

COURSE OUTLINE: WINTER 2009 - SECTION 61

Session	Date	Module and Description	Required Readings	Written Assignments
1	1/5	Module 1: Operations Strategy Introduction to Operations	<i>The Goal: Start</i> <i>MBPF, Chapter 1</i>	
2	1/8	Aligning Strategy and Operations. Focus	<i>MBPF, Chapter 2</i> Case: <i>Shouldice Hospital Limited</i> Case: <i>Wriston Manufacturing</i>	<i>Wriston Manufacturing</i>
3	1/12	Product-Process Matrix Module 2: Process Analysis & Applications Process Measures and Little's Law	<i>MBPF, Chapter 3</i>	
4	1/15	Process Flow Analysis. Targeting Improvement	<i>MBPF, Chapter 4</i> Case: <i>CRU Computer Rental</i>	<i>CRU Computer Rental</i>
5 Special Time!	WED 1/21	Flow Time & Capacity Analysis	<i>MBPF, Chapter 5</i> Case: <i>Pizza Pazza</i> <i>The Goal: up to p. 161</i>	
6	1/22	Flow Time & Capacity Analysis: Peak Loads	Case: <i>National Cranberry Cooperative</i>	<i>National Cranberry Cooperative</i>
7	1/26	Module 3: Lean Operations House Building Game		
8	1/29	Paradigm of Lean Operations	<i>MBPF, Chapter 10: Sections 10.1–10.4</i> Excel exercise: <i>The Dice Game</i>	
9	2/2	Lean Operations for Product Variety	Case: <i>Toyota Motor Manufacturing</i>	
Optional Review	WED 2/4; 2- 3:30pm	Optional Midterm Review, room TBA	Review Sessions 1–9	
10	2/5	Midterm Exam: in class, closed book	Review Sessions 1–9	

Session	Date	Module and Description	Required Readings	Written Assignments
11	2/9	Module 4: Supply Chain Management Inventory Basics. Economies of Scale	<i>MBPF, Chapter 6</i> Case: <i>Palii Gear</i> <i>The Goal: Finish (up to p. 246)</i>	
12	2/12	Uncertainty, Safety Inventory & Pooling	<i>MBPF, Chapter 7 (skip Section 7.3)</i>	
13	2/16	Pooling: Centralization & Postponement	<i>MBPF, Chapter 7: review 7.5–7.7</i> Case: <i>Shape Up, Ship Out (IBM)</i>	
14	2/19	Optimal Service Level	<i>MBPF, Chapter 7: Section 7.3</i>	Inventory Problem Set
15	2/23	Module 5: Service Operations Management Capacity, Queuing & Flow Time Analysis	<i>MBPF, Chapter 8</i>	
16	2/26	Application to Call Centers	Case: <i>BAT case</i>	<i>BAT case</i>
17	3/2	Module 6: Quality Management Quality and Voice of the Customer	<i>MBPF, Chapter 9: Sections 9.1–9.2</i> <i>Why Improving Quality...</i> (on Blackboard)	
18	3/5	Process Capability & Statistical Process Control	<i>MBPF, Chapter 9: Finish</i> Case: <i>Quality Wireless (A), (B)</i>	<i>The Goal</i>
19	3/9	The Value of 6-Sigma	Case: <i>6-Sigma Quality at Flyrock Tires</i>	
Optional Review	WED 3/11; 2-3:30pm	Optional Review, room TBA	<i>Review Chapters 8–9, plus all materials</i>	
20	3/12	Wrap Up and Review		
Final Exam	Either early option Or during exam wk	Final Exam: in class, open book	<i>Review all materials</i>	

OPERATIONS MANAGEMENT 430

WINTER 2009 - SECTION 61

Instructor: Jan Van Mieghem; VanMieghem@northwestern.edu
Phone: 847.491.5481. Fax: 847.467.1220
Office: Jacobs 565 (MEDS Department; 5th floor).

Office Hours: Wednesdays: 2pm-3:30pm

Course Page: <http://www.kellogg.northwestern.edu/course/opns430/vanmieghem/>

Course Description and Objectives

This course provides a general introduction to operations management. Operations management is the management of business processes, that is, the recurring activities of a firm. Along with finance and marketing, operations is one of the three primary functions of a firm. At the risk of being simplistic, one may say that marketing generates the demand for products and services, finance provides the capital, and operations produces the product. More generally, operations spans the entire organization: COOs are in charge of R&D, design/engineering, production operations, marketing, sales, support and service.

This course aims to (1) familiarize you with the major operational problems and issues that confront managers, and (2) provide you with language, concepts, insights and tools to deal with these issues in order to gain competitive advantage through operations.

This course should be of particular interest to people aspiring a career in designing and managing business processes, either directly (V.P. of Ops, COO) or indirectly (e.g., management consulting). The course should also be of interest to people who manage interfaces between operations and other business functions such as finance, marketing, managerial accounting and human resources. Finally, a working knowledge of operations, which typically employs the greatest number of employees and requires the largest investment in assets, is indispensable for general managers and entrepreneurs.

We will see how different business strategies require different business processes, and vice versa, how different operational capabilities allow and support different strategies to gain competitive advantage. A process view of operations will be used to analyze different key

operational dimensions such as capacity management, flow time management, supply chain management, and quality management. We will also discuss developments such as lean operations, just-in-time operations, and time-based competition.

Required Texts

Required materials available at the bookstore:

1. Course pack Part I: cases and readings (common across all instructors).
2. Course pack Part II: overhead slides (separate for each instructor).
3. *The Goal* by Goldratt and Cox. North River Press, 3rd edition, 2004, ISBN: 0884271781.
4. *Managing Business Process Flows: Principles of Operations Management (MBPF)* by Anupindi, Chopra, Deshmukh, Van Mieghem and Zemel. Prentice Hall, 2nd edition, 2005. ISBN: 0131676865

As a novel, *The Goal* is light reading and some sections are quite entertaining. Nevertheless, it has 337 pages, so you are encouraged to start reading now. We will draw on it during the entire course. You will be asked to hand-in your main take-away's near the end of the course.

Grading

The grade you receive for the course is intended to certify your demonstrated proficiency in the course material. Proficiency will be estimated by measuring your performance on (1) class contribution, (2) homeworks and (3) exams. The midterm exam will be in class, closed book, and will be held during regular class session 10. The final will be a three-hour, in-class exam with open readings, open class handouts and notes. It will be comprehensive, covering material from all course modules.

Your course grade will be based on a weighted evaluation of the following categories:

1. Class contribution	10%
2. Case write-ups	20%
3. Midterm examination	30%
4. Comprehensive final examination	40%

Assignments

The course assignments are designed to engage you in the issues, to teach you ways to think about and analyze operational problems, and to prepare you to be effective managers. The

enclosed course outline and detailed schedule provides you, class by class, with a brief description of the class, the readings and case preparation questions (if any).

As part of your class preparation, please consider how you would answer each of the discussion questions. The readings and assignments should require an average of about three to four hours of preparation per class meeting. If you find yourself *averaging* more preparation time per session, please let me know. (Typically, students find the class load high in the first three weeks. As you become more comfortable with the material, this subjective assessment will change for the better.)

Case Write-Ups and Group Work

Each case write-up should address the question in italics that goes with the case assignment. In preparing your write-up, please adhere to the following guidelines:

- ⇒ Be concise and well-structured: Start with summarizing your recommendations followed by a clear discussion of how these are backed up by your analysis. **Maximal 2 pages of text (11pt, 1 ½ lines spaced), not including exhibits.** (Note that 2 pages is a *limit*, not a *quota*.)
- ⇒ Be to the point: Know that you write to someone who knows the facts of the case; focus on your explaining, and making a clear case for, your recommendations.
- ⇒ Be punctual: Late submissions will not be accepted.

All case write-ups should be done in assigned groups. Group assignments will be available by the first class. The honor code stipulates that *you cannot use case solutions from other people or other sources*, and that you may put your name on the submission only if you contributed materially to the group discussion. Toward the end of the term, you will be asked to fill out an assessment of teammates' contributions to group assignments. These assessments will play a role in determining final grades.

For most cases, 3 to 4 hours of team-time (after personal prep) should be sufficient. Some cases (e.g., Cranberry and SofOptics) are detailed and more open-ended. You should use your team's judgment to figure out how to tackle those cases. The entire goal behind the team approach to case preps is to have you think and experiment, and to sensitize you to those issues that are novel and should be further discussed in class.

Class Contribution

I prefer voluntary in-class contribution. The GMA suggests that "supportive" cold calling encourages you to be better prepared for class and as a result improves the overall class discussion. Therefore, I also will call on students to encourage broader participation.

Use of the Web

Blackboard will be used to facilitate course progression—it contains information on:

- ❑ MBPF textbook exercises and solutions.
- ❑ Sample midterm and final exam questions & solutions.
- ❑ Software downloads for cases.
- ❑ Discussion group.
- ❑ Announcements.

Additional readings and related operations information can be found on the course web site www.kellogg.northwestern.edu/course/opns430/vanmieghem/.

Student Liaison

On the first day of class, I will be asking for a volunteer to be the class liaison. The responsibilities of the liaison include:

- Being a sounding board for the faculty member on student related issues
- Communicating any scheduling conflicts regarding assignments, classes, or exams to professors
- Organizing dates for lunches with professors and students
- Collecting TCE's and turning them in to Student Affairs during the last class

Responsibilities will be very similar to Academic Rep responsibilities in 1st quarter core classes. Time commitment should be no more than an aggregate of 2 hours of the term.

Suggested Readings

None of these readings are a requirement for the course. Nonetheless, you may find them interesting. The books are non-technical in nature.

1. *The Machine that Changed the World: The Story of Lean Production* by James P. Womack, Daniel T. Jones and Daniel Roos, Harper Perennial, 1991.
2. *The Discipline of Market Leaders* by Treacy and Wiersema, Addison Wesley, 1997.
3. *Plant and Service Tours in Operations Management* by Roger W. Schmenner, Fifth edition, Prentice Hall, 1997.

Module 1: Operations Strategy

Class 1: Introduction to Operations

Objective: Characterize “operations management” and its link to business strategy to gain competitive advantage.

Required Reading: *MBPF, Chapter 1.*

The Goal: start reading (there will be an assignment in Class 18.)

Preparation Questions:

1. In a business context, what is meant by operations?
2. What are the competitive priorities of a typical (service or manufacturing) business?
3. What role does operations management play in achieving these?

Class 2: Aligning Strategy and Operations. Focus

Objective: Illustrate how to do a strategic operational audit to align strategy and operations. Discuss the notion of focused operations, its advantages and challenges.

Required Reading: *MBPF, Chapter 2.*

Case: *Shouldice Hospital.* Be prepared to discuss the following questions:

1. Apply the process view to Shouldice Hospital: what are the key process features?
2. What are Shouldice’s competitive priorities? What kind of market have they chosen to focus on? How does their operations strategy support their business strategy?

Written Assignment: *Wriston Corporation: The Detroit Plant.*

Write-up should address the italicized question:

1. Why do overhead costs (Exhibit 2) vary so greatly from plant to plant in Wriston’s manufacturing network?
2. Why have managers in the Heavy Equipment Division under-invested in the Detroit Plant?
3. *What should Richard Sullivan do with the Detroit Plant? Justify your recommendation.*

Module 2: Process Analysis and Applications

Class 3: Product-Process Matrix (Module 1). Process Measures and Little's Law

Objective: Discuss process types, their characteristics and the product-process matrix (this wraps up Module 1).
Introduce the fundamental process measures throughput, inventory and flow time, and Little's Law, the key relationship among the three.

Required Reading: *MBPF, Chapter 3.*

Class 4: Process Flow Analysis. Targeting Improvement

Objective: Discuss where to target improvement using process flow charts and fundamental process performance measures such as flow time, inventory and throughput.

Required Reading: *MBPF, Chapter 4.*

Written Assignment: CRU Computer Rentals. We will discuss the questions listed at the end of the case in class. Address the following questions in your write-up:

1. *What is the process at CRU? Make a flow chart clearly identifying activities, routes and any other data given in the case. **Submit a 1-page Powerpoint file to Blackboard that contains your process flow chart--time-permitting, we may discuss some flow charts in class.***
2. *What do you think about the decision to launch a sales drive this year?*
3. *What actions would you suggest Richard focus on to improve performance at CRU? Make concrete recommendations and indicate anticipated benefits.*
4. *What are the key performance measures Richard should focus on?*

Note: your qualitative discussion should be backed by quantitative analysis.

Class 5: Flow Time & Capacity Analysis

Objective: Discuss the drivers of flow time and capacity.

Required Reading: *MBPF, Chapter 5.*

The Goal: at least up to p. 161.

Case: *Pizza Pazza.* Prepare questions attached to case. There is no assignment due.

Class 6: Flow Time & Capacity Analysis: Peak Loads

Objective: Reinforce and extend the concepts discussed in Classes 3-5 to settings with temporary excess demand and show how to apply them to guide capacity investment decisions.

Written Assignment: *National Cranberry Cooperative*. This is a challenging case, please allocate sufficient amount of time (which will be made up for next week). Consider the following questions for discussion. Write-up should address the italicized question:

1. Draw a detailed process flow map of the current process at Receiving Plant #1. What is the capacity of each process step?
2. What is the maximum long-term achievable throughput rate of Receiving Plant #1? What factors affect this throughput rate?
3. Currently what is (are) the major reason(s) for trucks waiting and excessive overtime?
4. On average, how long will the trucks have to wait on a **busy** day? Assume a 7am start of processing of berries and a continuous arrival rate of berries of 1,500bbls/hr.
5. What benefits would you expect if processing time was moved up from 11:00 a.m. to 7:00 a.m. during the peak period? Should this be done for the entire season?
6. *What are your recommendations to NCC on how to deal with their problems? Assume that drivers are paid \$5 per hour and that an average busy day has a continuous arrival rate of berries of 1,500bbs/hr. (You may assume 100% bulking on busy days.)*

You may use the Excel workbook NCC.xlsx (available on the course page) to analyze this case, although the analysis can be done without it.

Recommended problems: 4.1, 4.2, 4.4, 4.6 (flow time); 5.1, 5.2, 5.4 (capacity).

Module 3: Lean Operations

Class 7: House Building Game

Objective: Explore the relationship between process structure and performance (cost, quality and time) through a team-based simulation game.

Class 8: Paradigm of Lean Operations

Objective: Introduce, drawing on your house game experience, the paradigm of lean operations with its focus on attaining an ideal process through waste reduction.

Required Reading: *MBPF, Chapter 10: Sections 10.1 – 10.4.*

Interactive exercise: The *Dice Game* from *The Goal*, available in two versions. Point your browser (*Internet Explorer*) to:

www.kellogg.northwestern.edu/faculty/chopra/ftp/omd30/leanoperations/dicegame/pageone.htm

Class 9: Lean Operations for Product Variety and Continuous Improvement

Objective: Study the major components of the Toyota Production System, including its process of continuous improvement, and critically assess the costs and benefits. Discuss its application to an environment with product variety.

Required Reading: *Toyota Motor Manufacturing USA*. Prepare the following questions for discussion:

- Identify if, and if so where, Toyota carries inventory and excess capacity.
- How exactly does Toyota respond to a cord pull? *a) What is the cost of an average chord pull resulting in a stoppage of 1 minute, 30 minutes, or 60 minutes? b) Based on your financial estimate, what is your qualitative assessment of the practice of letting employees stop the line? c) Now, focusing on seats only: Do you think the line should be stopped when the station identifies a defective seat?*
- What is the value of a cord pull? What actions does Toyota take to lower the cost of a line stoppage?

Optional Reading: “The Lean Service Machine,” Cynthia Karen Swank, *HBR* 2003. Read from Blackboard course site with Northwestern Library permission.

Class 10: Midterm Exam

The midterm exam will be **in class, closed book** during our regular class session.

You may use your laptop as a calculator. Recommended preparation:

1. Sample midterm exam (see course page).
2. MBPF examples and exercises, especially the recommended & review problems.

Module 4: Supply Chain Management

Class 11: Inventory Basics. Economies of Scale & Cycle Inventory

Objective: Introduce the roles of inventory for business. Discuss how to manage cycle inventories to exploit economies of scale.

Required Reading: *MBPF, Chapter 6.*

The Goal: finish (you can stop at page 246.)

Case: *Palii Gear*. Questions 1.a & 1.b. There is no assignment due.

Recommended problems: 6.2, 6.4, 6.5, 6.10.

Class 12: Uncertainty, Safety Inventory & Pooling

Objective: Discuss forecasting characteristics and how to manage safety inventory to protect against uncertainty in demand and/or supply lead times. Discuss the concept of inventory “pooling” and its role in supply chain design.

Required Reading: *MBPF, Chapter 7 (skip Section 7.3)*

Case: *Palii Gear*. Questions 1.c & 1.d. There is no assignment due.

Recommended problems: 7.1, 7.2.

Class 13: Pooling: Centralization & Postponement

Objective: Discuss different pooling methods, particularly centralization and postponement, their pros and cons, and implications for supply chain design.

Required Reading: *MBPF, Chapter 7: review Sections 7.5-7.7*

Recommended problems: 7.3, 7.8, 7.9.

Reading: *Shape Up, Ship Out* (IBM). There is no assignment due. Consider italicized questions:

- a. Identify the key value drivers behind the various supply chain strategies that IBM considered. That is, why and when is a particular supply chain design to be preferred?
- b. In which other industries could (or are) these ideas be used?

Class 14: Optimal Service Level.

Objective: Discuss the “newsvendor” model, a simple but important methodology for determining the optimal order quantity and level of product availability, in the context of short-life cycle products, e.g., fashion goods, whose value quickly decay over time.

Required Reading: *MBPF, Chapter 7: Section 7.3*

Case: *Paliu Gear*. Question 2. There is no assignment due.

Recommended problems: 7.4, 7.5.

Written Assignment: Inventory Problem Set Questions 1 & 2 (as always: to be done in team).

Module 5: Service Operations Management

Class 15: Capacity, Queuing & Flow Time Analysis

Objective: Introduce congestions and queuing phenomena and discuss managerial actions that mitigate queuing’s negative impact on operational performance.

Required Reading: *MBPF: Chapter 8*.

Excel spreadsheet available under “Capacity Management in Services”. Point your web browser (*Internet Explorer*) to:

<http://www.kellogg.northwestern.edu/faculty/VanMieghem/ftp/430/queue-performance.xls>

Recommended problems: 8.1, 8.4, 8.5, 8.8.

Class 16: Applications: Financial Evaluation of a Call Center

Objective: Show how queuing theory can be used as a tool for managing service operations facing time-sensitive customers.

Written Assignment: The BAT Case. Submit a write-up focusing on question 7 below.

- 1) Given the current arrival rate, what would it take to offer a one minute average wait for all customers? What is the utilization of the system? How would these values change if the arrival rate increased or decreased by 50%?
- 2) Suppose Grayson implements Fast Track by keeping *BOP!* Team 1 together as one team and giving priority to Fast Track calls. Given the team's current staffing of eight technicians, what fraction of customers can be Fast Track with an average wait of less than one minute? How many more technicians are needed as the number of Fast Track callers increases?
- 3) What is the impact of Fast Track on standard calls? Holding the staffing level constant, how does the difference in the waiting time of standard and Fast Track calls change as the arrival rate falls to 20 calls per hour or rises to 25 calls per hour?
- 4) If additional technicians are needed, is Fast Track economically viable? Does it remain viable if BAT provides free service to all Fast Track callers who have a wait over one minute?
- 5) How should BAT implement Fast Track? Should *BOP!* Team 1 be kept as one team or should it be split into separate subteams, dedicated to either Fast Track or standard calls? (Assume that the standard call subteam has to be big enough to keep the average wait below current levels.)
- 6) Should Fast Track be sold as a pay per use service or as a service contract?
- 7) What is your evaluation of the Fast Track proposal? Should BAT implement it?

You may want to use the Excel workbook *Queue.xls* to analyze this case. It is available from the class web site.

Module 6: Quality Management

Class 17: Quality and Voice of the Customer

Objective: Discuss the different connotations of “quality”. The first step in strategic quality management is to map “the voice of the customer” into design and operational specifications.

Required Reading: *MBPF, Chapter 9: Sections 9.1 - 9.2.*

Why Improving Quality Doesn't Improve Quality. Read from Blackboard course site with Northwestern Library permission.

Class 18: Process Capability & Statistical Process Control

Objective: The second step in strategic quality management is to determine the current process capability and plans for improvement. Once the plans are implemented, a manager needs to “check” that improvement has actually taken place. Finally, a manager needs mechanisms to verify that the process continues to provide improved performance. In this context we introduce statistical process control.

Required Reading: *MBPF, Chapter 9: Finish.*

Case: *Quality Wireless (A) and (B).* Prepare the questions attached to case. There is no assignment due.

Suggestion: Experiment with *Greasesx Inc* workbook. Using *Internet Explorer*, go to:
www.kellogg.northwestern.edu/faculty/chopra/ftp/omd30/quality/greasesx/frameset1.htm

Written Assignment: *The Goal.* Summarize your main take-away’s (“what is worthwhile remembering 5 years from now?”) and critically assess their value and usefulness.
Note: This is a group effort, just like all assignments.

Class 19: The Value of 6-Sigma

Objective: Discuss the benefits from continuous process improvement.

Case: *6-Sigma Quality at Flyrock Tires.* Prepare the questions attached to case. There is no assignment due. Use *Internet Explorer* to step through the web version of the case:
www.kellogg.northwestern.edu/faculty/chopra/ftp/omd30/quality/flyrock/story0.htm

Recommended problems: 9.1, 9.2, 9.7, 9.9.

Class 20: Wrap Up and Review

No readings.

DURING EXAM WEEK—on the day announced by the registrar:

Final Exam: The final exam will be **in class, open book** over 3 hours. You may use a PC and any spreadsheets used in the course.

Recommended preparation:

1. Sample final exam (see web page)
2. MBPF examples and exercises, especially the recommended & review problems.