**Operations Management Summer 2022**

# COURSE DESCRIPTION AND LEARNING OBJECTIVES

Operations Management is the design and management of the processes that transform inputs into finished goods or services. Operations is one of the primary functions of a firm. In recent years, analytics and digitization have been transforming the way operations are managed. Whereas marketing focuses on the demand for the product, and whereas finance provides the capital for the product, operations actually produces and delivers the product.

This course provides a foundation for understanding the operations of a firm. Our objective by the end of the course is to provide you with the basic skills necessary to critically analyze a firm's operating performance and practices. Such knowledge is important for careers in a variety of areas, including general management, entrepreneurship, investment banking (e.g. business restructurings, mergers and acquisitions), venture capital (e.g. evaluating new business plans) and management consulting (business restructuring improvement). Unlike many courses in the core, which tend to treat the firm as a "black box", we will be primarily concerned with "opening up" the black box and discovering what makes a firm "tick" - or, for that matter, "stop ticking".

Because the operations of a firm vary widely from one industry to the next, a course like this cannot cover all topics that are relevant to any given industry. Rather, we have selected a set of topics that are fundamental to understanding operations in a wide range of industries. These concepts are then illustrated using cases from a diverse set of businesses.

# ASSIGNMENTS

All of your assignment submissions are subject to the CBS Honor Code. Violations of the CBS Honor Code may lead to failing the assignment, failing the course, suspension, and/or dismissal. Use of case or lecture notes from previous sections of the course is not allowed. Any allegation of academic dishonesty will be forwarded to the Dean’s office for investigation. Any case of proven academic dishonesty will result in failure in the course. In order to avoid ambiguity that may lead to unintentional violations of the Honor Code, assignment description types have been standardized and specified below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Designation** | **Grade** | **Preparation of submission** | **Discussion of Submission\*** | **Discussion of Concepts\*\*** |
| A | Group Work | Same grade for all group members | By the group | Permitted to discuss (within group) | Permitted |
| B1 | Individual w/ Discussions of Concepts and Submission | Individual grade | Individual preparation | Permitted to discuss; sharing solutions or submission files is not allowed | Permitted |
| B2 | Individual w/ Discussions of Concepts Only | Individual grade | Individual preparation | Not permitted to share/discuss solutions or submission | Permitted |
| C | Individual | Individual grade | Individual preparation | Not permitted to share/discuss solutions or submission | Not permitted\*\*\* |

\* The designated group can be either an assigned study group or a self-selected one.

* Submission means any work and/or output pertaining to the specific assignment. If an assignment submission contains a calculation or decision related to a specific set of data and setting, discussing the details how to make this calculation or decision with regard the data/setting is to discuss the submission. Providing another student with a draft of the calculation or decision is sharing the submission.

\*\* Concepts mean any ideas, examples, readings, or other related materials from the class/course. Conceptual discussion should not be based on a specific set of data or setting related to a calculation or decision required in the assignment, but could be based on other related examples, preferably those from class/course materials.

\*\*\* As no conceptual discussion is permitted, Type C is akin to a take-home exam.

## Individual Assignments

* + There are three individual homework assignments for the course. The first and last homework constitute 7.5% of your grade, while the second homework constitutes 10% of your final grade.
  + Homeworks are due at the beginning of the session on the assignment’s due date. Late assignments are not accepted.
  + Each student must turn in his or her own assignment. We encourage students to attempt completing the assignments on their own. However, to promote learning, students are allowed to discuss each assignment with other students. These are Type B1 assignments.

## Group Assignments

* + There is one group assignment. It is a Type A assignment and should be done with your learning team. It is an experiential game, “Littlefield Labs”, meant to provide some hands-on experience on some of the concepts covered in class. The game simulates a laboratory that provides blood testing to customers, and each team will have to manage several aspects of the lab (input materials, capacity at several stages of the process, etc.) in order

to maximize the profit of the company. Teams will compete during one week, playing the game online (using a web browser) outside lecture hours. The grade for this activity will be calculated based your ranking in the competition (20%) and a write-up to be handed in at the end of the game (80%). This assignment will constitute 15% of your final grade.

## Final Exam

* + The final exam is based on the content of the course: analytical tools, case discussions, lectures, etc.
  + It is a 3-hour written exam. No electronic files will be submitted.
  + The format of the final exam is open book and open notes.
  + Calculator and laptops allowed.
* Date:

o NOTE: The exam make-up day is

# GRADING

Your grade in the course will be based on individual, as well as group efforts and performance. We will use the following weighting scheme:

|  |  |
| --- | --- |
| Class Participation | 20% |
| Individual Assignments (3) | 25% |
| Group Assignment: Littlefield Labs Game | 15% |
| Final Exam | 40% |

# ATTENDANCE POLICY

Students are required to attend each class in the section which they are registered. Students should reach out to the Office of Student Affairs (OSA) by using Core Absence Form on this course’s Canvas page regarding excused absences (for religious observances; personal, medical, and family emergencies; military service; court appearances such as jury duty). Unexcused absences will affect your course grade as follows:

* Students that miss more than **33%** of their classes (unexcused absences) will at most receive a **P for the course grade**
* Students that miss more than **50%** of their classes (unexcused absences) will receive a **F for the course grade**

In addition to the effect on your final course grade, absences may also affect your final exam grades as follows:

* Students that miss the exam for an **excused** reason but are unable to take the exam within the stated make-up period will receive a **zero for the final exam grade**
* Students that miss the exam without notifying OSA (**unexcused**), will receive an **F for the course grade**

## Class Participation

We will judge class participation on the extent to which you appear prepared, the relevance and depth of your comments, the degree to which you listen carefully and respond to your peers, and your willingness to take chances in order to further the educational experiences of others. In many instances, we will ask you to provide to the class a brief summary and/or justification for your answers to pre-class assignments. These pre-class assignments are intended to get you to start thinking about the material for class and will not be graded on a basis of being right or wrong, but rather whether you properly prepare for class.

# REQUIRED COURSE MATERIALS

The course uses a variety of teaching methods and materials. Classes will consist of lectures, discussions, and video presentations. Fundamental concepts are contained in lecture notes and readings. Analytical tools are presented in notes, discussed in lectures, and reinforced by group as well as individual assignments. Cases are also used to illustrate the context and complexity of operations issues.

## Text and Readings

We have divided the readings into required and optional readings. The required readings, indicated with an asterisk (\*) in the syllabus, should be read before class to facilitate comprehension and discussion. Recommended readings provide more background and depth of the material covered in the lectures. They help to clarify the topics covered in the lectures and provide some examples of practical applications. All readings are contained in a customized textbook that will be distributed in the first class. Use the syllabus as a guide for readings.

For those who would like to consult a textbook for additional readings, I recommend: “Matching Supply with Demand” by

Cachon and Terwiesch. This book is held in the reserve of the library.

# CLASSROOM NORMS AND EXPECTATIONS

We have made a sincere effort to keep the amount of reading for each class reasonable; in turn, however, we expect you to read the required materials and be well prepared for each class. Cases, in particular, typically require a detailed reading and will often require analysis of relevant data. We expect that students will use evidence to support their point of view, will strive to avoid making generalizations, and will aim speak from their own experience.

Business School classes take place in an environment that supports learning and encourages the exchange of ideas. Behavior that distracts students and the professor negatively affects the learning environment. For example,

* + Using electronic devices other then CBS issues iPads for purposes not authorized by the professor,
  + Arriving late to class or leaving early, and
  + walking in and out during class

are particularly detrimental to the classroom environment. Such conduct violates the School's Community Contract, the Columbia Core Culture, and/or the School's Electronic Device Policy, and is disrespectful to classmates and instructors.

# INCLUSION, ACCOMMODATIONS, AND SUPPORT FOR STUDENTS

At Columbia Business School, we believe that diversity strengthens any community or business model and brings it greater success. Columbia Business School is committed to providing all students with the equal opportunity to thrive in the classroom by providing a learning, living, and working environment free from discrimination, harassment, and bias on the basis of gender, sexual orientation, race, ethnicity, socioeconomic status, or ability.

Columbia Business School will make reasonable accommodations for persons with documented disabilities. Students are encouraged to contact the Columbia University’s Office of Disability Services for information about registration. Students seeking accommodation in the classroom may obtain information on the services offered by Columbia University’s Office of Disability Services online at [www.health.columbia.edu/docs/services/ods/index.html](http://www.health.columbia.edu/docs/services/ods/index.html) or by contacting (212) 854-2388.

Columbia Business School is committed to maintaining a safe environment for students, staff and faculty. Because of this commitment and because of federal and state regulations, we must advise you that if you tell any of your instructors about sexual harassment or gender-based misconduct involving a member of the campus community, your instructor is required to report this information to a Title IX Coordinator. They will treat this information as private, but will need to follow up with you and possibly look into the matter. Counseling and Psychological Services, the Office of the University Chaplain, and the Ombuds Office for Gender-Based Misconduct are confidential resources available for students, staff and faculty. “Gender-based misconduct” includes sexual assault, stalking, sexual harassment, dating violence, domestic violence, sexual exploitation, and gender-based harassment. For more information, see [http://sexualrespect.columbia.edu/gender-based-misconduct-policy-students.](http://sexualrespect.columbia.edu/gender-based-misconduct-policy-students)

# Operations Management COURSE AT A GLANCE

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Topics** | **Readings** | **Assignment Due** |
| 1 | Introduction |  | Pre-class Assignment 1 |
| 2 | From process analysis to valuing improvements at Aroma Consumer Products | **Aroma Consumer Products(\*)**  Production Processes | Pre-class Assignment 2 |
| 3 | Scaling Operations via new process design at Happy Family | **Happy Family (\*)**  Bottleneck Analysis | Pre-class Assignment 3 |
| 4 | The impact of variability on process performance and approaches to mitigate it |  | Individual Hmwk 1 |
| 5 | Managing waiting times in services | **Saintemarie ED (\*)** | Pre-class Assignment 4 |
| 6 | Introduction to supply chain management: Newsvendor model |  | Pre-class Assignment 5 |
| 7 | Mitigating the impact of uncertainty through risk pooling at GE | **GE MRI (\*)** | Individual Hmwk 2 |
| 8 | Processes conformance: Quality management and the concepts of process capability, 6-sigma | **Littlefield Labs instructions (\*)** | 9am: deadline to sign up for Littlefield |
|  | **Littlefield starts at** | | |
| 9 | Evening Session with industry practitioner. Date |  | Attendance to the guest |
| and speaker based on cluster. **Replaces regular** | lecture is **required**. |
| **lecture on 2/21**. | 5:40pm in Cooperman |
| 2/22: Mei Xu, Founder Chesapeake Bay Candles | Commons |
| and Yes She May: Clusters A, C, E, G |
| 2/23: Ryan Petersen ’08, Founder & CEO |
| Flexport: Clusters B, D, F, H |
|  | **Littlefield ends at** | | |
| 10 | Improving processes and monitoring performance: Statistical Process Control | **Estee Lauder Company (\*)**  Statistical Process Control | Pre-class Assignment 6 |
| 11 | Lean operations: a framework for operational excellence | **Listen to NUMMI NPR documentary (\*)** | Individual Hmwk 3 |
| 12 | Course summary |  | Littlefield write-up |
|  | FINAL EXAM |  |  |

**(\*): Required. Other readings are optional, but recommended.**

**Class by Class Summary**

**Class 1**

## Topics:

Introduction to operations management and the process view of the organization. Overview of topics to be covered during the course.

## Class Activities:

Course overview. Introduction to process analysis, process vocabulary, and Little Law.

## Due:

Submit pre-class assignment 1 through Canvas.

# Class 2

## Topics:

Process Analysis and Vocabulary. Quantifying the impact of process improvement on business performance.

## Prepare:

Read “Aroma Consumer Products”, and think about the following questions:

1. Help Mei identify where the bottleneck is in the current candle manufacturing process. Verify that current operations can handle the current demand of 3,000 candles per hour.
2. Put yourself in Mei’s position, what would you do to increase capacity to meet Target’s demand?
3. How does the Target customer fit into Chesapeake Bay Candle’s business strategy? How does Aroma Consumer Products need to think about its processes to support this strategy and deliver on its production commitment to Chesapeake Bay Candle? Where do you see similar approaches adopted?

Recommended optional reading: “Production Processes”.

## Class Activities:

Introduce concepts for process analysis and discuss Aroma Consumer Products case.

## Due:

Submit pre-class assignment 2 through Canvas.

# Class 3

## Topics:

Scaling Operations via Process Analysis.

## Prepare:

Read “Happy Family: Investing in the Future”. To prepare for the discussion do the following:

1. Draw a process flow diagram showing the major process steps, inventories, and flows, beginning with Mixing the Product and ending with Loading the Cartons on trucks. Indicate the capacity at each of the process steps in pouches per hour. You should assume:
   * Demand is 120,000 pouches/day on the FFS line, 60,000 pouches/day on the PF line
   * Demand arrives at a constant rate from 6 a.m. to 10 p.m.
   * Mixer and loading docks are shared between the two lines
   * Demand should be fulfilled from 6 a.m. to 10 p.m., but employees can be paid overtime to remain after 10 p.m. if absolutely necessary
2. Which operation is (or operations are) the bottleneck?
3. How long does it take to process all the product in a day?
4. What are some basic options for improving the operation? Which options would you recommend and why? In justifying your recommendation, be sure to include a simple quantitative analysis (i.e., include an intelligent back-of-the-envelope calculation).

In class, be prepared to discuss and defend your recommendations.

Recommended optional reading: “Bottleneck Analysis”.

## Class Activities:

Discuss Happy Family.

## Due:

Submit pre-class assignment 3 through Canvas.

Think about the following questions for class discussion:

1. How important is response time in the businesses you are familiar with? What are the causes of the response time problems in these businesses? How can a firm effectively manage response time?
2. What are the consequences of exactly balancing capacity and demand? Why is excess capacity needed?

## Class Activities:

Discuss the queueing phenomenon, queueing models, and insights for designing queueing systems for improving service operations.

## Due:

Individual Homework 1. This is a Type B1 assignment.

# Class 5

## Topics:

Managing waiting time in service and healthcare operations.

## Prepare:

Read “Emergency Department Congestion at Saintemarie University Hospital” and be prepared to answer the following questions:

1. What operational problems is Saintemarie Emergency Department facing? What is your assessment of the current performance and what do you think is driving these problems?
2. What are some possible alternatives for improving Saintemarie ED’s performance?
3. Through a back of the envelope calculation, evaluate the average time that patients wait before entering the care process. To do so, view the patient management activities and discharge as a single activity. How does that compare to the 1h10 minutes mentioned in the case?
4. How would you formulate performance targets for the ED?

## Class Activities:

Discuss Saintemarie ED case.

## Due:

Submit pre-class assignment 4 through Canvas.

# Class 6

## Topics:

Introduction to Supply Chain Management. The Newsvendor Model.

## Prepare:

Make a **rough** forecast for the iPhone world-wide sales (in units) during the first calendar quarter (Jan-Mar) of 2022. Be prepared to discuss in class your strategy in making the forecast and what operational decisions need to be made based on it.

## Class Activities

In this lecture we discuss forecasts and how to use them to make “smart bets” through the Newsvendor model. We discuss the implications of production pre-commitment and risk in supply chain management.

## Due:

Submit pre-class assignment 5 through Canvas.

# Class 7

## Topics:

Risk pooling in matching supply with uncertain demand.

## Prepare:

Read “GE Healthcare: Managing Magnetic Resonance Operations”. Think about the following:

1. Using the forecast and actual demand data from Q2 2012 through Q4 2017, compare the mean-squared error between the forecasts and the actual demand for the 9 models to compare the accuracy of forecasts 6 months versus 2 months out. What might be the reasons for different trends in forecast accuracy among MR models?
2. Use the Newsvendor model to determine the optimal make-to-stock production decision to maximize expected profits based on the 6 month forecast. Assume that the demand distribution is normally distributed with the mean equal to the average actual demand in each period. Assume a standard deviation is given by the square- root of the mean-squared error of the demand forecasts as calculated in question 1. *This question is part of Individual Homework 2.*
3. As indicated in the case, due to long lead times and uncertainty in demand, GE has to make MR production decisions in order to carefully balance the costs of producing too many machines versus producing too few. Discuss qualitatively strategies that GE could employ to better match supply and demand and to mitigate the impact of uncertainty in demand.

## Class Activities:

This session studies how one manufacturing company can use demand forecasts and risk pooling to decrease the impact of demand uncertainty on profits.

## Due:

Individual Homework 2. This is a Type B1 assignment.

Quality Management.

Process capability and Six-Sigma.

## Prepare:

Read Instructions to play Littlefield Labs.

Think about the following questions for class discussion:

1. How do you define quality? How do you think companies should integrate a notion of quality into their overall strategy?

## Class Activities:

Discuss the definition of quality, process capability, and Six-Sigma. We will also introduce the Littlefield game.

## Due:

Sign up for Littlefield by 9am.

# IMPORTANT: Littlefield game starts Friday, Feb 18 at 12:00pm and finishes Friday, Feb 25 at 12:00PM.

**Class 9 (NOTE Evening session)**

## Topics:

Guest Speaker in Operational Excellence (Evening Session at 5:45pm in Cooperman Commons). Invited industry practitioner. Date is based on class meeting time.

## Class Activities:

**Attendance to the lecture is required as it replaces a regular class. Please let the TAs know ASAP if you have a conflict.**

* Tuesday, Feb 22:
  1. Mei Xu, Founder and Former CEO of Chesapeake Bay Candle, Founder and CEO Yes She May
  2. Students in Clusters A, C, E, G are required to attend this session
* Wednesday, Feb 23:

1. Ryan Petersen ’08, Founder & CEO Flexport
2. Students in Clusters B, D, F, H are required to attend this session

Quality Management and Statistical Process Control.

## Prepare:

Read “Continuous Quality Monitoring via Data and Analytics at The Estee Lauder Companies”. Think about the following questions for class discussion:

1. ELC and Avlash’s team were well on their way to understanding the root cause of the increased consumer contacts. What do you believe are some potential root causes of the increased consumer contacts? What data supports your belief?
2. Based on your hypotheses for root causes, what type of analysis do you recommend? What potential interventions do you recommend??

Recommended optional reading: “Statistical Process Control”.

## Class Activities:

We will discuss the Estee Lauder Companies case, root cause analysis and the importance of continuously monitoring processes. In particular, we introduce the notions of common and special cause variations as well as statistical process control as a conceptual tool.

## Due:

Submit pre-class assignment 6 through Canvas.

# IMPORTANT: Littlefield game ends. You will need to prepare a write up to be submitted in the last class.

Listen to the first 30 minutes of the NPR American Life documentary about NUMMI (prologue and Act 1). https:/[/www.thisamericanlife.org/561/nummi](http://www.thisamericanlife.org/561/nummi-2015)-[2015](http://www.thisamericanlife.org/561/nummi-2015) (the episode is also available on iTunes)

This case is part of the Individual, Business, & Society Curriculum.

## Class Activities:

We will discuss the principle of the framework of lean operations, just-in-time production, and continuous improvement as well as ways through which digitization and analytics are being used to transform lean operations.

## Due:

Individual Homework 3. This is a Type B1 assignment.

# Class 12

## Topics:

Course summary.

## Prepare:

Review the concepts and tools learned in the course.

## Class Activities:

This session will review some of the main concepts covered in class.

# Due:

Group Assignment: Littlefield write-up (Group assignment—Type A). 2-page summary explaining your actions. See “Instructions to play Littlefield Labs” for more information. Your write up should be single spaced and 12pt font. It should summarize your team’s strategy, what you learned, and what you would have done differently if you had to do the simulation again. **Be prepared to discuss your team’s strategy in class.**