



# BRANDEIS UNIVERSITY

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## International Business School

### **Business Dynamics: Managing in a Complex World Bus 276a, Fall 2012**

#### **GENERAL INFORMATION**

**This course makes use of experiential exercises and assignments to allow students to practice the skills essential to learning.**

**Schedule:** Monday and Wednesday, 9:30 am – 10:50 am. Room: TBD

**Instructor:**

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**Teaching Assistants:**

TBA

**Description:** The course uses systems thinking to study the patterns of behavior we observe in real-world businesses, markets, economies, ecosystems, and human interactions and how these patterns relate to the structure of the underlying systems. In particular, we look at why so many business strategies generate disappointing results or outright failure. Students learn to conceptualize a business organization as a set of structures and policies that create dynamics and govern performance. The course introduces the tools of system dynamics for modeling and analyzing business policy and strategy. Using role playing games, simulation models, and management flight simulators, we develop insights essential to managing in a world characterized by dynamic complexity. Case studies include successful applications of system dynamics in growth strategy, management of technology, operations, project management, and implementation of improvement programs.

**Intended Audience:** This class will appeal to several audiences. First, this course is useful for anyone who wants to develop a broader toolkit for examining the chronic challenges of managing and leading in today's organizations. It will be especially useful to those interested in careers in management consulting, in part for the modeling skills covered, but also for developing rigorous and structured thinking skills. The course has a heavy dose of "reality," so it should also appeal to students who wish to blend theory with the harsh realism of practical challenges in management.

**Pre-requisites:** None. **However, this course IS a pre-requisite for Bus 286a, Applications of Business Dynamics. The pre-requisite policy will be strictly enforced.**

**Mathematics:** The level of mathematics proficiency needed for this class is roughly equivalent to that attained through the study of high school algebra. The course does include formulation of equations to build formal mathematical models that we will understand with the assistance of computer simulations. The theories and models on which the course is based draw on an elegant and rigorous mathematical foundation. However, the aim of this course is to develop your intuition and conceptual understanding. Accordingly, we will develop the material, our models, and our understanding of dynamical systems with a minimum of mathematical foundation. If you don't have a strong mathematics background, fear not.

**Office hours:** My doors are always open to students, or make an appointment by email.

**Evaluation:** Assignments: 85%  
Class participation: 15%

Assignments will be graded on 10- or 15-point scales. Two points will be forfeited for assignments handed in late. Assignments handed in more than one class late will receive no credit. *This policy will be strictly enforced.*

**Learning Goals and Outcomes:** Learn to map the feedback structure of a system using causal loop diagrams.  
Learn to identify stocks and flows and understand the basic dynamics of stocks.  
Learn to formulate and specify system dynamics models using Vensim software.  
Learn to perform simulation analysis and interpret results.  
Learn to articulate how lessons from models can be used to inform discussion and improve performance of systems, for example, in business and public policy.

**Communication:** The course website will be on LATTE. The LATTE email system will be used for announcements.

**Disability:** If you are a student with a documented disability on record at Brandeis University and wish to have a reasonable accommodation made for you in this class, please see me immediately. Please keep in mind that reasonable accommodations are not provided retroactively.

**Academic Integrity:** You are expected to be familiar with and to follow the University's policies on academic integrity (see <http://www.brandeis.edu/studentlife/sdje/ai/>). Instances of alleged dishonesty will be forwarded to the Office of Campus Life for possible referral to the Student Judicial System. Potential sanctions include failure in the course and suspension from the University.

## Objectives and Scope

Why do so many business strategies fail? Why do so many others fail to produce lasting results? Why do many businesses suffer from periodic crises and fluctuating sales,

earnings, and morale? Why do some firms grow while others stagnate? How do once-dominant firms lose their competitive edge?

Why do the apparently well-intended actions of individuals and of various groups in organizations often lead to outcomes that differ so much from their intentions? Why do so many growth ventures and planned change initiatives exhibit a pattern of only transient success? How is it that the actions that some managers take in the service of their goals foster the very problems they are attempting to solve? How can a firm identify and design high-leverage policies, policies that are not thwarted by unanticipated side effects?

Accelerating economic, technological, social, and environmental change challenges managers to learn at increasing rates. We must increasingly learn how to design and manage complex systems with multiple feedback effects, long time delays, and nonlinear responses to our decisions. Yet learning in such environments is difficult precisely because we never confront many of the consequences of our most important decisions. Effective learning in such environments requires methods to develop systems thinking, to represent and assess such *dynamic complexity* – and tools managers can use to accelerate learning throughout an organization.

This course introduces you to system dynamics modeling for the analysis of business policy and strategy. You will learn to visualize a business organization in terms of the structures and policies that create dynamics and regulate performance. System dynamics draws on feedback theory and techniques of mathematical modeling and computer simulation to elucidate the relationships between structure in systems and the patterns of dynamic behavior they exhibit over time. A common theme that runs through the course is the search for connections between the behavior of people (and groups) in organizations and the organizational trajectories they generate. How do interactions among physical, cognitive, social, and informational factors in various organizational settings lead to dynamic behavior over time?

Most of the time most people have good intentions and act in a manner they believe is consistent with moving towards their goals. Yet these intentions are often confounded by limited information, pressures to continually act and make sense of the world, misattributions, complex interactions between physical and behavioral factors, and misunderstood delays between action and effect. Throughout the course, we will map these dynamically complex interactions into frameworks that lead to insights meaningful to managers who must navigate these changing terrains. We will use tools such as causal loop diagrams to map underlying feedback structures, formal mathematical models to represent the causal relationships, and computer simulations to analyze the relationship between these structures and the patterns of behavior they generate over time.

System dynamics allows us to create models and management flight simulators where space and time can be compressed, slowed, and stopped so we can experience the long-

term side effects of decisions, systematically explore new strategies, and develop our understanding of complex systems. We use role playing games, simulation models, case studies, and management flight simulators to develop principles of policy design for successful management of complex strategies. Case studies of successful strategy design and implementation using system dynamics will be stressed. We consider the use of systems thinking to promote effective organizational learning.

The principal purpose of modeling is to improve our understanding of the ways in which an organization's performance is related to its internal structure and operating policies as well as those of customers, competitors, and suppliers. During the course you will use several simulation models to explore such strategic issues as fluctuating sales, production and earnings; market growth and stagnation; the diffusion of new technologies; the use and reliability of forecasts; and the rationality of business decision making.

Students will learn to recognize and deal with situations where policy interventions are likely to be delayed, diluted, or defeated by unanticipated reactions and side effects. You will have a chance to use state of the art software for computer simulation and gaming. Assignments give hands-on experience in developing and testing computer simulation models in diverse settings.

**NO PRIOR COMPUTER MODELING EXPERIENCE IS NEEDED.**

## Texts and Software

### Required Materials:

Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World* (Text and CD-ROM). Irwin/McGraw Hill. ISBN 0-07-238915X.

To supplement the book, several cases available from HBS Publishing will be required. Additional readings will be handed out on an occasional basis. The syllabus indicates which sections you should be sure to read to learn the material you will need to do the assignments, and which sections you can skim (*NOTE*: ‘skim’ ≠ ‘skip’). Further, we will be analyzing several cases in the course you need to prepare *before* the class in which we discuss them. We have noted on the syllabus the days for which these cases should be prepared.

We will also be using a simulation exercise provided by Strategy Dynamics. Use of this simulation exercise will require each student to purchase a registration code.

In addition, we will be using modeling software. Several excellent packages for system dynamics simulation are now available commercially, including **iThink**, from High Performance Systems, **Powersim**, from Powersim Corporation, **Professional DYNAMO**, from PA Consulting, and **Vensim**, from Ventana Systems. All are highly recommended. You may wish to learn more about these packages, as all are used in the business world, and expertise in them is increasingly sought by potential employers. For further information, see the following resources:

**iThink**: See the High Performance Systems web site at [www.hps-inc.com](http://www.hps-inc.com).

**Powersim**: See the Powersim web site at [www.powersim.com](http://www.powersim.com).

**Professional DYNAMO**: Contact the Business Dynamics division of PA Consulting, 1 Memorial Drive, Cambridge, MA 02142, 617.225.2700.

**Vensim**: See the Ventana Systems web site at [www.vensim.com](http://www.vensim.com).

In this course, we will be using the **Vensim** Personal Learning Edition (**VensimPLE**) by Ventana Systems. VensimPLE is free for academic use. VensimPLE is available for both Windows and Macintosh; models created with it are fully convertible across platforms. VensimPLE comes with on-line user’s guide and help, and also a folder of demo models. Download VensimPLE from [www.vensim.com/venple.html](http://www.vensim.com/venple.html).

**NOTE**: The CD-ROM that comes with the *Business Dynamics* textbook includes a version of VensimPLE. However, that version is now out of date. Be sure to download the current version from the Vensim website above. All the Vensim models on the text CD work with the new version.

## BUSINESS DYNAMICS Bus276a SCHEDULE

(Preliminary: schedule will change)

**Notice: We will agree on some schedule changes to schedule workshops and adjust to the availability of guest speakers and some travel by the professor.**

Date		Class	Topic	Reading Due	Assn Out	Assn Due
9/5	W	1	Introduction and Overview: Why are we here? What is System Dynamics and why do I care?	Read <i>Business Dynamics</i> [BD], Ch. 1		
9/10	M	2	<b>System Dynamics Tools Part 1:</b> A Whirlwind Tour of System Dynamics	Read BD, Ch. 3, Ch. 4		
9/12	W	3	Workshop: Vensim Tutorial	Prepare workshop questions	#1	
9/19	W	4	<b>System Dynamics Tools Part 2:</b> Reference modes, mapping and the grammar of causal links	Read BD, Ch. 5 (Skim sections 5.4, 5.6)		
9/20	Th	5	<b>System Dynamics Tools Part 3:</b> The Nuts and Bolts of Causal Loops		#2	#1
9/24	M	6	Workshop: Causal Loop Diagram Tutorial	Prepare workshop questions		
10/3	W	7	<b>System Dynamics Tools Part 4:</b> Practice with Causal Loop Diagrams	Read BD, Ch. 6 (Skim sections 6.2.7, 6.2.8, 6.2.9, 6.3.4, 6.3.6)		
10/9	T	8	<b>System Dynamics Tools Part 5:</b> Introduction to Stocks and Flows	Read BD, Ch. 6 (Skim sections 6.2.7, 6.2.8, 6.2.9, 6.3.4, 6.3.6)	#3	#2
10/10	W	9	<b>System Dynamics Tools Part 6:</b> Mapping the stock and flow structure of systems	Read BD, Ch. 6 (Skim sections 6.2.7, 6.2.8, 6.2.9, 6.3.4, 6.3.6)		
10/15	M	10	<b>System Dynamics Tools Part 7:</b> Dynamics of stocks and flows	Read BD, Ch. 7		
10/17	W	11	<b>System Dynamics Tools Part 8:</b> Putting it together: Linking feedback with stock and flow structure; First-order systems	Read BD, Sections 8.1-8.4 Read BD, Ch. 8.5 to end	#4	#3
10/22	M	12	<b>Growth Strategies Part 1:</b> Interactions of Operations, Strategy, and Human Resource Policy:	<i>Please Prepare:</i> People Express (A)	#5	

10/24	W	13	<b>System Dynamics in Action—</b> Tentative slot for guest speaker			
10/29	M	14	<b>Growth Strategies Part 2:</b> The feedback structure of s-shaped growth. The diffusion and growth of new products, network externalities, and complementarities	Read Ch. 9.1 (Skim 9.1.2, 9.1.3) Skim BD, Ch. 9.2 Read BD, Ch. 9.3 (Skim 9.3.5 – end) Read BD Ch. 10(Skim 10.2)		#4
10/31	W	15	<b>Growth Strategies Part 3:</b> Managing Hyper Growth: Lessons from People Express.		#6	#5
11/5	M	16	<b>Managing Instability Part 1:</b> Formulating and testing robust models of business processes	Read BD, Sections 13.1, 13.2.1-13.2.7, 13.3 and 13.4		
11/7	W	17	<b>Managing Instability Part 2:</b> The supply line and supply chains	Read BD, Sections 17.1, 17.2 and 17.3	#7	#6
11/12	M	18	<b>System Dynamics in Action—</b> Tentative slot for guest speaker			
11/14	W	19	<b>Managing Instability Part 3:</b> Inventory modeling in Supply chains; Review of delays			
11/19	M	20	<b>System Dynamics in Action:</b> Applications of System Dynamics to Environmental and Public Policy Issues	Read Meadows, et. al., “Groping in the Dark: The First Decade of Global Modeling” (excerpts), Meadows, “The Global Citizen” (selections)		
11/26	M	21	<b>System Dynamics in Action:</b> Social issues in sustainability			
11/28	W	22	<b>System Dynamics in Action:</b> Process Improvement: You Can’t Get There from Here?	Read BD, Sections 17.4 and 17.5	#8	#7
12/3	M	23	<b>System Dynamics in Action:</b> The dynamics of service quality: cutting corners and working overtime	Read BD, Sections 14.1 – 14.4	#9	
12/5	W	24	<b>System Dynamics in Action:</b> The dynamics of project management – On time and under budget	Read BD, Sections 2.3 and 6.3.4.		

12/10	M	25	<b>System Dynamics in Action:</b> Process Improvement Case Vignettes			<b>#8</b>
12/12	W	26	<b>System Dynamics in Action:</b> The implementation challenge  Conclusion: How to keep learning. Follow-up resources. Career opportunities. Course evaluations	Read BD, Ch. 22		<b>#9</b>