individual stress. In this chapter we will focus on certain models that have been proposed for understanding the impact of organizational stress on companies' key performance indicators. Most importantly, we will use the concept of employee energy to design our framework for understanding of stresses most peculiar to USPS employees.

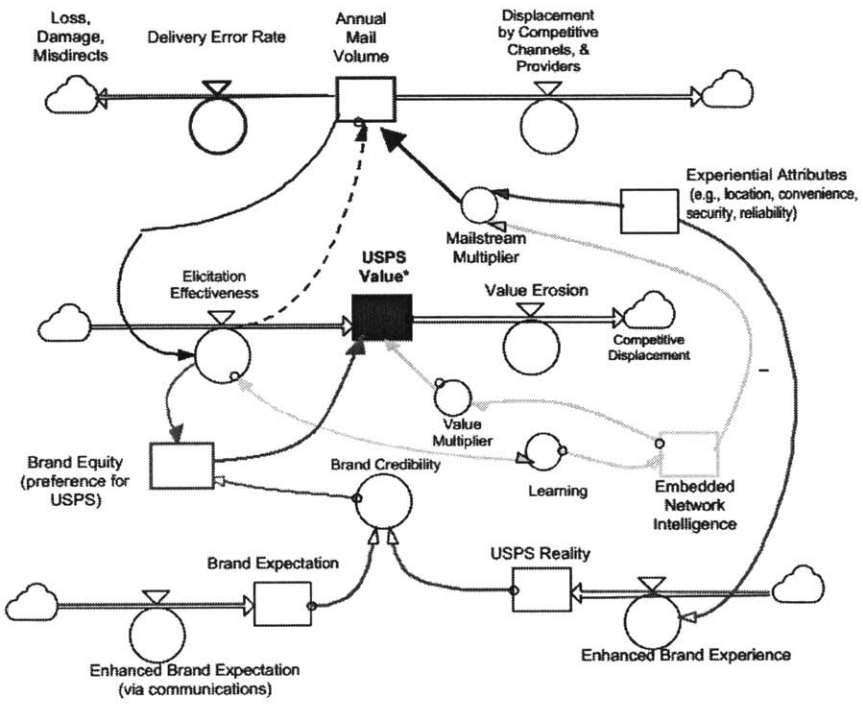
5.2 Method

Essentially, we applied similar systems dynamics modeling method for constructing a framework for understanding organizational stress much like in the chapter above. Being an extension of individual stress theories, work stress required only inclusion and focus on perceptive stressor inputs, which we modeled according to singe stock delay structure proposed by Sterman.

From organizational perspective, while financial impact of stress is clear, there are less material, but equally important factors to consider – i.e. output quality, corporate reputation implications, efficiency, work environment , etc. All our previous research points to the direct correlation of work stress and healthy

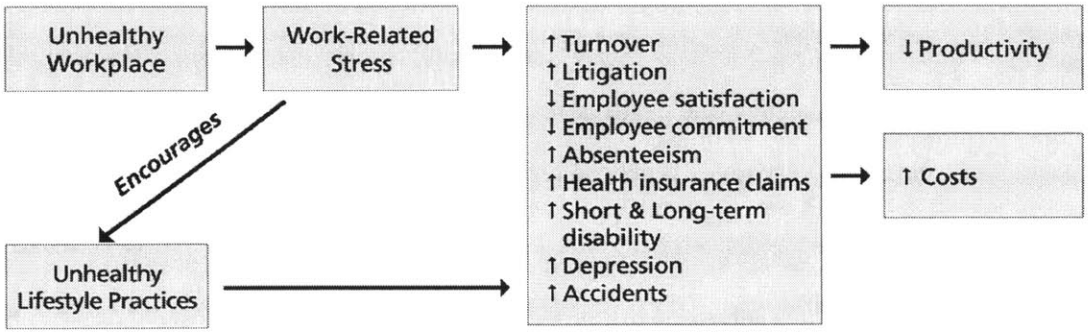
(or unhealthy) work environment. With regards to direct impact on organizational performance, both research, and my experience at MIT in my classes on Project Management and System Dynamics shows that volume of work to be done, rework, quality, and employee burnout are among common problems that modeling was used to analyze. Considering the inevitable employee cuts and severely limited capacity to invest in operations, understanding and perhaps measuring the degree of mutual interference of the abovementioned factors can prove rather beneficial to USPS.

Interestingly, system dynamics has been used in one research in an attempt to analyze variables - the value losses of the USPS. It is interesting to note the interrelationship of value loss and the mail delivery stocks, a clear attempt to correlate intangible variables with key performance indicators.



***Source**: United States Postal Service at a Crossroads: Insights and Questions, A discussion paper, Nazir Ahmad, November 2001*

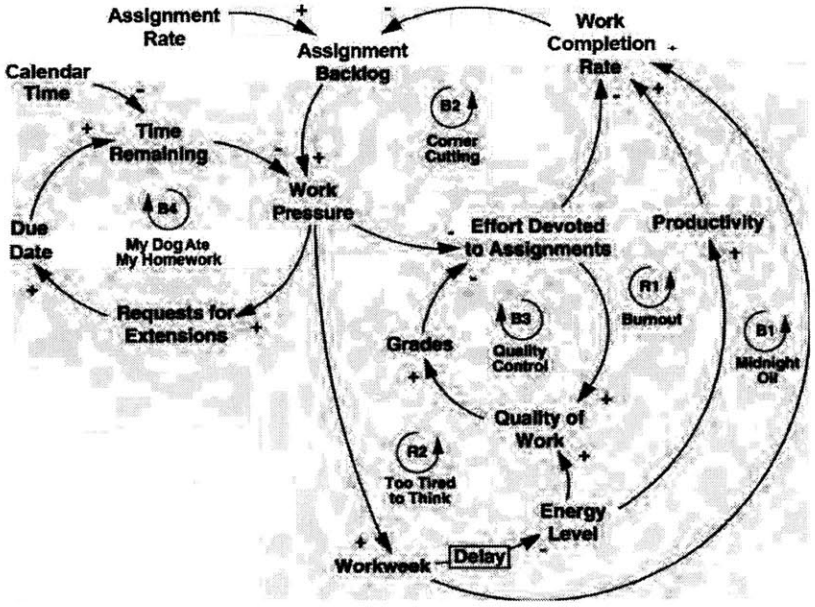
A research non peculiar to USPS provides a general framework of how work stress affects costs and productivity, and essentially- the bottom line.



***Source**: The Business Case for a Healthy Workplace By: Joan Burton, Senior Strategy Advisor, Healthy Workplaces; Industrial Accident Prevention Association*

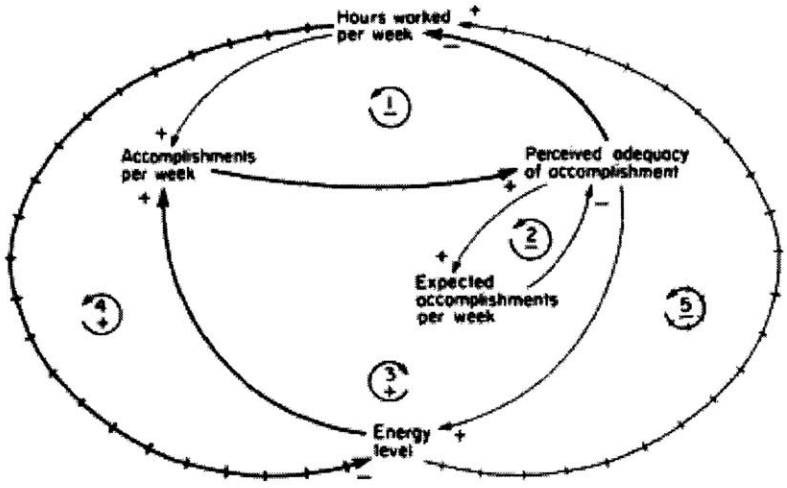
In this model, the word stress is used to describe "*subjective feelings that result from any number of conditions at work ("stressors"), such as being overwhelmed by work demands that are out of our control or unpleasant "toxic" workplace relationships"*. This report also mentions an interesting fact – often a notable increase in the quality of work costs almost nothing for employers. Similarly, we learn that there is proven and measured relationship between employee satisfaction and revenues, namely "*...every 5-unit increase in employee satisfaction in one quarter, there is a 2-unit increase in customer satisfaction in the next quarter and a 0.5 unit increase in revenues above the national average in the following quarter*" (64).

Another interesting model is proposed by Sterman (15). This model is interesting as using students as examples, it explains the effects of prolonged work ours and increased (unnatural) pace of work to get more things done. In both cases, exhaustion reinforcing feedback loops ("too tired to think" and "burnout") reduce all focused efforts to increase the work completion rate. In both cases, a variable called "Energy level" is defined the dynamics of the "quality of work" and that of the "productivity" variables.



Source: *Sterman, John D. "Business dynamics." (2000)*

Another interesting model was developed as early as in 1985 by Jack Homer (65). In this work, the researcher presented a dynamic model of burnout. The problem was viewed through the familiar lens of placed demands and available resources.



Causal loop cycle for underlying burnout cycles. Source: *Homer, J. (1985) Worker burnout: A dynamic model with implications for prevention and control, System Dynamics Review 1(1), 42-62.*

The conclusion the author reaches is that burnout is not achieved by stressful work environment alone, but by one's workaholic personality. The model also proposes that stability, a key factor in reducing the amplitude and duration of burnouts, can be controlled by limiting work hours. The model showed that temporary relaxation (as the author called it, the "time off response") is not a viable solution, and that even the workload should be further reduced in case of recurring symptoms. The use of term "energy" is important, as we will refer to this as the main stock that jointly represents employee psychological and emotional well-being.

We would like to emphasize the distinction between stress and energy. While the difference is subtle, however these categories are not exactly the same. Often the term energy is used to summarize the resources that our body has (the capacity, as we referred to earlier in this paper) to combat stress. In previous sections of this report, we proposed a conceptual framework for understanding individual stress. A central idea for this model was the "functional capacity" of the human body to process various stressors, both physical and perceptive. During our research, we came across a similar idea – employee energy. We came across a number of publications that used the term "energy" do describe the capacity of employees to perform their daily tasks. These two categories (stress and energy) were not only viewed in tandem, but also had a number of similar properties - much like stress, energy was also presented having physical, mental and emotional levels. In many cases, the cumulative notion of energy was used to join all aspects (physical and psychological) of employee wellbeing into one perhaps not exact, but a comprehensive idea. This term appeared to be wide spread in business and work stress literature. We based our further endeavors on the fact that individual physical, environmental and some perceptive stressors and their monitoring is accounted for and can be done through the individual stress framework presented in earlier chapter of this work. These individual factors, while crucial and system defining are somewhat exogenous to the work environment, as for the most part they are not dependent on it (i.e. – being an equal opportunity employer implies this). We will consider only endogenous factors, cumulatively referred to as "energy" for analyzing work stress dynamics.

Having looked through research and some models of work stress, we will proceed with our proposed framework for modeling work stress using the notion of energy. We will pay special attention to variables that we have come across during our research on work related stress, as well as those peculiar to USPS. We will use structures and concepts adapted from a number of models (more specifically, we will use structures and concepts from J. Sterman's book (15), pages 167 and 579).

5.3 Proposed Framework

In line with good modeling practices, (model the problem, not the situation) we took note of the "Nonfatal Violence at Work" section of a comprehensive report about workplace violence in USPS (9). Important information, covering the topics of attitudes about work, psychological conditions, and substance abuse were covered in this section. An interesting observation form this research is that compared to national averages USPS employees consistently scored lower on crucial stress-related factors, such as Anger, Hostility, Aggressiveness, **Stress**, Depression, Distress and Anxiety, and showed better Coping responses. However, the pictures was quite different on other factors: as the report mentions *"In contrast with their positive scores on general psychological measures, postal employees have more* ***negative attitudes than employees in the national workforce about work, coworkers, and management****."* In summary, while USPS employees are less stressed per se, they have rather negative notions of their work, colleagues and the management.

In essence, these factors define the work environment from the perspective of most, if not all, work stress research frameworks. The importance of these results is further emphasized if we consider the results of another research – the core self-evaluation (CSE) theory (66). As the authors mentioned, CSE is "*individual's conclusions about him- or herself*". It was established that a strong correlation exists between CSE variables and job satisfaction. CSE variables were self-esteem, locus of control, self-efficacy, and neuroticism. All these variables were measured by well-researched 5-scale Likert scale, or by similar simple survey method.

To further appreciate the magnitude of some of the factors, we have looked at responses that show a difference of **twice or more** compared to identical national workforce average numbers. Based on this information, we have compiled a list of variables that essentially define the model and its behavior.

USPS Survey Findings (The phrasing has been copied from the report (9))	Endogenous Variables
Postal employees are twice as likely as employees in the national workforce to say they would accept a job offer from a different employer with the same wages, retirement and fringe benefits (46 vs. 23 percent)	**Turnover Intent**
Postal employees are twice as likely to agree that "employees I work with should not be working here because of their mental or emotional problems"	**Comfort with Colleagues**
Postal employees are less than half as likely to agree that "I am responsible for counseling my subordinates or helping them solve their problems" (22 vs. 50 percent).	**Support from Colleagues**
Postal employees are four times as likely to agree that "the use of threats or violence is an effective way to get things done in the workplace" (8 vs. 2 percent	**Aggression**
Postal employees are more likely than the national workforce to agree that "many… managers and supervisors… try to provoke employees to violence" (27 vs. 6 percent)	**Support from Management**
Postal employees USPS workers feel more pressured and are more likely to be asked to do more work.	**Work Pressure**
Postal employees are half as likely to agree that "I have a lot to say about what happens on my job" (32 vs. 63 percent).	**Job Control**
Postal employees are more than twice as likely to agree: "on my job, I have very little freedom to decide how I do my work" (48 vs. 23 percent).	**Job Autonomy**
Postal employees are less likely to agree: "I get to do a variety of different things on my job" (59 vs. 85 percent).	**Variety (or routine)**

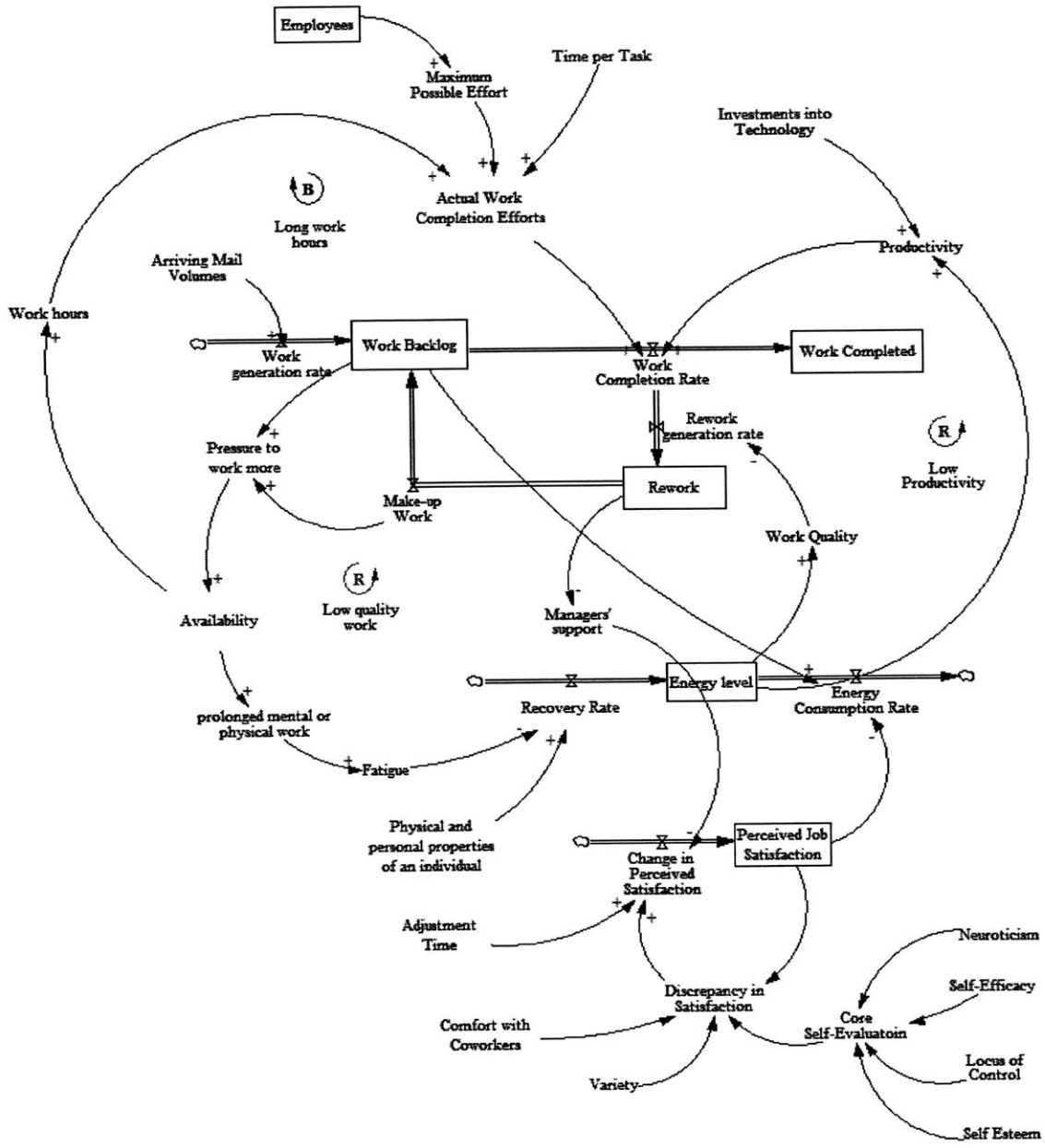
Source: USPS Commission on a Safe and Secure Workplace, August 2009

Again, for variables like above, a precise measurement applicable to all employees across all personalities is a challenging task. However, simple Likert scale surveys have proved effective for generating reliable datasets for conclusive analyses.

In building our model, we have made several assumptions. As mentioned before, we will not consider the effects of individual physical nature in here, only those related to work environment. We will focus on the cumulative variable, that defines employee performance both professionally (productivity and work quality) and personally (the dynamics of relationships).

- Support form Colleagues is a perceptive variable that can be obtained only from survey;
- Support form Management is a perceptive variable, however it is also dependent on employee performance;
- The CSE variables are distinguished as a separate group due to their well-researched and high correlation with job satisfaction (66);
- Job satisfaction as a perceptive variable modeled to accumulate and reflect all significant perceptive factors associated with work environment;
- Much like the "HPA axis functional capacity" variable defines the limited ability of human body to process stressor inputs, "Energy" stock variable is used to depict the limited capacity of employees to carry out their duties in a proper manner.

Below is our proposed framework:



5.3 Results

As we discussed, the framework was built to facilitate our understanding of impact of negative attitudes towards coworkers, management and work in general. We integrated important perceptive variables into a stock variable named "Job Satisfaction", and proposed to model it as a single perceptive variable; we called it "Energy level". Conducted research indicates that employee energy correlates with

productivity and efficiency. It is with this premise in mind that we constructed the loops responsible, in our understanding, for employee energy levels and ultimately – his/her performance. There are a few exogenous variables in the system, such as **employee levels** (this is defined by company policy, in the case of USPS we know that this variable will be decreasing in the years to come), **arriving mail volumes** (again, a decreasing variable, unless USPS embraces a drastic policy change and a new business model), and **investment into technology**. There variables have been considered for allowing the system to be expanded to include inputs and implications on the corporate level.

The remaining variables are peculiar to an individual and can be either obtained through simple interviews and questionnaires, or be assumed a specific number. One of our goals was also the integration of common KPIs, known as Overall Labor Effectiveness (OLE). These factors are important in understanding how effective is the existing workforce is used. The important feature is that these factors are quantifiable and can be relatively easily acquired. The combination of these factors is used for measuring the utilization, performance, and quality of the workforce and its impact on productivity. While variable names are different in model, conceptually they measure the same capacity – **Availability** (time spent making effective contributions), **Performance** (the measurable quantity of completed work – in this case, for instance, the total number of letters processed) and **quality** (measurement of properly or correctly completed work, in our case measured by either Rework Generation Rate, or the stock of Rework).

The concept of employee energy (the capacity to carry out his/her responsibilities) is a rather complex one. In this model, we assume the concept of energy to be similar to notion of stress we examined earlier, and the notion of carrying capacity as outlined by Sterman. It is limited; as they are limited ways, in which employees can restore his/her energy, and this will take certain amount of time depending on physical and personal characteristics of an individual. While intuitively this is clear, in many cases we oversee the difficulties of working with such limited, dynamic and feedback-driven systems. For this reason, in our framework, we do not aim for precision, but rather for awareness - we believe that our framework, while not precise, brings a lot of value to employers and employees by creating a dynamic

understanding of employee energy levels and the ways this level affects both personal and corporate performance.

We will look into system defining feedback loops:

Long work hours loop

This is the only balancing feedback loop in the system. This loop is the depiction of putting more hours into work, and hence getting more work done. Earlier in this work, we discussed the well-known relationships of effort (demands, arousal, etc.) and productivity. More specifically, Yerkes-Dodson Law and the Human Function Curve both elaborate that increased demands placed on human physiological and mental systems provide for a spike of productivity increase, however eventually they cause a drop in performance. For the purposes of this model, we propose to model this "overshoot and collapse" relationship using "Energy level" stock. The "Long work hours" loop is responsible for the initial boost in the "Work Completion Rate", however after time, and with continuing to input extended working hours, the next two loops abate this effect and are responsible for pursuant negative dynamics. While somewhat coarse, we believe that this simplified approach will prove useful when combined with large datasets.

Low quality loop

This is the reinforcing loop abating the effect of the previous balancing feedback loop through generating rework. Low employee energy contributes to mistakes in judgment and physical work (i.e. error generation rate), which results in work carried out improperly. We know that amongst other complaints, USPS is often blamed for poor service (late, wrong or incorrect deliveries) (67). The "Work Quality" variable is also a part of OLE indicators, and should be measure by on organization. We have included a variable responsible for incorporating a function, or the extent to which low energy level affects work quality. An important aspect of this loop is that the stock of "Rework" (which represents the work not done properly) is likely to cause management discontent, the importance of which cannot be undermined if we consider the situation with regards to the attitudes towards managers in USPS (significantly worse than in the national averages).

Low productivity loop

This is the second reinforcing feedback loop. This can be well measured by the ratio of volume of processed mail to the hours worked. Low energy levels adversely affect productivity, which in turns abates work completion efforts. We have also include the variable "Investments in technology" as one of the ideas defining productivity. This is true for all companies; however, this is especially important for USPS. As we discussed, due to financial circumstances, USPS will not be able to even update its aging fleet, let alone undertake the burden of other significant technology investments for productivity increase. It is likely that in these conditions, sustaining employee energy levels is the most optimal solution for USPS for maintaining and increasing overall productivity levels. However, how do you do that?

Perceived Job satisfaction

After reviewing the USPS report on Safe Working Environment (9), and a number of other reports and articles (68) (69), it is clear that working environment and its perception remain a grave issue within USPS. As one former USPS employee put it: "*... the postal culture embraces and reflects core values that center on achieving bottom-line results with little or no regard for employee participation, respect, dignity, or fairness. Additionally, there is little or no accountability for the actions of top management in the Postal Service.*" (68). It is our firm belief that this is one of the key variables defining the "Energy level" and hence, the dynamics of the system. One of our main assumptions was about the limited capacity of employees to restore their energy. Since employees carry out their duties by spending their energy, we assume the pace of energy spent to be dependent on the Job Satisfaction stock variable. We modeled it in accordance with perceptive delay structure proposed by Sterman (15). We opted to include all perceptive inputs into one stock variable, because of our intent – awareness: the breakdown of each input into will perhaps yield better fidelity, but this level of detail perhaps would not provide us significantly better understanding of the situation. The "Time to Adjust" variable is used to allow for smooth transitions between one set of beliefs to another, as immediate transitions do not happen in practice.

While not precise, we believe the structure of the framework proposed above captures, for the most part, known and researched relationships that exist on an individual level for employees in organizations. With the feedback loops and the structure of the proposed framework

5.4 Conclusion

In this chapter, our goal was to look at existing dynamic models used to analyze USPS and work stress, and to propose our own framework for organizational stress. We saw that the dynamic relationship of work stress, productivity, quality and other key performance indicators are well-researched phenomena and commonly the subject of applications of SD tools. Since it was our intent to construct an organizational stress framework that reflects and raises our awareness of the problem, we followed good modeling practices - elaborate specific problems, and not focus on just system portrayal. We chose to design a framework that would allow us to understand, be aware and perhaps manage a major problem among USPS employees – attitude towards work, management and unhealthy work environment in general.

Work stress theory, being an extension of general stress theories, has a number of similar properties, one of the significant similarities being the "overshoot and collapse" behavior. As we know from Sterman, this is one of the fundamental system behavior modes, and is a result of the limited carrying capacity (or processing capacity, in our case) of the system under scrutiny.

During our research, we came across a precedent when work burnout was modeled by the use of a single universal "energy" variable. Since our philosophy was not precision, but rather awareness and problem understanding, we also adopted this approach. Like many notions in individual and organizational stress research theory, we also adopted a notion from engineering discipline: to carry out work, one must expend energy. We used one generic "Employee Energy" stock variable to depict the limited organizational stress "processing" and working capacity of the employee. Although detailed modeling is required to understand the specific thresholds for the "overshoot and collapse" behavior, however the existing of two strong reinforcing feedback loops provide for the basic system structure.

For this framework to be of real value to an organization, we have also included KPIs that are commonly used, and in some way measured by companies. We have also envisaged inputs of important perceptive variables, which can be assessed by simple Likert type scales - this practice is rather wide spread in various job satisfaction surveys. In this age of proliferation of wearable devices, data accumulation might not present a significant challenge. If a stress-monitoring program is implemented across a large employee population, the results might be remarkable. Again, our goal is not to devise a precisely measured variable, but to build up general awareness of employee energy levels both amongst employees themselves, and among managers. This will also facilitate the understanding of performance they deliver at work.

The framework also has another central characteristic – it elaborates an important fact, which is often overlooked. Even depending on one's personal characteristics, there are only so many way's one can restore his / her energy, and a number of ways we can mitigate its disbursement. If individuals, teams and organizations embrace this notion, the benefits can be substantial. This is especially significant for an organization like USPS, as it is, and for at least the near future will be severely limited in its capacity to invest into technology, or any other mean of increasing productivity. The nature of USPS work is not going to change either; hence, other ways of employee energy management must be explored.

This leaves us with limited choices of low to zero financial investment changes. Focus must be placed on activities geared towards increasing employee job satisfaction (i.e. participative management, smaller closer working teams, positive feedback and recognition, etc.), hence, productivity. In addition, allowing more time for rest (often breaks, flexible timetables), while counterintuitive, is also likely to contribute to productivity increase.

We know that USPS employees in general have negative attitudes towards work. In part, this is understandable, since due to the repetitive mail processing and delivery functions, for many employees the nature of work is not exciting (lack of flexibility, control over one's job, etc.). These issues were revealed during the survey referred to earlier. However, these discreet measurements, while important, can be significantly more valuable if applied through the proposed framework. In our opinion, perhaps one of the

greatest benefits of the implementation of the proposed system will be is the ability to monitor and be aware of the *cumulative* nature of important organizational dynamic defining variables.

If implemented, the information gathered from employees through Likert type questionnaires will also enable the continuous evaluation of management's efforts towards improving the work environment. As we know, attitude towards management was reported to be a serious problem. The implementation of the proposed framework will facilitate continuous feedback, hence the ability to conduct trends analysis beforehand, mitigating workplace violence risks and allowing for preventive stress alleviation measures. Once this system is mature and in the stable state, it will provide dynamic information about work environment (further framework extension for accommodating management evaluation will be unproblematic to implement).

Having said this, this framework does not account for physical / objective inputs which were the basis of our "stress processing capacity" modeling in the previous chapter. The goal of this paper is the development of a joint framework, which will account for all major variables defining individuals stress processing physiological and psychological stress processing capacity in an organizational context. This joint framework will be the subject of our next and final chapter.

CHAPTER 6

AN INTEGRATED FRAMWORK FOR UNDERSTANDING AND MONITORING EMPLOYEE STRESS IN ORGANIZATIONS

ABSTRACT

Two previously proposed frameworks were joined in this chapter – the individual stress framework and the organizational stress framework. Our combined framework maintains all the feedback loops present in original separate frameworks. At the same time, the significant alteration is the focus on work related perceptive stressor inputs. Significant attention was paid to common and Likert scale measureable work related aspects of stress; however, other perceptive stressors can be certainly incorporated into the framework. Physical and physiological aspects of stress and our capacity to process stress, we believe, were captured in the proposed framework.

6.0 Introduction

In this chapter, we finalize our work by joining two separate frameworks – individual and organizational stress frameworks. On one hand, the framework accounts for important physiological and psychological factors. On the other hand, the framework incorporates and reflects important organizational key performance indicators. We believe the framework to be a useful foundation for further elaboration and application. Furthermore, we believe the framework to be especially useful when applied to large datasets, much like those in possession of large corporate HR departments.

6.1 Method

For the development of our joint framework, we went through a significant literature research to compile an observational study. In line with good modeling practices, we did not define too broad of a scope, but focused on problems peculiar to USPS. Qualitative modeling was used to construct standalone individual and organizational stress models. In each of these models, a limited processing capacity was assumed. In the latter case – the HPA axis, in the former case – employee energy. Recognizing the importance of concepts reflected in these two models, our ultimate goal was to develop a unified model, a structure that can be applied on large datasets (i.e. corporate HR databases). The joint framework includes

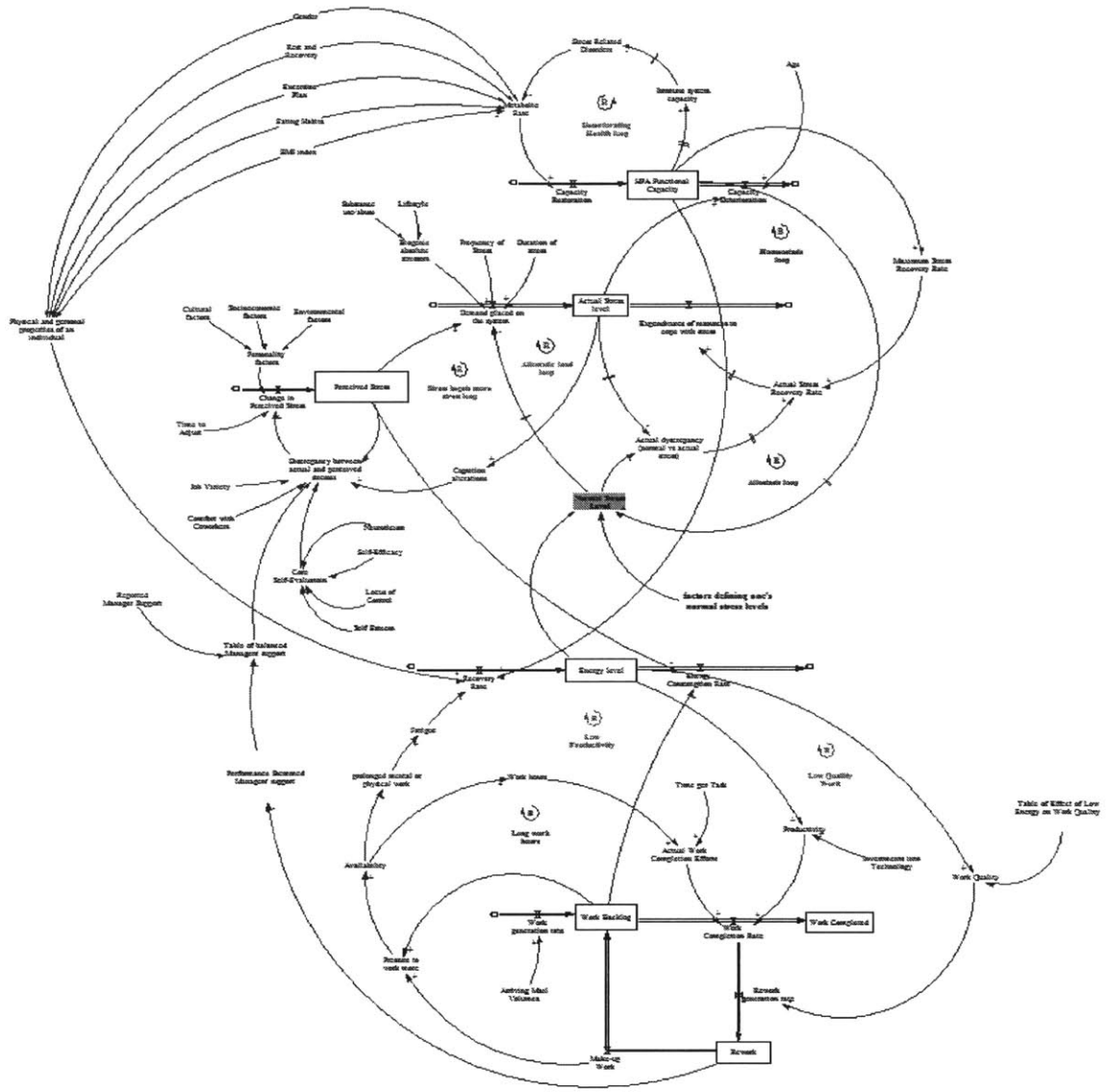
7 stocks that enable the monitoring of important individual psychological and physiological variables, and organizational key performance indicators.

6.2 The Joint Framework for Individual and Organizational Stress

Below is the joint framework that we developed as a result of our research. In this joint framework we have reflected factors of individual and organizational nature. In both of the cases, we have modeled a balancing feedback loop with another stock of limited system input processing capacity. Due to our goal of adapting the model for a use in specific case – the case of USPS, we have focused more on work related aspects of stress. Based on work environment study survey, we were able to identify that the major problem among USPS is not the stress (as defined by employees), but rather the significantly negative attitudes towards job satisfaction, the management and the work environment. This is why we focused on perceptive factors defining job satisfaction. Below are some important considerations when building our joint framework.

- Cumulative resources that our body has to process stress in general are represented by "HPA functional capacity" stock variable;
- Cumulative resources (especially mental and emotional resources) that we as employees have to process stress is represented by "Energy Level" stock variable;
- Work is carried out at the expense of a generic stock variable we named "Energy level". The rate of this energy outflow is controlled by both by perceptive factors and our workload;
- Perceptive inputs are modeled according to a single stage information delay. The focus of perceptive inputs was on employee job satisfaction assessment as per Core Self Evaluation theory (66). These variables were measured by well-researched 5-scale Likert scale, or by similar simple survey method;
- To increase the practicality of our framework, we have also considered general KPIs, such as Overall Labor Effectiveness (OLE) defining factors (variables measuring Availability, Performance and Quality);

- Our stress processing capacity is deteriorating as a result of stressor inputs, and more importantly there is a latent capacity deterioration through natural aging processes in our bodies;
- Our metabolic rate is a crucial factor in nearly all processes in our bodies, especially for the efficient work of the HPA axis glands. Hence improving our metabolic rate is one of the main ways to improve our stress "processing" capacity.



6.2 Results

The results of our endeavors are encouraging. On the outcome we have created a rather complex system model that incorporates all contains individual and organizational stress related variables, explains patterns of behaviors noted during our research, and proposes dynamic relationships to explain them. It also identifies major feedback loops responsible for system behavior. The framework ties together objective, subjective, psychological and physiological facets of an individual in an organizational context. The model

also introduces significant flexibility concerning its expansion with improved building blocks and structures.

6.3 Conclusions

Our research indicated that while there is a significant body of research on stress reaction, and in general our body response patterns to stress are known, we came across very few SD models designed to analyze human stress, and no models tailored for increasing employees and management awareness of individuals' stress loads and their relationship with key performance indicators.

In this paper, we conducted literature review on individual stress, and we believe to have captured in our framework major causal relationships within the system of human stress. We took a somewhat broad approach, and tried to cover some body of previous research on stress and apply system-thinking tools (more specifically – system dynamics) to devise a general framework for understanding two aspects of stress – individual and from on organization's perspective (organizational). Naturally, we did come across significant similarities between these two lines of research, as organizational stress is the extension of general stress theories. Our goal was to understand, and based on our understanding depict a closed-loop based system with endogenous explanations of stressor inputs and human performance both physiologically, physiologically, and most importantly – to show how these interactions impact workplace performance. The set of factors was chosen specifically to reflect issues present amongst many thousands of USPS employees. Particularly, we repeatedly came across a pattern that is well known in system dynamics under the name of "overshoot and collapse" behaviors. This is a fundamental property of a system with a limited carrying capacity. This was the underlying assumption in both of our proposed frameworks, and in the join framework we did have two stock variables with limited capacity – to reflect our physiological (represented by "HPA functional capacity" stock variable) and emotional/psychological processing capacities ("Energy Level").

Considering the main feedback loops in the framework, what might be the specific takeaway points for an organization like USPS?

- There are only so many ways to increase productivity, and all (or so we intuitively think) of them are associated with significant investments. USPS has no resources to invest in major technology and infrastructure improvement projects. While some improvements can be achieved by staff training, with deteriorating infrastructure and staff cuts these are likely to have marginal effects.
- USPS employees' reported stress indicators are somewhat similar to those of national workforce averages. However, situation is grave with regards to work environment, attitude towards management and job satisfaction: "*... the postal culture embraces and reflects core values that center on achieving bottom-line results with little or no regard for employee participation, respect, dignity, or fairness. Additionally, there is little or no accountability for the actions of top management in the Postal Service.*" (68).
- Much like an engineering and ecological system have their load bearing and carrying capacity limits, such statement is even more true for system like a human body is. Pursuant to a number of researchers, we assumed stress being the situation when demands placed on our bodies exceed their processing capacity. Furthermore, we assumed there to be two kinds of stress processing capacities – physiological and emotional/psychological. Our joint framework indicates that maintenance of stress within reasonable limits is a challenging task.
- Our bodies are constantly losing their capacity to process stress due to natural aging processes and consequent metabolic rate decrease. Without conscious efforts to sustain our recovery capacity this chances of a psychological and physiological burnout increase significantly. The latest stress and stress related disease statistics speak for themselves.
- This conscious efforts must be undertaken both on personal and corporate levels (monitoring of workloads, rest and recovery times, healthy lifestyle promotion campaigns, creating of smaller, teamwork oriented groups, constant feedback on job satisfaction, and a number of other framework-enabled data driven programs). This might be counterintuitive, but from policy

resistance examples (15) we know that often best choices are counterintuitive (i.e. more rest to increase productivity);

- Our framework enables dynamic insights into workplace environment, employee current stress levels and trends thereof, as well as productivity KPIs not based on discreet survey results, but based on a dynamic framework that considers a number of factors' trends over time.
- Implementation of framework will also enable to exact uses of short bursts of stress load increases, as they have been proved in increase our body's performance. Furthermore, framework will also indicate when performance decline is due to "system" extended abuse.
- A program aimed at implementing the framework can be considered. Data can be populated from USPS employee databases, or considering the proliferation of wearable computing (smart) devices, perceptive and biometric data can be acquired from employees directly. Employee "buy-in" into the program and information sharing question is an interesting one, however considering strong negative attitudes towards work environment, lack of job control perception and lack of information feedback mechanisms, the framework's value promise is likely to generate a healthy interest amongst USPS employees.
- Proposed framework implementation is dependent on employees who willingly and honestly share information, and allow for the use of their private information. Clearly, employee "buy-in" is likely to present a significant challenge for framework implementation. As discussed earlier, objective information is usually available through HR management information systems, however individuals must be willing to provide subjective information. Although the question whether employees will welcome the idea of sharing, on regular basis, opinions about their work environment remains open, in the age of proliferation of personal computing devices, personal and professional social networks, and information technologies in general, this issue does not present an insoluble problem.

6.4 Future Research Areas

Those who choose to continue their endeavors in the interesting field of analyzing stress through using system dynamics modeling should consider making the next step – applying an actual algorithm to a specific dataset. It is long known that an uncomplicated algorithm applied on a large dataset can be rather meaningful, and we believe our framework, while not quite simple, does provide a solid basis for researches in this regard.

Another interesting research area could be the elaboration on homeostatic and allostatic mechanisms in human system. While we believe we have well captured the high-level relationships, further, more detailed research will be valuable in expanding our understanding of mechanisms that can be explored to expand human stress resilience and stress response capacities without deteriorating effects on health.

It will also be exciting to gain insight into the topic of "normal stress level", as we have named our variable. We know that various inputs define normal stress levels for individuals, however if applied to large datasets, the framework might indicate equilibrium "normal" stress levels for certain groups of individuals, and allow for doing sensitivity analysis with regards to different system inputs.

Finally yet importantly – we know that one of the most valuable aspects of any system dynamic modeling is the change in mental models that a thorough thinking process brings to all stakeholders. It is out hope that this model, which graphically shows the fragile and constantly deteriorating nature of our stress processing capacity, will deliver the message of proactive stress management culture to individuals and organizations.

CONCLUSIONS

In this thesis, we have explored the following, we have reviewed the history of one of the most important organizations in the U.S. – the United States Postal Service. The analysis of USPS current financial and operational standing leaves little doubt that unless radical steps are taken, USPS problems are highly likely to only aggravate. It is from this perspective that the issue of employee physiological well-being must be reassessed.

An alarming discovery was that with long-standing history of employee violence, there are significantly negative attitudes towards management and work environment amongst USPS employees. This being our focus of research,, we commenced on understanding how the field of System Dynamics can be used to help employers and individuals understand not so much the actual stress levels (which can be measured through surveys), but the more so the cumulative capacity of an individual to "process" stressor inputs. We were also interested in different facets of stress – individual and organizational not as separate prices, but as subsystems of a greater structure.

Pursuant to completing our research and creating the framework, we believe the following are the key contributions of this thesis :

1. Two separate system dynamic frameworks for individual and organizational stress. While the latter is an extension of the former, in each case we have considered factors and structure that can be expanded into full standalone models;

2. A joint framework that recognizes the cumulative nature of a number of stress related variables, most importantly - individuals' limited capacity to process stressor inputs, both objective physical and perceptive.

3. A basis for a comprehensive algorithm that, if applied to large datasets like those of corporate HR departments, can provide interesting insights into employee well – being, existing stressors and will allow the establishment of tangible relationship between perceptive factors and organizational key performance indicators.

4. The capacity to allow for stress management in a significantly better (or perhaps efficient) manner: We know that shorts bursts of stress have a beneficial outcome – increase in performance, arousal, etc. We also know that extended exposure to stressors can have rather negative outcomes in the forms and apathy, burnout and various diseases. The framework enables individuals and organizations manage personal and group efforts (resources) in a more efficient manner.

It is our hope that this model will serve basis for future endeavors into the fields of stress. Specifically, the framework can be expanded into a model. As a next step, I would suggest that perhaps the greater benefit of the framework would be the application of its algorithm to a large dataset, where the arising correlations will enable curious cross references.

REFERENCES

1. Harris Interactive. *Work Stress Survey.* s.l. : Everest College, 2013.

2. American Psychological Association. *Stress in America: Missing the Healthcare Connection.* s.l. : American Psychological Association, 2013.

3. The American Institute of Stress. *Workplace Stress.* [Online] Want a Better Website, Inc., 2014. http://www.stress.org/workplace-stress/.

4. Adams, Susan. The Least Stressful Jobs of 2014. *Forbes.* 2014.

5. Chang, Vivian. The 10 Most Stressful Jobs Of 2014. *Business Insider.* 2014.

6. Brooks, Chad. The Most (And Least) Stressful Jobs Of 2014. *Huffington Post.* 2014.

7. Edwards, Jeffrey R. and Cooper, Cary L. The Person-Environment Fit Approach to Stress: Recurring Problems and some Suhhested Solutions. *Journal of Organizational Behavior.* 1990, Vol. 11.

8. Edwards, Jeffrey R., Caplan, Robert D. and Van Harrison, R. *Person-Environment Fit Theory: Conceptual Foundations, Empirical Evidence, and Directions for Future Research.* s.l. : The Kenan–Flagler Business School.

9. Califano, Joseph A. JR. (Chairman), et al. *The United States Postal Service Commission On A Safe And Secure Workplace.* New York : The National Center on Addiction and Substance Abuse at Columbia University, 2000.

10. Ponemon Institute. *2012 Most Trusted Companies for Privacy.* s.l. : Ponemon Institute, January 28, 2013.

11. Rubio, Philip F. *There's Always Work at the Post Office.* Chapel Hill : University of North Carolina Press. p. 446. ISBN 9780807859865., 2010.

12. About.com Inventors. *About.com Inventors.* [Online] http://inventors.about.com/library/inventors/blmailus5.htm.

13. Smithsonian Institute . Pushing the Envelope Blog. [Online] 03 17, 2010. http://postalmuseumblog.si.edu/2010/03/the-1970-postal-strike.html.

14. St. Petersburg Times. Wildcat Postal Strike Worsens, 3 States Hit. *St. Petersburg Times.* March 20, 1970, 3-A.

15. Sterman, John. *Business Dynamics. Systeh Thinking and Modeling For A Complex World* . s.l. : Irwin McGraw-Hill, 2000.

16. US Office of Technology Assessment . *Implications of Electronic Mail and Message Systems for the U.S. Postal Service.* Washington, D.C. 20402 : U.S. Government Printing Office, , 1982. Library of Congress Catalog Card Number 82-600599.

17. U.S. Postal Service Office of Inspector General. *Postal Service Revenue: Structure, Facts, and Future Possibilities.* USPS. s.l. : USPS: Risk Analysis Research Center, 2011. RARC-WP-12-002 .

18. The American Postal Workers Union, AFL-CIO. The American Postal Workers Union, AFL-CIO. *The American Postal Workers Union, AFL-CIO.* [Online] http://www.apwu.org/index2.htm.

19. Fujishiro, Kaori. FAIRNESS AT WORK: ITS IMPACTS ON EMPLOYEE WELL-BEING. *Ph.D. thesis.* s.l. : The Ohio State University, 2005.

20. Pollard, Tessa M. Environmental change and cardiovascular disease: A new complexity. *America Journal of Physical Anthropology.* 1997. Vols. 104:1-24.

21. *The Effects of Organizational Change on Worker Well-Being And The Moderating Role of Trade Unions.* Alex Bryson, Erling Barth, Harald Dale-Olsen. July 2013, ILR Review, 66(4), Cornell University.

22. United States General Accounting Office . *USPS: Financial Outlook and Transformation Challenges. GAO-01-733T.* 2001.

23. Smith, Frederick W. *Competing with the Postal Service.* CATO. March 1999 . pp. Vol. XXI, No. 2.

24. United States Government Accountability Office. *Report to Congressional Requesters, USPS Delivery Performance Standards, Measurement, and Reporting Need Improvement.* July 2006. GAO-06-733.

25. Kosar, Kevin R. *The Postal Accountability and Enhancement Act: Overview and Issues for Congress.* American National Government. s.l. : Congressional Research Service, December 14, 2009.

26. Groves, David. Congress broke U.S. Postal Service, and now must fix it. *The Stand.* February 7, 2013.

27. Nader, Ralph. The Manufactured "Financial Crisis" of the U.S. Postal Service. *Monthly Review Foundation.* September 21, 2011.

28. USPS. *USPS: Plan to Profitability, 5-year Business Plan.* 2012.

29. United States Postal Service. *Sustainability Report.* 2012.

30. United States Government Accountability Office. *USPS: Strategy Needed to Address Aging Delivery Fleet.* May 2011.

31. National Center for Victims of Crime. Workplace Violence. *NCVRW Resource Guide.* 2013.

32. The National Center for Victims of Crime. *ResouRCe Guide.* 2013. pp. 36-37.

33. MCintosh, Don. USPS hiring freeze hurts veterans, postal workers say. *People's World.* 2012.

34. Ayyadurai, Shiva V.A., Abraham, Sonu M. and Michelosn, Leslie P. *Email Management & Potential Opportunities for United States Postal Service.* s.l. : Reviewed for Publication of USPS Office of the Inspector General, August 24, 2012.

35. Ayyadurai, Shiva V.A., Abraham, Sonu M. and Zawacki, Thomas. *International Small Business Commerce (ISBC): Potential Source of New Revenue for the United States Postal Service.* s.l. : Submitted to United States Postal Service – Office of Inspector General (USPS-OIG) Draft 3.6 - February 15, 2013, 2013.

36. American Psychological Association. *Impact of Stress.* 2012.

37. Cannon, W.B. Physiological regulation of normal stares: some tentative postulates concerning biological homeostasics. [ed.] A Charles Richet A. Pettit. *Editions Meicales.* 1926, p. 91.

38. Selye, Hans. Stress without distress. 1974.

39. *Eustress, distress and their interpretation in primary and secondary occupational stress management interventions: which way first?* Le Fevre, Mark, Kolt, Gregory S and Matheny, Jonathan. 6, 2006, Journal of Managerial Psychology, Vol. VI, pp. 547 - 565.

40. Holmes, Thomas H., and Richard H. Rahe. The social readjustment rating scale. *Journal of psychosomatic research.* 1967, Vol. 11.2, pp. 213-218.

41. Lazarus, R.S. *Psychological stress and the coping process.* New York : McGraw-Hill., 1966.

42. Folkman, Susan, et al. Dynamics of a stressful encounter: Cognitive appraisal, coping, and encounter outcomes. *Journal of Personality and Social Psychology,.* May 1986, Vol. 50(5).

43. Lazarus, Richard S., Susan Folkman. *"Stress." Appraisal and Coping .* New York : s.n., 1984.

44. *Human Stress Response from the System Dynamics Point of View.* Susta, Marek and Bizik, Gustav. Prague : Charle's University, 2011. System Dynamics Review.

45. *Theories of Pshychological Stress at Work.* Dewe, Philip J., O'Driscoll, Michale P. and Cooper, Cary L. [ed.] R.J. Gatchel and I.Z. Schultz. New Tork : Springer Science + Business Media, 2012.

46. *Designing the human stress ontology: A formal framework to capture and represent knowledge about human stress.* Khoozani, Ehsan Nasiri and Hadzic, Maja. Perth, Australia : Digital Ecosystems and Business Intelligence Institute, Curtin University of Technology, Perth, Western Australia, Australia, December 2010, Vol. 45 (4), pp. 258–273.

47. National Institute for Occupational Safety and Health. [Online] 1999. [Cited: 02 14, 2014.] http://www.cdc.gov/niosh/docs/99-101/#a.

48. *Advances in Occupational Health: From a Stressful Beginning to a Positive Future?* Macik-Frey, Marilyn, Campbell Quick, James and L. Nelson, Debra. 2007 , Journal of Management 33: 809.

49. The American Institute of Stress. http://www.stress.org/workplace-stress/. *http://www.stress.org/workplace-stress/.* [Online] http://www.stress.org/workplace-stress/.

50. Society for Human Resource Management, 2009 Employee Job Satisfaction Survey. *Understanding the Factors That Make Worth Gratifying,.* 2009.

51. Ullah, Muhammad Aman, Arthanari, Tiru and Li, Anson. *Enhancing the Understanding of Corruption through System Dynamics Modelling.* Auckland, New Zealand : Department of Information Systems and Operations Management, University of Auckland Business School.

52. Judy Y. Wang, Wiljeana J. Glover, Allison M. Rhodes, Deborah Nightingale. A Conceptual Model of the Psychological Health System for U.S. Active Duty Service Members: An Approach to Inform Leadership and Policy Decision Making. *Military Medicine.* 2013, Vol. 178, p. 6:569.

53. Anderson, C. R. Coping behaviors as intervening mechanisms in the inverted-u stress-performance relationship. *Journal of Applied Psychology.* 1, 1976, Vol. 61, pp. 30–34.

54. Nixon, P. G. The human function curve. With special reference to cardiovascular disorders: part I. *The Practitioner 217.1301 (1976):* . 1976, Vol. 765.

55. Virginia Hill Rice. *Theories of Stress and Its Relationship to Health.*

56. Chrousos, George P. "Stress and disorders of the stress system.". *Nature Reviews Endocrinology.* 2009, Vol. 5.7, pp. 374-381.

57. McEwen, Bruce S., Seeman Teresa. Protective and damaging effects of mediators of stress: elaborating and testing the concepts of allostasis and allostatic load. 896.1, 1999, pp. 30-47.

58. Boston, Gabriella. Basal metabolic rate changes as you age. *The Washington Post.* March 6, 2013.

59. McEwen, Bruce S. "Stress, adaptation, and disease: Allostasis and allostatic load.". *Annals of the New York Academy of Sciences.* 1998, 840.1, pp. 33-44.

60. Wu, Garrett. Data Informed. *Why More Data and Simple Algorithms Beat Complex Analytics Models.* August 7, 2013.

61. Shearer, Natash. s Work Related Stress Costs UK Economy Nearly £6.5bn Each Year, What Steps Should Businesses and Employees Be Taking? *The Huffington Post.* 05/07/2013.

62. Hoel, H., Sparks, K., & Cooper, C. The cost of Violence/Stress at work and the benefits of a violence/stress-free working environment. *Interntational Labour Organisation.* 2001.

63. Flash. What is the cost of employee turnover? . *Compensation & Benefits Review, Sept/Oct 1997.* 1998., Article #8582.

64. *Health Promotion Programs at Work: A Frivolous Cost or a Sound Investment?* Bachmann, Kimberly. s.l. : Conference Board of Canada, 2002.

65. Homer, Jack B. Worker burnout: A dynamic model with implications for prevention and control. *System Dynamics Review.* 1.1, 1985, pp. 42-62.

66. Dormann, Christian, et al. A State-Trait Analysis of Job Satisfaction: On the Effect of Core Self-Evaluations. *Applied Psychology: An International Reivew.* 55, 2006, Vol. 1, pp. 27-51.

67. Robinson, Alan. Is Poor Service Causing the USPS to lose Standard Mail Customers? *Courier Express and Postal Observer.* May 29, 2012.

68. S., Musacco. The U.S. Postal Service is a Toxic Work Environment. *Postal Employee Network.* April 14, 2010.

69. Jamison, Peter. Hate Mail: A Mailman's Revenge Shows Workers Still "Go Postal". *San Francisco Weekly.* Mar 7 2012.

70. *A Conceptual Model of the Psychological Health System for U.S. Active Duty Service Members: An Approach to Inform Leadership and Policy Decision Making.* Judy Y. Wang, Wiljeana J. Glover, Allison M. Rhodes, Deborah Nightingale. 2013, Military Medicine, Vol. 178, p. 6:596.

71. *Change Recipients' Reactions to Organizational Change: A 60-Year Review of Quantitative Studies.* Shaul Oreg, Maria Vakola, Achilles Armenakis. Dec 2011, Journal of Applied Behavioral Science, Vol. 47 Issue 4, pp. 461-524. 64p.

72. *Some Social and Psychological Consequences of the Longwall Method of Coal-Getting.* Eric L. Trist, K.W. Bamforth. Feb1951, Vol. 4 Issue , Human Relations, pp. p3-38, 36p.

73. United States Postal Service. *Fact Sheet: Modified Network Realignment Plan.* s.l. : United States Postal Service, 2012.

74. *Putting Stress in Life: Hans Selye and the Making of Stress Theory.* Vinner, Russell. Social Studies of Science 29 (3) : s.n., 1999, pp. 391–410.

75. Lazarus, Richard. *Psychological Stress and the Coping Process.* New York, Toronto, London : McGraw-Hill Book Co., 1966.

76. *Stress, coping and somatic adaptation.* Holroyd, K. and R., Lazarus. [ed.] L. Goldberger & S. Breznitz (Eds.). New York : s.n., 1982, Handbook of stress: Theoretical clinical aspects, pp. 21-35.

77. Murray, H. *Explorations in personality.* Boston : Houghton Mifflin, 1938.

78. The Boston Consulting Group, Inc. *Projecting U.S. Mail Volumes to 2020.* Bost : s.n., 2010.

79. Rogowsky, Mark. First Class Mail is Doomed. Get Over It. *Forbes.* 2/15/2013.

80. Girdano, Daniel, Dusek, Dorothy, & Everly, George. *Controlling Stress and Tension.* San Francisco, CA : Pearson Benjamin Cummings., 2009.

81. Smith, K. J., Everly, G. S., & Johns, T. The role of stress arousal in the dynamics of the stressor-to-illness process among accountants. *Contemporary Accounting Research.* 1993, Vol. 9, pp. 432-449.

82. Maxon, Rebecca. Stress in the Workplace: A Costly Epidemic. 1999.

83. Canadian Center for Occupational Health and Safety. CCOHS. *CCOHS.* [Online] http://www.ccohs.ca/oshanswers/psychosocial/fatigue.html.

84. Kawada, Tomoyuki and Otsuka, Toshiaki. Participative management (or job control). *Work.* 2011, Vol. 40, 4, pp. 393-399.