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Interactive Learning Environments to Address Department of Navy Acquisition Workforce Issues

8 July 2019

Dr. David N. Ford, Associate Professor

Graduate School of Business and Public Policy

Naval Postgraduate School

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Abstract

The Department of the Navy (DoN) acquisition workforce includes many diverse parts, processes, and stakeholders that interact over time in a wide variety of ways. Understanding the interactions among workforce components is critical to developing improved policies. Developing that understanding is not intuitive or obvious, largely because the workforce and its performance are dynamic—that is, they evolve in response to system structure, current conditions, and current and future policies. Improving policy maker and acquisition workforce understanding and developing effective and efficient policies requires tools and methods that can capture the systemic, dynamic feedback in the system, current and future policies, and can reflect their impacts on workforce performance. The current research developed an interactive learning environment (ILE) of a Navy Acquisition Workforce (NAW) issue. A formal system dynamics simulation model is the core of the ILE. The prototype illustrates some of the capabilities of an ILE for addressing NAW issues.

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About the Author

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Table of Contents

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Introduction

Department of the Navy (DoN) acquisition provides materiel solutions and services to fulfill the Navy's mission and support operations. To do this, the DoN acquisition workforce manages the planning, design, procurement, manufacturing and construction, testing, and making-ready-for-use of those solutions. This requires thousands of contracts, millions of contract actions, and billions of dollars each year. The DoN acquisition workforce must be both effective and have adequate capacity to fulfill the demand for naval acquisition. The DoN faces several challenges in providing an adequate acquisition workforce. First, the demands placed on the acquisition workforce are changing. The naval fleet is growing toward a target of more than 300 ships (DoN, 2015). This requires increases in acquisition capacity (Government Accountability Office [GAO], 2012). In addition, materiel solutions are becoming increasingly complex as threats and the technologies needed and used to meet and defeat those threats evolve. This requires that the acquisition workforce have more and different knowledge and skills than were required in the past. In addition to these demand-side challenges, the DoN faces challenges in providing and maintaining its acquisition workforce. For example, the current acquisition workforce is relatively old. Therefore, the workforce is currently losing, and will soon lose more, experience, capabilities, and capacity as members retire or seek employment elsewhere. This requires the DoN to recruit and train new acquisition personnel.

The Naval Acquisition Workforce (NAW) includes many diverse parts, processes, and stakeholders that interact over time in a wide variety of ways. This prevents solutions that address individual parts (e.g., training, assignment rotation) or aspects (e.g., economics, experience levels) of the system and its challenges from being completely successful in isolation. Therefore, addressing NAW challenges requires a systems perspective and systems level solutions. The tools and methods that facilitate that perspective and those solutions must be able to integrate the numerous and diverse aspects of the workforce (e.g., specialization, training, experience, assignment rotation and advancement, location) and measures of workforce performance (e.g., capabilities and capacities). Understanding the interactions among workforce components is critical to developing improved policies. Developing that understanding is not intuitive or obvious. The structures and interactions create causal feedback loops, unintended side effects, delays, and resistance to well-intended and otherwise well-designed policies. Improving acquisition workforce understanding and developing effective and efficient policies requires tools and methods that can capture the systemic, dynamic feedback in the system, current and future policies, and can reflect their impacts on workforce performance.

The current research developed and initially tested a prototype interactive learning environment (ILE) about a single NAW issue. The researcher developed a system dynamics simulation model and ILE to investigate the usefulness of ILEs for addressing NAW issues.

Background

The Department of Defense Acquisition Workforce

The Defense Acquisition Workforce (DAW) obligates more than $300 billion annually to acquire goods and services. The GAO has reported on the need for ensuring that the DAW is adequately sized, trained, and equipped to meet Department of Defense (DoD) needs. To help address some of the challenges, Congress created the Defense Acquisition Workforce Development Fund. The Fund has been applied to a variety of uses, including increasing the size of the workforce. The Better Buying Power initiative (DoD, 2015b) also addresses acquisition workforce needs. It includes improvements in recruiting and hiring, training and development, and retention and recongition. These efforts have improved the DAW. For example, acquistion workforce certification has generally increased (Figure 1).

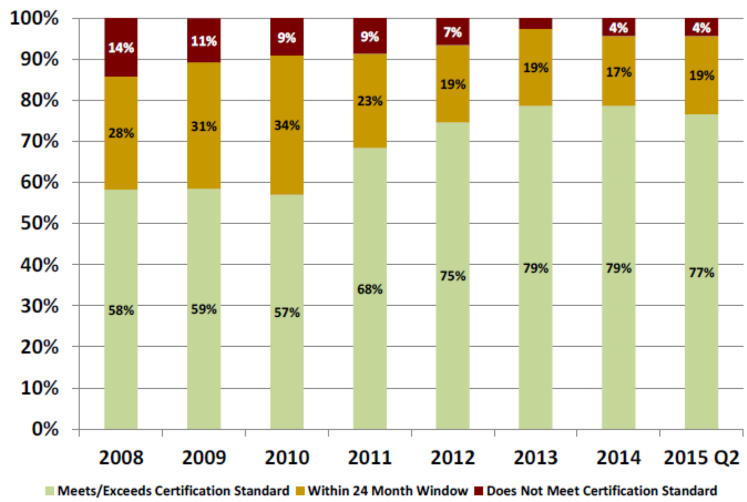

Figure 1. Acquisition Workforce Meeting Certification Standards (2008–2015Q2) (DoD, 2015, p. 127)

However, significant improvement is still required to meet DoD needs. The 2015 Performance of the Defense Acquisition System report (DoD, 2015a) identified five measures of acquistion performance that require improvement and offered many insights that point to additional areas where changes can improve acquisition. However, as described, the tight interdependencies within the defense acquisition system can severely limt improvement if the various parts of the workforce challenges are addressed separately.

System Dynamics-Based Interactive Learning Environments

An interactive learning environment is “software for educational purposes, for supporting the process of learning, where the focus is on learning through the interaction with the computer (human-computer interactivity)” (Sterman, 2000, p. 412). Other terms used to refer to an ILE include management flight simulator, microworld, and business simulator. Davidsen (2000) identifies changing users’ mental models, a critical component of improving understanding of NAW issues, as one of the two purposes of an ILE. While interacting with an ILE, users typically read an introduction to the issue and a set of instructions for simulating with the underlying model. Fully developed ILEs can then guide users to perform simulations that have been designed to lead users through a set of scenarios (guided simulation) or allow users to simulate a wide range of conditions of their choice (freeform simulation), depending on the desired outcomes. Interpretations of simulation results can be provided within the ILE or through human interactions with a facilitator.

The research applied the system dynamics modeling methodology to develop a prototype ILE and a formal system dynamics simulation model that is the core of the ILE. The system dynamics methodology combines a broad perspective of systems with a control theory approach to improve the design and management of complex human systems. System dynamics combines servo-mechanism thinking with computer simulation to allow the analysis of systems in ways that are not possible with human reasoning alone. It is one of several established and successful approaches to systems analysis and design (Flood & Jackson, 1991; Jackson, 2003; Lane & Jackson, 1995). Forrester (1961) developed the methodology philosophy, and Sterman (2000) specified the modeling process with examples and described numerous applications. When applied to engineered systems such as the defense acquisition workforce, system dynamics focuses on how performance evolves in response to interactions within the causal structure of the system (e.g., retirement rates, development and loss of knowledge and experience), development, and management policies (e.g., training developed in specialty areas), and conditions (e.g., capacity levels, budget constraints). System dynamics is appropriate for modeling the acquisition workforce because of its ability to explicitly model the diverse set of critical features, characteristics, and relationships that drive behavior and performance.

System dynamics has been applied to military systems, including planning and strategy (Bakken & Vamraak, 2003; Duczynski, 2000; McLucas, Lyell, & Rose, 2006; Melhuish, Pioch, & Seidel, 2009), workforce management (Bell & Liphard, 1978), technology (Bakken, 2004), command and control (Bakken & Gilljam, 2003; Bakken, Gilljam, & Haerem, 2004), operations (Bakken, Ruud, & Johannessen, 2004; Coyle & Gardiner, 1991), logistics (Watts & Wolstenholme, 1990), acquisition (Bartolomei, 2001; Ford & Dillard, 2008, 2009a, 2009b; Homer & Somers, 1988), and large system programs (Homer & Somers, 1988; Lyneis, Cooper, & Els, 2001). Coyle (1996) also provides a survey of applications of system dynamics to military issues.

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Methodology

A traditional model development process when applying the system dynamics methodology was adopted. That iterative process includes the following (Sterman, 2000): (1) problem articulation, (2) development of a dynamic hypothesis (conceptual modeling), (3) formal modeling, (4) model validation, and (5) model use. Simultaneously, the interface that makes the dynamic model into an ILE was developed. The ILE content that was not included in the dynamic model included text that provided context for users, user instructions, and explanations of model behavior. The ILE based on the system dynamics model is based on existing ILE literature and examples. In addition to the system dynamics model, the ILE developed for this work includes an introduction to the NAW challenge, a model structure description, ILE use instructions, guidance on useful simulations, presentation of simulation results, explanations of simulation results, and a user interface. The resulting product is described next.

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Prototype Contents

In general, the ILE is structured as a set of images with text (a “view”), many of which have layers in which additional information appears sequentially to lead users through the learning experience. Users can use the ILE interface to iteratively loop back to previous parts of the tool. The contents of the ILE are presented here by showing and describing the information on each ILE view in the sequence presented in the ILE.

The “Title” and “Main Menu” views provide the general purpose and ILE navigation tools.

View: Title

Text

The Workforce Overload Death Spiral: An Interactive Learning Environment for Improving Understanding of System Dynamics

View: Main Menu

Text

- Introduction
- Understanding the System
- A Progression of Interesting Experiments
- A Policy Laboratory Dashboard
- Search for High-Leverage Point

Notes

Users click on each item to go to that portion of the ILE (see views below for detail). The third and fifth items are under development.

The four “Introduction” views describe the problem that the ILE addresses.

View: Introduction (1 of 4)

Text

Workloads can increase or decrease suddenly, managers can misunderstand their workforce's capabilities, and organizations are under pressure to increase efficiency. These changes can cause unexpected and very undesirable consequences. One potential impact is the separation of employees from the organization. Even if hiring continues, this can decrease the size of the workforce and therefore its ability to complete work. How do workload, workforce capacity, and other factors interact to impact the ability of an organization to complete its work?

Consider the example of the Emergency Medical Technician workforces in many American communities.

Notes

Users click "Back," "Main Menu," or "Continue" links that are located at the bottom of this view to navigate from this view.

View: Introduction (2 of 4)

Text

EMT workforces in many American cities are stressed far beyond the point where it impacts the quality of their work. Despite providing lifesaving services (literally) to their communities, EMTs are paid an average of about $16 per hour, 40% less than the average American earns. This forces many EMTs to work overtime or second and third jobs to make ends meet. Therefore, they often work while very tired. EMT work is very stressful for other reasons, as well.

As first-responders, EMTs can serve in violent, contaminated, and other conditions that threaten their own lives as well as their patient's lives. In smaller communities the opportunities for advancement are few. Therefore, burnout is a serious problem in many EMT workforces.

One result of these stressors is a 20% per year turnover in EMT workforces as employees leave for better opportunities, working conditions, and compensation. This limits the level of experience of EMT workforces. With an aging American population, the need for EMTs will increase, so communities must continuously hire a steady stream of new EMTs to adequately staff community departments, or risk overworking and therefore overstressing their remaining EMTs even more.

Notes

Users click "Back," "Main Menu," or "Continue" links that are located at the bottom of this view to navigate from this view.

View: Introduction (3 of 4)

Text

As illustrated by the EMT workforce example, one impact of an increasing workload on an employee is an increase in stress. This increase in stress reduces the satisfaction that the employee experiences with his or her job and can reach out into other important aspects of the employee's life, such as family relationships and personal health. For most people, the increase in stress makes their job less attractive. If the workload-induced stress increases enough, an employee will seek alternative employment.

Most organizations hire on a regular basis to replace normal employee turnover and may increase hiring to meet a target workforce size. However, if more employees are leaving than can be hired, the size of the workforce shrinks. To maintain production, management may spread the workload over the remaining employees, increasing their workload and stress, which makes their jobs less attractive, increasing the likelihood of them separating from the organization, thereby making the problem even worse.

This behavior mode (shape of behavior over time) has been called the "workforce overload death spiral."

Notes

Users click "Back," "Main Menu," or "Continue" links that are located at the bottom of this view to navigate from this view.

View: Introduction (4 of 4)

Text

The purpose of this tool is to help managers and employees understand the workforce overload death spiral as a basis for designing policies to prevent the syndrome and manage it if it starts to occur. The tool does this by allowing users (you) to simulate an organization that is vulnerable to the workforce overload death spiral, understand what causes it, and test ways to address it, all without risking your actual organization, its workforce, or production of work.

This is intended to provoke thought and stimulate discussion, as well as to demonstrate how the tool can support management and policy design. We start by stimulating the workforce overload death spiral itself.

Note that, although the numbers used in the model, and the outcomes are given in numerical form, the specific numbers in the model are illustrative and not predictions of any specific organization. More work than shown here is needed to develop effective policies.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

The two “Understanding the System” views set the context for the users and provides an overview of the ILE structure.

View: Understanding the System (1 of 2)

Text

Multiple factors can influence a workforce system and whether it experiences a workforce overload death spiral. Using a traditional mental model of such a system we create a list of the factors we think influence the system’s behavior. In systems thinking using such a list to explain a system is called “Laundry List Thinking,” or sometimes “Critical Success Factors Thinking.” But knowing the factors does not tell us how to manage the system.

We need to understand how the different parts of the system interact with each other. This tool focuses on describing those interactions and using them to improve our understanding of the system and what causes the workforce overload death spiral.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: Understanding the System (2 of 2)

Text

When you click the Explore Model link below, you will start with one part of the system (the workforce) and incrementally build up a mental model of what causes the workforce overload death spiral in organizations. Notice that the model parts and their interactions are operational, they describe some of the parts we find in actual workforce systems and describe realistic ways in which they influence each other. Being operational is part of being a good systems thinker.

Also notice that the interactions create feedback loops, sequences of parts of the system and their interactions that create a closed casual loop so that the impacts of a change in one part will work its way around the loop to influence the part that initially changed. We will identify and describe these feedback loops as the model is developed.

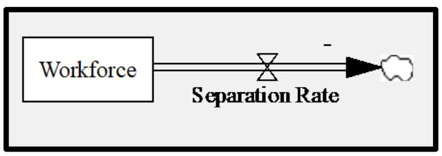
Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

The 17 “Model Development” views build up the model, a bit at a time, to facilitate the user understanding the structure of the model and the reasoning behind the structure. Each view adds a little more to the model diagram (“Image” in the view descriptions below) and text that describes the added structure.

View: Model Development (1 of 14)

Image



Text

The focal point of the workforce overload death spiral story is the number of employees, counted in full-time equivalent employees, FTEs. In systems thinking this workforce is represented by a “stock,” or “accumulation,” and shown in a rectangle. Employees retire, quit, or otherwise separate from the workforce each month at a particular rate, thereby reducing the size of the workforce.

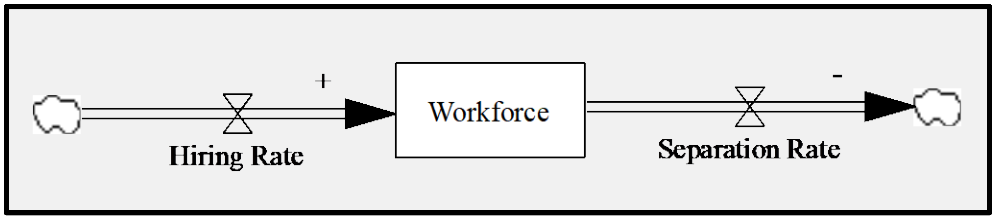
The higher the Separation Rate, the faster the Workforce shrinks, and vice versa (if the Separation Rate decreases, the Workforce shrinks more slowly and therefore stays larger than it would have without the change). In systems thinking this movement of employees out of the Workforce is represented by a "flow" and shown with a wide arrow and valve symbol. The arrow points away from the stock of employees to indicate that the Separation Rate decreases the size of the workforce.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: Model Development (2 of 14)

Image

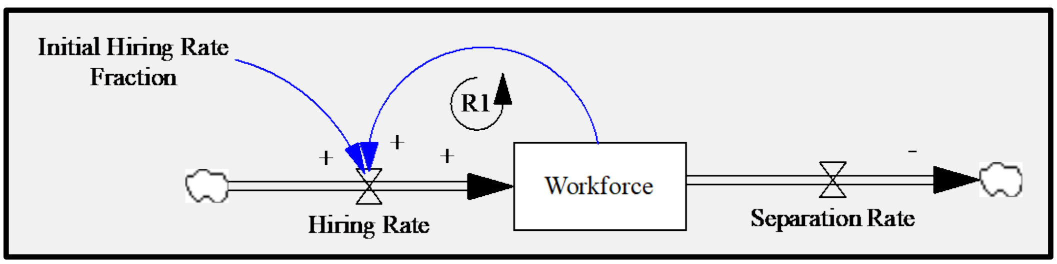


Text

The workforce increases as new employees are hired at a certain rate each month. The Hiring Rate is another flow (counted in FTEs per month). This time the arrow points into the Workforce stock, indicating that the Hiring Rate increases the size of the Workforce. The higher the Hiring Rate is, the faster the Workforce grows, and vice versa.

View: Model Development (3 of 14)

Image



Text

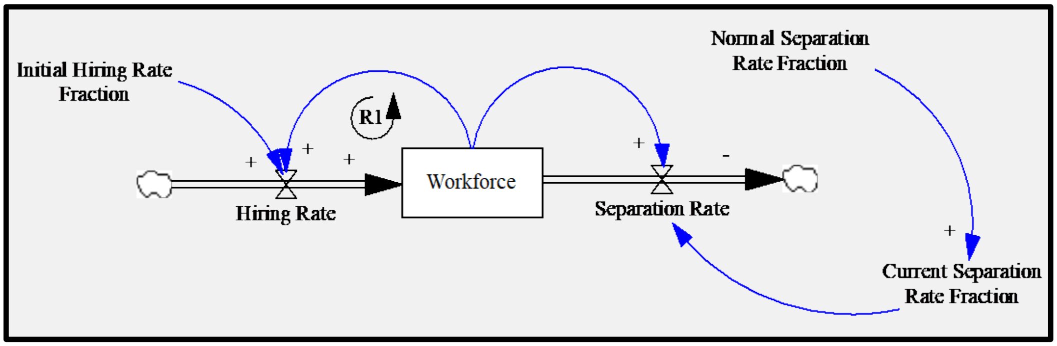
The dependence of the Hiring Rate on the Workforce is shown with a causal link (thin arrow) between the Workforce and the Hiring Rate. Likewise, the dependence of the Hiring Rate on the Initial Hiring Rate Fraction Workforce is shown with a causal link between the Initial Hiring Fraction and the Hiring Rate. Each month the number of employees that are hired (the Hiring Rate) is calculated as the product of the Workforce and the Hiring Rate Fraction.

The connection between the Workforce stock and the Hiring Rate flow creates a reinforcing feedback loop (R1). The plus sign (+) at the arrowhead of the link from the Workforce to the Hiring Rate indicates that they both move in the same direction (up or down). Similarly, the plus sign near the Hiring Rate arrowhead means that the Hiring Rate and Workforce move in the same direction. This reinforcing feedback loop tends to push the system farther and farther away from where it started.

We use a “Legend of Loops” to keep feedback loops organized and to contribute to model understanding.

View: Model Development (4 of 14)

Image

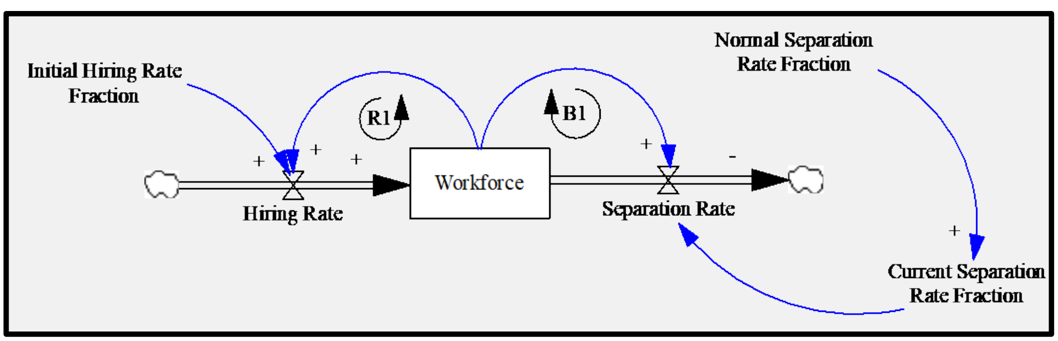


Text

The Separation Rate is also based on the size of the Workforce and a fraction of the workforce, the fraction that separate each month (Current Separation Rate Fraction, in % per month). Therefore, there is a causal link between the Current Separation Fraction and Separation Rate and another link between the Workforce and the Separation Rate. Each month the number of employees that separate from the workforce (the Separation Rate) is calculated as the product of the Workforce and the Current Separation Rate Fraction. For now, assume that the Initial Hiring Rate Fraction and the Normal Separation Rate Fraction are the same, so that the managers are hiring the same number of employees as leave.

View: Model Development (5 of 14)

Image



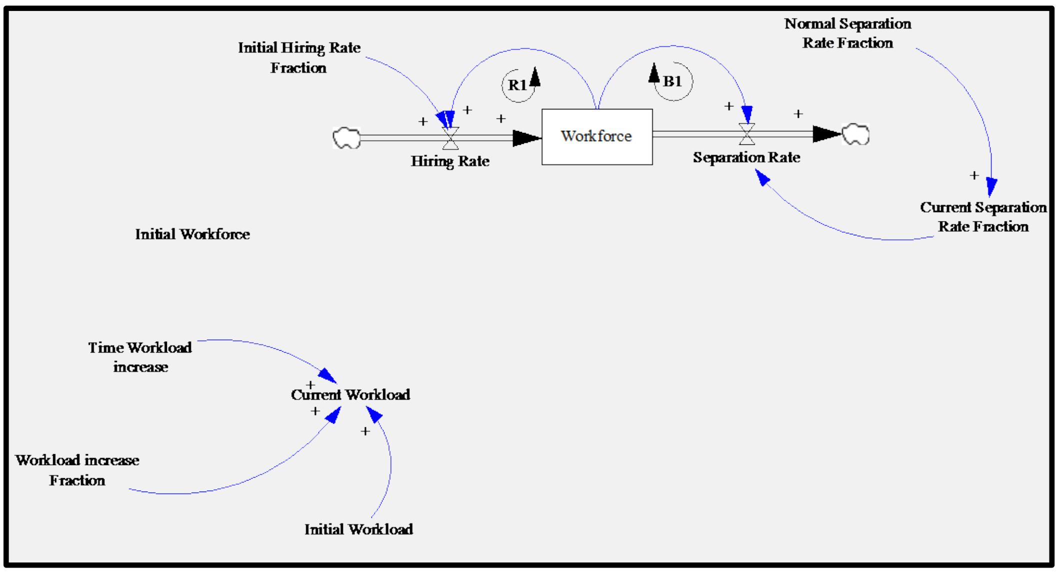
Text

The connection between the Workforce and the Separation Rate and the flow between the Separation Rate and the Workforce creates a balancing feedback loop (B1). The plus (+) sign at the arrowhead of the link from the Workforce to the Separation Rate indicates that they both move in the same direction (up or down). The minus (-) sign at the stock end of the Separation Rate arrow indicates that they move in opposite directions (up/down or down/up). This balancing feedback loop tends to control (balance out) the behavior of the system.

The workforce increases as new employees are hired at a certain rate each month. The Hiring Rate is another flow (counted in FTEs per month). This time the arrow points into the Workforce stock, indicating that the Hiring Rate increases the size of the workforce. The higher the Hiring Rate is, the faster the workforce grows, and vice versa.

View: Model Development (6 of 14)

Image



Text

At a particular time, the workload can increase instantly to a new size. The variable “Time Workload Increases” specifies the month of the increase.

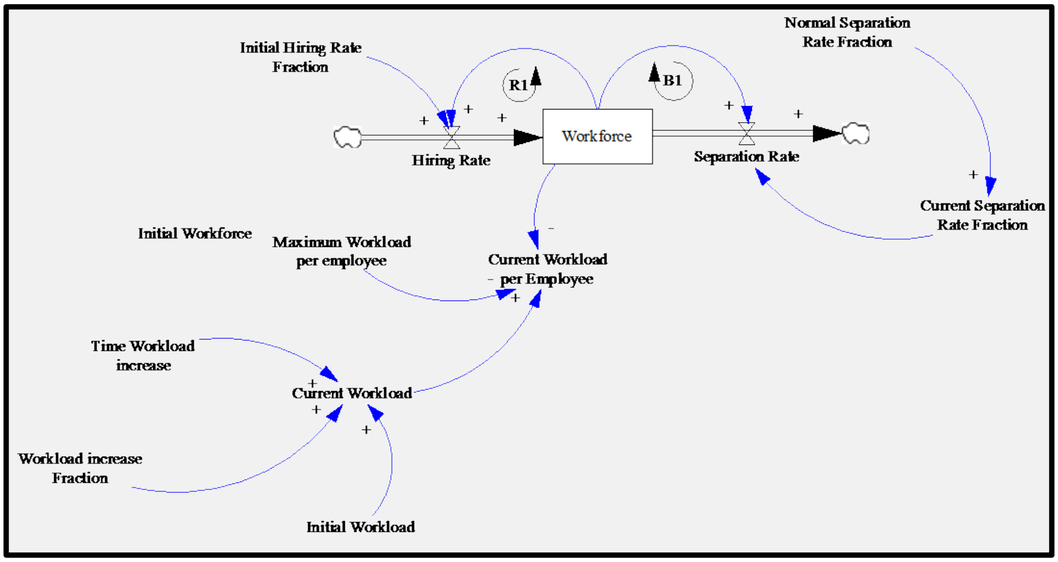
The size of the increase in the workload is described as a fraction of the Initial Workload. The variable “Workload Increase Fraction” specifies how much the workload will increase. For now, assume that the Workload Increase Fraction is zero, indicating no change in the workload.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: Model Development (7 of 14)

Image



Text

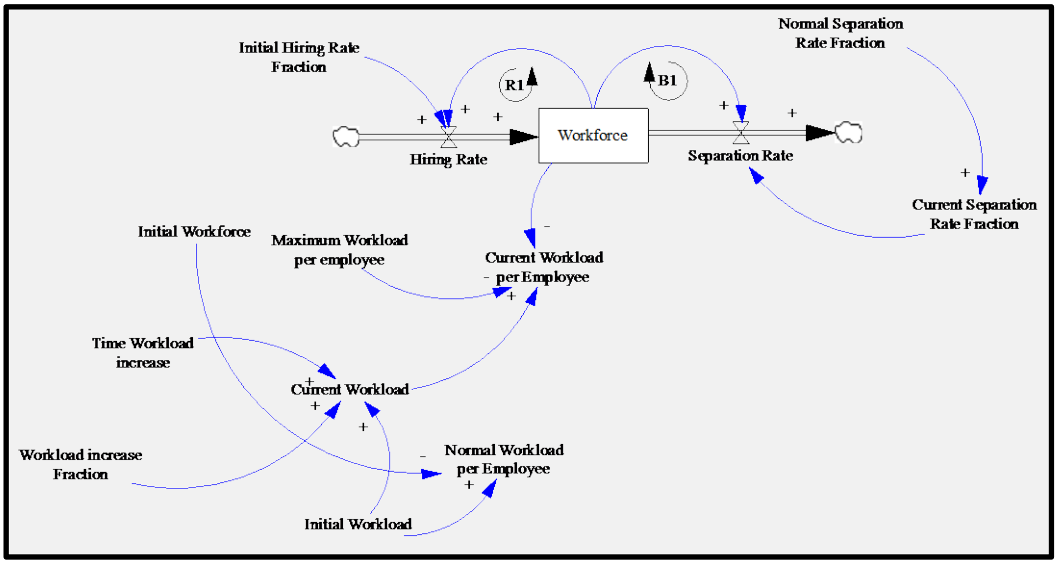
The Workload is allocated among the employees in the Workforce. The average workload per employee is the Current Workload divided by the Workforce, measured in work packages completed per month per FTE. There is a maximum amount of work that an employee can perform (the Maximum Workload per employee), regardless of how much work is assigned to them.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: Model Development (8 of 14)

Image

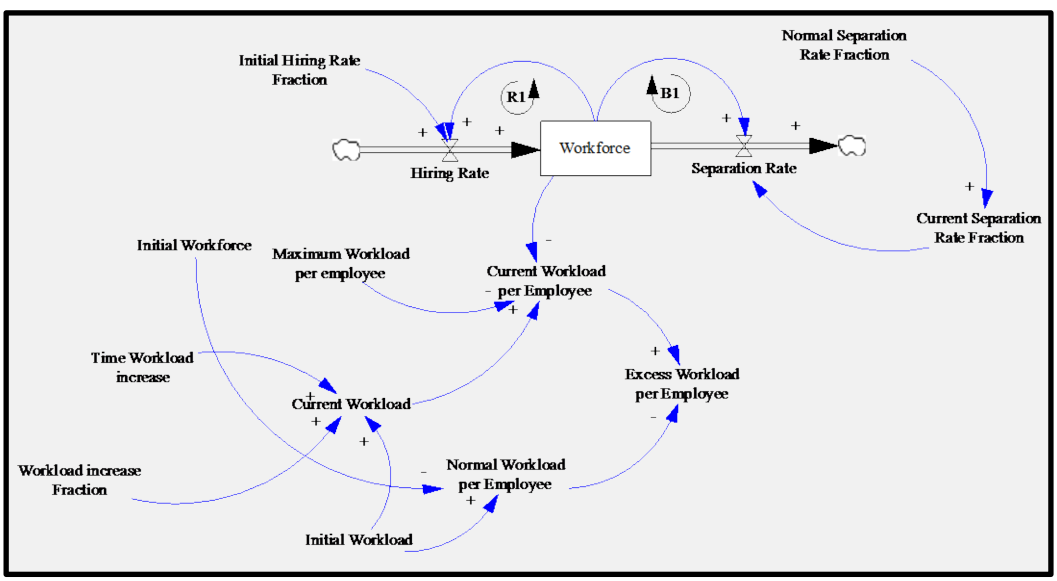


Text

At the beginning of the simulation the employees have a normal, or sustainable, workload, defined as the Initial Workload divided by the Initial Workforce, also measured in work packages completed per month per employee.

View: Model Development (9 of 14)

Image

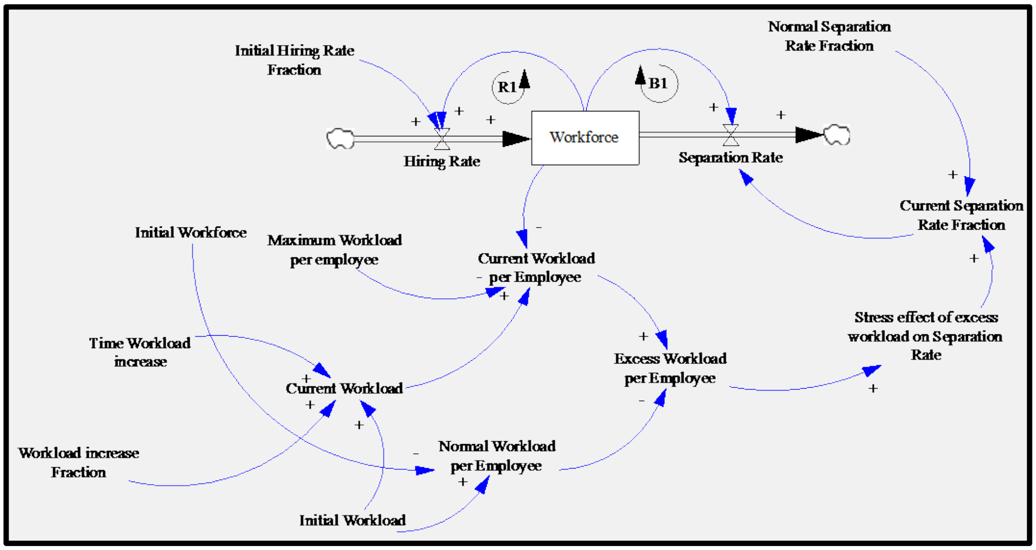


Text

By comparing the Current Workload per employee and the Normal Workload per employee the amount that the current workload exceeds the normal, sustainable workload is calculated. This is the Excess Workload per employee. When the current and normal workloads (per employee) are equal, there is no excess.

View: Model Development (10 of 14)

Image



Text

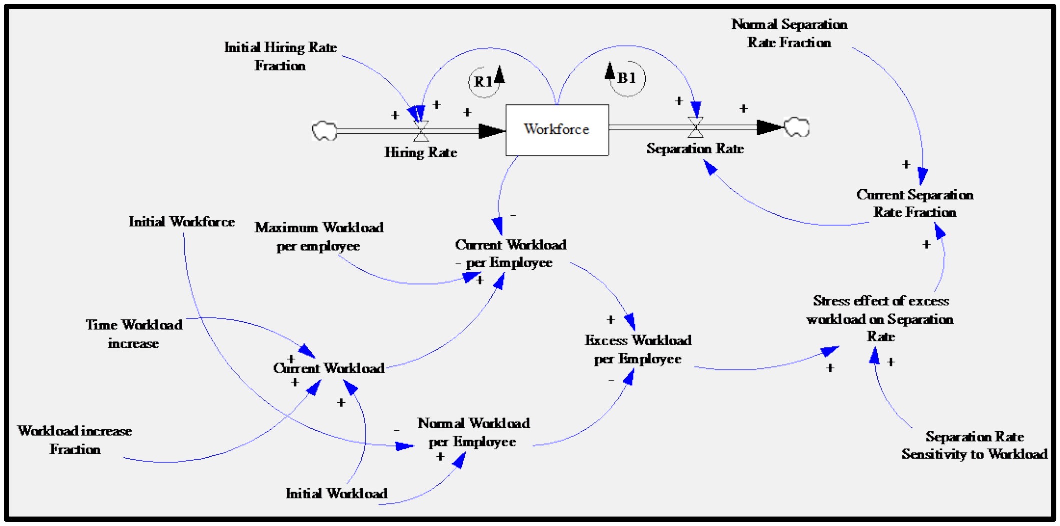
Excess Workload per employee creates added stress for the employees, which reduces the attractiveness of their job and increases the Current Separation Rate Fraction. This stress is described with “Stress effect of excess workload on Separation Rate.”

Notes

Users click “Back,” “Main Menu,” or “Next Section” links that are located at the bottom of this view to navigate from this view.

View: Model Development (11 of 14)

Image



Text

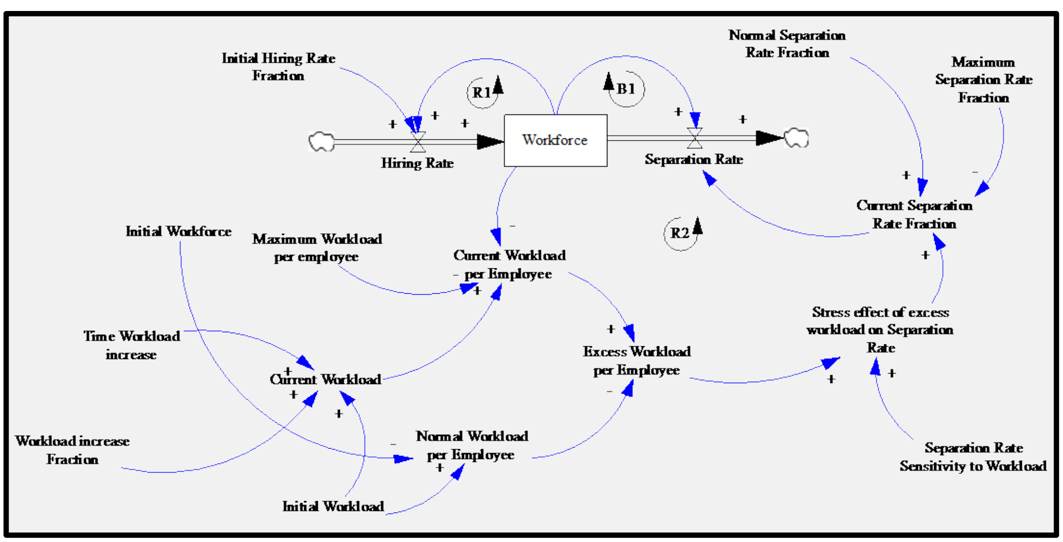
How much does the Separation Rate Fraction increase due to the added stress? We can describe this with the Separation Rate Sensitivity to Workload. This sensitivity acts as a “multiplier” to reflect the impact.

Notes

Users click “Back,” “Main Menu,” or “Next Section” links that are located at the bottom of this view to navigate from this view.

View: Model Development (12 of 14)

Image



Text

But the Current Separation Rate Fraction can only go so high (some people will never leave), so the Current Separation Rate is limited by the Maximum Separation Rate.

The Current Fractional Separation Rate Fraction is the sum of the Normal Separation Rate Fraction and the Stress effect of excess workload on Separation Rate. In the model, an increase in workload generates more workload per employee and excess stress, thereby increasing the Separation Rate Fraction and thereby the Separation Rate.

With our new links, we have created another feedback loop (R2). Starting at the Workforce, the feedback loop passes through Workforce, which impacts the Workload per employee, then Excess Workload per employee, then Excess stress effect of workload on Separation Rate, then the Current Separation Rate Fraction, then the Separation Rate, which impacts the Workforce. This feedback loop is a reinforcing feedback loop that tends to move the system farther and farther away from where it started.

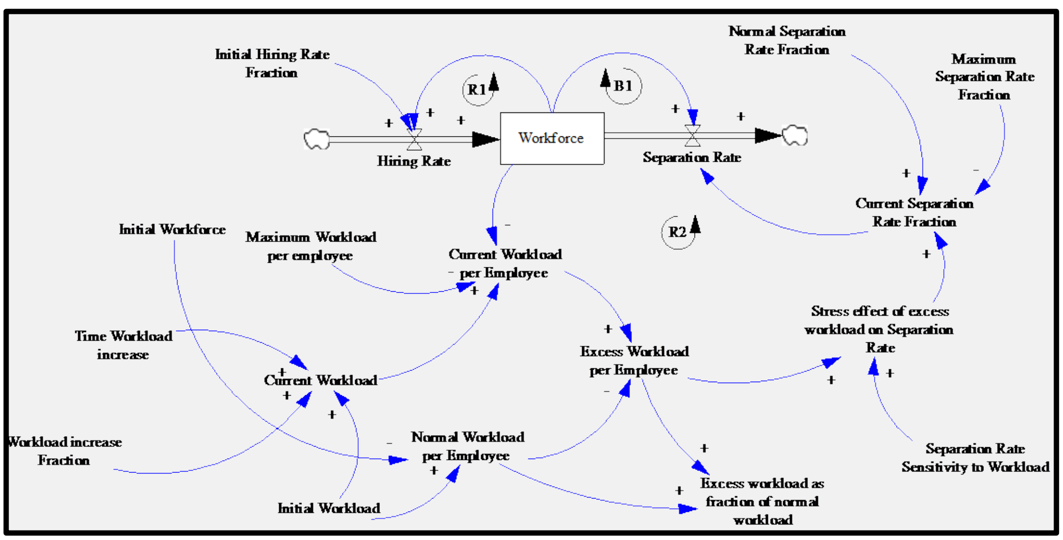
When the workload increases it strengthens reinforcing feedback loop R2, initiating a workforce overload death spiral. This loop increases stress and the Separation Rate, and therefore decreases the Workforce, which increases workload and stress even more.

Notes

Users click “Back,” “Main Menu,” or “Next Section” links that are located at the bottom of this view to navigate from this view.

View: Model Development (13 of 14)

Image



Text

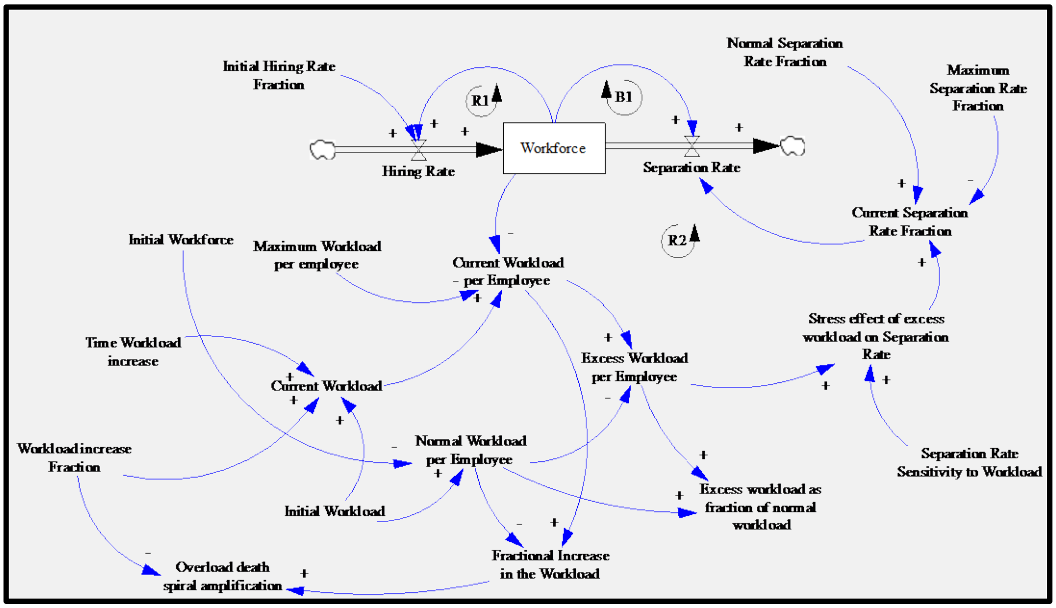
Some people think of excess workload as a percentage (“I’m completing 50% more work than normal”). We can use “Excess workload as a fraction of normal workload,” which compares the “Excess workload per employee” and the “Normal Workload per employee” to describe this condition.

Notes

Users click “Back,” “Main Menu,” or “Next Section” links that are located at the bottom of this view to navigate from this view.

View: Model Development (14 of 14)

Image



Text

Since we know the Current Workload per employee and the Normal Workload per employee, we can calculate the Fractional Increase in workload (the difference divided by the Normal Workload per employee). We can compare the Fractional Increase in workload to the Fractional size of the workload increase to calculate how much the feedback in the system amplifies the change in the workload. When the amplification equals 1, there is no increase. When the amplification equals 2 (for example), the feedback has doubled the impact of the workload increase, etc.

Notes

Users click “Back,” “Main Menu,” or “Next Section” links that are located at the bottom of this view to navigate from this view.

The nine “Progression of Experiments” views incrementally guide the user through a set of model simulations that reveal part of how the structure of the model and system generate behavior.

View: A Progression of Experiments (1 of 9)

Text

Performing experiments in real-world circumstances is almost always very difficult, can be impossible or unethical, and often does not improve our understanding very much because there are too many things changing at once to isolate the impacts of individual drivers of performance. These challenges are particularly true in social settings such as workforces. Therefore, social scientists of all types (including you as a user of this ILE) do experiments in laboratories such as this ILE, where they can control the external impacts on the system. Usually to start, all the external factors are held constant except one, which is changed in a simple way. The resulting system behavior and performance help reveal how that one factor impacts the system. Then other, carefully planned experiments are used to help explain why the system did what it did, and the learning continues. Let’s start to develop our understanding of the workforce death spiral using this method.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (2 of 9)

Text

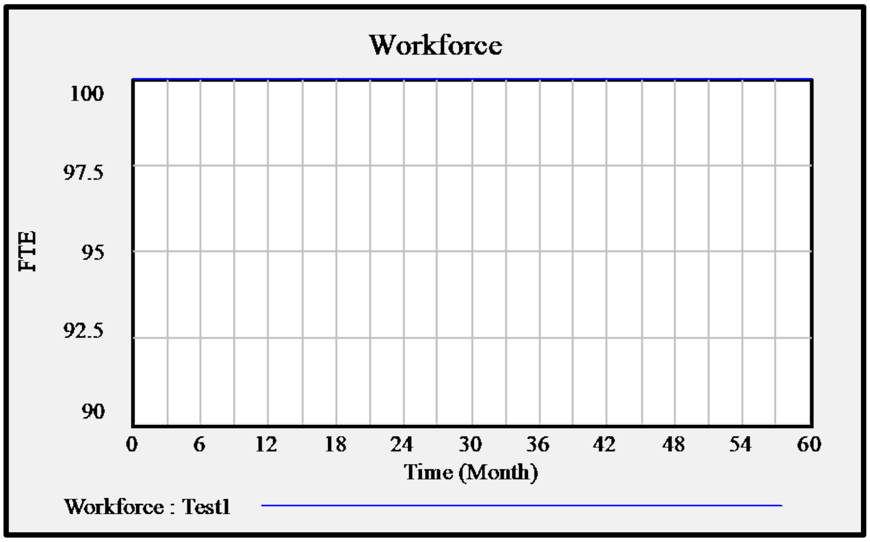
What happens to the workforce if we simulate the system exactly as it was described in the previous section of this ILE? Will we see the workforce overload death spiral? First think about the system structure as described and review the previous section if you wish. Then click “Next” to see the behavior over time graph (BOTG) of the size of the workforce for this first simulation.

Notes

Users click “Back,” “Main Menu,” or “Next” links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (3 of 9)

Image



Text

The size of the workforce stays constant. This is NOT the decreasing workforce and increasing stress that we expect in a workforce death overload spiral. Why does the model behave this way? Reconsider the conditions of the system as described. Feel free to go back and review the model description (especially the workload part) and then return to this slide. When you think you know why the size of the workload remains constant, click "Next."

Notes

Users click "Back," "Main Menu," or "Next" links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (4 of 9)

Text

The description of the system includes "For now assume that the Workload Increase Fraction is zero, indicating no change in the workload." Following the arrows from Current Workload per employee, the workload does not add any stress, so the Separation Rate does not increase, so the Hiring Rate continues to equal the Separation Rate, so the size of the Workforce will stay the same, so the Workload per employee stays the same, and the conditions in the loop R2 remain the same. This is a simple example of how we can use the feedback structure of the model to explain its behavior.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (5 of 9)

Text

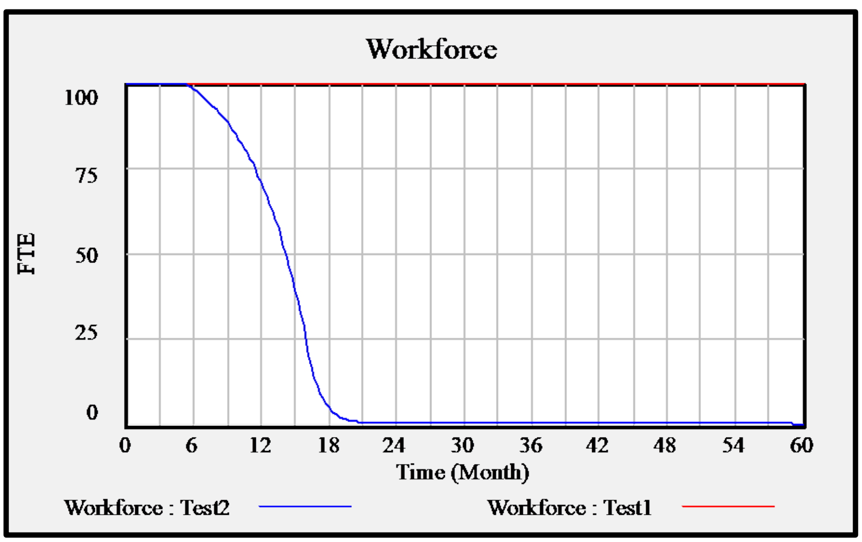
What is required to see the workforce overload death spiral in the simulation? What causes the death spiral? Based on our descriptions, the death spiral is due to an increase in how hard an individual employee works and therefore becomes stressed. One thing that can cause this is an increase in the workload. How does the size of the Workforce behave if we simulate an increase in the total workload (assume 10%) in month 5? Predict how the Workforce stock will behave over time and sketch on paper what you think the BOTG will look like. Then click “Next” to see what the behavior looks like.

Notes

Users click “Back,” “Main Menu,” or “Next” links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (6 of 9)

Image



Text

This simulation illustrates the workforce overload death spiral and allows us to compare it to the BOTG without the increase in the total workload. Again, we can use the feedback structure of the model to explain the behavior. In this case, the increase in the workload increases the Current Workload per employee (+ sign, changes in same direction), and the increased workload creates Excess Stress, which increases Separation Rate. The decreased Workforce reduces the Hiring Rate, and more employees are leaving than joining and the size of the Workforce decreases. This increases the Current Workload per employee even MORE, and the impacts go around the reinforcing loop R2 again, making the problem worse and worse and shrinking the workforce more and more.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

View: A Progression of Experiments (7 of 9)

Text

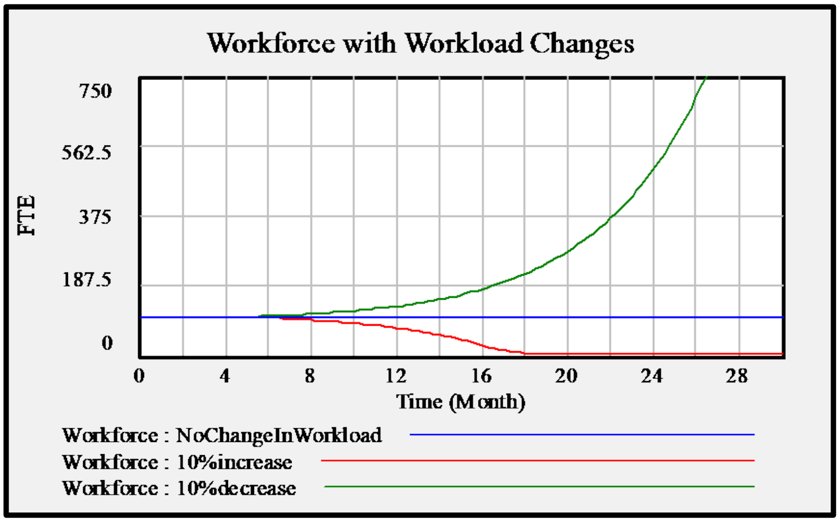
Let’s do one more simulation and use the model structure to explain it before you design and run your own experiments. We simulated the system with a 10% increase in the workload. What happens if there is a 10% decrease in the workload. Use your understanding of the model to predict what will happen to the size of the workforce by sketching BOTG on paper, and mentally describing why it has that shape before you click “Next” to see the BOTG.

Notes

Users click “Back,” “Main Menu,” or “Next” links that are located at the bottom of this view to navigate from this view.

View: Progression of Experiments (8 of 9)

Image



Text

Hopefully you predicted that the reinforcing feedback loop would operate in the opposite direction, reducing the Separation Rate to below the Hiring Rate, and thereby increasing the size of the Workforce. In the model, the size of the Workforce keeps growing faster and faster until the end of the simulation. In practice, other factors would limit the size of the workforce.

Notes

Users click “Back,” “Main Menu,” or “Next” links that are located at the bottom of this view to navigate from this view.

View: Progression of Experiments (9 of 9)

Text

The three simulations we have run demonstrate that the system has a tipping point. A tipping point is a feedback structure and set of conditions that can create perplexing behaviors that are difficult to manage. At the tipping point, a system remains constant (Workforce size does not change). But move the system a little above the tipping point and it behaves very differently than if we move it a little below the tipping point. It does this by changing which feedback loop controls the BOTG or by changing the direction in which the strongest feedback loop operates. In our workforce system, increasing the workload moves the system away from its tipping point. It strengthens reinforcing loop R2, increases the Separation Rate, and decreases the size of the Workforce. In contrast, decreasing the workload does the opposite, weakening loop R1, thereby increasing the size of the workforce. Understanding how the feedback structure impacts behavior helps us explain why systems behave the way they do.

Notes

Users click “Back,” “Main Menu,” or “Continue” links that are located at the bottom of this view to navigate from this view.

Software Use

The prototype ILE was developed in Vensim®, a system dynamics–based software platform. Model development used Vensim PLE®. Users download the (free) Vensim Model Reader® software package to load and use the prototype ILE. See the appendix for user instructions.

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Future Work

The prototype ILE can be used and reviewed as the basis for further development. That development can include additional guided simulations with causal explanations of how structure drives behavior and freeform simulations in which users set variable values to reflect actual or hypothetical conditions of interest.

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Conclusions

The research developed an ILE that can be used to illustrate and investigate a DoN acquisition workforce challenge, explain the structural causes of behaviors related to the challenge, and communicate the same to policy makers. The ultimate goal is a set of tools that can be used by policy makers to better understand a DoN acquisition workforce challenge and thereby design effective and efficient policies. The research helps meet this goal by addressing the question: “How can an interactive learning environment be used to investigate, explain, and communicate a DoN acquisition workforce challenge and potential solutions?” This initial step demonstrates the potential of an ILE to help improve the understanding of the NAW system and the impacts of potential policies, and thereby play a role in educating and communicating with policy makers about the challenges and possible solutions. This will help the Director, Acquisition Career Management (DACM) to better understand the capability and applicability of ILE to NAW issues and how to exploit those capabilities to meet DACM objectives. Addressing this question positions the DACM to plan and develop ILEs that can facilitate and accelerate the evolution and improvement of the mental models of policy makers and NAW leaders.

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Appendix: Prototype Interactive Learning Environment User Instructions

Users engage with the Interactive Learning Environment (ILE) through the Vensim Model Reader® software interface. The download/installation of Vensim Model Reader ® takes about five minutes and each user only needs to do this once. To download and install Vensim Model Reader®:

- Using Windows or Macintosh, go to the web page for Ventana Systems (http://www.vensim.com/).
- Click the ***Downloads > Free Downloads.***
- Select ***"Model Reader"*** in the product section. Fill in the form by filling out the type of Platform, Name, and E-mail. It needs to be a real email address, but users will not be put on Vensim's mailing list.
- A software download link will be sent to the E-mail address entered. ILE users should use that link to download Vensim Model Reader® onto their computer.
- Open Vensim Model Reader®. This will open the ***venread.vmf*** file downloaded with the software. On the Overview page, use the navigation buttons to review the material to learn to use the model reader, or learn by experimentation. Going through this material takes 15 minutes or less.

Once the user has downloaded Vensim Model Reader® they are ready to open and use the ILE. To do this, within Vensim Model Reader® the user goes to File > Open a Model and selects the prototype ILE file provided. That file should have a ".vmf" extension.

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