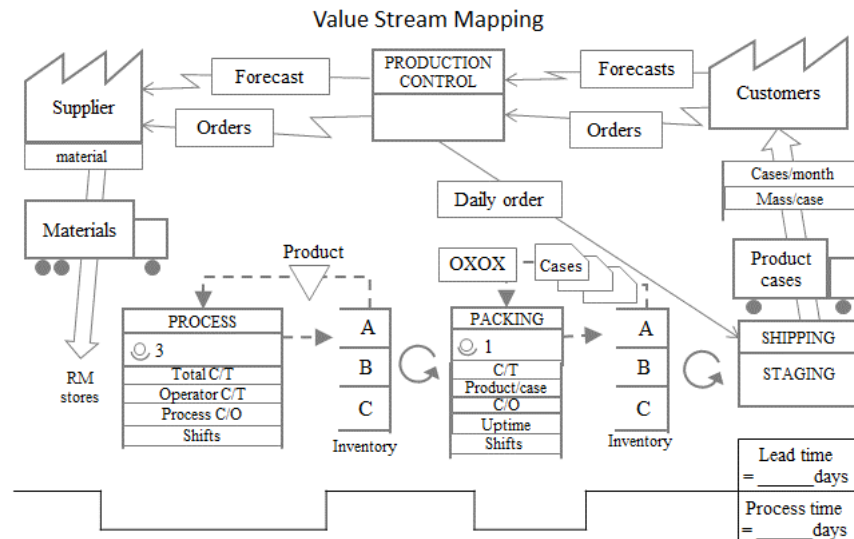


Purdue University School of Materials Engineering

## MSE 597 Lean Manufacturing 2021



**Instructor** Prof. Paul Mort, FLEX 3021B, 765-496-3450, [pmort@purdue.edu](mailto:pmort@purdue.edu)

**Lecture** MWF, mix of in-class and video lectures available via Brightspace, times and locations to be announced.

**Office Hours:** To be announced in ARMS 2303 (MSE Office Area), or by appointment in FLEX 3021B.

### Course Description

Lean Manufacturing is about creating value. The Lean process starts with creating value for the ultimate customer which requires providing the right product at the right time for the specified price. While all manufacturing attempts to do this, what makes Lean Manufacturing distinct is the relentless pursuit and elimination of waste. Students will learn the concepts and tools of Lean which include types of waste, visual management, 5S, value stream mapping, A3, & flow and how it applies to materials systems.

The course was originally designed by Chris Owen who led Lean Project Initiatives at Alcoa Aluminum (now Arconic) in Lafayette; initial course content included examples of specialty aluminum alloy processing. Prof. Mort (Purdue Center for Particulate Products and Processes) has an industrial background with Procter & Gamble, including product development and manufacturing process control and optimization of particulate products.

Enrollment has grown to include a wider range of students, both on and off campus, having a broad range of interests including assembled-product manufacturing, materials processing, industrial engineering, engineering management, product development, systems optimization, and start-up innovation. To better meet these diverse mastery objectives, the syllabus has been modified to introduce a matrix of special interest areas. Following an introductory survey of course content, students are required (in HW#1) to identify a specific topical area for deeper-divide study. The matrix exercise includes:

1. An individual literature survey according to student's specific area of interest;

2. A group presentation on a matrix topic (e.g., culture of lean and innovation, specific element of lean, type of lean manufacturing, lean process intensification, value stream optimization, lean product development, etc.). Students will be assigned to groups based on content clustering of their specific interest areas.

### **Enduring Understandings**

1. To understand the distinction between Mass Production and Lean Manufacturing and to analyze a facility's progress in the transition from Mass to Lean.
2. Value Stream Mapping. The intent is to "provide lean thinkers the most valuable tool they will need to make sustainable progress in the war against muda [waste]: the value stream map". (Rother and Shook).
3. Matrix exercise. An individual deep-dive survey of a specific interest selected by each student, and a group exercise to synthesize and present elements of individual surveys clustered by topical area.

### **Learning Objectives**

1. Articulate a case for Lean. Students will be able to present an argument on why Lean is a superior environment to Mass.
2. Compare and contrast the culture, organizational structure and leadership in Mass and Lean environments.
3. List and describe the Types of Waste and why waste elimination is a core component of Lean Manufacturing.
4. List and describe lean functionality (i.e. quality, continuous flow, pull systems, 5S, Visual Control, Kanban, etc.).
5. Articulate why the "Rules in Use" were a breakthrough in understanding the Toyota Production System.
6. Understand A3 thinking and draw an A3.
7. Demonstrate ability to draw a Value Stream Map of an actual manufacturing process.
8. Understand the similarities and differences between Lean Manufacturing and Product Development.

### **Prerequisites**

Junior or higher standing in Engineering or Science

### **Textbooks:**

Recommended for purchase:

- (1) J.P. Womack, D.T. Jones, D. Roos, The Machine that Changed the World, Free Press, 1990 (2007 in paperback). ISBN-13: 978-0-7432-9979-4. The content is basically the same for both printings. Convenient e-reader versions also available
- (2) J.K. Liker, The Toyota Way, McGraw Hill, 2004. ISBN 0-007-139231-9

Optional (much will be covered in class):

- (3) M. Rother, J. Shook, Learning to See, Lean Enterprise Institute, 2009. ISBN: 978-0-9667843-0-5.
- (4) D. Reinertsen, The Principles of Product Development Flow, Second Generation Lean Product Development, Celeritas Publishing, 2009. ISBN 13: 978-1-935401-00-1.

### **Supplemental reading**

Will be posted on Blackboard as needed.

### **Learning Environment**

The research is clear that long-term learning takes place only when accompanied by deliberate, distributed practice. To accomplish that end, this class is structured so that subjects will be covered in a way to provide students opportunity to practice.

### **We expect that the student will:**

1. Attend all classes or watch all videos. Attendance is expected, and video of the lecture can be provided for excused absences or special circumstances (i.e. we expect you to attend class if you signed up for the on-campus class). Electronic postings of the video will be available online for the distance students.  
URL for distance students is [https://engineering.purdue.edu/ProEd/current\\_student](https://engineering.purdue.edu/ProEd/current_student).
2. Read the assigned material before class. By coming prepared to class, students will be in a better position to learn the content.
3. Do good work. Utilize this opportunity to do work that will be expected of you as a practicing engineer.
4. Turn assignments in on time. Deductions will be taken for late assignments.
5. Turn off your cell phone, and only use your computer during class for class purposes.
6. Follow scholastic conduct policy:  
[http://www.purdue.edu/univregs/pages/stu\\_conduct/stu\\_regulations.html](http://www.purdue.edu/univregs/pages/stu_conduct/stu_regulations.html)

### **You can expect that the instructors will:**

1. Provide a supportive learning environment that fosters your success.
2. Create exercises, homework assignments and tests that approach real life problems and situations (authentic performance tasks) faced by the practicing engineer.
3. Provide timely feedback on your work with the intent of facilitating your understanding of the content.
4. Follow the syllabus.
5. Structure exams to predominantly address the Learning Objectives.

### **How to approach this class:**

1. You need to stay current with the lectures. Students have reported getting behind in previous courses. As some of the most important content build on previous concepts, it is important that you master one concept before being introduced to the next. This is the deliberate, distributed practice. If you do not deliberately practice the concepts in sequence, the probability of doing well in the course decreases significantly.
2. Read the material before the lecture; this provides a foundation for the concepts discussed in the lecture.
3. Get help sooner rather than later. Because of the sequential nature of the course, falling behind will likely result in the class becoming a struggle.
4. Recognize the importance of the Learning Objectives. Homework and exams will be based on the learning objectives. Make sure you understand the expectations for each learning objective. This will be especially important when preparing for exams.

5. In addition to group component of the matrixed “deep-dive” exercise, several case studies will be assigned as team projects (teams include on campus and distance students). The intent is for you to research the topic and do sufficient work to learn the subject and be able to both teach and learn from others. In preparing to engage in discussion groups on blackboard, ensure that you have identified the concepts in the course that are the foundational concepts for the case study. Work with your team to ensure everyone can address the topics that have been provided.

## **Grading**

This is a 500-level class that is designed to build on prior learning. The intent is to synthesize content from earlier courses taken as an undergraduate. Recognizing that some time may have lapsed and that some content may have been forgotten, assessments and feedback will be provided. The purpose for these assessments is to provide the student feedback on gaps in understanding. Students are expected to recognize gaps and to seek help either from the instructor, on-line, or from other sources. By being clear about course curricular priorities and learning expectations, the intent is that you, as the student, will take an active role in learning and mastery of the content.

Graded homework due every 2 to 3 weeks, one midterm exam, one final exam, a literature survey on an aspect of Lean of the student’s choice (within a matrix provided), and a group project synthesizing elements of individuals’ literature surveys and short presentation thereof.

- Homework sets (individual), 10%
- Case studies (group), 10%
- Matrix exercise, deep-dive study:
  - Individual literature review papers, 20%.
  - Synthesis and group presentation 10%.
- Midterm exam, 20%.
- Final exam, 30%.

Final grades will be based on A>90%, 89%<B<80%, 79%<C<70%, etc.; +/- will be assigned as appropriate within these bands. The instructors reserve the right to slide the scale down if needed (i.e. if we decide an 89% is reflective of an A, we’ll do that), but we promise if the above noted scores are achieved, you will receive a grade in that letter range.

## **Academic Dishonesty Policy**

Purdue University Regulations, Part 5, Section III-B-2-a describes the formal policies governing academic dishonesty. A guide providing specific examples, tips, and consequences is available at <http://www.purdue.edu/odos/osrr/academic-integrity/index.html>. You are encouraged to work to together and discuss concepts and general approaches to the homework problems but the solutions you turn in for grading are expected to be your own original work.

## **Nondiscrimination, Disability, and Support Service Statements**

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her

own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue's nondiscrimination policy can be found at [http://www.purdue.edu/purdue/ea\\_eou\\_statement.html](http://www.purdue.edu/purdue/ea_eou_statement.html).

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: [drc@purdue.edu](mailto:drc@purdue.edu) or by phone: 765-494-1247. <http://www.purdue.edu/drc/faculty/syllabus.html>.

If you find yourself beginning to feel some stress, anxiety, and/or feeling slightly overwhelmed, try WellTrack, <https://purdue.welltrack.com/>. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please see the Office of the Dean of Students, <http://www.purdue.edu/odos>, for drop-in hours (M-F, 8 am- 5 pm).

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 and <http://www.purdue.edu/caps/> during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

### **Emergency Procedures**

Fire, weather, and civil emergency procedures specific to Hampton Hall will be reviewed in class. Information on emergency preparedness at Purdue is available on the Purdue homepage and at [http://www.purdue.edu/emergency\\_preparedness/](http://www.purdue.edu/emergency_preparedness/).

Evacuation Emergency Assembly Areas (fire alarm): Immediately evacuate the building and proceed to the parking lot area away from the building.

Shelter in Place recommendation for a tornado warning: If a tornado warning has been issued for campus, move to the lowest level possible away from exterior doors and windows. Seek more information on storm conditions from National Weather Service weather radio or application on mobile device.

Shelter in Place recommendation for an active threat such as a shooting: If one cannot get away, shelter in a room that is securable preferably without windows.

Shelter in Place recommendation for a major hazardous materials release: shelter in nearest building or classroom, shutting any open doors and windows.

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on Blackboard and I will send an email.