



Massachusetts Institute of Technology
Sloan School of Management

15.737 Advanced System Dynamics

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E51-325

Syllabus

Building on your prior exposure to system dynamics, this two-day workshop is designed to deepen your skills in system dynamics modeling, including conceptualization, formulation of simulation models, use of data, and policy design. You'll work in teams to develop working simulation models of two important issues, one at the level of industry dynamics and one addressing operations strategy in a successful firm. You will deepen your systems thinking and modeling skills, and learn about important operational, strategic and policy issues.

1. Industry cycles: Oil and gas industry boom-bust cycles

From real estate to energy to agriculture, many markets exhibit persistent boom and bust cycles. These cycles arise from long delays in the feedbacks that work to balance supply and demand. We'll explore how delays create these cycles, with the petroleum and fossil gas markets as examples. The oil and gas markets involve long delays in developing new production capacity and revising expectations about costs and prices. We'll explore how these delays create chronic boom-and-bust cycles, with extraordinary profits in some years followed by a collapse in prices and large losses. You will learn how to represent different types of delays in models. The session also develops your skills in causal mapping, model formulation, and analysis.

2. Operations Strategy: Managing supply chain disruption

The COVID pandemic disrupted supply chains around the world. Supplies became scarce, lead times increased, and firms and consumers struggled to get critical products. Some industries saw panic ordering and hoarding, followed by surplus inventories and financial losses. We will explore the case of a major manufacturer who experienced these dynamics. Although their systems for managing raw materials inventories worked well under normal conditions, during the pandemic they experienced an unplanned and costly surge in their raw material inventories, tying up significant working capital. You will develop models to explain why this happened and explore policies to mitigate these dynamics. We'll discuss how the firm is implementing the results of their internal modeling by redesigning their supply chain management system to deliver high performance even in the face of the shocks and disruptions that are sure to arise in the future.

3. Participant presentations of system dynamics work

Have you used system dynamics in your work? We will set aside time for brief presentations of your work, with opportunities for feedback from the participants and faculty. We welcome both completed and in-progress work.

What to bring:

We will be using VensimPLE. Bring your laptop and charger, and *please make sure you install the current version of Vensim PLE beforehand*. Download the latest version from <https://vensim.com/free-downloads/>.

Please read in advance:

1. *Business Dynamics*, Ch. 11 (Delays), through section 11.5.3, pp 409-449.
2. Read the excerpts from news articles on the fossil gas industry posted on the course website: <https://canvas.mit.edu/courses/31787>.

Grading:

The grading system for this course is Pass/Fail. Your participation and accomplishments in the classroom will determine your grade.