3rd Lean Construction Institute Academic Forum
Michigan State University – East Lansing, Michigan

Forum Minutes

by

Tariq Abdelhamid and Reshma Sambare

Forum Members: Afshan Barshan (Michigan State University), Ahmad Hadavi (Northwestern University), Bolivar Senior (Colorado State University), Brad Sims (University Of Florida), Dan Halpin (Purdue University), Eric Johansen (University of Northumbria at Newcastle), Glenn Ballard (University of California- Berkeley / Lean Construction Institute), Greg Howell (Lean Construction Institute), Howard Bashford (Arizona State University), Iris Tommelein (University of California- Berkeley), James Diekmann (University Of Colorado), Jerald Rounds (Rounds & Associates), John Draper (Virginia Tech), Julio Martinez (Virginia Tech), Keith Molenaar (University Of Colorado), Kenneth Walsh (Arizona State University), Leonard Bernold (North Carolina University), Louis Prudhomme (Construction Industry Institute), Michael Horman (The Pennsylvania State University), Mike Casten (Construction Concepts), Mohammad El-Mashaleh (University of Florida), Poon Thiengburanathum (University Of Colorado), Rafael Sacks (Israel Institute of Technology-Technion), Ron Wakefield (Virginia Tech), Russell Kenley (UNITEC), Susan Bogus (University Of Colorado), Sven Bertelsen (Strategic Counselor APS), Tariq Abdelhamid (Michigan State University), Vijay Chitla (Michigan State University), William Maloney (University Of Kentucky), William O'Brien (University Of Florida).

Attendees: Afshan Barshan (Michigan State University), Bhavin Patel (Michigan State University), Greg Howell (Lean Construction Institute), John Draper (Virginia Tech), Matt Syal (Michigan State University), Mohammad El-Mashaleh (University of Florida on behalf of William O'Brien), Reshma Sambare (Michigan State University), Sven Bertelsen (Strategic Counselors APS), Tariq Abdelhamid (Michigan State University), and Vijay Chitla (Michigan State University)

3rd Forum time and place: March 28-29, 2002 – East Lansing, Michigan (Michigan State University)

Meeting Objectives:

1. Catalogue ongoing research and teaching efforts in Lean Construction

2. Align ongoing research efforts to the thrust areas identified at the International Group for Lean Construction (IGLC) meeting held in Singapore August 2001

3. Develop a mission statement and strategic priorities for the Academic Forum

The following is an account of the 2-day Academic Forum meeting. The forum was presentation driven to facilitate constructive input and lively discussions and thoughtful dialogues (not debates). In general, everyone felt this was a good format and that it should continue in future forums.

March 28, 2002 Meeting Highlights

Welcome and Introductions

The meeting began with a welcome by Tariq Abdelhamid (meeting host) wherein he greeted attendees of the 3rd Lean Construction Institute Academic Forum. He gave a brief review of the first two academic forums organized at University of Colorado by Jim Diekmann and at Arizona State University by Howard Bashford. He further explained his involvement and overall teaching and research efforts in lean construction and construction ergonomics at Michigan State University. The welcome concluded with an overview of the meting objectives and agenda for the two-day forum.

Forum Special Guest – Matt Syal

Matt Syal (Professor of Construction Management at Michigan State University) welcomed the attendees and introduced the origin and development of the construction management program at Michigan State University. He also discussed how Lean Construction is integrated into the teaching and research programs in the Construction Management Program. He announced the launching of the Construction Ergonomics and Lean Construction (CELC) initiative with Tariq Abdelhamid as the Research Director. The CELC initiative is part of the newly formed Center for Construction Research at Michigan State University.

The status of Lean Construction Research and Teaching – G. Howell

Greg Howell started his presentation with the origin and history of construction management in the United States. He explained that there has always been a weak link between theory and practice in construction, which led to tenuous relations between academia and industry. Based on several examples from his own professional life, he argued that this weak link was a result of the lack of a solid theoretical base in construction management. He acknowledged the presence of some underlying theories in conventional project management that is supplemented to a large

extent by professional experience and personal intuitions in the classroom. Lean Construction, according to Howell, is an ambiguous term for many but it gives a theory and base for construction management. He believes that Lean Construction offers a new and almost "operating system" for managing production in project settings.

He further continued his discussion related to the origin and principals of the International Group of Lean Construction (IGLC) and the Lean Construction Institute (LCI). He also stated that LCI was initially chartered as the "Center for Innovation in Project Management and Production Management". He also introduced Lean Production Consulting (LPC) and Strategic Project Solutions (SPS) and the relationship of both to LCI.

Howell then discussed the link between project management and production management and related misconceptions in the construction industry. He said "Projects are the general case of production, while manufacturing is a unique case." He stressed the need to approach construction production systems with a systems design mentality and to stop the practice of subsystems optimization.

Following this discussion, Howell then proceeded to discuss a number of current lean thinking approaches to construction which are counter to many of the Newtonian and Cartesian theories influencing conventional views of construction management. These were as follows:

- ✓ Dependence / Variation (ref. Goldratt; Factory Physics)
- ✓ Language Action: This is a line of thinking that emphasizes that organizations need to perfect the process of making and keeping commitments. Also, it is espoused here that learning arises from the breakdown in communication occurring in typical offer/request transactions. (ref. www.good2great.com; Fernando Flores)
- ✓ Systems Engineering – many references exist for this subject
- ✓ Transformation – Flow – Value (Lauri Koskela – see LCI website for references)
- ✓ Contracts (Oliver Williamson, Transaction Cost Economics: "The governance of contractual relations." The Journal of Law and Economics, Ian R. McNeil"The Many Futures of Contracts")

- ✓ Safety: The work of Jens Rasmussen (Cognitive Systems Engineering, Wiley 1994. provides a theoretical explanation of *why* accidents happen (G. Howell has paper).
- ✓ Organizations – many references exist for this subject
- ✓ Complexity: This is a non-conventional view of construction as a system characterized by complex interactions along many dimensions (ref. See Sven Bertelsen's topic of discussion below also "Seeing Around Corners" Atlantic Magazine, April 2002; Also the Santa Fe Institute www.sfi.org)

In the final segment of his discussion, Howell briefly listed ongoing research efforts in lean construction that he is familiar with. Some of these were:

- ✓ LCI research on:
  - o Engineered to Order Materials
  - o Safety
  - o Design Management
  - o Cost accounting
  - o Operations design
- ✓ J. Diekmann research on Buffers (Proposal to NSF)
- ✓ J. Diekmann research on lean construction viability (sponsor: Construction Industry Institute)
- ✓ C. Tao (UC-Berkeley) with Iris Tommelein Work Structuring
- ✓ Iris Tommelein has a number of other projects underway.
- ✓ Lean construction thrust areas:
  - o Theory of Project Management – Lauri Koskela
  - o Buffer Management - Michael Horman
  - o Change management in organizations – Luis Fernando Alarcon
  - o Integration of Quality Management to Lean Construction – Marton Marosszeky
  - o Safety in Lean Production Systems– Greg Howell
  - o Managing Complexity – Sven Bertelsen
  - o Design Management & Value Generation – Peter Hauck
  - o Reducing Lead Time in Fabrication Shops – Glenn Ballard

- Business Relationships and Integration – Mohammed Dulaimi
- Lean Construction and Open Buildings – Iris Tommelein and Ype Ciperus
- Flow and Pull – Flávio Picchi
- Construction Supply Chain Management – William O'Brien
- IT and Lean Construction – Lucio Soibelman and Julio Martinez

Managing Complexity

Sven Bertelsen began his discussion with an overview of NIRAS, the consulting firm that he previously worked for. He also made general remarks regarding the utilization of time on construction projects and mentioned that only one third of the time is used for actual productive work, another third is for contributing activities, while the remaining one third is purely waste. He also commented on the major differences between master schedules and look ahead planning (per the Last Planner Technique).

The discussion then progressed to Bertelsen's views and work on construction complexity. He started his presentation with a software program he developed to explain behaviors in a massive and chaotic world. He then drew parallels to the construction industry. He believes that many tools are available for solving problems but unfortunately few know how to use them. With the help of different quotations and theories, he discussed several different aspects towards "Understanding Nature", "Quantum Mechanics", etc. Then he directed his talk towards the theory of complexity, as a new way to understand construction systems and processes. He explained some complex system characteristics to the group such as non-linearity, dynamic and adaptive, emergent (such as whole is greater than sum of parts), self-organized criticality, etc.

Using Zip's law, Bertelsen explained some of the thinking behind complexity. He introduced the group to three dimensions that encompass and describe construction systems and processes. The three dimensions are the project and the process, the production system, and the social system. These dimensions parallel the concept proposed by Howell regarding the complex nature of the construction industry and factors affecting capacity utilization.

Bertelsen also explained why our interpretation of construction systems and processes are dominated by Cartesian logic and suggested that the focus should be moved from the elements to their interaction, which is same as focusing on relationship among the activities instead of activities in and of themselves.

Howell joined the discussion and explained another theory related to the distribution of decisions and demonstrated how diametrically apposed this thinking is to the current project management paradigms. He further explained how the last planner method would help in distributing the decisions and creating an open culture in the construction industry.
(See PowerPoint slides in the appendix).

Production System Design in a Lean Framework- J. Draper

John Draper presented his doctoral thesis research. In the introduction, he presented a conceptual view of the AEC industry and the sources of project complexity. He explained the contemporary relationship between business environment and organizational structure and extended his hypothesis to the relationship between product designs and work structures. He shared different methods to reduce the variation such as arranging the activities in parallel instead of serially, introducing a buffer between two activities, or distributing the activity duration over a longer time span. The hypothesis mainly focuses on performance improvement by accommodating variation at the construction job site by arranging production processes in a parallel orientation. His presentation is attached in the appendix.

Lean Construction teaching and research at MSU – T. Abdelhamid

Tariq Abdelhamid discussed lean construction teaching and research efforts at Michigan State University. The structure and organization of a new graduate course on Lean Construction was presented. He also presented his own Lean Construction Research Roadmap specifically targeting the areas of lean assembly, lean supply, work structuring and production control. He discussed, in some detail, the nexus between construction ergonomics and lean construction. He then discussed criteria for designing worker-oriented processes. The discussion concluded with a list of future research areas (His presentation is attached in the appendix).

Safety in Lean Production Systems - G. Howell

Greg Howell once again presented to the group research work related to safety programs in the construction industry. He addressed different aspects that characterize safety programs such as training, hazard awareness, motivational awareness, pre-task hazard analysis and root cause accident analysis models. He characterized most of the current accidents cause and effect analyses as worker-centered or management-centered. He advocated a systems-centered approach and explained Rasmussen's theory of accident causation to the group.

Academic Forum Mission and Strategic Priorities – T. Abdelhamid

Tariq Abdelhamid discussed with the group the goal and mission of the Lean Construction Academic Forum (LCIAF). While addressing strategic priorities, he stated that researchers in lean construction need a designated venue for publishing in a journal, newsletter, and/or bulletin. The presentation and supporting document can be found in the appendix.

March 29, 2002 Meeting Highlights

Construction Supply Chain Management - Mohammad El-Mashaleh

Mohammad El-Mashaleh, on behalf of William O'Brien, presented the ongoing supply chain management research projects at the University of Florida. Two main categories of research were presented, namely, Subcontractor production costs, benchmarking and IT for supply chain decision support. The presentation can be found in the appendix.

Production Control in Manufactured Housing – V. Chitla

Vijay Chitla gave a presentation on his Master thesis titled: "Production Control in Manufactured Housing using Lean Construction Principles." He gave an overview of the manufactured housing industry and the projected demands for manufactured housing units. The goal of his work is to evaluate plant production planning processes in the Manufactured Housing industry and to identify improvement opportunities. The last planner will be used to assess the production planning process performance. Workers' efficiency will be measured using productivity ratings. The presentation material can be found in the appendix.

Towards safety in lean systems – B. Patel

Bhavin Patel presented his Masters thesis "Accident Causation Model for Falls Accidents in Construction". He shared data on fall accidents in construction and established the problem statement, goal, objectives, and methods. He explained that this research project would develop a hybrid accident causation model capable of tracing Human Error and Unsafe Conditions to fall Accidents. The model will be generalized to other accident scenarios. In this project, fall accidents will be examined and categorized according to root cause. Using Process-Based Reliability Assessment Techniques the most contributing factors to the accidents will be determined. This will make it possible to identify where the most significant change could be made to prevent reoccurrence. The presentation material can be found in the appendix.

JIT in Manufactured Housing – MSU

Afshan Barshan presented to the group an outline of his proposed masters thesis "Viability of Lean Manufacturing Just-In-Time Material Procurement Practices in the Manufactured Housing Industry." He explained that the main aim of this research is to:

- Study the present material procurement practices, business models, and waste generation in the Manufacturing Housing industry.

- Compare both the JIT procurement practices and the existing material supply chain in the Manufactured Housing industry.

- Propose JIT based changes in the existing supply chain for Manufactured Housing industry and investigate their feasibility.

The presentation material can be found in the appendix.

Action Items:

- Create a website for the Academic Forum on LCI's homepage and an email list for the forum – G. Howell and T. Abdelhamid

- Establish an advisory council, from forum members, to assist Masters and PhD level students in evaluating their Lean Construction research ideas – G. Howell

- Discussing with IGLC the recommendations for publication venues – T. Abdelhamid

- Writing a group proposal to NSF to sponsor a Lean Construction Awareness / Understanding workshop – T. Abdelhamid

- Scheduling the 4th Academic Forum; when and where based on Forum members preference – T. Abdelhamid

APPENDIX

1. Complexity Slides by Sven Bertelsen
2. Production System Design in a Lean Framework- J. Draper
3. Lean Construction teaching and research at MSU – T. Abdelhamid
4. Academic Forum Mission and Strategic Priorities – T. Abdelhamid
5. Construction Supply Chain Management - Mohammad El-Mashaleh
6. Production Control in Manufactured Housing – V. Chitla
7. Towards safety in lean systems – B. Patel
8. JIT in Manufactured Housing – MSU