

COURSE OUTLINE: WINTER 2015 - SECTION 61

PROFESSOR GURVICH

| Session | Date | Module and Description | Required Readings* | Written Assignments |
|-----------------|---------------|---|--|---|
| 1 | Jan 6 | Module 1: Operations Strategy Introduction to Operations | <i>The Goal: Start</i> <i>MBPF, Chapter 1</i> | |
| 2 | Jan 9 | Aligning Strategy and Operations. Focus | <i>MBPF, Chapter 2</i> <i>Article: Chronodrive</i> <i>Case: Wriston Manufacturing (via ForClass)</i> | |
| 3 | Jan 13 | Product-Process Matrix Module 2: Process Analysis & Applications Process Measures and Little's Law | <i>MBPF, Chapter 3</i> | |
| 4 | Jan 16 | Process Flow Analysis. Targeting Improvement | <i>MBPF, Chapter 4</i> <i>Case: Portland Computer Systems</i> | <i>Portland Computer Systems (via ForClass)</i> |
| 5 | Jan 20 | Flow Time & Capacity Analysis | <i>MBPF, Chapter 5</i> <i>Case: Pizza Pazza (via ForClass)</i> <i>The Goal: up to p. 161</i> | Little's Law quiz |
| <i>Review 1</i> | <i>Jan 21</i> | <i>Optional Review, Check web for time and room</i> | <i>Review Chapters 3–5</i> | |
| 6 | Jan 23 | Flow Time & Capacity Analysis: Peak Loads | <i>Case: National Cranberry Cooperative</i> | <i>National Cranberry Cooperative</i> |
| 7 | Jan 27 | Module 3: Lean Operations House Building Game | | Capacity and Flow Time quiz |
| 8 | Jan 30 | Paradigm of Lean Operations | <i>MBPF, Chapter 10: Sections 10.1–10.4</i> <i>Excel exercise: The Dice Game</i> | |
| 9 | Feb 3 | Variability and Quality at the Source | <i>Case: Toyota Motor Manufacturing</i> | |
| <i>Review 2</i> | <i>Feb 4</i> | <i>Optional Review, Check web for time and room</i> | <i>Review Sessions 1–9</i> | |
| 10 | Feb 6 | Midterm Exam: in-class, closed-book | | |

* There are optional readings not listed here. See detailed syllabus and Canvas.

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| Session | Date | Module and Description | Required Readings* | Written Assignments |
|-----------------|---------------|--|--|--|
| 11 | Feb 10 | Module 4: Quality Introduction, Voice of the Customer, Voice of the Process (Capability and Control) | <i>The Goal: Finish (up to p. 246)</i> <i>MBPF, Chapter 9</i> Case: <i>Quality Wireless (A), (B)</i> | |
| 12 | Feb 13 | The Value of 6-Sigma | <i>6-Sigma Quality at Flyrock Tires</i> | <i>Quality quiz</i> |
| 13 | Feb 17 | Module 5: Capacity Management in Services Introduction, Theory of Queues Evaluation of service systems | <i>MBPF, Chapter 8</i> | <i>Queuing quiz</i> |
| 14 | Feb 20 | Design of service systems (Economies of Scale and Priorities) | <i>MBPF, Chapter 8</i> Case: <i>The BAT Case</i> | <i>The BAT Case (via ForClass)</i> |
| 15 | Feb 24 | Design of service systems: flexibility and pooling | | |
| <i>Review 3</i> | <i>Feb 25</i> | <i>Optional Review, Check web for time and room</i> | <i>Review Chapters 8-9</i> | |
| 16 | Feb 27 | Module 6: Supply Chain Management Introduction Optimal Service Level | <i>MBPF, Chapter 7: Section 7.3</i> Case: <i>Palü Gear</i> | |
| 17 | Mar 3 | Economies of Scale, Cycle Stock | <i>MBPF, Chapter 6</i> | |
| 18 | Mar 6 | Uncertainty, Safety Stock | <i>MBPF, Chapter 7: Section 7.1, 7.2, 7.4.1 (skip Section 7.3 and 7.4.2)</i> Case: <i>Palü Gear</i> | |
| 19 | Mar 10 | Pooling: Centralization & Postponement | <i>MBPF, Chapter 7: Section 7.5–7.7</i> Case: <i>Palü Gear</i> <i>Netflix</i> | |
| <i>Review 4</i> | <i>Mar 11</i> | <i>Optional Review, Check web for time and room</i> | <i>Review Chapters 6-7</i> | <i>Inventory quiz</i> |
| 20 | Mar 13 | Wrap Up and Review | | |
| <i>Exam</i> | | Final Exam: in-class, open-book, cumulative. | | |

OPERATIONS MANAGEMENT 430

WINTER 2015

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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: cases (common across all instructors).
2. *The Goal* by Goldratt and Cox. North River Press, 3rd edition, 2004, ISBN: 0884271781.
3. *Managing Business Process Flows: Principles of Operations Management (MBPF)* by Anupindi, Chopra, Deshmukh, Van Mieghem and Zemel. Prentice Hall, 3rd edition, 2011. ISBN: 0136036376

All cases listed in the class-by-class reading list below are found in the Course Pack. Readings listed as “optional” can be found in the Course Materials section of the class Canvas site.

As a novel, *The Goal* is light reading and some sections are quite entertaining. Nevertheless, it is well over 300 pages long, so you are encouraged to start reading now. We will draw on it during the entire course and there may be questions on the based on the book on the exams.

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) individual quizzes, (3) written team assignments and (4) 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 | 15% |
| 3. Individual quizzes | 10% |
| 4. Midterm examination | 25% |
| 5. Comprehensive final examination | 40% |

Preparing for Class

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

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: Recommendations should be summarized on the first page and be complemented by a crystal clear discussion of how these follow from your analysis.
- ⇒ Your write up should not exceed 2 pages of text (11pt, 1 ½ lines spaced), not including exhibits. (Remember: 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 are to be done in assigned groups. Group assignments will be available by the end of the first week of the term. For most cases, 3 to 4 hours of team-time (after personal prep) should be sufficient. Some cases are detailed and more open-ended. You should use your team's judgment to figure out how to tackle those cases. The goal of the team approach to case prep is to have you think and experiment while sensitizing you to those issues that are novel and that will be further discussed in class.

The Kellogg Honor Code stipulates that you may put your name on the submission only if you contributed 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.

The Kellogg Honor Code also stipulates that you may not use any outside materials in preparing the case write ups. This includes (but is not limited to) handouts from past terms and materials found on the Internet.

Class Contribution

In-class contribution will consist mainly of voluntary contributions, although I may call upon students to encourage broader participation. (Although cold calling may increase anxiety, the GMA suggests that “supportive” cold calling encourages you to be better prepared for class and as a result improves the overall class discussion.)

Classroom Etiquette

The Kellogg Code of Classroom Etiquette can be found at

http://www.kellogg.northwestern.edu/stu_aff/policies/etiquette.htm.

This etiquette policy was developed by students to foster an atmosphere that is conducive to collective learning in the classroom. While attendance for any given class session is not compulsory (though encouraged), students’ compliance with the Kellogg classroom etiquette policy will be strictly enforced.

In particular, you may not:

1. Engage in any:
 - a. Cross-talking,
 - b. Late-coming,
 - c. Leaving the class for a coffee or snack break, picking up mail, etc.,
 - d. Use of a cell or smart phone in class, or
 - e. Other similar activities that have the potential of distracting other students and disrupting the progress of the class.
2. Use a computer (e.g., a laptop or a tablet) in class unless given permission.
3. Indulge in any other behavior that may be deemed by other students or the instructor to be inappropriate or inconsistent with Kellogg Code of Classroom Etiquette.

Use of the Web

Canvas will be used to facilitate course communication through announcements. Also, on the class Canvas site you will find:

- Lecture slides
- MBPF textbook exercises and solutions.
- Sample midterm and final exam questions & solutions.
- Software downloads for cases.
- Additional readings obtained through the Northwestern Library with permissions for Kellogg students and faculty.

You are also encouraged to check out Kellogg's operations management blog, *The Operations Room*:



<http://operationsroom.wordpress.com/>

Suggested Readings

None of these readings are a requirement for the course. Nonetheless, you may find them interesting.

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. *Chasing The Rabbit: How Market Leaders Outdistance the Competition and How Great Companies Can Catch Up and Win*, by Steven Spear, McGraw-Hill, 2008.
3. *Call Center Management on Fast Forward: Succeeding in Today's Dynamic Customer Contact Environment* by Brad Cleveland, ICMI Press, 2006.
4. *Matching Supply with Demand: An Introduction to Operations Management* by Gerard Cachon and Christian Terwiesch, McGraw-Hill/Irwin; 2 edition 2008.
5. *Supply Chain Management* (5th ed) by S.C. Chopra and P. Meindl, Prentice Hall, 2012.
6. *Operations Strategy: Principles and Practice* by J.A. Van Mieghem, Dynamic Ideas, 2008.
7. *Uncommon Service: How to Win by Putting Customers at the Core of Your Business*, Frances Frei and Anne Morriss, Harvard Business Review Press, 2012.

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.

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 the importance of aligning strategy and operations. Discuss the notion of focused operations, its advantages and challenges.

Required Reading: *MBPF, Chapter 2.*

Required Reading: Be prepared to discuss the following article about Chronodrive.

In France, a Drive-Up Grocery Takes Off, C. Passariello, Wall Street Journal, Jan. 14, 2010.

Case: *Wriston Corporation: The Detroit Plant.*

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. Perform a rough NPV analysis of the three options given on the first page of the case using the data in Exhibit 7. What option is most attractive from a financial perspective?
4. What option would you recommend using the strategic framework introduced in class 1?

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: *Portland Computer Systems.*

Your write up should address questions 1, 5, 6 & 7:

1. What is the process at PCS? Make a flow chart clearly identifying activities, buffers, routes and any other relevant data.
2. How much total inventory is there on average at the IFC? How long does equipment spend on average classified as different Category Labels?
3. Consider a piece of equipment just coming off lease. On average, how long does it take until that equipment is rented out again?
4. What does it cost PCS to have a piece of equipment sitting idle for a week in the IFC?
5. What is your evaluation of how Brownstein and Corin responded to the drop in sales?
6. What process changes would you suggest to Brownstein? Make concrete recommendations and quantify anticipated benefits.
7. Which key performance indicators would you recommend PCS managers track? Justify your recommendations.

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

Note: In addition to submitting the response to the questions mentioned above, you should upload your flow chart through SimClass.

Recommended problems: 3.4, 3.8, 3.9

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 written 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). In doing the analysis, you may make the following assumptions:

- a) An average busy day has a continuous arrival rate of berries of 1,500bbs/hr.
- b) There are 20 busy days in the average growing season.
- c) Assume there is sufficient capacity in Bagging and Bulking.
- d) The case description of how many workers are needed when the plant runs over time is vague. Assume that there are 20 workers and that they are evenly split between full time and seasonal employees.

Consider the following questions. The write-up should address Question 6:

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.
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. **(For write up)** What are your recommendations to NCC on how to deal with their problems?

You may use the Excel workbook NCC.xls (available through Canvas) to analyze this case, although the analysis can be done without it.

Recommended problems: 4.1, 4.3, 4.5 (flow time); 5.1, 5.2, 5.3 (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.*

Optional Listening: NUMMI, This American Life, March 26, 2010. Available here:

<http://www.thisamericanlife.org/radio-archives/episode/403/nummi>

Class 9: Variability and Quality at the Source

Objective: Study the major components of the Toyota Production System and critically assess the costs and benefits.

Required Reading: *Toyota Motor Manufacturing USA*. Consider the following questions:

1. Identify if, and if so where, Toyota carries inventory and excess capacity.
2. 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?
3. What is the value of a cord pull? What actions does Toyota take to lower the cost of a line stoppage?

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

Optional Reading: “Lean Knowledge Work,” Bradley R. Staats and David M. Upton, *HBR* 2011.

Class 10: Midterm Exam

In preparing for the midterm, we suggest that you review the sample midterm (available on Canvas) and *MBPF* examples and exercises (solutions are available on Canvas).

The midterm exam is, of course, an individual assignment. Be aware of the following:

1. The midterm exam will be in-class during our regular class session.
2. This is a closed-notes/closed-book exam.
3. You may use a calculator but you may *not* use a laptop or cell phone as a calculator.

Module 4: Quality Management

Class 11: 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. 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*

Case: *Quality Wireless (A) and (B)*. Prepare questions attached to cases.

There is no assignment due.

Class 12: The Value of 6-Sigma

Objective: Discuss the benefits from continuous process improvement.

Reading: *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.

Module 5: Capacity Management in Services

Class 13: Capacity, Queuing & Flow Time Analysis

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

Required Reading: *MBPF: Chapter 8.*

Optional Reading: "The Long-Distance Journey of a Fast-Food Order," Matt Richtel, *NYT*, April 11, 2006.

"Managing Real and Virtual Waits in Hospitality and Service Organizations," D. Dickson, R. Ford, and B. Laval, *Cornell Hotel and Restaurant Administration Quarterly*, February 2005.

Recommended problems: 8.1, 8.4, 8.5, 8.8.

Class 14: Design of service systems (Economies of Scale and Priorities)

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

Written Assignment: The BAT Case.

The case is available through SimClass. Students should submit their responses with the platform.

You may want to use the Excel workbook Queue.xls to analyze this case. It is available from Canvas.

Class 15: Design of service systems: flexibility and pooling

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

Optional Listening: Waiting In Line In America, BBC World Service, Sep 24, 2012. Available here:

<http://www.bbc.co.uk/programmes/p00y2wt0>

Module 6: Supply Chain Management

Class 16: Optimal Service Level.

Objective: Discuss the “newsvendor” model, an 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*

Recommended problems: 7.4, 7.5.

Class 17: Economies of Scale & Cycle Inventory

Objective: 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: *Palü Gear.* Questions 1.a & 1.b. There is no assignment due.

Recommended problems: 6.2, 6.4, 6.5, 6.10.

Class 18: 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 7.4.2)*

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

Recommended problems: 7.1, 7.2.

Class 19: 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*

Netflix: Read the case and answer the questions on SimClass.

Recommended problems: 7.3, 7.8, 7.9.

Class 20: Wrap Up and Review

No readings.

Final Exam

The date and time of the final will be announced as soon as we have the information from student affairs.

In preparing for the final, we suggest that you review the sample final (available on Canvas) and *MBPF* examples and exercises (solutions are available on Canvas).

Be aware of the following:

1. The final will be an in class exam and you will have 180 minutes (three hours) to complete it.
2. The exam is cumulative.
3. The exam is open book. You may consult your textbook, class handouts (including material from the class Canvas site), and class notes. You may use the computer worksheets used in class. You may not use any other materials.
4. You may use a calculator and/or laptop computer. A laptop may only be used for a calculator, Excel, or to access class files.