CON E 650 – Construction Labor Productivity
Fall 2014

INSTRUCTOR:
Thais Alves (talves@mail.sdsu.edu)
Office: ED 100E
Phone: 619-594-8289
Office hours: T 1100-1200; W 900-1030, Th 1330-1500 and by appointment

MEETING TIME:
T 1900 – 2140

ROOM:
GMCS 306

FINAL EXAM SCHEDULE:
12/16/2014, 1900-2100

BASIS OF GRADING:
A>=94%; A->=90%
B+>=87%; B>=84%; B->=80%
C+>=77%; C>=74%; C->=70%
D+>=67%; D>=64%; D->=60%

GRADING:
Class attendance and participation 10%
Project 1 20%
Project 2 25%
Project 3 20%
Final Exam: 25%

COURSE DESIGNATION
Course acceptable on Master's degree program in Civil, Construction and Environmental Engineering.

COURSE DESCRIPTION
Definition of productivity measures and factors that affect productivity of construction labor. Quantification techniques of labor productivity in construction.

PRE-REQUISITES
Construction Engineering 401 and Construction Engineering 301.

ASSIGNED READINGS AND IMPORTANT RESOURCES
• Additional assigned readings will have links posted on Blackboard.
• Other important resources for this class can be found in these websites: www.iglc.net, www.leanconstruction.org, http://p2sl.berkeley.edu/, www.lean.org, www.asce.org – Journal of Construction Engineering and Management
COURSE LEARNING OUTCOMES:

Students should be able to:

A. **Identify** factors that affect productivity in different activities related to the construction industry.
B. **Select** techniques for measuring and reporting about labor productivity.
C. **Use** concepts, principles and tools originating in other industry sectors to **analyze** productivity in construction, and **recommend** improvement actions.
D. **Design** construction operations using process improvement techniques.

CLASS POLICIES

Changes or supplements to this syllabus will probably occur. When this happens, I will announce changes in class, but it may only happen once. You are responsible for these changes even if you were not present for or did not hear the announcement.

Students are expected to behave as if they are interested and engaged in the material. Reading a newspaper, texting, emailing, or talking with a neighbor are examples of activities that are inconsistent with being interested and engaged in the material. If you do not act as if you are interested and engaged, you may distract students who are interested and engaged. This is not acceptable. I will ask students to leave if their actions are inconsistent with being interested and engaged in the material; repeated such requests will lead to more significant consequences up to and including involuntary drop.

*If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services. Your cooperation is appreciated.*

Assignments

All assignments will be due on the assigned date, either at the start of class or via the digital dropbox (as detailed in the assignment). Late assignments, or assignments which are not neat and orderly, will be determined non-responsive. In this context, “neat and orderly” means that the method and order of presentation will facilitate understanding the logic and procedure of the solution. Non-responsive assignments may be briefly reviewed, but will not be counted towards a grade. An organized presentation of assignments will include short descriptive headings above each step or section.

Your homework is to represent your individual effort. Collaboration is encouraged and will occur, but copied work will receive a grade of zero. Each student is expected to understand and be able to explain his or her own work. Also, please check [http://infotutor.sdsu.edu/plagiarism/index.cfm?p=graphic](http://infotutor.sdsu.edu/plagiarism/index.cfm?p=graphic) for information on plagiarism.

Exams

Exams will be mandatory and comprehensive. You will be responsible for everything in the reading, lectures, class notes, handouts, class assignments, or other related documents.

Class Participation

During class I will ask questions of the students about the material being discussed and the examples being performed. You will be expected to be prepared to answer when I call upon you. More importantly, I will give you a number of opportunities to work together on the material in class. I expect you to participate, and I will want an explanation if you consistently fail to participate. Failure to actively participate can have consequences for your grade. Professional and courteous behavior in all interactions with the instructor and fellow students is expected.

Cell phones should be turned off during class. Please do not make a habit of coming late or leaving early.
We will use Blackboard extensively in this course. *It is the student's responsibility to check blackboard regularly, and to make sure the email registered with webportal is one that the student frequently checks.* I will NOT send out special announcements to any student via email other than via blackboard. I will send out frequent updates on the schedule and homework due dates, but only via blackboard.

*For every week's readings there are important topics and questions you should pay attention to and look for answers in the readings. Be sure to address these topics and questions and come prepared for discussion in every class.*

**University Sanctioned Activities:**

Some students may participate in university sponsored activities (such as intercollegiate athletics or student government), which may require them to miss class. These students, and ONLY these students, *will* be given the chance to make up graded work they miss as a result of travel. This right will be granted *ONLY* if **all** of the following conditions are met.

1. Students participating in University-sanctioned activities need to identify themselves *prior* to missing class.
2. Students must provide me a copy of their travel schedule indicating the SDSU organization sponsor or on letterhead of the sponsor.
3. Missed work will be rescheduled at a convenient time on a case-by-case basis. In general, the student should expect to make up quizzes very shortly *before* their departure.

**GUEST SPEAKERS AND SIMULATIONS**

At the end of each lecture when we have guest speakers or develop simulations, students are required to turn in a one-page summary of the lecture containing three main points:

- **Lessons learned:** what are the main points you have learned from the guest lecture and/or simulation?
- **Plus:** what did work well in the lecture and/or simulation during the class period?
- **Delta:** what are potential points to improve the experience about the lecture and/or simulation? (e.g., what can be changed to promote learning, link the topics to additional concepts, room organization, etc.)

**PROJECTS:** *(additional details will be provided to students when the projects are assigned)*

**Project 1 – Factors affecting productivity and analysis of operations**– Teams of three students will study a process used to deliver a product or a service outside of the construction industry. This project comprises the following phases, which should be clearly presented on the final report and the class presentation:

1. **On-site data collection** - You will be required to collect data about the productivity of the crew performing the tasks and the workplace where the tasks were developed (e.g., time to perform task, number of workers, batch of work performed, layout of the workplace, tools and equipment used).
2. **Representation and analysis of the data** using the tools and concepts discussed in the readings for weeks 2 through 4 (process bar charts, crew balance charts, flow diagrams, photographs, videos).
3. **Clearly identify the main factors affecting the productivity of those involved with the task studied.**

**Project 2 – Analysis of operations in a construction site and value stream map (VSM)** – Teams of three students will study a field construction process used to deliver a product or a service. This project comprises four main phases, which should be clearly presented on the final report and the class presentation:
1. On-site data collection - You will be required to collect data about the productivity of the crew performing the tasks (time to perform task, number of workers, batch of work performed, etc.)
2. Representation and analysis of the data using the tools discussed in class (process bar charts, crew balance charts, flow diagrams, photographs, videos)
3. Development of a current Value Stream Map (VSM) based on readings for weeks 7 and 8.
4. Proposition of a future VSM and discussion on how to move from the current to the future state map.

Project 3 – Analysis of site logistics and material/equipment management in a construction site–
Teams of three students will study the site logistics of a construction site and investigate how materials and equipment are managed to support the work of construction crews. Teams will document characteristics of site layout, plans for delivery of materials, schedule of major equipment, safety programs and elements found at the site. Each team should report on the current conditions and propose realistic changes.

**FINAL EXAM**

The final exam will be comprehensive.
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<th>Week</th>
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<th>Reading / assignments</th>
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| 1    | Introduction to CON E 650.  
*Simulation: Making Dice (introduction to productivity studies)* (8/26)  
(TENTATIVE SCHEDULE – FALL 2014) | CONE 650 Syllabus  
Project 1 assigned |
| 2    | Factors Affecting Productivity in Construction and Productivity Studies (9/2) | Readings: Oglesby et al. (1989) Skim: Ch.1 through Ch.3 (Productivity studies in the construction industry). Read Ch.7 and Ch.8 (Tools) |
| 3    | Tools to measure productivity in Construction (Cont.). Interaction between Subcycles and Operations Design (9/9) | Readings: Oglesby et al. (1989) Ch.7 and Ch.8, Howell et al. (1993) |
| 4    | Constructability and Off-site Construction  
Assignment (Due 9/16): Presentation Feedback |
| 5    | Project 1 presentations and discussion (9/23) | Project 1 report + presentation (Due 9/23)  
Assignment (Due 9/23): Presentation Feedback  
Projects 2 and 3 assigned |
| 6    | Value Stream Mapping – Guest speaker: Mike Osterling (Osterling Consulting)  
Intro to Lean Construction (9/30) | Reading: Koskela (1992) and Diekmann et al. (2004) Chapter 6 and appendix |
| 7    | Intro to Lean Construction (cont.). The effects of variability and dependency (10/7) | Reading: Tommelein et al. (1998), Mitropoulos et al. (2014)  
Assignment (Due 10/7): Use the Excel spreadsheet provided and come prepared to answer and discuss the questions posted on Blackboard. |
Assignment (Due 10/14): Presentation Feedback |
| 10   | Productivity measurement and claims Confirmed: Kenneth Baker, Senior VP, Hill International (10/28) | Assignment (Due 10/28): Students to compile information on methods and cases. Additional guidance will be provided by the instructor.  
Assignment (Due 10/28): Presentation Feedback |
| 11   | Project 2 presentations and discussion (11/4) | Project 2 report + presentation (Due on 11/4)  
Assignment (Due 11/4): Presentation Feedback |
| 12   | Holiday – Veterans Day (11/11) |  |
| 14   | Theory of Constraints – understanding the impact of production system design on productivity (11/25) | Reading: Goldratt’s The Goal  
Assignment (Due 11/25): Come prepared to answer and discuss the questions posted on Blackboard. |
| 15   | Course overview (12/2) | Review lecture notes, assignments, and readings |
| 16   | Project 3 presentations and discussion (12/9) | Project 3 report + presentation (Due on 12/9)*  
Review class notes |
| 17   | FINAL EXAM 12/16/2014 1900-2100 | Comprehensive Exam |
Assigned readings:

Week 1
- Syllabus and Project 1 description.
- For every week’s readings there are important topics and questions you should pay attention to and look for answers in the readings. Be sure to address these topics and questions and come prepared for discussion in every class.

Week 2
  - Productivity and performance definition.
  - State-of-the-art of productivity studies then and now.
  - What factors influence productivity in construction?
  - What can be done to improve productivity in construction?
  - What are the traditional tools to develop productivity studies in construction?

Week 3
  - What factors influence productivity in construction?
  - What can be done to improve productivity in construction?
  - What are the traditional tools to develop productivity studies in construction?
  - What is decoupling? How is it illustrated in the paper?
  - When is decoupling appropriate to improve productivity?
  - Can you think about examples of when/how decoupling is used in your work?

Week 4
  - What is constructability?
  - How is constructability related to productivity improvements in construction?
  - What is the difference between constructability and value engineering?
  - How different are shop activities when compared to site activities regarding productivity?
  - What are the advantages, disadvantages and requirements to send activities to be performed off-site?

Week 5
- Project 1 presentations and discussion.
Week 6
  o Which principles does Koskela recommend to improve production in construction?
  o Which two principles could you apply on your job? How?
  o How are Koskela's principles directly or indirectly addressed in Diekmann et al.'s examples?

Week 7
  o What are the main lessons you learned from the Parade Game?
  o If you were a project manager and had a choice which trade would you chose to perform the initial activities in your project? Which trade would you chose to perform the final activities in your project?
  o How do variability and dependency affect productivity in construction?

Week 8
  o What is shielding production?
  o What is the Last Planner System (LPS) of Production Control?
  o What are the main components of the LPS?

Week 9
  o What are the physical flows in construction projects?
  o What are the main barriers to managing physical flows in construction projects?
  o How does the management of physical flows affect craft productivity?
  o What is visual management? How can it be applied to construction projects to improve productivity?

Week 10
• Students to compile information about cases for discussion.

Week 11
Project 2 presentations and discussion.
Week 12
*Holiday – Veterans Day*

Week 13
  - How is different are the approaches discussed in these two publications?
  - How are safety and productivity related?

Week 14
  - What is a critical resource? How does it limit productivity?
  - How do you plan to keep a critical resource productive?

Week 15
*Course Overview. Review course material and come prepared for a Q&A session.*

Week 16
*Project 3 presentations and discussion.*

Week 17
*Final exam.*
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