Operations Management
Sample Syllabus

COURSE DESCRIPTION:
This course serves as an introduction to Operations Management. The coverage of the discipline is very selective: We concentrate on a small number of powerful themes that have emerged recently as the central building blocks of world-class operations. We also present a sample of operations management tools and techniques that have been proved extremely useful over the years. The topics are equally relevant in the manufacturing and service sectors.

Attendance in all sessions is required for full credit. If you have to miss up to one session, please notify the instructor in advance.

INSTRUCTOR: René Caldentey, KMC 8-77, (212) 998-0298, rcaldent@stern.nyu.edu
Office Hours: After class or by appointment.

TEACHING ASSISTANT: T.B.A
Office Hours: T.B.A.

MEETINGS: T.B.D
Room: T.B.D

CLASS MATERIAL:
Required:
CASES AND READINGS: Packet (e-version) available from Harvard Business Publishing. To access the e-packet go to

https://cb.hbsp.harvard.edu/cbmp/access/25128192

You need to register on the HBP site to create a student account if you do not already have one.

Recommended:


COMPUTER SOFTWARE: EXCEL
GENERAL INFORMATION

1. TEXTBOOKS: There are two recommended (optional) textbooks for this class.
   a. Operations and Supply Chain Management (OSCM in this syllabus): This is a customized version with selected chapters from Operations & Supply Management; Chase, Aquilano and Jacobs; Thirteenth Edition; McGraw-Hill Irwin. Available in bookstore.
      This is a terse book that mostly covers the technical details of the concepts we will cover in class.

      The syllabus includes specific references to chapters in these textbooks (and companion DVD) that you should read before the corresponding class.

2. CASES DIGITALCOURSEPACK: Includes the following HBS cases that we will use in this class. Please go https://cb.hbsp.harvard.edu/cbmp/access/25128192 to order a copy of this e-packet.
   - National Cranberry Cooperative (including MS Excel spreadsheet supplement)
   - Benihana of Tokyo (including MS Excel spreadsheet supplement)
   - Kristen Cookies
   - Shouldice Hospital
   - Toyota Motor Manufacturing, USA Inc.
   - L.L. Bean, Inc.
   - Zara, Fast Fashion (HBS)

      Other cases and readings will be distributed in class, and some can be downloaded from the course website. I will also post slides (and selected lecture notes) on the course website prior to each class.

3. GRADING COMPONENTS
   - Individual Case Assignments 15%
   - Group Homework 10%
   - Class Participation 10%
   - Midterm Exam (2) 40%
   - Final Exam 25%

   Individual Case Assignments: There are eight case assignments to be done individually. Submissions should be up to two pages in length and be submitted at the beginning of the session in which they are due. Keep a copy for your reference during class. Show all the work if your response requires a calculation.

   Group Homework: There are two homework assignments to be done in groups of maximum four students. Assignments submitted by groups of five or more students will not be accepted for credit. In the same spirit, groups should not collaborate with each other for the purpose of doing the assignments. There is no restriction in the length of these homework submissions but precise and short answers are expected. Keep a copy for your reference during class.

Course Schedule, Assignments and Deliverables

<table>
<thead>
<tr>
<th>SESSION</th>
<th>DATE</th>
<th>TOPICS AND CASES</th>
</tr>
</thead>
</table>
| 1       | Monday, February 3, 14 | Introduction to Operations Strategies and Process Design  
CASE: Benihana of Tokyo  
Individual Assignment #1 |
| 2       | Monday, February 10, 14 | Process Flow Analysis & Capacity Management  
CASE: Kristen’s Cookie Company (A). |
| 3       | Monday, February 17, 14 | National Cranberry Cooperative & Midterm Review  
CASE: National Cranberry Cooperative  
GROUP HOMEWORK #1 & Individual Assignment #3 |
| 4       | Monday, March 3, 14 | Midterm I  
Individual Assignment #2 |
| 5       | Monday, March 10, 14 | Introduction to Simulation  
GROUP HOMEWORK #2 & Individual Assignment #5 |
| 6       | Monday, March 17, 14 | Benihana Simulation Debrief  
Project Management & Time-to-Market |
| 7       | Monday, March 24, 14 | Service Operations  
CASE: Shouldice  
Individual Assignment #5 |
| 8       | Monday, April 7, 14 | The Effects of Uncertainty–Waiting Lines & Queueing Theory  
CASE: First City National Bank |
| 9       | Monday, April 14, 14 | Quality as a Strategic Issue  
CASES: Toyota Motor Manufacturing  
Individual Assignment #6 |
| 10      | Monday, April 21, 14 | Six Sigma Principles & Midterm Review  
MIDTERM II |
| 11      | Monday, April 28, 14 | Introduction to Inventory management  
GROUP HOMEWORK #2 & Individual Assignment #8 |
| 12      | Monday, May 5, 14 | Inventory Under Uncertainty & Revenue Management  
CASES: LL Bean  
Individual Assignment #7 |
| 13      | Monday, May 12, 14 | Beer Game & Supply Chain Management  
CASE: Zara Fast Fashion  
GROUP HOMEWORK #2 & Individual Assignment #8 |
| Final Exam | Tuesday, May 20, 14 | Room KMC 3-70  
11:15am - 1:15pm |
Module I: Introduction to Operating Systems: Process Design and Analysis

Session 1 (Feb 03): Production Processes and Process Design

Readings
1. Case: Benihana of Tokyo (available in e-packet)
2. Chapters 1 and 2 in OSCM and chapters 1 and 2 in MBPF. (Optional)
3. Article “Implementing Restaurant Revenue Management” (available in course website)

Virtual Plant Tours
In the first part of this course, we will study different types of operating processes and discuss their suitability for producing various goods and services. Some of these processes and products are illustrated in about 50 virtual PLANT TOURS accessible from the website http://www.mhhe.com/omc/tours-frames.htm. This syllabus includes a number of references to videos available in the OSCM DVD.

The following tours can help you understand the different types of manufacturing processes:

- **Job shop**: Louisville Slugger Aluminum Bat Plant Tour (available in OSCM DVD)
  
  Yamaha (http://www.yamaha.co.jp/edu/english/index.html)

- **Assembly Line**: Volkswagen “Transparent” Factory
  
  (http://www.youtube.com/watch?v=nd5WGLWNIIA)


- **Continuous process**: Crude Oil Refinery (http://www.youtube.com/watch?v=XDK20wJUuKQ)

Questions
1. Identify the key elements of each company’s operating system. The operating system is the collection of all processes that a company uses to produce/deliver the goods and services that it offers.
2. What are the differences between the operating systems of the firms?
3. What is your assessment of the fit between each company’s business strategy and its operations strategy?

Case: Benihana of Tokyo, HBS case (available in e-packet)
Read, analyze, and be prepared to discuss the Benihana of Tokyo case. Use the following study questions as an aid in analyzing the case.

a. Describe Benihana as an operating system. (Draw a process flow diagram.) List the relevant inputs, process, and output elements in three columns.

b. How does the operating system support the Benihana concept? How this operating system impact Benihana’s “revenue per available seat hour (RevPASH)” (see article “Implementing Restaurant Revenue Management” for a definition and further discussion).

c. Which parameters of the operating system influence the throughput of a Benihana Restaurant?

d. How does the cost structure of a Benihana restaurant compare with that of a typical American restaurant? How does Benihana get its competitive advantage? (Excel spreadsheet with Exhibit 1 data available in e-packet)

**INDIVIDUAL ASSIGNMENT #1: (Due at the beginning of Session 1)**
Answer questions b) and d) and submit them at the beginning of class. Justify your answers.

Related Links
Benihana commercials: http://www.benihana.com/about/video
A history of Benihana: http://www.benihana.com/about/
Session 2 (Feb 10): Process Flow Analysis

Readings:
1. Case: Kristen’s Cookie Company (available in e-packet)
2. Chapter 5 in OSCM and chapters 3 and 4 in MBPF. (optional)

Topics:
- Flow Diagram, Capacity, Throughput Time, Cycle Time, Gantt Chart, Bottleneck
- Factors that Affect Throughput and the Bottleneck
  - Order Size, Resources (Labor, Supplies), Set-up Time
- Multi Product Analysis

Cases:
Kristen’s Cookie Company (A). Read, analyze, and be prepared to discuss the Kristen’s Cookie Company case, utilizing the six key questions at the end as guides. In addition try to answer the following questions

a) Draw a process flow diagram for the operating system in Kristen’s Cookie Co. Assuming that each order is a custom order for one dozen cookies. Compute the cycle time, throughput time, and capacity for each process in the system and for the entire operating system.

b) Identify ALL possible bottlenecks in the Kristen’s operation. Explain how would you reduce the negative effects of these bottlenecks in the production process?

Session 3 (Feb 24): Optimal Resource Allocation

Readings
1. Appendix A on OSCM on “Linear Programming”. (Optional)
2. Introduction to Linear Programming (available on course website)

Topics:
- Linear Programming, Models and Applications
- Sensitivity Analysis and Shadow Prices

INDIVIDUAL ASSIGNMENT #2: (Due at the beginning of Session 3)
See description at the end of this syllabus

Session 4 (Mar 03): National Cranberry Cooperative and Midterm Review

Topics:
- Discuss the NCC Homework #1 and solutions.
- Review class material in preparation for Midterm I.

INDIVIDUAL ASSIGNMENT #3: (Due at the beginning of Session 4)
See description at the end of this syllabus

Group Homework #1: National Cranberry Cooperative
Submit your Homework at the beginning of class, Monday March 03
See description at the end of this syllabus.
Session 5 (Mar 10):
First Half: **Midterm I**

This is an in-class, open book/notes test. It will include calculations and short answers and
responses. The material on the test is based primarily on class lectures and discussions. Calculators
allowed but please, NO computers or cellphones.

Second Half: *Introduction to Simulation*

**Readings:** Read chapter 19A in OSCM (optional).

**Topics:**
- Monte-Carlo simulation
- Designing a simulation experiment
- Spreadsheet simulation
- Evaluating results and statistical analysis

**Individual Assignment #4 (Due by Sunday Mar 23rd): Benihana Simulation**

1. Access simulation at the HBS website https://cb.hbsp.harvard.edu/cbmp/access/25128734
2. Complete Challenges 2 to 6 of the simulation
3. Prepare a report (max two pages in length) with a summary of your recommendations for Challenge #6.
   Explain your proposed operating policy and expected financial. You will need to submit this report at the
   beginning of Session 6 (Mar 24th).

Please note that access to simulation website will be suspended by the end of Sunday, Mar 23rd.

**Module II: Managing Operations for Competitive Advantage**

Session 6 (Mar 24): **Project Management**

**Reading**

1. Read Chapter 10 "Projects" in OSCM (optional).
2. **Caselets:** Project Management Exercises (available on course website): FCN Securities Demo (A), FCN
   Securities (B), FCN Securities (C), Allied Distributing, Specialty Contractors, and Aerospace Components.

**Topics:**
- Project Management: CPM & PERT
- Crashing the project

**Additional Links**
- Video "Project Management at Six Flags" (available in OSCM DVD)
- Video on Project Management in the Construction of the Alton Bridge over the Mississippi. (14
  mins)
  http://sterntv.stern.nyu.edu:8080/ramgen/faculty/Project-Management-The-Alton-Bridge.rm
Session 7 (Mar 31): *Service Operations*

**Readings:**
1. Case: Shouldice (available in e-packet)
2. Chapters 6 and 20 in OSCM (optional)
3. Framework for Analyzing Service Operations (available on course website)

**Topics:**
- Distinctive Aspects of Service Management: Intangibility, Perishability, Heterogeneity.
- Matching Supply and Demand

**Case:** Shouldice Hospital

a) Outline the main differences between the experiences faced by a patient at Shouldice, relative to that of a patient at a typical hospital. If possible, use a personal anecdote to demonstrate your observations. (1 paragraph)

b) List the most important insight you have gained from reading the Shouldice case that may be useful in the context of your own work environment. (1 paragraph)

**INDIVIDUAL ASSIGNMENT #5: (Due at the Beginning of Session)**
Answer questions a) and b) and submit them at the beginning of class. Justify your answers.

Session 8 (Apr 07): *The Effects of Variability – Waiting Lines & Queueing Theory*

**Readings**
1. Read "Queueing management and Models" (available on the course website)
2. Read chapter 7A: "Waiting Line Analysis" in OSCM and chapter 8 in MBPF (optional)
3. Read “Managing Real and Virtual Waits in Hospitality and Service Organizations” (available on course website)

**Topics:**
- Characteristics of a Waiting-Line System: Arrival, Waiting Line, Service Characteristics
- Measuring the Queue’s Performance and Queuing Costs
- Psychology of Queues

**Case:** Read, analyze, and be prepared to discuss First City National Bank case available on course website.

Session 9 (Apr 14): *Quality as a Strategic Issue & Process Improvement*

**Topics:** Quality – Its Definition and Basis for Competition: Quality Measurement and Improvement

**Cases:** TOYOTA MOTOR MANUFACTURING, USA INC. (available on e-packet)

**Questions**

a) What are the principal components of the Toyota Production System? What capabilities must an organization possess in order to implement TPS effectively?

b) How does ‘quality control’ work at Toyota Motor Manufacturing?

c) List the most important insight you have gained from reading the Toyota case that may be useful in the context of your own work environment. (1 paragraph)

d) Put yourself in the shoes of the plant manager; what steps would you take to address the seat problem? (1 paragraph)

**Related Links:** Business week article “Can Anything Stop Toyota?” available on course website.
INDIVIDUAL ASSIGNMENT #6: (Due at the Beginning of Session)
Answer questions c) and d) and submit them at the beginning of class. Justify your answers.

Session 10 (Apr 21): Statistical Quality Control & Midterm Review

Readings
1. Read Chapters 9 and 9A in OSCM and chapter 9 in MBPF (optional)

Topics
- Total Quality Management, Continuous improvement & Six Sigma, Control Charts

Module III: INVENTORY AND SUPPLY CHAIN MANAGEMENT

Session 11 (Apr 28):
First Half: MIDTERM II
This is an in-class, open book/notes test. It will include calculations and short answers and responses. The material on the test is based primarily on class lectures and discussions. Calculators allowed but please, NO computers or cellphones.

Second Half: Introduction to Inventory Concepts and Models

Reading
1. Chapters 15 and 17 in OSCM (optional)

Topics:
- Importance of Inventory
- Inventory Measures
- EOQ and Periodic Review Models

Session 12 (May 05): Inventory Management under Uncertainty

Readings:
1. Chapters 6 and 7 in MBPF. (optional)
2. Read "A Note on the Newsvendor Model: Inventory Planning for Short Lifecycle Items." (available on course website)
3. Note "Capacity-Based Revenue Management" (available on the course website)

Topics:
- Perishable Asset Revenue Management
- Demand segmentation and capacity rationing
- Applications in service operations (airlines, hospitality, retail, among others)

Case: L. L. BEAN, INC (Included in the e-packet)

Questions
1. What are the challenges facing LL Bean in meeting demand for their products?
2. 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?
3. What item costs and revenues are relevant to the decision of how many units of an item to stock?
4. How would you address the concerns of Rol Fessenden and Mark Fasold towards the end of the case?
5. How would you improve the forecasting and ordering process at LL Bean?

**INDIVIDUAL ASSIGNMENT #7: (Due at the Beginning of Session)**
What are the PROS and CONS of the demand forecast and inventory strategy used at L.L. Bean? Can you recommend a better system?

**Group Homework #2: TBA on Blackboard**
Submit your Homework at the beginning of class, Monday May 13th

**Session 13 (May 12): Inventory in Action and Supply Chain Management**
Topics:
- Beer Game and the Bullwhip Effect.
- Supply Chain Management strategies

**Readings**
1. Read Chapter 11 in OSCM and chapter 10 in MBPF (optional)
2. Read the article “The Bullwhip Effect in Supply Chains” (available on course website)
3. What Is the Right Supply Chain for Your Product? (available on course website)

**Case: “Zara: Fast Fashion” HBS case (Included in the e-packet)**

**Questions:**
1. What is Zara value proposition to customers? How is Zara’s Supply Chain helping this value proposition? (1 paragraph)
2. How is Zara managing the uncertainty in demand? (1 paragraph)
3. Under the Newsvendor paradigm, how would you compare the Overage and Underage costs of Zara and Gap?
4. In your opinion, what should Zara do to keep its competitive advantage?

**INDIVIDUAL ASSIGNMENT #8: (Due at the Beginning of Session)**
Answer questions (1) and (3) submit them at the beginning of class. Justify your answers.

**Final Exam: Tuesday, May 20th. 11:15am to 1:15pm. Room KMC 3-70**
This is an in-class, open book/notes test. It will include calculations and short answers and responses. The material on the test is based primarily on class lectures and discussions. Calculators allowed but please, NO computers or cellphones.
INDIVIDUAL ASSIGNMENT #2: (Due at the beginning of Session 3 – Feb 24)

The time it takes to play a round of golf is considered one of the major obstacles to the growth of the game. In this assignment, you are asked to analyze this problem from the perspective of process flow and capacity management. To fix some characteristics of the problem, let us consider the Van Cortland golf course in the Bronx (the oldest public golf course in the USA). The course has five Par-3 holes, ten Par-4 holes, and three Par-5 holes distributed as follows:

<table>
<thead>
<tr>
<th>Hole</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Par</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
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<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

The managers of the course are interested in estimating basic performance measures such as average flow time of the course, throughput and cycle time. Currently, the tee time (starting time) for the first group of players (four on each group) is scheduled at 7am and subsequent groups are scheduled every 9 minutes until 4:30 pm (last group tee time).

In an effort to determine the time it takes a group to play a hole, the managers have divided each hole into the following four steps: Tee, Walk, Fairway Shot and Green. As a result, the flow diagrams for each of the three types of holes are the following:

Par-3 Hole:

Tee (3 min) → Walk (3 min) → Green (4 min)

Par-4 Hole:

Tee (3 min) → Walk (3 min) → Fairway (3 min) → Walk (2 min) → Green (4 min)

Par-5 Hole:

Tee (3 min) → Walk (3 min) → Fairway (3 min) → Walk (2 min) → Fairway (3 min) → Walk (2 min) → Green (4 min)

The number (in parenthesis) on each step is the average time it takes a group to complete that step. For example, it takes 3 minutes for a group to tee off and 4 minutes to clear the Green. Holes are divided in Hitting Areas (or gates). A group cannot begin play in a particular gate until after the group ahead has cleared the hitting area. For example, in a Par-3 hole, a group cannot tee off until the previous group has cleared the Green. On a Par-4 hole, a group can start teeing off as soon as all players in the previous group have completed their Fairway shots (and are walking to the Green).

You can assume that there is ample space at the tee of each hole where groups can wait (buffers).

Based on this information, answer the following questions:

a) Which hole(s) is (are) the bottleneck of the Van Cortlandt course?

b) Given the current schedule of tee times, what is the average throughput (in groups per hour) and cycle time (in minutes per group) of the course?

c) Draw an inventory build-up chart that depicts the level and location where inventory (groups) build up in the course. What are the theoretical, average and maximum flow times to complete the course? At what time the last group finishes it round?

d) Suppose you can reorganize the location of the holes (i.e., change the sequence) and modify the scheduling of the tee times (keeping the first tee time still at 7am). What changes would you recommend to improve golfers experience, reduce the time it takes them to complete the
course and maximize the throughput? Assume that you would like the last group to finish by 9pm.

**INDIVIDUAL ASSIGNMENT #3: (Due at the beginning of Session 4 – March 03)**

*Product mix problem at Kristen’s Cookies:* Kristen has received suggestions for two new types of cookies.

<table>
<thead>
<tr>
<th>Suggestion 1</th>
<th>Suggestion 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choc. Chip cookies</td>
<td>Oatmeal Raisin cookies</td>
</tr>
<tr>
<td>Sale price</td>
<td>$ 5.00 per dozen</td>
</tr>
<tr>
<td>$ 5.00 per dozen</td>
<td>$ 5.50 per dozen</td>
</tr>
<tr>
<td>Cost of materials</td>
<td>$ 2.50 per dozen</td>
</tr>
<tr>
<td>$ 2.40 per dozen</td>
<td></td>
</tr>
</tbody>
</table>

Weekly demand for CC cookies is limited to 100 dz and for OR cookies to 50 dz. The processing times of the two types of cookies in different steps of production are as follows:

<table>
<thead>
<tr>
<th>Processing times for each step (1 tray = 1 dozen cookies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Chocolate Chip</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Oatmeal Raisin</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Kristen and her friend work each 20 hours each week (or 1200 minutes per week).

1. Formulate Kristen’s production problem as a linear program by identifying the decision variables, the objective function and the constraints. Write your answer in the format of a linear program discussed in class.
2. Solve this problem using the graphical procedure discussed in class. How many of each type should Kristen produce? What are you bottlenecks (explain)? What is the optimal profit (in $ per week)? If Kristen works exclusively on Step 1, what is her and her friend utilizations?
3. Solve Kristen’s problem using the Excel Solver and make sure to include both the Answer Report and the Sensitivity Report as part of your submission. What is the marginal value of increasing demand for CC cookies by one unit? What is the marginal value of increasing demand for Oatmeal cookies by one unit? What are the implications for promotions and marketing?
4. What is net effect (in $ per week) of getting an additional oven?
Group Homework #1: National Cranberry Cooperative
Submit your Homework at the beginning of class, Monday March 03

1. Draw a process flow diagram for the process fruit operation of RP #1. Based on the data in Exhibit 1, what is the arrival rate (in barrels per hour) for wet and dry berries during the day? What are the implications for the operations of the plant?

2. Identify the problems at NCC. How severe are these problems?. Answer the following questions:
   a. Identify any possible bottleneck(s) in the process.
   b. Should the fifth dumper have been purchased? Justify your answer.
   c. NCC is considering selling two dumpers to create more space for trucks waiting to unload. In addition, NCC is considering reserving one dumper for trucks bringing dry berries and the two remaining dumpers for trucks bringing wet berries. Evaluate these alternatives.

3. Consider a day when 18,000 barrels arrive, of which 70% are wet. Assume that trucks arrive evenly spaced for 12 hours starting at 7:00 am. Develop and evaluate alternative solutions to the problems in point 5. Conduct detailed numerical analyses including:
   a. Production capacity
   b. Inventory build-up chart of wet berries only.
   c. Overtime needed to process all berries.
   d. Truck average waiting and cumulative cost (note that it costs $100 per hour to keep a truck waiting).

   Based on this analysis, what are you final recommendations?

4. Comment on how your recommendations are affected by daily supply variability (Exhibit 2).

Note that the digital e-packet includes an Excel spreadsheet with the data in Exhibits 1 and 2.