



Capability Trap Simulator

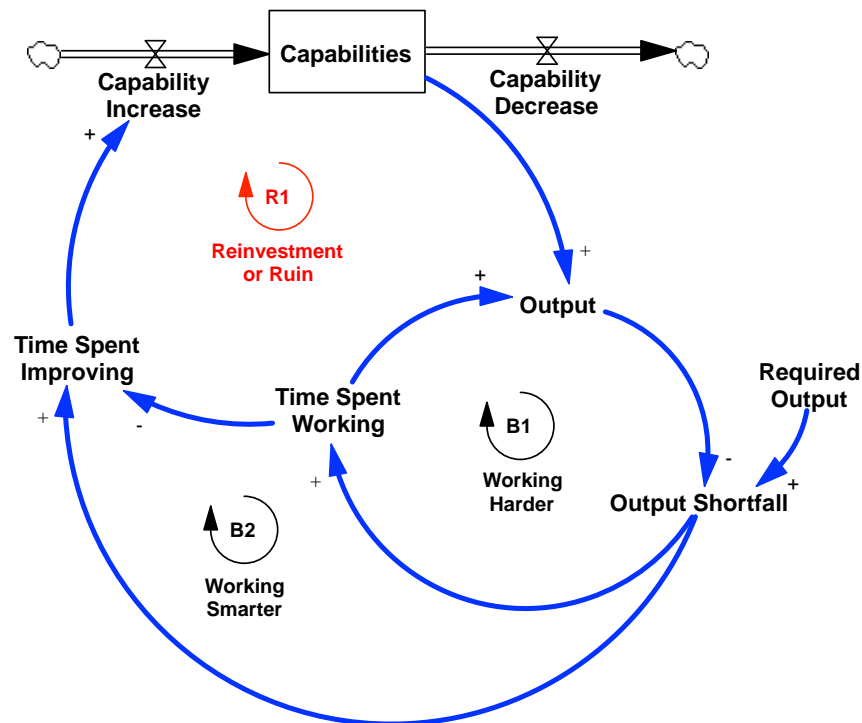
to accompany:

Lyneis, J. and Sterman, J. (2016) “How to Save a Leaky Ship: Capability Traps and the Failure of Win-Win Investments in Sustainability and Social Responsibility” Academy of Management Discoveries.

This document provides instructions to download and install the Capability Trap Simulator and the free software to use it (Vensim Model Reader). The simulator is provided as a free resource to accompany Lyneis and Sterman (2016). The Vensim Model Reader allows you to run the Capability Trap Simulator and any other models in Vensim Published Model (.vpm) format. Sterman (2000) provides a textbook covering systems thinking and system dynamics.

The Capability Trap: Repenning and Sterman (2001, 2002) developed the theory of the capability trap to explain the failure of many process improvement programs. Sterman (2015) applies the theory to sustainability and pro-social investments; Lyneis and Sterman (2016) expand the theory to the case of energy efficiency and facilities in a large research University.

The managers of any process, whether production, product development, maintenance, human resources, customer service or environmental quality, are responsible for the performance of that process against target or desired performance. If performance falls short of the target, managers have two basic options to close the gap: working harder or working smarter (see figure).



The Capability Trap

Working harder includes adding resources (hiring, capacity expansion), increasing resource utilization (overtime, shorter breaks, speeding up), and boosting output per person-hour by cutting corners (skipping steps, cutting testing, deferring maintenance, cutting training and coordination with stakeholders, failing to follow safety procedures). These activities form the balancing (i.e., negative) Work Harder feedback, B1: a performance shortfall leads to longer hours, corner cutting, deferring maintenance, and other shortcuts that improve performance.

Alternatively, managers can interpret the performance gap as a sign that the organization's capabilities are inadequate. They can increase improvement activity designed to eliminate the root causes of poor performance and invest in the capabilities that make improvement effort effective, including investments that enhance people's skills, knowledge of and adherence to best practices, and build cooperation and trust across organizational boundaries. Investing in capability improvement forms the balancing Work Smarter feedback, B2.

The organization's capabilities are shown as a stock. Capabilities—including productive, well-maintained equipment, skilled workers, effective improvement methods, organizational routines, and trust between workers and management and across organizational boundaries—are assets that build up as the result of investment and erode over time as equipment ages, employees leave, and changes in the environment render skills, knowledge, routines and relationships obsolete.

Working harder and working smarter interact because time and resources are limited. When organizations are heavily loaded and resources constrained, greater work effort necessarily comes at the expense of maintenance, improvement, learning, training, coordination and other activities needed to preserve and enhance capabilities.

The result is the reinforcing (i.e., positive) feedback denoted Reinvestment or Ruin (R1). As the name suggests, the reinforcing feedback can operate as a virtuous cycle that builds capabilities and performance, or as a vicious cycle that degrades both.

An organization that increases the time and resources devoted to improvement sufficiently will, after a lag, build capabilities that boost performance, easing the performance gap and yielding still more time and resources for improvement. In contrast, if managers respond to a performance gap with greater pressure to boost output, improvement effort falls, the organization's capabilities erode, and the throughput gap grows still larger, forcing ever-greater reliance on working harder.

The vicious cycle drives out improvement activity, leading to low capabilities and poor performance, and, all too often, environmental damage, accidents, or organizational failure.

The Capability Trap Simulator is a simple interactive model that illustrates the dynamics described above. The simulator allows you to examine the response of an organization to strategies such as working harder or working smarter, and to changes in required organizational output, the workforce and parameters governing organizational attributes such as worker productivity and responses to shortfalls between required and actual output.

1. Installing the Simulator

Download the Vensim Model Reader from <http://vensim.com/free-download/>.

The default download is VensimPLE. Change your selection to the **Vensim Model Reader**. Provide the requested information. Please check the Anti-spam box. You will receive an email with a link you can use to download the software.

Choose a Product and Platform:

Anti-spam	<input type="checkbox"/> Please tick this box
Product	<input checked="" type="radio"/> Vensim PLE 6.3G <input type="radio"/> Vensim PLE 5.11A <input type="radio"/> Model Reader
Platform	<input checked="" type="radio"/> Windows (XP/Vista/7/8/8.1) <input type="radio"/> Macintosh OSX (10.4+)
Vensim newsletter	<input checked="" type="checkbox"/> Subscribe Name <input type="text"/> PLEASE NOTE: DOWNLOAD INSTRUCTIONS WILL BE EMAILED TO YOU, A FAKE EMAIL ADDRESS HERE WILL NOT WORK. Email address <input type="text"/> Retype email address <input type="text"/> The Vensim newsletter is used for announcements of software updates, courses, and related information. Frequency is low – typically quarterly – and addresses are never shared.

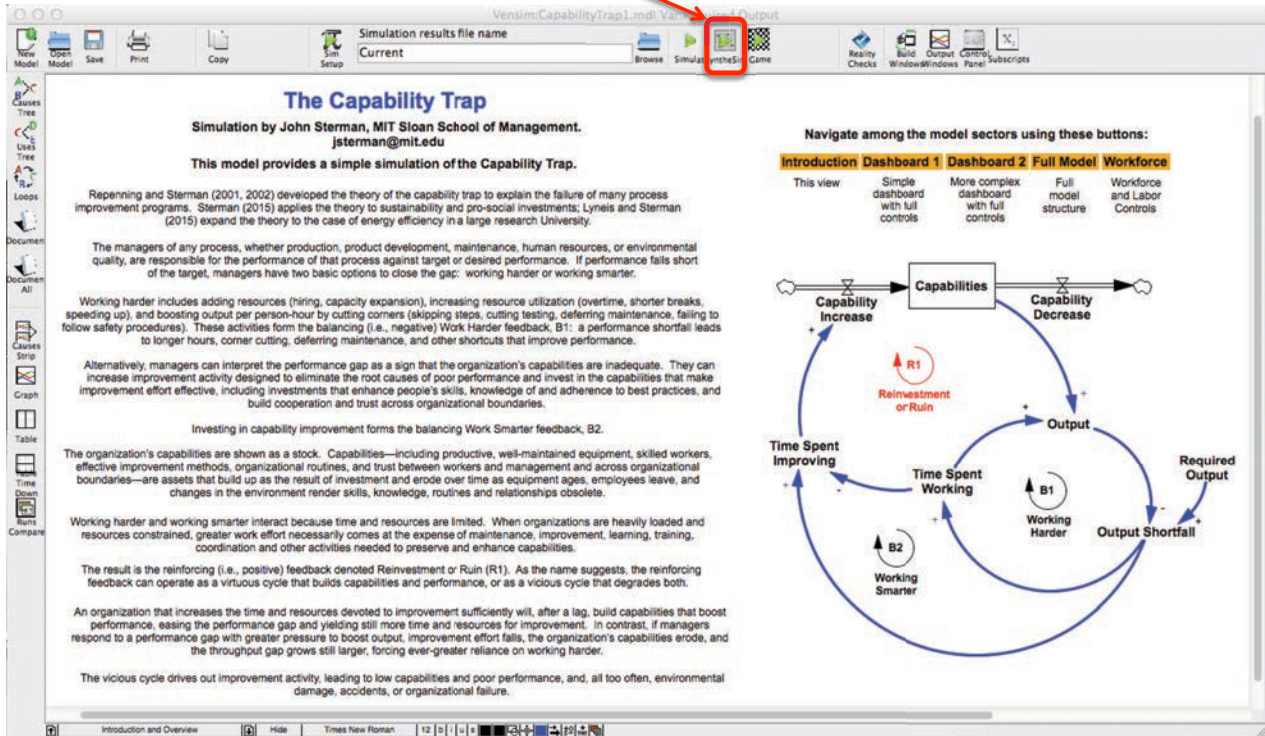
[Download software](#)

After downloading and installing the model reader, download the zip archive containing the Capability Trap Simulator from the paper website. Extract the model into the folder of your choice. Once extracted, you should be able to open the model, **CapabilityTrap1.vpm**, using the Vensim Model Reader.¹

¹ A brief video tutorial on running models with Vensim Model Reader is available at <http://vensim.com/running-models-with-vensim-ple-and-the-model-reader/>.

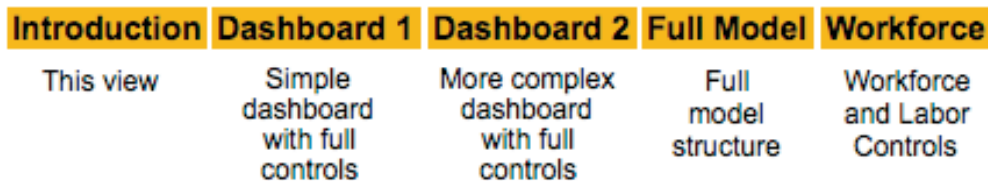
2. Simulator Overview: When you launch the simulator you'll see the Introduction screen. Launch the simulation by clicking on the SyntheSim button. The SyntheSim button is a green button in the top menu bar:

Launch the simulator using the "SyntheSim" button



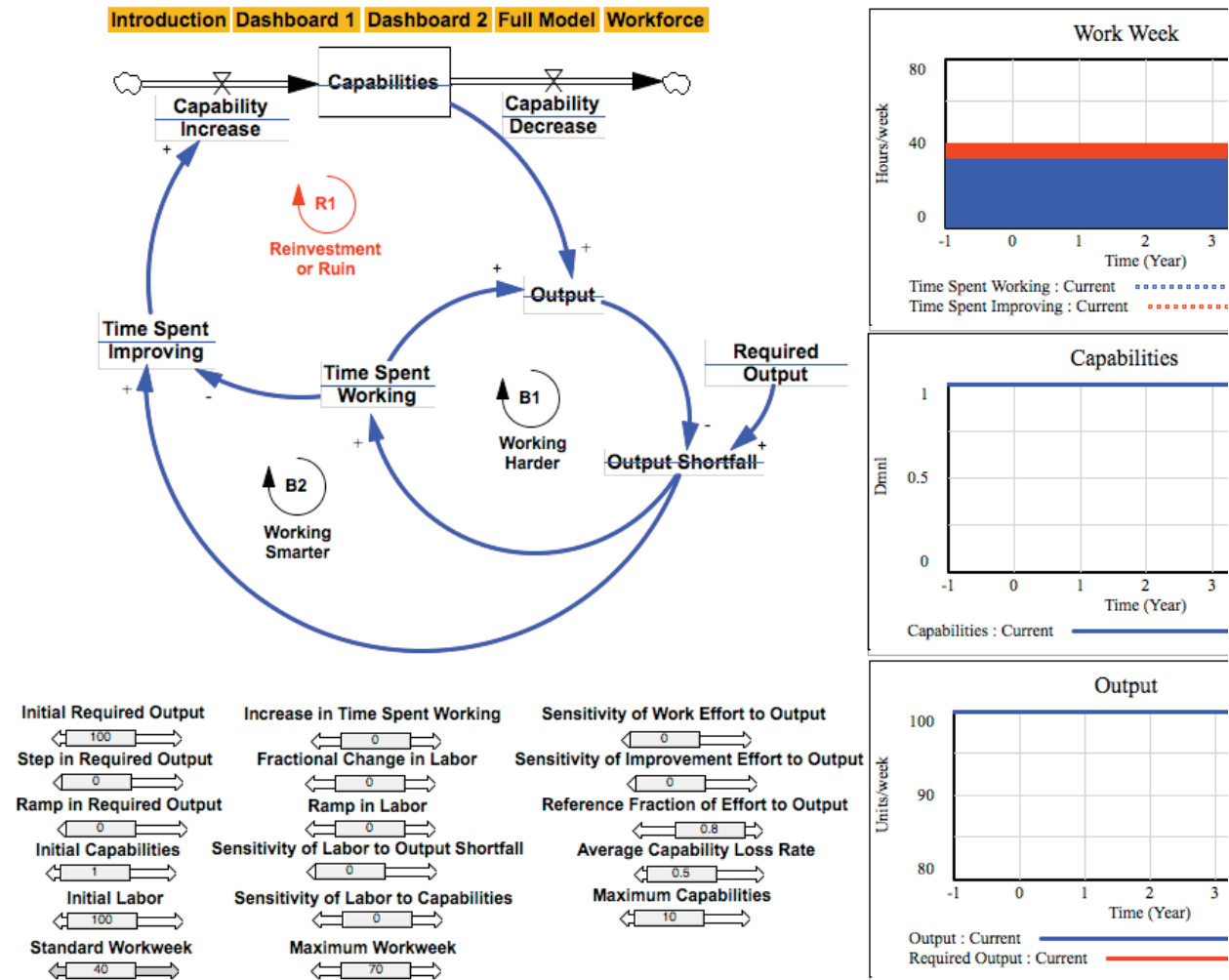
The model contains different sectors (called views) that allow you to see different aspects of the system behavior. The name of the current view is at the bottom left of the Vensim Reader window. To see results, select one of the model views. You can navigate to the different views of the model using the buttons on each screen:

Navigate among the model sectors using these buttons:



You can also cycle through the views by using the page up and page down keys. Depending on your screen size, the graphs in some views may extend beyond edge of your screen. If so, use the scroll bars to see the rest of the view. Alternatively, go to the **View** menu, select **Zoom...** and choose the zoom level you prefer.

3. Setting Scenarios: Use the navigation buttons to go to **Dashboard 1**. After you launch SyntheSim, you will see sliders for the parameters and switches you can use to create your own scenario.

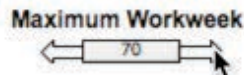


Definitions of Parameters (Sliders):

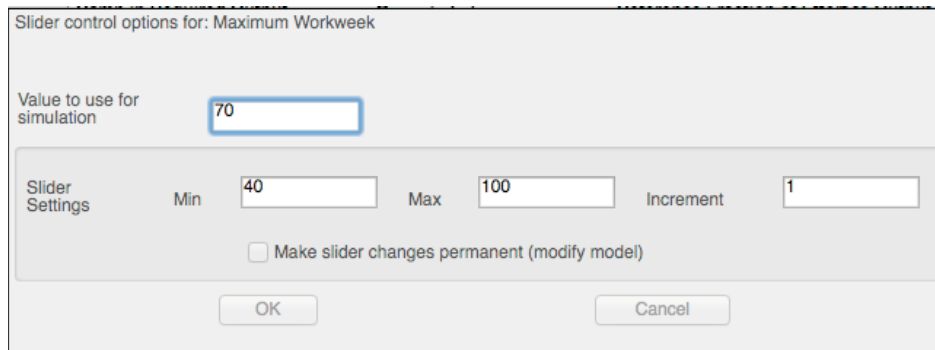
- **Initial Required Output:** The initial value for required output. Set to a default of 100, which can be thought of as an index value (100% of the initial level of required output).
- **Step in Required Output:** At time zero, required output can jump (step) from the initial value to value of this slider. For example, a value of 0.2 will cause a 20% jump in required output at time zero, and remains at the new, higher level thereafter.
- **Ramp in Required Output:** At time zero, required output can follow a linear ramp, increasing (or decreasing) by the value of the slider (measured in fraction/year). For example, a value of 0.20/year will cause required output to grow linearly by 20 units/year (0.2 of the initial required output of 100 units/year). Negative values will cause required output to fall linearly.
- **Initial Capabilities:** The initial level of organizational capabilities is set to 1.

- **Initial Labor:** The initial workforce, set to 100 people.
- **Standard Workweek:** The normal, or standard workweek, with a default value of 40 hours/week.
- **Increase in Time Spent Working:** Increase or decrease in work effort, occurring at time 0, measured in hour/week. For example, setting this parameter to 5 increases the average time spent on production by 5 hours/week, and therefore decreases the time spent investing in capabilities by the same amount (so that the workweek remains at the same level).
- **Fractional Change in Labor:** An exogenous fractional change in the authorized labor force, representing the impact of budget cuts or increases on the workforce. For example, setting this parameter to -.05 would impose a 5% reduction in the authorized workforce at time zero.
- **Ramp in Labor:** The slope of a linear ramp in authorized labor, as a fraction of the initial labor force per year. For example, setting the ramp to .05 would increase the authorized workforce linearly by 5% of the initial workforce per year.
- **Sensitivity of Labor to Output Shortfall:** When positive, this parameter causes the firm to seek additional workers to close any gap between required and actual output. The actual workforce will then increase unless constrained by the authorized labor force. The default value is 0, implying hiring does not respond to the output shortfall. The larger the value, the more responsive hiring is to a given output gap.
- **Sensitivity of Labor to Capabilities:** When positive, this parameter causes the firm to seek additional workers to improve capabilities, even if there is no output shortfall. The actual workforce will then increase unless constrained by the authorized labor force. The default value is 0, implying hiring does not respond to capabilities. The larger the value, the more responsive hiring is to the pressure to improve capabilities.
- **Maximum Workweek:** The maximum average workweek for the workforce. The default value is 70 hours/week.
- **Sensitivity of Work Effort to Output:** The larger the sensitivity, the more responsive work effort will be to the output shortfall. The default value is zero.
- **Sensitivity of Improvement Effort to Output:** The larger the sensitivity, the more responsive improvement effort will be to the output shortfall. The default value is zero.
- **Reference Fraction of Effort to Output:** The initial fraction of the workweek devoted to output. The remainder is devoted to improvement and investment in capabilities. The default value is 0.8, meaning 80% of time is normally spent on output and 20% on improvement and capability development.
- **Average Capability Loss Rate:** The fractional rate at which capabilities erode as personnel turn over and as environmental, technological, competitive and other conditions change. The default value is 0.5/year (50%/year).
- **Maximum Capabilities:** The maximum level of capabilities, determined by the user. The default value is 10, implying a ten-fold improvement is possible relative to the default value for initial capabilities.

Tips for setting slider values: To set parameter values just move the slider until you get the value you want. If you want to specify a particular value, click on the arrow at the end of the slider (either the left or right arrow will work).

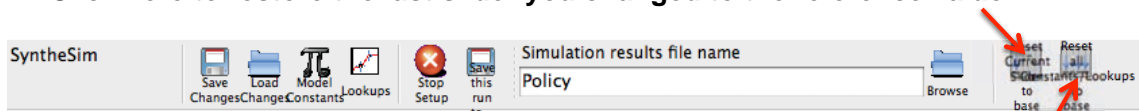


You will get a dialog box allowing you to enter the value you wish for that parameter. Enter the value you wish to use for the simulation and click OK:



While in SyntheSim, you can restore the value of the last slider you changed to its reference case value by clicking on the button labeled “Reset current slider to base value” in the top tool bar. You can restore the value of all sliders you change to their reference case values by clicking on the button to the right labeled “Reset all constants/lookups to base values”:

Click here to restore the last slider you changed to the reference value



Click here to restore all sliders to their reference values

References

- Lyneis, J. and J. Sterman 2016. How to Save a Leaky Ship: Capability Traps and the Failure of Win-Win Investments in Sustainability and Social Responsibility. *Academy of Management Discoveries*. http://jsterman.scripts.mit.edu/Online_Publications.html#HowToSave.
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- Sterman, J. 2000. *Business dynamics: Systems thinking and modeling for a complex world*. Chicago, IL: Irwin/McGraw-Hill.