

**COURSE SYLLABUS**  
**The University of Texas at Arlington**  
*College of Engineering*  
**Department of Civil Engineering**  
**CE 5387 – Construction Productivity**  
**(3 Credit Hours)**

**Name of Instructors:** Dr. Mohammad Najafi, P.E., and Dr. Mostafa Ghandehari

**Contact Information and Office Hours:**

**Dr. Najafi:**

428 Nedderman Hall

817-272-0507

[Najafi@uta.edu](mailto:Najafi@uta.edu)

Monday and Wednesday, 2:00 – 5:00 PM (Additional Office Hours by Appointment).

**Dr. Ghandehari:**

430 Nedderman Hall

817-272-5688

[gandeha@uta.edu](mailto:gandeha@uta.edu)

Monday and Wednesday: 11:00 AM - 12:00 PM; Tuesday and Thursday: 3:30-5:00 PM (Additional Office Hours by Appointment)

**Teaching Assistant (TA):** Jwala Raj Sharma

**Office Number:** Civil Engineering Laboratory Building (CELB) – Room 141

**Office Telephone Number:** 817-272-9164

**Office Hours:** Tuesday and Thursday, 1:30 to 4:30 PM

**Email:** [jwalraj.sharma@mavs.uta.edu](mailto:jwalraj.sharma@mavs.uta.edu)

**Course Number, Section Number, and Course Title:**

- Section 001-LEC (21175) **Room 111 Nedderman Hall**
- Section 002-LEC (21176) **Off Web**

CE 5387 – Construction Productivity

**Time and Place of Class Meetings:** Monday and Wednesday, 7:00 – 8:20 PM, Room 111, Nedderman Hall.

**Description of Course Content:** Evaluation of construction project management's effectiveness. An investigation of the advanced techniques required for improvement of construction projects including time, cost, quality management, preplanning, field evaluation techniques, time-lapse photography, safety, human factors, and communications.

**General Student Learning Outcomes:** Upon completion of the course, the student will have:

- an ability to apply knowledge of mathematics, science, and engineering,
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability,
- an ability to function on multi-disciplinary teams,
- an ability to identify, formulate, and solve engineering problems,
- an understanding of professional and ethical responsibility,
- an ability to communicate effectively,
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,
- a recognition of the need for, and an ability to engage in life-long learning,
- a knowledge of contemporary issues, and
- an ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

**Specific Student Learning Outcomes:** Upon completion of CE 5387, the students will:

- understand importance of productivity in construction operations,
- understand measurement, evaluation, and presentation of productivity data,
- know methods to improve both productivity and performance in a construction project,
- understand the variables impacting project effectiveness, productivity, and performance, such as, planning and scheduling, cost estimating, project control, project organization, project layout, total quality management, project safety, constructability, project communications, contract management, project design, LEED, and lean construction, and so on,
- acquire ability to use computer software for productivity evaluation, design of construction operations, and contract management, and
- acquire ability to use statistical models to analyze data and make decisions to improve productivity of construction operations.

**Prerequisite:** CE 5379, CE 5386 and IE 5318; or consent of instructor.

**Textbooks and Other Course Materials:**

No required textbook. The students are required to utilize a variety of library and Internet sources, including lecture materials, sources provided on WebCT, the following text books, journal and conference papers, theses and dissertations, magazines and library search engines, such as Engineering Village and ASCE Database, to prepare for course requirements. WebCT will be used for course management. MicroCYCLONE Simulation System (available at Purdue University Web site), Sage Timberline Contract Control Software and/or Primavera Expedition Software (available at the Civil Engineering Lab, Room 226 Nedderman Hall) will be utilized.

**Reference Books:**

The following are books available in the 3-hour reserve section of the Engineering Library. Additional reference materials are listed starting from Page 6.

**Ref # 1:** Oglesby, C. H., Parker, H.W., and Howell, G.A. (1989). "Productivity Improvement in Construction," McGraw-Hill, New York.

**Ref # 2:** Adrian, J. J. (2004). "Construction Productivity: Measurement and Improvement," Stipes Publishing L.L.C., Champaign, Illinois.

**Ref # 3:** Halpin, D. W. and Riggs L. S. (1992). "Planning and Analysis of Construction Operations," John Wiley & Sons, Inc., New York.

**Ref # 4:** Naoum, S.G. (1999). "Dissertation Research and Writing for Construction Students," Butterworth Heinemann, Great Britain.

**Ref # 5:** Ayyub, B. M., McCuen, R.H. (1997). "Probability, Statistics, and Reliability for Engineers," CRC Press, Boca Raton, Florida.

**Ref # 6:** Devor, R.E., Chang, T., and Sutherland, J.W. (2007). "Statistical Quality Design and Control: Contemporary Concepts and Methods," Pearson/Prentice Hall, Upper Saddle River, N.J.

**Ref # 7:** Mincks, W. R. and Johnston, H. (2004). "Construction Jobsite Management," 2<sup>nd</sup> Edition, Thomson Delmar Learning, Clifton Park, New York.

**Descriptions of Major Assignments and Examinations with Due Dates:** There will be one midterm and one final exam, one term project with presentation, a term paper with presentation, and several assignments and class presentations. In most class periods, time will be allocated for students' presentations. Students are encouraged to take advantage of this opportunity, study sources related to construction productivity, and make short but formal presentations to class to obtain maximum points for class attendance, participation and presentations category. See Active/Cooperative Learning Section for more details.

**Grading Policy:** Grades will be determined according to the following scale (the grading scale may be lowered at the discretion of the instructor, but will not be raised):

Grade	% Required
A	90 -100
B	80-89
C	70-79
D	60-69
F	Less than 60

Students will be required to accumulate points from the following:

Assignments (Including HW and Labs), Class Attendance, Assignments, Participation & Presentations	20%
Term Paper	15%
Project	20%
Midterm	20%
Final Exam (Comprehensive)	25%
<hr/> Total	<hr/> 100%

**Active/Cooperative Learning:** This class supports a new pedagogy that promotes active learning for students' higher order critical thinking. Active learning promotes full student participation in class. Instructor may assign students to do assignments in teams and all the team members receive the same grade. If a team member refuses to cooperate on an assignment, his or her name should not be included on the completed work. Additionally, instructor may ask students to discuss lecture materials in groups and ask one of the group members to present the topic to the class.

**Attendance Policy:** Students are expected to attend all classes. For total professional development, class participation and oral discussions will be encouraged. Everyone is asked to arrive on time and be seated promptly for duration of class to minimize the disruption to others.

**Drop Policy:** Students need to consult UTA Web site for information on the university drop policy.

**Americans with Disabilities Act:** The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 - The Rehabilitation Act of 1973 as amended. With the passage of federal legislation entitled *Americans with Disabilities Act (ADA)*, pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As faculty members, we are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels. Information regarding specific diagnostic criteria and policies for obtaining academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability). Also, you may visit the Office for Students with Disabilities in room 102 of University Hall or call them at (817) 272-3364.

**Academic Integrity:** It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, and the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Series 50101, Section 2.2)

**Student Support Services Available:** The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. Classes are held as scheduled during this week and lectures and presentations may be given.

**Librarian to Contact:**

Barbara R. Howser  
 Librarian  
 UT Arlington Science & Engineering Library  
 Mailing address: 702 Planetarium Place, Arlington, TX 76019  
 Phone: 817.272.7519  
 Email: [howser@uta.edu](mailto:howser@uta.edu)

**E-Culture Policy:** The University of Texas at Arlington has adopted the University email address as an official means of communication with students. Through the use of email, UT-Arlington is able to provide students with relevant and timely information, designed to facilitate student success. In particular, important information concerning registration, financial aid, payment of bills, and graduation may be sent to students through email.

All students are assigned an email account and information about activating and using it is available at [www.uta.edu/email](http://www.uta.edu/email). New students (first semester at UTA) are able to activate their email account 24 hours after registering for courses. There is no additional charge to students for using this account, and it remains active as long as a student is enrolled at UT-Arlington. Students are responsible for checking their email regularly.

**Laptop and cell phone use in the classroom:** In order to minimize distraction to class, the **use of laptop and cell phones, including text messaging, in the classroom is NOT allowed**. Those students, who violate this rule, will lose part or all of their participation points.

**Grade Grievance Policy:** Refer to UTA Catalog.

**Assignment and Project Guidelines:** Will be announced in class. **NOTE:** If the assignment guidelines are not followed, the Grader will either reject the assignment outright, for extreme cases, or deduct points for items that do not conform to the specifications. See also **Academic Integrity** section above. Section 2 Off Web (21176) students must submit their assignment on WebCT by the due date and time. Additionally, these students must make arrangements with other students to perform the group project. The graded homework will be mailed or emailed to students.

**Exam and/or Quiz Guidelines:** will be announced in class. See also **Academic Integrity** section above.

**Make-up Exam Policy:** All students must take the final exam. Only extenuating circumstances will be accepted as excuse for missing the exam. Health related excuses require medical reports and the signature of a physician that provided the treatment. Section 2 Off Web (21176) students need to attend the exams in class or make appropriate arrangements with the instructor at least two weeks before the specific exam date.

**CE 5387 – Construction Productivity  
 TENTATIVE COURSE OUTLINE**

Day	Date	Topic	References	Learning Objectives	Assignment Due
<b>Week 1 – LEED</b>					
Wednesday	January 20	LEED	<b>Category C Guest Speaker: Mr. Fairchild</b>	Overview of US GBC's LEED 2009, v. 3 "Green Building Design & Construction" Manual.	
<b>Week 2 – Introduction &amp; Elements of Construction Productivity</b>					
Monday	January 25	Introduction to Construction Productivity	<b>Ref # 1 &amp; 2</b>	Defining productivity, effects & reasons of low productivity in construction industry, performance vs. productivity, characteristics of construction industry.	

Day	Date	Topic	References	Learning Objectives	Assignment Due
Wednesday	January 27	Responsibilities & Roles of Project Participants to Improve Productivity	<b>Ref # 1 &amp; 2</b>	Current practices for developing work methods, needs to improve construction productivity, off-site and onsite project activities, effects of preplanning on productivity, monitoring construction project.	
<b>Week 3 – Productivity Data Gathering and Presentation</b>					
Monday	February 1	Data Gathering for Productivity Improvement	<b>Ref # 1, 2 &amp; 3</b>	Statistical aspects of data gathering, definition and objectives of productivity study, various scientific and shortcut methods used in data gathering and productivity study, Method Productivity Delay Model (MPDM).	<b>Term Paper Topic Assignment # 1</b>
Wednesday	February 3	Presenting and Implementing Productivity Improvement Findings	<b>Ref # 1, 2 &amp; 4</b>	Techniques for data analysis and presentation, using new technologies to improve productivity, impact factors affecting productivity (human factors, company organization, motivation theories and so on).	
<b>Week 4 – Line of Balance and Queueing Models</b>					
Monday	February 8	Line of Balance	<b>Ref # 3</b>	Analysis of a set of data following different distributions, repetitive process in construction, production curves, project control using production curves.	<b>Term Paper Outline Assignment # 2</b>
Wednesday	February 10	Queueing Systems	<b>Ref # 3</b>	System states, Markovian models, finite population queueing, shortcomings of queueing models.	
<b>Week 5 – Modeling Process and Building Models</b>					
Monday	February 15	Modeling Process	<b>Ref # 3</b>	NORMAL, COMBI, & COUNTER elements, building a model.	
Wednesday	February 17	Building Models	<b>Ref # 3</b>	Defining flow units, cycle times, resource flow patterns, cyclic structures of work tasks.	<b>Draft Paper Due</b>
<b>Week 6 – Library Research Tools, Modeling Concepts and MicroCYCLONE</b>					
Monday	February 22	Library Research Tools and Writing Term	<b>Guest Lecturer: Ms. Barbara Howser, Science &amp; Engineering Librarian</b>	How to write a term paper, project report, theses and dissertations. How to use library resources and different databases.	
Wednesday	February 24	Modeling Samples: MicroCYCLONE	<b>Ref # 3</b>	Building a model on MicroCYCLONE, calculate productivities and costs of a construction operation. Examples of earthmoving and concrete operations, design a construction operation.	
<b>Week 7 – TQM, Lean Construction &amp; Quantifying Lost Productivity</b>					
Monday	March 1	Lost Productivity	<b>Ref # 2</b>	Define impact factors affecting productivity and how to quantify lost productivity.	<b>Form Groups &amp; Select the Group Project</b>

Day	Date	Topic	References	Learning Objectives	Assignment Due
Wednesday	March 3	TQM & Lean Construction	Ref # 2	Define TQM, TPQM and lean construction.	Assignment # 3
Week 8 – Term Project and Term Paper					
Monday	March 8	Term Project Guidelines	Ref # 4	Methods for effective technical writings and communications in construction projects.	Term Project Progress Reports
Wednesday	March 10	Term Paper Presentations			Final Paper Due
Week 9 – Spring Break					
Monday	March 15	Spring Break			
Wednesday	March 17	Spring Break			
Week 10 – Contract Management					
Monday	March 22	Contract and Record Management	Ref # 1, 2 & 7	Methods for effective record keeping and documentations, such as daily reports & correspondences	
Wednesday	March 24	Midterm Test			
Week 11 – Decision Theory					
Monday	March 29	Decision Theory Part 1	Ref # 5 & 6	Identification of values and uncertainties of decision and obtaining optimum decision.	Project Progress Report Assignment # 4
Wednesday	March 31	Decision Theory Part 2	Ref # 5 & 6	Quality control using principles of statistics and probability.	
Week 12 – Effective Project Management					
Monday	April 5	Effective Project Management	Ref # 7	Manage project owner, subcontractors and other parties in the project.	Lab Assignment
Wednesday	April 7	Contract Control Lab Assignment			
Week 13 – Statistical Quality Control					
Monday	April 12	Quality Control Part 1	Ref # 5 & 6	How to control construction quality using principles of statistics and probability – Part One.	
Wednesday	April 14	Quality Control Part 2	Ref # 5 & 6	How to control construction quality using principles of statistics and probability – Part Two.	
Week 14					
Monday	April 19	MicroCYCLONE Lab Assignment			
Wednesday	April 21	Meetings, Negotiations, Labor Relations, and Dispute Resolution	Ref # 7	How effectively start, layout and manage a construction project.	
Week 15 – Project Presentations					
Monday	April 26	Term Project Presentations			Project Reports & Presentations Due
Wednesday	April 28	Term Project Presentations			
Week 16 – Project Presentations					
Monday	May 3	Term Project Presentations			
Wednesday	May 5 – Last Day of Class	Term Project Presentations			
Week 17 – Final Exam					
Wednesday, May 12, 8:15 – 10:45 PM		Final Exam (Comprehensive)			

## **Additional Reference Books**

### **A). Productivity and Project Management**

- Adrian, J. (1993). "Construction Estimating," Stipes.
- Callahan, M. T., Quackenbush, D. G., Rowings, J. E. (1992). "Construction Project Scheduling," McGraw-Hill, New York.
- Clough, R. H. and Sears, G.A. (1994). "Construction Contracting," Sixth Edition, Wiley.
- Fisk, E. R. and Reynolds, W. D. (2006). "Construction Project Administration," 8<sup>th</sup> Edition, Prentice Hall.
- Halpin, D. W. (2006). "Construction Management," Third Edition, Wiley.
- Holm, L., Schaufelberger, J.E., Griffin, D., Cole, T. (2005). "Construction Cost Estimating, Process and Practices," Pearson
- Peurifoy, R., Schexnayder, C. and Shapira, A. (2006). "Construction Planning, Equipment, and Methods," Seventh Edition, McGraw-Hill, New York.
- Levy S.M. (2007). "Project Management in Construction," Fifth Edition, McGraw-Hill, New York.
- Means' Construction Cost Data
- Production and Cost Estimating of Material Movement with Earth Moving Equipment, Terex Company.
- Samuels, B.M. (1996). "Construction Law," Prentice Hall, Upper Saddle River, New Jersey.
- CII Website.
- Instructors' Lecture Materials, Notes and Handouts.

### **B). Construction Methods**

- Caterpillar Performance Handbook
- Harris, F. (1994). "Modern Construction & Ground Engineering Equipment & Methods."
- Najafi, M. (2005). "Trenchless Technology: Pipeline and Utility Design, Construction and Renewal," McGraw-Hill, New York.

### **C). Green Building and Sustainable Construction**

- Glavinich T.E. (2008). "Contractors' guide to Green Building Construction," John Wiley & Sons, Inc, Hoboken, New Jersey.
- Krygiel E. and Nies B. (2008). "Green BIM," Wiley Publishing, Inc., Indiana.
- Kibert C.J. (2008). "Sustainable Construction," John Wiley & Sons, Inc, Second Edition, Hoboken, New Jersey.
- Lean Construction Web Site and Publications.
- Vallero D. and Brasier C. (2008). "Sustainable Design," John Wiley & Sons, Inc., Hoboken, New Jersey.

### **D). Engineering Economics**

- Thuesen, G. J., Fabrycky, W.J. and Thuesen, G.J. (1977). "Engineering Economy," Prentice Hall, Englewood Cliffs, New Jersey.
- Nelson, Emmitt J. & Haggard, Rusty, January/February, 1995, "The Economics of Zero-Injury," CFMA Building Profits.
- Nelson, Emmitt J., July 1995, "A Shift is Afoot, It Readers Pulse Section, Professional Safety.
- Nelson, Emmitt J., May 1994, "Task force says use of safety techniques helps achieve "Zero-Injury, " Professional Roofing.

### **E). Engineering Ethics**

- Martin, M.W. and Schinzinger, R. (2005). "Ethics in Engineering," Fourth Edition, McGraw-Hill, New York.

### **F). Construction Safety**

- Goetsch, D.L. (1996). "Occupational Safety and Health," Second Edition, Prentice-Hall, Inc. Englewood Cliffs, New Jersey.
- Hinze, J. W. (1997). "Construction Safety," Prentice-Hall, Inc. Upper Saddle River, New Jersey.
- Buchanan, Don, Editor, 2000, "Zero Injuries Handbook," Hazard Alert Training & Supplies Canada, Inc.
- Bureau of Labor Statistics, U.S. Department of Labor, "Injury Incidence Rates for Construction," December 2003.
- Business Roundtable, "Improving Construction Safety Performance," The Construction Cost Effectiveness Project A-3, New York, NY 1982.
- Construction Industry Institute, Austin, Texas: "Zero-Injury Techniques," Product 32.1 of the Zero Accidents Taskforce, Nelson, Emmitt J., Principal Author, 1993.
- Construction Industry Institute, Austin, Texas: "Zero Accident Techniques," CII Source Document 86, Roger W. Liska, David Goodloe and Rana Sen, Clemson University, January 1993.
- Construction Industry Institute, Austin, Texas: "Zero-Injury Economics," "CII Special Publication 32.2, Nelson, Emmitt J., Principal Author, September 1993.

- Construction Industry Institute, Austin, Texas: "Indirect Cost of Injury," CII Product of Research Taskforce, Jimmie Hinze, University of Washington, Seattle, 1991.
- Construction Industry Institute, Austin, Texas: "Making Zero Injuries a Reality," CII Product of Research Taskforce, Jimmie Hinze, University of Florida, Gainesville, 2002.
- Krause, Thomas R. 1997, "The Behavior-based safety Process, Managing Involvement for an Injury Free Culture," Second Edition.
- Levitt, Raymond E. and Samelson, Nancy M., 1993, "Construction Safety Management," Second Edition.
- Nelson, Emmitt J., March 2002, "Zero-Injury Performance," Hydrocarbon Engineering.
- Nelson, Emmitt J., December 1998, "Safety Commitment Redefined," Professional Safety.
- Nelson, Emmitt J., January 1996, "Remarkable Zero-Injury Safety Performance," Professional Safety.
- Snee & Hoerl, 2003, "Leading Six Sigma." Prentice Hall

### **References in Lean Construction**

With the exception of the textbooks, the papers listed can be found online at the IGLC website <http://www.iglc.net/conferences/> or at the indicated link.

### **Origins of Lean Production**

- Liker, J. (2004). *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* (Hardcover) - McGraw-Hill.
- Additional Reading
  - James Womack and Daniel Jones, *Lean Solutions: How Companies and Customers Can Create Value and Wealth Together*, Simon and Schuster, New York, NY. 2005.
  - James Womack and Daniel Jones, *Lean Thinking*, Simon and Schuster, New York, NY. 2003 – Preface and Chapter 1-7 is enough.
  - James Womack, Daniel Jones, and Daniel Roos, *The Machine That Changed the World*, MacMillan Publishing, New York, NY. 1990.

### **Production Theories in Construction**

- Koskela, L. and Howell, G., (2002), The Underlying Theory of Project Management is Obsolete. Proceedings of the PMI Research Conference, 2002. Pg. 293-302 (<http://www.leanconstruction.org/wpapers/index.htm#Theory>)
- Ballard, G., and Howell, G. (2004). "Competing Construction Management Paradigms." *Lean Construction Journal* ([www.leanconstructionjournal.org](http://www.leanconstructionjournal.org)), Volume 1, issue 1.
- Bertelsen, S. and Koskela, L. (2002). "Managing the Three Aspects of Production in Construction." Proceedings of the 10<sup>th</sup> Conference of the International Group for Lean Construction, Brazil, August 6-8 (<http://www.iglc.net/conferences/>).
- Howell, G., and Macomber, H. (2006). "What Should Project Management be Based on?" Proceedings of the 14<sup>th</sup> Conference of the International Group for Lean Construction, Santiago, Chile, July 25-27 (<http://www.iglc.net/conferences/>).
- Luo, R. Y. and Najafi, M. (2008). "Closure to Productivity Study of Microtunneling Pipe Installation Using Simulation," ASCE Journal of Infrastructure Systems, Manuscript No. IS/2008/022701.
- Additional Reading
  - \* Everett, J. G. (1992). "Let's pass on Mass Production." *Construction Business Review* (CBR), 2(2), 13-14.
  - \* Koskela, L. (1993). "Lean production in construction." Proceedings of the 10<sup>th</sup> ISARC, Houston, Texas, May 24-26, 47-54
  - Howell, G and Ballard, G (1994). "Lean Production Theory: Moving Beyond 'Can-Do'". Proceedings of the 2<sup>nd</sup> Conference of the International Group for Lean Construction, Santiago, Chile, September (<http://www.iglc.net/conferences/>).
  - Koskela, L (1999). "Management of Production in Construction: A Theoretical View" Proceedings of the 7<sup>th</sup> Conference of the International Group for Lean Construction, Berkeley, California, USA, 26-28 July 1999 (<http://www.iglc.net/conferences/>).
  - Koskela, L. (2000). [An exploration towards a production theory and its application to construction](#), VVT Technical Research Centre of Finland.
  - Bertelsen, S. (2003). "Construction as a Complex System". Proceedings of the 11th Annual Meeting of the International Group for Lean Construction, Blacksburg, Virginia (<http://www.iglc.net/conferences/>).



- Abdelhamid, T., S. (2004). "The Self-Destruction and Renewal of LEAN CONSTRUCTION Theory: A Prediction from Boyd's Theory". Proceedings of the 12th Annual Conference of the International Group for Lean Construction, 03-06 August 2004, Helsingør, Denmark (<http://www.iglc.net/conferences/>).

### **Lean Construction**

- Howell, G. (1999). "What Is Lean Construction" Proceedings of the 7th Conference of the International Group for Lean Construction, Berkeley, California, USA, 26-28 July 1999 (<http://www.iglc.net/conferences/>).
- \*Koskela, L., Howell, G., Ballard, G., and Tommelein, I. (2002). "The Foundations of Lean Construction." Design and Construction: Building in Value, R. Best, and G. de Valence, eds., Butterworth-Heinemann, Elsevier, Oxford, UK.
- Abdelhamid, T. and Salem, O. (2005). "Lean Construction: A New Paradigm for Managing Construction Projects." Proceedings of the 1st International Workshop on Innovations in Materials and Design of Civil Infrastructure, Cairo, Egypt, December 28-29 (<http://www.hbrc.edu.eg/ehbrc/workshop/cmn.asp>).

#### **- Additional Reading**

- Ballard, G. and Howell, G. (1998). "What Kind of Production Is Construction?" Proceedings of the 6<sup>th</sup> Conference of the International Group for Lean Construction, Guarujá, Brazil, August 13-15. (<http://www.iglc.net/conferences/>)
- Howell, G and Ballard, G (2000). "Implementing lean construction: understanding and action." Proceedings of the 8<sup>th</sup> Conference of the International Group for Lean Construction, Brighton, UK, July 17-19. (<http://www.iglc.net/conferences/>)
- Howell, G. and Koskela, L. (2000). "Reforming Project Management: The Role of Lean Construction". Proceedings of the 8<sup>th</sup> Conference of the International Group for Lean Construction, Brighton, UK, July 17-19. (<http://www.iglc.net/conferences/>)
- Ballard, G. (2000). "Lean Project Delivery System". Lean Construction Institute White Paper #8. Available at <http://www.leanconstruction.org/>.
- Bertelsen, S. (2004). "Lean Construction: Where Are We and How to Proceed?" Lean Construction Journal ([www.leanconstructionjournal.org](http://www.leanconstructionjournal.org)), Volume 1, issue 1.
- Abdelhamid, T. S. (2003). "Six-Sigma in Lean Construction Systems: Opportunities and Challenges". Proceedings of the 11th Annual Conference for Lean Construction, 22-24 July 2003, Blacksburg, Virginia, 65-83. (<http://www.iglc.net/conferences/>)

### **Work Structuring - Production System Design**

- Howell, G., Alexander, L., Ballard, G. (1993). "Interaction between sub cycles –One key to improved methods." *Journal of Construction Engineering and Management*, ASCE, 119 (4) 714-728 (<http://www.leanconstruction.org/pdf/interaction.pdf>).
- Howell, G. and Ballard, G. (1999). "Design of Construction Operations". Lean Construction Institute White Paper #4. Available at <http://www.leanconstruction.org/>.
- \*Tommelein, I.D. (1998). "Pull-driven Scheduling for Pipe-Spool Installation: Simulation of Lean Construction Technique." ASCE, J. of Constr. Engrg. And Mgmt., 124 (4) 279-288.
- Tsao, C. et al. (2000). "Case Study for Work Structuring: Installation of Metal Door Frames". Proceedings of the 8<sup>th</sup> Conference of the International Group for Lean Construction, IGLC-6, Brighton, UK, July 17-19 (<http://www.iglc.net/conferences/>).
- Tsao, Cynthia (2005). [Use of Work Structuring to Increase Performance of Project-Based Production Systems](#). Ph.D. Diss., Dept. of Civil & Envir. Engrg, University of California, Berkeley, 325 pp.
- Fábio K. Schramm, Alana A. Rodrigues and Carlos T. Formoso (2006). The Role of Production System Design in the Management of Complex Projects. Proceedings of the 14<sup>th</sup> Conference of the International Group for Lean Construction, Santiago, Chile, July 25-27 (<http://www.iglc.net/conferences/>)
- Alberto Esquenazi and Rafael Sacks (2006). Evaluation of Lean Improvements in Residential Construction using Computer Simulation. Proceedings of the 14<sup>th</sup> Conference of the International Group for Lean Construction, Santiago, Chile, July 25-27 (<http://www.iglc.net/conferences/>)

#### **- Additional Reading**

- Oglesby, Clarkson, Henry Parker and Gregory Howell (1990). *Productivity Improvement in Construction*. New York: McGraw-Hill. Ch 7 and 8. (available in PDF format on CD for \$15 through [ghlci@earthlink.com](mailto:ghlci@earthlink.com))
- Ballard, G. and Tommelein, I. (1998). "Aiming for Continuous Flow." Lean Construction Institute White Paper #3. Available at <http://www.leanconstruction.org/>.

### **Production Management (Last Planner System)**

- Ballard, G. and Howell, G. (1998). “[Shielding Production: An Essential Step in Production Control](#)” Journal of Construction Engineering in Management, ASCE, 124 (1) 18-24.
- Glenn Ballard (1997). “[Lookahead Planning: The Missing Link in Production Control](#)” Proceedings of the 5th Annual Conference of the International Group for Lean Construction, Griffith University, Gold Coast, Australia, July.
- Sacks, R., Goldin, M., and Derin, Z. (2005). “Pull-Driven Construction of High-Rise Apartment Buildings,” Proceedings IGLC-13, July 2005, Sydney, Australia. (<http://www.iglc.net/conferences/>).
- Macomber, H., Howell, G.A., Reed, D. (2005). “Managing Promises With The Last Planner System: Closing In On Uninterrupted Flow”. Proceedings IGLC-13, July 2005, Sydney, Australia. (<http://www.iglc.net/conferences/>).
- Hyden, B. B. (2006). “Lean Scheduling: An Innovation in Construction Scheduling” <http://www.bricker.com/legalservices/industry/construction/resources/articles/198.asp>

#### **- Additional Reading**

- Ballard, G. (2000). *The Last Planner System of Production Control*. PhD Thesis, University of Birmingham. Available at <http://www.leanconstruction.org/>.
- Tommelein, I., Riley, D., and Howell, G. (1998). “Parade Game: Impact of Work Flow Variability on Succeeding Trade Performance”. Proceedings of the 6<sup>th</sup> Conference of the International Group for Lean Construction, Guarujá, Brazil, August 13-15. (<http://www.iglc.net/conferences/>).
- Howell, G., Ballard, G., and Hall, J. (1998). “Capacity Utilization and Wait time: A Primer for Construction” Proceedings of the 6<sup>th</sup> Conference of the International Group for Lean Construction, Guarujá, Brazil, August 13-15. (<http://www.iglc.net/conferences/>).
- Pappas, M. (1990). “Evaluating Innovative Construction Management Methods through the Assessment of Intermediate Impacts” Master of Science in Engineering” Thesis, University of Texas at Austin, 1990. Summary available at <http://www.leanconstruction.org/>.

### **Value Management, Relational Contracting, Lean Design, and Target Costing**

- Wandahl, S., and Bejder, E. (2003). “Value-based Management in the Supply Chain of Construction Projects”. Proceedings of the 11th Annual Meeting of the International Group for Lean Construction, Blacksburg, Virginia, USA. (<http://www.iglc.net/conferences/>).
- Emmitt, S., Sander, D., and Christoffersen, A. (2005). “The Value Universe: Defining A Value Based Approach To Lean Construction”. Proceedings IGLC-13, July 2005, Sydney, Australia. (<http://www.iglc.net/conferences/>).
- Owen Matthews, Gregory A. Howell, and Panagiotis Mitropoulos (2003). Aligning The Lean Organization: A Contractual Approach,” Proceedings of the 11<sup>th</sup> conference of the international group for lean construction, Blacksburg, Virginia, 22-24 July 2003.
- Lichtig, W. A. (2005). “Sutter Health: Developing a Contracting Model to Support Lean Project Delivery.” Lean Construction Journal ([www.leanconstructionjournal.org](http://www.leanconstructionjournal.org)), Volume 2, issue 1.
- Ballard, G. and Reiser, P. (2004). “The St. Olaf College Fieldhouse Project: A Case Study in Designing to Target Cost”. Proceedings IGLC-12, August 2004, Denmark. (<http://www.iglc.net/conferences/>).

#### **- Additional Reading**

- [Lean Construction Journal - Volume 2, issue 1: April 2005](#)
- Zabelle, T. and Ballard, G. (1999). “Flow Driver”. Lean Construction Institute White Paper #6. Available at <http://www.leanconstruction.org/>
- Ballard, G., and Zabelle, T. R. (2000). “Project Definition”. Lean Construction Institute White Paper #9. Available at <http://www.leanconstruction.org/>

### **Lean Supply and Lean Assembly**

- Obrien, W., J., London, K., and Vrijhoef, R. (2002). “Construction Supply Chain Modeling: a research review and interdisciplinary research agenda”. Proceedings of the 10<sup>th</sup> Conference of the International Group for Lean Construction, Brazil, August 6-8. (<http://www.iglc.net/conferences/>).
- Vrijhoef, R., Koskela, L., and Voordijk, H. (2003). “Understanding Construction Supply Chains: A Multiple Theoretical Approach to Inter-Organizational Relationships in Construction”. Proceedings of the 11<sup>th</sup> conference of the international group for lean construction, Blacksburg, Virginia, 22-24 July 2003. (<http://www.iglc.net/conferences/>).

- Ballard, G. and Howell (1995). "Toward Construction JIT," Proceedings of the 1995 ARCOM Conference, Association of Researchers in Construction Management, Sheffield. (<http://www.leanconstruction.org/pdf/TowardsJIT.PDF>).
- Ballard, G. (1998). "Implementing Pull Strategies in the AEC Industry". Lean Construction Institute White Paper #1. Available at <http://www.leanconstruction.org/>
- Tommelein, I. and Li, A. (1997). "Just-in-time concrete delivery: mapping alternatives for vertical supply chain integration". Proceedings of the 7<sup>th</sup> conference of the international group for lean construction, Berkeley, California, 26-28 July 1999. (<http://www.iglc.net/conferences/>).
- Tommelein, I. and Beeche, G. (2001). "De-coupling cladding installation from other high-rise building trades: A case study". Proceedings of the 9<sup>th</sup> conference of the international group for lean construction, Singapore, 6-8 August. (<http://www.iglc.net/conferences/>).
- Christine Pasquire, Rupert Soar, Alistair Gibb (2006). Beyond Pre-Fabrication - The Potential Of Next Generation Technologies To Make A Step Change In Construction Manufacturing. Proceedings of the 14<sup>th</sup> Conference of the International Group for Lean Construction, Santiago, Chile, July 25-27 (<http://www.iglc.net/conferences/>).

### **Lean Construction Implementation**

- Mastroianni, R. and Abdelhamid, T. S (2003). "The Challenge: The Impetus for Change to Lean Project Delivery," Proceedings of the 11th Annual Conference for Lean Construction, 22-24 July 2003, Blacksburg, Virginia. (<http://www.iglc.net/conferences/>)
- O. Salem, J. Solomon, A. Genaidy, and M. Luegring (2005). "[Site Implementation and Assessment of Lean Construction Techniques](#)." Lean Construction Journal, volume 2 issue 2, pp. 1-21.
- Richard Bayfield and Paul Roberts (2005). "[Contract or Co-Operation? Insights From Beyond Construction: Collaboration – The Honda Experience](#)." Lean Construction Journal, volume 2 issue 2, pp. 22-50.

### **Lean Construction vs. Conventional Construction Management**

- Gregory Howell and Glenn Ballard (1996). Can Project Controls Do Its Job? Proceedings of the 4th Annual Conference of the International Group for Lean Construction, Birmingham, England. (<http://www.iglc.net/conferences/>)
- Yong Woo Kim and Glenn Ballard (2000). Is the Earned-Value Method an Enemy of Workflow? Proceedings Eighth Annual Conference of the International Group for Lean Construction, IGLC-6, Brighton, UK, July 17-19. (<http://www.iglc.net/conferences/>)
- Greg Howell & Lauri Koskela (2000). Reforming Project Management: The Role of Lean Construction. Proceedings Eighth Annual Conference of the International Group for Lean Construction, IGLC-6, Brighton, UK, July 17-19. (<http://www.iglc.net/conferences/>)
- Bob Huber and Paul Reiser (2003). THE MARRIAGE OF CPM AND LEAN CONSTRUCTION. Proceedings of the 11th conference of the international group for lean construction, Blacksburg, Virginia, 22-24 July 2003. (<http://www.iglc.net/conferences/>).
- Hal Macomber (2002). [Critical Path Method: Fool Me Once, Fool Me Twice](#). ©2002 Hal Macomber. From the weblog Reforming Project Management.
- Chitla, V. K., and Abdelhamid, T. S. (2003). "Comparing Process Improvement Initiatives Based On Percent Plan Complete And Labor Utilization Factors". *Proceedings of the 11th Annual Conference for Lean Construction*, 22-24 July 2003, Blacksburg, Virginia, 118-131. (<http://www.iglc.net/conferences/>).