STERN SCHOOL OF BUSINESS
NEW YORK UNIVERSITY
COURSE SYLLABUS BO1.2314
COMPETITIVE ADVANTAGE FROM OPERATIONS

Fall 2005
K-MEC 2-65

MEETINGS: Thursdays 9:00-11:50 a.m.

INSTRUCTOR: Sridhar Seshadri, Room 873 KMC sseshadr@stern.nyu.edu

OFFICE HOURS: Wednesdays 2:00-3:00 p.m. (subject to change)

REQUIRED COURSE MATERIALS:


THE GOAL; Eliyahu Goldratt; 2nd Revised Ed.; North River Press; 1992

CASES & READINGS: Packet available in bookstore (also, some will be distributed in class, and some can be downloaded from the course web site)

COMPUTER SOFTWARE: EXCEL - For Linear Programming HOM - For other OM Topics to be downloaded from Blackboard

TEACHING FELLOW: Jay Chen zc241@stern.nyu.edu
MATERIALS REQUIRED


COMPUTER SOFTWARE: NYU Software Package - HOM (to be downloaded)

CASE PACKET (Buy packet in Bookstore)

COMPETING ON CAPABILITIES: The New Rules Of Corporate Strategy
L.L. BEAN, INC.
PIONEER HI-BRED INTERNATIONAL, INC.
RED BRAND CANNERS CASE
TOYOTA MOTOR CO. CASE

OTHER CASES and READINGS (To be distributed in class or on Web Site)

ANALYSIS OF AN OPERATION
FIRST CITY NATIONAL BANK
FCN SECURITIES DEMO A, B and C
FORD-FIRESTONE
NETWORK CASES - ALLIED, SPECIALTY and AEROSPACE
XENON DRIVES CASE

THE GOAL, second revised edition (Buy in Bookstore), Eliyahu Goldratt, North River Press, Inc. 1992
HONOR CODE

I expect every student to be familiar with the Stern School of Business Honor Code. Some of the ways in which the code applies to this course are discussed below:

- The honor code stipulates that no student will lie, cheat, copy or otherwise behave in an unfair manner to obtain academic advantage over other students.
- As per the honor code, an individual’s name on a report should be included only if they have contributed to the analysis. If an individual has not contributed to the analysis in an intellectual manner, it is a violation of the honor code to include his or her name.
- Furthermore, you may not refer to case write-ups from classes offered in earlier semesters.
- The premise of the honor code is that ideas should be attributed to their source. Therefore, please acknowledge the main source(s) of data, facts, and ideas (other than from the instructor or textbook) in all your written work and when you make a presentation. If you use material from a source other than the lecturer, the textbooks or the lecture notes, you must attribute the source. For example, say, “I discussed this with the TA.” Or “I obtained this from the following website.”
- You may discuss assignments with your classmates, TA or me. However, you must do them individually. The discussion is limited to “how to solve” type of questions. The actual solution must be done individually or in the same group for the entire semester. Do not be worried of getting the exact answer. Most of the points will be given for using the correct approach.
SYLLABUS

COMPETITIVE ADVANTAGE FROM OPERATIONS

Fall 2005

MODULE 1: Introduction to Operating Systems:
Process Design and Analysis

September 8
SESSION 1A: INTRODUCTION - OPERATIONS AS A SOURCE OF COMPETITIVE ADVANTAGE

Class Plan:
In this session we discuss the course contents, form groups, and discuss other details. The main themes in this session are: what are business processes, how operations management involves the design, planning, and management of business processes, and how operations is a source of competitive advantage to a firm.

Concepts: What is operations strategy? How is it related to business strategy?

1. Begin reading “The Goal” by E.M. Goldratt (should be completed within 3 weeks). Read up to p. 264.
2. Read the note Competing on Capability: The New Rules of Corporate Strategy
3. To be discussed in class:
   • Recall some recent decisions made by you to purchase a product or to visit a service provider (hotel, air travel, bursar, etc.). What were the high and low points of your experience and why?

Related Links:
Operations Strategy http://www.stern.nyu.edu/om/under_cafo/Seshadri/allrefs.htm#operations_strategy
List of topics and companies http://www.stern.nyu.edu/om/under_cafo/Seshadri/allrefs.htm#general.refs

SESSION 1B: OPERATING SYSTEMS - TYPES OF OPERATING PROCESSES

Class Plan:
In this session we discuss process choice. Two variables that affect the choice of a process are volume and variety. The choice of process goes beyond determining whether to mass-produce or make by hand. It also influences the labor skills, the degree of automation, the controls used, the IT and information systems, etc.
We study service operations to see if they have special characteristics that are different from manufacturing operations. For service operations, the key factors are the degree of customization versus the intensity of labor.

Concept: Product-process matrix, service design matrix, process design and operational implications.
2. In this class, we will study different types of operating processes and discuss their suitability for manufacturing various products. Some of these processes and products are illustrated in virtual PLANT TOURS accessible by visiting:
   http://www.mhhe.com/omc/tours-frames.htm

3. **Study** at least two of the following three tours and answer the questions that follow:
   
   **Job shop:** Stickley furniture [http://www.stickley.com/](http://www.stickley.com/)

   **Continuous flow process:**

   **Assembly line process:**

   a) What would you expect to be the key elements of each company’s business strategy?
   b) What would you expect to be the key elements of each company’s operations strategy? What is your assessment of the fit between each company’s business strategy and its operations strategy?
   c) What are the major differences between the operations of the firms?

**September 15**

**SESSION 2: PROCESS ANALYSIS: PROCESS CAPACITY AND PROCESS COST, FLOW TIME, PRODUCT VARIETY**

**Class Plan:**
We learn to analyze a business process in detail. The objectives of the analysis are: identify the process capacity, process cost, and time to serve customers. Additionally, understand how to schedule labor and use the identity of the bottleneck to manage capacity. We shall link these ideas back to the book "The Goal."

**Concepts and techniques:** Process charting, capacity calculations, bottleneck, throughput time calculations, work assignment, Gantt charts, product costing, and process improvement. I = RT law.

1. Read Chapter 5 in CAJ: Process Analysis
2. Read the note “Analysis of an Operation” from the course website.
3. Read, analyze and be prepared to discuss the **Kristen's Cookie Company (A)** case (Ch 5 pp. 178-79 in CAJ) utilizing the study questions at the end as a guide.
Assignment 1 (due next class):

(1) Draw a Gantt chart for Kristen's operation assuming orders are for two-dozen cookies, orders come every 20 minutes AND Kristen’s roommate is absent.

(2) Assume that Kristen and her roommate have 300 days left before they graduate. They sell one-dozen cookies for $3.40, the material costs are $0.60 and the packaging costs are $0.10 per dozen. Kristen is considering buying a second oven (just like the first one.) She accepts orders for cookies in single dozens. If she gets the second oven, answer the following questions:

- What is the bottleneck operation?
- What are the cycle times and capacities for each operation?
- What is the throughput time (flow time) for an order of a dozen cookies? For two-dozen cookies?
- What is the maximum number of cookies (in dozens) that can be made in one evening with one-dozen and two-dozen batches (they work exactly four hours)?
- What is the value of the new oven assuming no cost of labor?
- What is the utilization of Kristen and her roommate’s time?

September 22
SESSION 3: PROCESS CHOICE EXERCISE
in Cantor Boardroom, 11th Floor of KMC

1. Please read the Toyota Motor Company Case before class (case will be handed out in class)
2. Be prepared to discuss the root cause of the seat problem.

Related Links:
Process Analysis http://www.stern.nyu.edu/om/under_cafo/Seshadri/allrefs.htm#process_analysis

MODULE 2 Managing for Competitive Advantage: Time-to-Market & Responsiveness

September 29
SESSION 4A: THE EFFECTS OF SET-UP TIME ON CAPACITY

Class Plan:
In this class, we study the effect of set-up time on capacity. The Donner Company case will also serve as another example for analyzing processes. The process in this case is quite complex, but we will see that the simple but powerful ideas of capacity management that we have learnt so far, such as, identifying and managing the bottleneck, will prove to be adequate even for managing the most complex processes. I urge you to explore the spreadsheets in the website before class.

Concepts: Set up time, external and internal set up, batch size, effect of product-mix on capacity, order size - cost - due dates.
1. Read the Donner Company case. Use the EXCEL spreadsheets (Donner.xls and Donner1.xls) to analyze and understand the relationships between number of orders (set-ups) in a month, order size, and capacity.

2. Use the following study questions as guides in analyzing the case:
   a) Describe Donner as an operating process. To simplify this task, consider only the flow of the most important output.
   b) Assume Donner has to process 60 orders in a certain month. What is the capacity (in terms of the number of boards) of each operation and of the entire system? How soon can an order for 80 boards be delivered?
   c) What factors influence the capacity of the entire system? What is the current utilization of the machines?
   d) What was the efficiency of Donner?

3. Read Chapter 11 in CAJ: Strategic Capacity Management

Related Links:

Assignment 2 (submit next class): Donner has decided to take our advice and add a CNC drill. Assume that cost of the new drilling machine is $80,000. Assume that the total number of orders remains unchanged from its current value of 60 orders per month. When I say ‘old’ below I mean before adding the second CNC drilling machine. When I say ‘New” I mean after adding the second CNC drilling machine.

a) What is the old shop capacity? What will be the new shop capacity? (Hint: Slightly modify -- change exactly one number -- in the spreadsheet Donner.Xls.) Provide (attach) a printout of the calculations.

b) What was the old bottleneck? What will be the new bottleneck?

c) Using Exhibit 1 of the case, what is the current gross margin per dollar sold?

d) Assume that all the extra capacity in part (a) can be converted to sales. Using your answers to (a) and (c), compute the time to breakeven on investment in the second CNC drill.

e) What assumptions are critical to your answer in (d)? (In other words, how sensitive is your answer to the assumptions made?) Explain and make a recommendation.

SESSION 4B: TIME BASED COMPETITION

Class Plan:
Competing based on time means being able to execute large projects, on time and within cost. In this session we first discuss the value of time-based competition. Then, in this and the next session, we learn about network techniques for planning and managing large projects. Successful project management involves planning and managing the time to complete the project, monitoring the use of resources during project execution, and increasing the probability of successful completion. Network planning and control techniques provide the tools necessary for undertaking these tasks.

Concepts: Critical time, planning and control issues for projects, work breakdown structure (WBS), drawing project networks, cost-time analysis.
1. Read Chapter 3 in CAJ: Project Management.
2. Download the six project management exercises from Blackboard.

_Do not submit but encouraged to practice:_ Draw the network and find the minimum project completion time for the **Allied Distributing** case. **Solution in the next class.**

**October 6**
**SESSION 5A: PROJECT MANAGEMENT**

**Class Plan:**
We will discuss the probabilistic methods for project analysis. We will also touch upon project crashing. We will learn why it is sometimes beneficial to reduce the duration of a project, even though it may increase the cost of the project. We will discuss project crashing techniques that optimally reduce the duration of a project by selectively reducing the duration of only certain activities.

1. Read, analyze and be prepared to discuss the project management network cases (exercises): FCN (B), FCN (C), Specialty Contractors, and Aerospace Components.

_Assignment 3 (submit next class):_ Solve the **Specialty Contractors** case. HOM can be used.

**Related Links:**
Please visit the website of Primavera ([http://www.primavera.com/](http://www.primavera.com/)) to see examples of the state-of-art network planning tools.

**SESSION 5B: THE EFFECTS OF UNCERTAINTY- WAITING LINES**

**Class Plan:**
Recall Pete's people who were trying to beat the robot? Demand and supply often do not match. The mismatch creates special problems for managers. To understand these problems it is important to understand the time-scale at which these uncertainties happen. Very long and gradual changes in demand can be dealt with using techniques for managing seasonal demand. Medium term uncertainties, such as day-to-day fluctuations in demand levels, can be dealt with using staffing solutions and overtime. Demand uncertainties on the same time scale as operational variables such as processing time or set-up time need special techniques. These techniques are called waiting line or queueing techniques. We learn a bit about the other two and lot more about the waiting line techniques in this and the next session.

Regarding waiting lines, we learn: why uncertainties in processing times as well as arrival patterns create delays? These delays are due to queues. We learn why queues form? How to estimate the queueing delays? How to plan for extra capacity to reduce unwanted delays? And how to reduce uncertainty?
**Concepts**: Uncertainty - time scale and planning demand and supply, service level in queues, cost-service tradeoff in queues, queueing formulae -- averages and distribution of number of customers in system and time spent in the system, revisit I = RT law. Dynamics of processes.

1. Read Technical Note 7 in CAJ: Waiting Line Management. (See ERRATA on the course webpage, or in the text on the page after the Table of Contents.
2. Solve problems 1, 5, 10 and 17 at the end of TN 6. These problems should be solved by-hand using the proper formulas in the chapter. HOM can be used to check your calculations.

**October 20**
**SESSION 6 A:**

**QUEUEING THEORY IN ACTION**

**Class Plan:**
We apply waiting line techniques to analyze the **First City National Bank** case. In particular, we discuss whether S-lines are better than single lines, whether and when specialization using dedicated servers is preferred, as well as, several psychological factors that affect the perception of "waiting" in lines.

1. Read, analyze, and be prepared to discuss the First City National Bank case. The following study questions will help:
   a) Considering the data supplied for arrival and service times, how would you calculate an average arrival rate and service rate?
   b) As Mr. Craig, what characteristics of this queueing system would you be most interested in observing?
   c) What is the best number of tellers to use?
   d) Calculate the waiting time for a customer (time spent in the queue before service) and determine which of the two line configurations you would recommend. Support your result with the appropriate quantitative queuing analysis.

   **Concepts**: Design of queueing systems, staffing, scheduling, psychology of queues.

**SESSION 6B:**
First **midterm** examination. Open book and notes. Duration 60 mins.
Coverage - up to Project Management.

************************************************************************

**NOTE**
The book, *The Goal*, has been turned into an excellent movie. The length of the film is 50 minutes. From feedback received and own experience, seeing the movie after reading the
book enhances the learning. The viewing is completely optional. You can view the movie in the OM area after making an appointment.

Related Links:

************************************************************************

MODULE 3  Managing for Competitive Advantage: Quality as a Strategic Issue

October 27
SESSION 7A: QUALITY - ITS DEFINITION AND BASIS FOR COMPETITION

Class Plan:
In this session we discuss quality management in the context of the Ford-Firestone tire recall case. The objectives of the session are to understand what is quality, what are the costs associated with it, and raise questions about managing quality in the age of super-mass production. These questions will be answered in the next two sessions.

Concepts: Quality its definition, analysis, planning and control. Dynamics of processes.

1. Read the Ford-Firestone case and be prepared to discuss it. In particular attempt question 4 below to determine what was the true cause of the problem?
2. Prepare a Fishbone Diagram of the problem.
3. Read Chapter 8 in CAJ: Quality Management: Focus on Six Sigma

SESSION 7B: QUALITY CONTROL -Introduction to Six Sigma

Class Plan:
In this session we learn about the two faces of quality. What does a customer want? What can a process deliver? And, how to manage their interaction? We shall discuss useful quality management tools, such as, the fishbone chart, Pareto analysis, and process control charts. We will also learn about six-sigma quality. Specifically:
1. What is six sigma quality and how it applies to product and process design?
2. What is process capability? How to measure process capability?
3. How does six sigma quality relate to the teaching of Deming?
4. What is meant by "Quality is free"?
5. Revisit the Toyota case and suggest whether the use of six sigma technique and statistical process control can be used in Toyota? (Good exam question)
6. Read Technical Note 8 in CAJ: Process Capability and Statistical Process Control

Pick up problem set and solution in class or from website.

Concepts: Type I and Type II errors, process control and process capability, six sigma quality.
MODULE 4 Managing for Competitive Advantage: Supply Chain Management

November 3

SESSION 8: INVENTORY AND LOGISTICS

Class Plan:
In this and the next two sessions, we discuss inventory management and more broadly supply chain management. Material, information and funds flow through supply chains. Demand is matched with supply, orders with fulfillment, and products are planned to fill customer needs and to compete against other products in the market. The integrated management of the three flows, material, information, and funds, is called supply chain management. We learn how firms compete using new principles of supply chains. We also learn how inventory, one of the fundamental levers for managing supply chains, can be analyzed and managed.

Concepts: EOQ, safety stock and cycle service level, effect of scale on inventory cost, risk pooling and safety stock. If time permits, transportation and logistics concepts.

Dynamics of processes.

1. Read Chapter 15 in CAJ: Inventory Control. The EOQ (ELS) model will be introduced in class.

2. Read and analyze the Xenon Drives case (distributed in class). Be prepared to discuss questions 1, 2, 4 and 6

   Assignment 4 (submit this class): Answer and submit question 1 in the case. No detailed analysis necessary, but your intuition about the answer to the question and the issues involved.

   Pick up problem set for inventory management. Not to be submitted.

November 10

SESSION 9: INVENTORY IN ACTION: THE BEER GAME

   in Cantor Boardroom, 11th Floor of KMC

   PLEASE BE A FEW MINUTES BEFORE TIME!!

Related Links:
What is systems dynamics? http://www.albany.edu/cpr/sds/

November 17

SESSION 10A:
1. In this class we will discuss the effect of uncertainty on inventory management. We will study a model, called the newsvendor model, and see how it is used to plan inventory when demand cannot be forecasted accurately. We will also introduce the concept of safety stock.

2. Read “A Note on the Newsvendor Model: Inventory Planning for Short Lifecycle Items” from the course website.

3. Read, analyze and be prepared to discuss the L.L. Bean case. L. L. Bean has adopted a two stage ordering process for products with “one-shot” commitments (i.e., products that they get to order only once because of long supplier lead times). First, they determine a forecast for an item and then they have a process for converting that forecast into an order quantity. Use the following study guide questions to help with your preparation of the case.

4. How significant (quantitatively) of a problem is the mismatch between supply and demand for LL Bean?

5. How does LL Bean use past demand data and a specific item forecast to decide how many units of that item to stock? Is this the best they can do?

6. Consider the second part of the process, converting a forecast into an order quantity. What item costs and revenues are relevant to the decision of how many units of that item to stock? What is the relationship between LL Bean’s method and the newsvendor model?

7. The Excel file, LLBean.xls, on the course webpage contains demand and forecast data for 84 items. Suppose that these are the data that LL Bean will use to plan their next season. Consider an item that retails for $45 and costs LL Bean $25. The liquidation price for this item is estimated to be $15. The sales forecast for this item is 12,000 units. What order quantity should LL Bean choose for this item?

Concepts: Stockout cost, newsvendor problem, critical fractile and marginal cost analysis.

SESSION 10 B:

Second midterm examination. Open book and notes, Duration 60 minutes.

MODULE 5 Allocating Resources for Strategic Capacity Planning
December 1

Session 11 A

THE BASIC LP PROBLEM

Class Plan: We begin the last module, which is integrative in nature. It deals with the use of linear programming for planning and optimizing systems. We shall discuss several applications of LP to Operations Management problems.
Concept: Modeling operations problems for optimization of processes, product-mix, diet and transportation problems, solution techniques.

1. Read the chapter on Linear Programming located at the very end of our custom text (Stevenson chapter supplement to Ch 6, pp. 265-295). (Note: these page numbers are not sequential to the Chase text. Go to the very end of the custom book.) The first reading should be to skim the chapter for a quick overview.
2. Review discussion questions 1 -6 (p.289).
3. Attempt to set-up (not solve) in standard LP form, Problems 3, 4 and 5 on page 291.

Related Links:
Linear Programming and other Operations Research Topics http://www.informs.org/Resources

SESSION 11B: SOLUTION TECHNIQUES: GRAPHICAL METHOD AND ENUMERATING THE CORNER POINTS

Class Plan:
We learn how to solve LP problems by hand using a graphical technique. We also learn to carry out sensitivity analysis.
Related Links:
Visit the website of Ilog and look under OPL Studio. http://www.ilog.com/

December 8
SESSION 12: LP SOLUTION (LINDO OR EXCEL INTERPRETATION)

Class Plan:
We learn how to formulate and solve LP problems using Excel. How to interpret Excel outputs for LP problems.

Read Text Chapter 6S & 10.
Prepare: Pioneer Hi-Bred International Case
1. Why was John Smith so apprehensive about the 1998 production plan? How would uncertainty of forecast demand and production yield affect the supply management decisions at Pioneer?
2. What should John Smith do about the 33% safety stock? What would be the impact on the 1998 plan if the safety stock inventory was reduced to 20%? How would changing production yields affect the safety stock decision?
3. What should John Smith do about Northern Hemisphere production and off-season production?
4. What should John Smith do about overseas production issues?
5. How would the LP model help John Smith make such decisions as the overproduction rate and overseas production?
6. What are the advantages and disadvantages (limitations) of the LP model in the current case?
7. How can the LP model be improved?

**Related Links:**
Linear Programming and other Operations Research Topics [http://www.informs.org/Resources](http://www.informs.org/Resources)

*Assignment 5 (submit next class): Formulate and solve the Red Brand Canners case.*
*Submit next class.*

**December 15**
**SESSION 13:**
Discuss your solutions to the Red Brand Canners case.
Review and summary of entire course.

**Final Examination during final exam period.**
GRADING

Class Participation, Quizzes 15%
Mid-Term Examinations (Open book) 30%
Final Examination (Open book) 30%
Five assignments (Group work) 25%

ASSIGNMENTS

There are five assignments. They are due on the dates (sessions) shown in the syllabus and also shown below. Only assignments that are specifically designated as SUBMIT are to be handed-in. They are due at the beginning of class. Keep a copy of all assignments submitted for reference during class.

Assignments will be graded, and will not be accepted late. Individuals group members should participate in order to receive credit.

QUIZZES

Quizzes might be given in any class in which a case is to be discussed. The quiz will relate to facts given in the case and study questions asked in the syllabus.

HOW TO PREPARE FOR CLASS DISCUSSIONS

Please read the cases carefully. Use the study questions supplied in the syllabus as a guide. Be prepared to be called-upon to present the facts of the case, or to carryout the analysis indicated by the study questions.

OVERVIEW OF ASSIGNMENTS WITH DUE DATES

<table>
<thead>
<tr>
<th>DUE DATE</th>
<th>ASSIGNMENT TO BE SUBMITTED</th>
<th>DETAILS FOUND IN SESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 22</td>
<td>Questions related to Kristen's Cookie Co. Case</td>
<td>Session 2B</td>
</tr>
<tr>
<td>Oct 06</td>
<td>Question on Donner Co. Case</td>
<td>Session 4A</td>
</tr>
<tr>
<td>20</td>
<td>Specialty Contractor Case</td>
<td>Session 5A</td>
</tr>
<tr>
<td>20</td>
<td>First Midterm Examination</td>
<td>Session 6B</td>
</tr>
<tr>
<td>Nov 03</td>
<td>Ford-Firestone Case</td>
<td>Session 8A</td>
</tr>
<tr>
<td>17</td>
<td>Second Midterm Examination</td>
<td>Session 10A</td>
</tr>
<tr>
<td>Dec 15</td>
<td>Red Brand Canner Case</td>
<td>Session 12</td>
</tr>
</tbody>
</table>
Selected References


