## OPNS 430

### COURSE OUTLINE: SPRING 2019

**PROFESSOR IRAVANI**

<table>
<thead>
<tr>
<th>Class</th>
<th>Module and Description</th>
<th>Readings</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Module 1: Operations Strategy</strong>&lt;br&gt;Introduction to Operations&lt;br&gt;Product-Process Matrix</td>
<td>The Goal: Start&lt;br&gt;MBPF, Chapters 1, 2&lt;br&gt;Case: Shouldice Hospital Limited</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Module 2: Process Analysis &amp; Applications</strong>&lt;br&gt;Process Measures and Little’s Law</td>
<td>MBPF, Chapter 3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Aligning Strategy and Operations. Focus</td>
<td>Case: Wriston Manufacturing</td>
<td>Survey: Wriston</td>
</tr>
<tr>
<td></td>
<td><strong>Module 3: Lean Operations</strong>&lt;br&gt;House Building Game</td>
<td>MBPF, Chapters 4, 5&lt;br&gt;Case: Portland Computer Systems</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Paradigm of Lean Operations</td>
<td>MBPF, Chapter 10: Sections 10.1–10.4&lt;br&gt;Case: Toyota Motor Manufacturing USA</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>Module 4: Capacity Management in Services</strong>&lt;br&gt;Introduction, Theory of Queues&lt;br&gt;Evaluation of service systems&lt;br&gt;Design of service systems: Economies of Scale</td>
<td>MBPF, Chapter 8&lt;br&gt;Case: To Pool or Not to Pool (Canvas)</td>
<td>Survey: To Pool...&lt;br&gt;Take-Home Midterm Exam (open-book)</td>
</tr>
<tr>
<td>7</td>
<td>Design of service systems: Priorities and Limited Buffers</td>
<td>MBPF, Chapter 9</td>
<td>Team: The BAT Case</td>
</tr>
<tr>
<td></td>
<td><strong>Module 5: Data Driven Quality Management</strong>&lt;br&gt;Managing Processes with Variable Output</td>
<td>MBPF, Chapter 9</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Process Capability and Robust Processes</td>
<td>MBPF, Chapter 9&lt;br&gt;Case: Quality Wireless (A)</td>
<td>Quiz: Queueing</td>
</tr>
<tr>
<td></td>
<td><strong>Module 6: Supply Chain Management</strong>&lt;br&gt;Economies of Scale, Cycle Stock</td>
<td>MBPF, Chapters 6&amp;7&lt;br&gt;Case: Palü Gear (1.a, 1.b)</td>
<td>Quiz: Quality</td>
</tr>
<tr>
<td>9</td>
<td>Uncertainty, Safety Stock&lt;br&gt;Optimal Service Levels</td>
<td>MBPF, Chapter 9&lt;br&gt;Case: Palü Gear (1.c, 1.d)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Supply Chain Management</td>
<td>MBPF, Chapter 9&lt;br&gt;Case: Palü Gear (1.c, 1.d)</td>
<td>Team: Inventory Problem Set</td>
</tr>
<tr>
<td>Week 10</td>
<td>Course Wrap-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam</td>
<td>Final Exam: In-class, open-book, cumulative.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This course provides a general introduction to operations management. Operations management is the design and control 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, finance provides the capital, and operations produces the product or delivers the service. 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, and supply chain management.

**Required Texts**

Required materials available at the bookstore:

1. Course Pack.

Cases listed in the class-by-class reading list below are found in the Course Pack.
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 class contribution, written team assignments, individual quizzes and exams. There will be three short (3 to 5 questions) quizzes over the quarter. These will be administered through Canvas. **Note: No credit will be given for quizzes submitted after the solution set for the quiz is posted.**

The midterm exam will be a 90-minute *take-home*, open-book, open class handouts, exam during week 6. The final exam 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. It will only be available during the exam period.

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

1. Class contribution 10%
2. Case write-ups and problem set 15%
3. On-line 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.
• Submit your team’s write up through Canvas.
• Be punctual: Late submissions will not be accepted.

All case write-ups are to be done in assigned groups. 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 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 improves overall class discussion.) Beyond directly participating in class discussions, class contribution will also depend on completing two brief Canvas-based surveys (note these surveys will not be graded for correctness; only for completing them).

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. While attendance for any given class session is not compulsory (though encouraged), students’ compliance with the Kellogg classroom etiquette policy will be enforced.

In particular, you may not:
1. Engage in cross-talking.
2. Engage in disruptive movement (e.g., arrive late, leave class for a coffee or snack).
3. Use of a smart phone or other device for texting, e-mail etc.
4. 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.

A laptop or tablet may be used only for note taking or accessing class materials.
Use of the Canvas

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

- Lecture slides (will be available on the day of the lecture)
- MBPF textbook exercises and solutions.
- Sample midterm and final exam questions & solutions.
- Excel spreadsheets for cases.

Suggested Readings

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


Suggested Podcast

Containers [https://soundcloud.com/containersfmg](https://soundcloud.com/containersfmg)
Module 1: Operations Strategy

Class 1a: Introduction to Operations

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

Required Reading: MBPF, Chapters 1 & 2

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 1b: Aligning Strategy and Operations.

Objective: Illustrate how to do a strategic operational audit to align strategy and operations. Introduce and discuss the Product-Process Matrix.

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?

Class 2a: Aligning Strategy and Operations: Focus

Case: Wriston Corporation: The Detroit Plant.

Note: There is no submission due for this case. However, there is a brief survey to complete on Canvas focused on Question 4 below. This survey will count toward your class contribution.

1. Why do overhead costs vary so greatly across plants 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. Which of the three options presented in the case (i.e., close the Detroit plant, build a replacement plant, or make a minimal investment in the Detroit plant) would you recommend?
Module 2: Process Analysis and Applications

Class 2b: Process Measures and Little’s Law

Objective: 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 3a: 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.

Written Assignment: Portland Computer Systems. Your write up should address questions 1, 3, 4 & 5:

1. What is the process at PCS? Make a flow chart clearly identifying activities, buffers, routes and any other relevant data.
2. How long does equipment spend on average classified as different Category Labels? Consider a piece of equipment just coming off lease. On average, how long does it take until that equipment is rented out again?
3. What is your evaluation of how Brownstein and Corin responded to the drop in sales?

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

Note: In addition to submitting a hard copy of your write up in class, submit a PowerPoint file with your process flow chart through Blackboard.

Recommended MBPF textbook problems: 3.4, 3.8, 3.9

Class 3b: Flow Time & Capacity Analysis

Objective: Discuss the drivers of flow time and capacity.

Required Reading: MBPF, Chapters 4, 5.

Case: Pizza Pazza. Prepare questions attached to case.

There is no assignment due.
Class 4a: Flow Time & Capacity Analysis: Peak Loads

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

Required Reading: The Goal: at least up to page 161.

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 1,500 bbs/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 on the course page) to analyze this case, although the analysis can be done without it.

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

Module 3: Lean Operations

Class 4b: House Building Game

Objective: Explore the relationship between process structure and performance (cost, quality and time) through a team-based simulation game.
Class 5a and 5b: 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.

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 Match Game from The Goal, look on Canvas under Files/Spreadsheets

MIDTERM EXAM (Week 6):

This exam is a take-home exam and will be open readings, open class handouts and open class notes. The following instructions and Honor Code restrictions apply to this exam.

1. You will have 90 minutes to do this exam.
2. You must do this exam completely by yourself.
3. You may consult your textbook, class handouts (including material from the class website), and class notes. You may not use any other materials. You may use a calculator and/or laptop computer. A laptop may be used for a calculator or Excel only.

Module 4: Capacity Management in Services

Class 6a: 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.

Class 6b: Design of service systems: Economies of Scale

Objective: Show how queuing performance varies with arrival volume and examine what this implies for system design.
Case:  *To Pool or Not to Pool. Available on Canvas.* Prepare questions at end of case.

**Note:** There is no submission due for this case. However, there is a brief survey to complete on Canvas. This survey will count toward your class contribution.

**Class 7a: Design of service systems: The Impact of Priorities and Limited Buffers**

Objective: Examine the impact of priorities and how to serve customers with different sensitivities to waiting through one system.

<table>
<thead>
<tr>
<th>Written Assignment: The BAT Case. The write-up should address Question 7.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) What is the current wait experienced by callers reaching BOP! Team 1? What is the utilization of BOP! Team 1? Given the current arrival rate, what would it take to offer a one-minute average wait for all customers?</td>
</tr>
<tr>
<td>2) Suppose Grayson implements Fast Track by keeping BOP! Team 1 together as one team and giving priority to Fast Track calls. What staffing levels are needed to deliver a one-minute Fast Track wait for the demand rates that the consultants have forecasted? If additional technicians are needed, is Fast Track economically viable?</td>
</tr>
<tr>
<td>3) Is promising a one-minute wait sufficient or should they have service be free when the wait exceeds one minute? Is the program viable if BAT provides free service to all Fast Track callers who have a wait over one minute? (Hint: In evaluating this question, think about how the fraction of Fast Track missing the one-minute target would compare to the fraction missing that target if calls were handled first-in, first-out.)</td>
</tr>
<tr>
<td>4) What is the impact of Fast Track on standard calls to BOP! Team 1? 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 24 calls per hour?</td>
</tr>
<tr>
<td>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 at or below current levels.)</td>
</tr>
<tr>
<td>6) Before calling in, a BAT customer cannot see how many people are waiting. Would a system like Fast Track work if customers could see the line before choosing whether to pay for priority service?</td>
</tr>
<tr>
<td>7) <em>(For write up)</em> What is the economic return on implementing Fast Track for BOP! Team 1? Would you implement Fast Track? Clearly explain why or why not.</td>
</tr>
</tbody>
</table>

You may want to use the Excel workbook Queue.xls (available on Canvas) to analyze this case.

Recommended problems: 8.1, 8.4, 8.5, 8.8.

**Module 5: Data Driven Quality Management**

**Class 7b: Managing Processes with Variable Output**

Objective: In a perfect world, a process would always produce exactly the same outcome. In an imperfect world, there is variation in process output. How do we know whether an observed level of variability is a cause for concern?
Required Reading:  MBPF, Chapter 9
Case:  Quality Wireless (A) Prepare questions attached to cases. No assignment is due.


Class 8a: Process Capability and Robust Processes

Objective:  How then do we measure the capability of a process? How do we verify that a process improvement effort has been successful?

Required Reading:  MBPF, Chapter 9
Case:  Quality Wireless (B). Prepare questions attached to cases. No assignment is due.

Module 6: Supply Chain Management

Class 8b: 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 9a: 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.

Required Reading:  MBPF, Chapter 7
Case:  Palü Gear. Questions 1.c & 1.d. There is no assignment due.

Recommended problems: 7.1, 7.2.

Class 9b: 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 rapidly decays.

Recommended problems: 7.4, 7.5.
Class 10a: Supply Chain Management

Objective: Discuss the issues with inventory management in supply chains, including bullwhip effect and misalignment of objectives of supply chain members. Illustrate how strategies such as inventory pooling, centralization and postponement can improve supply chain performance.

Class 10b: Course Wrap-Up

Final exam: (Exam Week)

In preparing for the final, review the sample final (available on Canvas) and MBPF examples and exercises (solutions are available on Canvas). In addition, be aware of the following:

4. The final will be an in-class exam. You will have 180 minutes (three hours) to complete it.
5. The exam will only be available during the exam period.
6. The exam is cumulative.
7. 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.
8. You may use a calculator and/or laptop computer. A laptop may only be used for a calculator, Excel, or to access downloaded class files.