

A RESPONSE TO CRITICS OF LEAN CONSTRUCTION

Glenn Ballard¹ and Lauri Koskela²

ABSTRACT

Lean construction advocates criticized the first edition of Graham Winch's *Managing Construction Projects*. In the 2nd edition, Winch responds and adds his own criticisms of lean construction. The purpose of this paper is to reply to Winch's criticisms of lean construction. Other papers will continue the debate regarding the appropriate conceptualization of projects in relation to production, including the question whether organization design is part of production system design.

Regarding the mainstream construction management community, we respectfully propose that it should get rid of certain temporal myopia. Two central concepts of lean construction are production, as a starting point for managing and organizing, and waste, as a focus of improvement. Winch denies the role of production in management and fails to recognize the importance of waste: it is not in the index of his book, although lean production and lean construction is discussed. This is fully aligned to other current literature in management, which – through silence - denies the role of production and waste. However, these concepts were present in the management literature preceding the two influential books on business education in 1959 (Gordon & Howell 1959, Pierson 1959). Lean construction represents a continuation of the discussion in the first half of the 20th century, which seems to have become opportune again as a result of the massive criticism on the lack of relevance of management science since the 1980's.

KEYWORDS

Construction management, lean construction, theory

INTRODUCTION

This paper continues a discussion with Graham Winch that has taken place primarily in print, beginning with an exchange in the Building Research & Information Forum in 2006, in which Winch's views on construction management and lean construction, expressed in the 1st edition of his *Managing Construction Projects*, were criticized (Koskela & Ballard, 2006). Winch replied to those criticisms in that same Forum exchange (Winch, 2006), and has made additional criticisms of lean construction in the 2nd edition of his text.

There are more critics of lean construction, but Graham Winch is widely, and properly, recognized as a leading thinker in the field of construction management. In this discussion, we understand ourselves to be in conversation with a number of

¹ Research Director, Project Production Systems Laboratory (p2sl.berkeley.edu), 215-B McLaughlin Hall, Univ. of California, Berkeley, CA 94720-1712, USA, Phone +1 415/710-5531, ballard@ce.berkeley.edu

² Professor, School of the Built Environment, University of Salford, Maxwell 412a, Crescent, Salford, l.j.koskela@salford.ac.uk

scholars in the field, and engage in the conversation in hopes of providing more clarity regarding the lean construction movement.

The next section of the paper presents the discussion to date; claims and counterclaims. A critique of Winch’s comments in the 2nd edition follows, leading to a concluding section in which we propose implications of the issues in dispute and suggest what the lean construction community can do to initiate fruitful interaction with the mainstream academic community.

BRIEF HISTORY OF THE DISCUSSION

The discussion with Graham Winch has spanned over eight years, from the publication of his major work on construction project management in 2002 (Winch, 2002) to the 2nd edition of that text in 2010. The previous contributions to this conversation have been:

- A. Winch, G. M. (2002), *Managing Construction Projects: an Information Processing Approach*, Blackwell, Oxford.
- B. Koskela, L., Ballard, G., and Howell, G. (2004), “Project management reconceived from a production perspective”, *Proceedings of the CIB World Congress*, Toronto, Canada.
- C. Koskela, L. and Ballard, G. (2006), “Should project management be based on theories of economics or production?,” *Building Research & Information Forum*, 34(2), 154-163.
- D. Winch, G. M. (2006), “Towards a theory of construction as production by projects”, *Building Research & Information Forum*, 34(2), 164-174.
- E. Winch, G. M. (2010), *Managing Construction Projects: an Information Processing Approach, 2nd edition*, Wiley-Blackwell, Chichester.

The primary contributions have been made in Winch’s two editions and in the BRI Forum exchange in 2006. At the risk of concealing the richness of the argument, it seems fair to say that the conversation, although amicable and constructive by intent, has thus far not brought the parties closer together in their thinking. We hope to achieve a remedy, if not in this paper, hopefully in the future discussions it enables and provokes.

The initial critique, expressed in C above, was summarized in Table 1, contrasting Winch’s approach, termed economics-based, and the lean approach, termed production-based.

Table 1: Comparison of the foundational issues of the economics- and production-based approaches to project management (p. 161, Koskela & Ballard, 2006)

	Economics-based	Production-based
Fundamental assumption on the nature of projects	organizations integrated through transactions	production systems
Conceptualization of the project	information-processing system	transformation, flow, value
Intrinsic goal	uncertainty reduction (i.e. elimination of a lack of information)	getting the facility produced, eliminating waste, increasing value
Nature of management	creating the (contractual and organizational) structure	designing, operating and improving the production system

Winch responded to each of these criticisms as follows (Winch, 2006):

- Koskela and Ballard have misconstrued the nature of transaction cost economics. The make or buy decision is central, and both production costs and transaction costs are taken into account in making those decisions.
- The job of the project manager is to coordinate production, which involves processing information rather than materials. (Winch refers us to an earlier book, which is said to explain how information and materials processing are integrated (Winch, 1994)).
- "...a construction project is essentially a proposition about a unique future state, and...uncertainty in decision-making is inherent to the process of achieving that future state." (p. 168)
- In defense of his tectonic approach to management, Winch again refers back to his 1994 book in arguing that "...information processing in organizations cannot be directly managed, but is managed through changes in organizational structure in terms of both internal and inter-organizational arrangements." And further on the same page: "From the tectonic perspective, project management is essentially about the coordination of discrete materials transformation processes, not the management of the materials transformations that take place within those processes." (p. 168)

Winch also takes the opportunity to direct two criticisms at Lean Construction; "...two surprising omissions from the LPDS (Lean Project Delivery System) toolbox"; namely:

- lack of attention to new forms of organization to provide the context for the LPDS, and
- lack of attention paid to Goldratt's theory of constraints and critical chain³.

CRITICISM OF LEAN CONSTRUCTION IN WINCH'S 2ND EDITION

In the 2nd edition of his *Managing Construction Projects*, Winch repeats his response to previous criticisms of his own work by the authors of this paper, and adds new criticisms of Lean Construction, among them the following:

- Lean construction is a form of bureaucracy, as opposed to the professionalism Winch advocates.
- Lean construction has its roots in high-volume lean manufacturing and is thus constrained to "high volume construction", rather than one-off projects.

These closely connected criticisms reveal a fundamental misunderstanding of lean in both manufacturing and construction. We could note the many publications and presentations that contradict this conceptualization, and we will do that, but the question still remains why those have been ignored. We analyze this misunderstanding for its root causes and make some proposals for its correction.

³ For the record, a special issue on relational contracting was published in the Lean Construction Journal (www.leanconstructionjournal.org) in 2003 and Goldratt's critical chain was discussed in relation to the Last Planner® System in (Ballard and Howell, 2003). The latter topic was also addressed in (Koskela, Stratton & Koskenvesa 2010).

WINCH'S CONCEPTUALIZATION OF LEAN CONSTRUCTION

According to Winch, the principal features of lean production are the following (pp. 471-2):

- “The production flow is paramount – the flow of components through a factory, or the flow of passengers through an airport, should be maximized and the old concept of batch and queue to maximize capital utilization is outmoded.
- The production process should be pulled by customer demand rather than be pushed by production scheduling which requires flexibility in production processes.
- Suppliers should be tiered in proactively managed and partnered supply chains.
- The elimination of in-process and finished inventory by the focus on flow and pull-scheduling leads to reduced working capital requirements for production.
- Continuous improvement of the production process takes place through team-oriented activities such as total quality management.
- The challenges in improving performance are largely organizational and do not depend on high levels of technology in the production process.”

We agree that these are among the underlying principles of lean production. However, when Winch characterizes Lean Construction as follows (p. 475), we cannot see how he is deriving these characterizations from the “principal features of lean production” above:

- Winch sees Lean Construction appropriate for slow, simple and certain projects, as distinct from those that are complex, uncertain and quick; interestingly, the exact opposite of the way Lean Construction advocates understand the matter. “Where needs are predictable and can be standardized, bureaucracy remains the most effective way to meet them.” “Where needs are more complex or dynamic, professionalism defined as the ability to configure established expertise to solve novel problems is more appropriate.”
- Winch sees lean construction as imitating manufacturing’s product development in separating designing and making: “(Lean production) is, essentially, about what happens in the factory or on the construction site.”
- Winch sees lean construction as limited to the production of standard products: “The crucial question in assessing the potential for the application of the lean approach to construction is the extent to which the one-off nature of the construction process can be changed.” “Lean concepts as a whole are unlikely to be applicable to refurbishment projects, let alone repair and maintenance,…” and he dismisses the applicability of lean construction to most if not all new construction because of the limited ability to standardize product designs.

REBUTTAL

Briefly stated, we see Lean Construction the more needed for more dynamic projects, integration of designing and making as the hallmark of the lean approach to production, and the applicability of lean concepts and methods, far from being limited

to standardized products, rather enabling and promoting innovation and value generation.

Our characterization is inconsistent with Winch's criticisms; namely, 1) 'Lean construction is a form of bureaucracy, as opposed to the professionalism Winch advocates', and 2) Lean construction has its roots in high-volume lean manufacturing and is thus constrained to "high volume construction", rather than one-off projects. We shall try to understand and rebut Winch's claims, and also to support our own characterizations of lean construction.

Categorization of TPS as bureaucratic despite its origin is presumably based on its formalization and standardization, but this ignores the differentiation between coercive and enabling bureaucracies introduced by Adler in his 1996 paper, in which he cites Toyota as exemplary in its use of standardization as a platform for learning. It also ignores the findings of research by the National Center for Manufacturing Sciences (2000) that found Toyota's product development system alone to value learning rather than compliance, and found Toyota's product development performance much superior to competitors from a variety of industries (see the mentioned research report and also the two popular books, 2003 and 2008, by Michael N. Kennedy).

Winch's assessment of lean production seems to have been formed in 1994 when he claimed in *Managing Production* (Winch, 1994) that lean production was limited to high volume manufacturing, based on the argument that JIT (Just-in-Time) was essential to lean production and that JIT was possible only in high volume manufacturing. In our view, this reflects a misunderstanding of JIT, the essence of which is to do work in response to customer request. Winch appears to assume that some specific quantitative criterion is implicit in the concept, but no such criterion is possible for 'just-in-time'. The objective is to strive continuously to reduce the time work is performed prior to the use of that work output by the immediate customer process; done in order to reduce the waste of overproduction (Ohno, 1998). The ideal is to achieve zero lead time. The extent to which the ideal can be approximated will vary with the nature of the work being performed. What's more, JIT has been demonstrated to work in construction, in the delivery of components to sites (Arbulu & Ballard, 2003) and of information to design offices (Ballard, 2002).

A second issue is **the implicit assumption that if lean production has a certain characteristic, that also applies to lean construction**. The Lean Construction community has not tried to simply imitate lean in repetitive manufacturing, but to abstract up to fundamental principles, then move them to new domains, and adapt them and the corresponding methods as needed for the new domains.

Part of the gap in understanding may be a consequence of the tendency, at least until recently, for lean construction to be understood in the U.K. as turning construction into (repetitive) manufacturing; a barely hidden subtext in the Egan Report (Construction Task Force, 1998). In contrast, the International Group for Lean Construction and the Lean Construction Institute have embraced the differences between construction and repetitive manufacturing and have sought since 1993 to adapt lean principles and methods to a new domain. To take but one example⁴,

⁴ Other examples of the treatment of these issues are provided in (Koskela 2000, Vrijhoef & Koskela 2000).

consider the following statement from the abstract to Ballard and Howell's "What Kind of Production is Construction?":

"Applicability of lean principles to construction might seem to require that construction's differentiating characteristics be softened or explained away. This is the strategy employed by those who advocate making construction more like the manufacturing from which lean thinking originated. Following that line of thought, successive waves of implementation would leave ever smaller remainders that are not yet reduced to manufacturing, and consequently not yet capable of being made lean. This approach offers tremendous opportunity for reducing the time and cost of constructed facilities. However, for our part, we are interested in that remainder, in understanding its peculiar characteristics, and in learning how to make it lean. Our interest is founded on the belief that construction is a fundamentally different kind of production; i.e., that there is an irreducible remainder. We also suspect that learning how to make construction lean will help show the way to the manufacturing of the future. Manufacturing is becoming more like construction. Far from being the most backward, in our view, construction can be among the leading edge industries in lean thinking. Adopting a single-minded strategy of transforming construction into manufacturing would be precisely the wrong thing to do." (Ballard & Howell, 1998)

Construction is one type of project production system. Projects may be dedicated to the production of standard products, products that have previously been designed, but are the type of production system appropriate for non-standard products, which require the integration of designing and constructing. As such, projects present unique challenges to the application of lean principles and methods. Many, though not all, of the studies done in applying lean to construction have tried to meet those challenges.

Does lean construction only apply to site production? Consider the closing paragraph from (Ballard & Howell, 1998) - cited above:

"What is dynamic construction and what challenges and opportunities does it pose for lean thinking? While product and process design can be standardized for standard products, for non-standard products it is necessary to standardize at the meta-level of planning and control⁵. In other words, it is necessary to develop standard procedures for planning and managing the design and installation of unique facilities. The engineer/constructor firms of the industrial sector have gone the farthest in this direction. The building sector in the U.S. has only just begun to map its production (design, procure, install) processes. The industrial sector's lead seems based on their control of the entire process, as opposed to the extreme fragmentation in the building sector. This is now changing as building sector specialists band together to pursue design-build opportunities. This social unity is a prerequisite for process mapping and streamlining that can maximize customer value and minimize waste."

Designs, whether 'completely' unique or only slight modifications from templates, are produced using many of the same processes; e.g., making calculations, producing drawings, evaluating design alternatives. Consequently, standardization of

⁵ The "meta-level of planning and control" refers to the Last Planner® system.

component processes or even component parts need not imply standardization of constructed assets. Further, even in Toyota's repetitive manufacturing, not everything is standardized, and not everything that is standardized is standardized at the same level of detail (Ohno, 1998; Liker & Meier, 2007).

This issue is linked with Winch's view that lean construction is basically a set of tools. He applauds Last Planner^{®6} on several occasions, but does not seem to recognize that the 'tool' is intimately linked with the lean philosophy. The entire lean community is indebted to Jeffrey Liker for his books that reveal the intimate connection between the lean ideal, lean principles, and lean methods and tools (Liker, 2004 and Liker & Maier, 2005).

What evidence exists to support our claim that **lean construction applies to, and in fact substantially improves the performance of, 'one-off' projects**? Winch makes no reference to lean construction's work on other aspects of project management than site management. One notable area of LC contribution has been to target costing, to which Winch (2010) makes reference on six different pages (161, 241, 263, 264, 268 and 480), but never mentions any lean construction publication on the topic. Indeed, on p. 264, he cites Nicolini (2000) in support of his claim that target costing is not viable in the current state of the (construction) industry, despite the fact that the first successful application of target costing in construction was reported in 2004 (Ballard & Reiser, 2004), and a stream of successful projects have been reported in subsequent publications; e.g., (Ballard, 2006) and (Ballard, 2008). Experimentation has so far been done in the institutional sector (healthcare and education), with projects ranging from relatively simple medical office buildings to highly complex acute care hospitals. Two anomalous outcomes have proved to be predictable; namely, 1) the expected cost has fallen as the design has become more detailed, and 2) costs at completion are 15-20% below market. These outcomes are, we believe, the result of aligning commercial interests of the participants, integrating organizationally, including the client as a permanent and active member of the project team, revealing to the team what the client is able and willing to pay to acquire the constructed asset, setting targets for the facility to be delivered and for client conditions of satisfaction regarding cost and time, steering design toward these targets proactively and aggressively, and using lean management methods such as Last Planner[®] and set based design⁷. Increasingly, also building information modeling is being used in these efforts⁸.

The inspiration for lean construction should naturally be from lean product development, which has the same scope. Repetitive manufacturing begins when product development ends. The construction project is a product development process, though not necessarily of a product the design of which will be copied multiple times. Remarkably Winch ignores the Toyota Product Development System (Clark & Fujimoto 1991, Ward et al. 1995, Fujimoto 1999, Sobek et al. 1998, Sobek et al. 1999), not to mention the Toyota Way (Liker, 2003), each a reconceptualization of Toyota's achievement and contribution, moving from a focus on making to the

⁶ The Lean Construction Institute holds a trademark.

⁷ See (Ward, et al., 1995) and (Sobek, et al., 1999) for set-based design in Toyota; and (Parrish, et al., 2007) for application of the concept in construction.

⁸ The intimate connection between lean and building information modelling has been analyzed in (Sacks et al. 2010).

integration of designing and making and finally to a philosophy of organizational management in which the organization's purpose is to generate value to customers and to society through its products and services.

CONCLUSIONS

We have critically countered the following claims made by Winch:

- Lean construction is a form of bureaucracy, as opposed to the professionalism Winch advocates.
- Lean construction has its roots in high-volume lean manufacturing and is thus constrained to “high volume construction”, rather than one-off projects.
- Lean construction is limited to site construction, and separates designing and making.
- Lean construction is applicable only to slow, simple and certain projects.
- Lean construction is limited to the production of standard products.

We contend that there are two underlying complexes of reasons for the difficulties Winch has encountered when trying to make sense of lean: one related to IGLC, another related to the received view in management.

The International Group for Lean Construction was formed in 1993, as a forum for discussing the theory and practice of lean construction. From the first workshop, attended by a dozen people, it has grown to a medium sized conference, held annually. Except for a few of the first conferences, a rigorous refereeing process has been in place. The conferences are characterized by knowledgeable discussion on the papers presented. Indeed, IGLC conferences have evolved to be the main outlet of scholarly work on lean construction for many researchers in the field. This feature seems to have gone unnoticed by mainstream construction management researchers who have expected main results to be published in Journals. In addition, the lack of overview presentations on lean construction has added to the problem. In view of these factors, it is suggested that the IGLC members make the nature of their work as conference centred clearer, but also strengthen their presence in mainstream Journals.

Regarding the mainstream construction management community, we respectfully propose that it should get rid of certain temporal myopia. Two central concepts of lean construction are production, as a starting point for managing and organizing, and waste, as a focus of improvement. Winch denies the role of production in management and fails to recognize the importance of waste: it is not in the index of his book, although lean production and lean construction is discussed. This is fully aligned to other current literature in management, which – through silence - denies the role of production and waste. However, these concepts were present in the management literature preceding the two influential books on business education in 1959 (Gordon & Howell 1959, Pierson 1959), which achieved a social science turn in management science. Lean construction represents a continuation of the discussion in the first half of the 20th century, which seems to have become opportune again as a result of the massive criticism, since the 1980's, on the lack of relevance of management science.

REFERENCES

- Adler, Paul S. (1996), "Two Types of Bureaucracy: Enabling and Coercive", *Administrative Science Quarterly*, March 1996, 21/1, 61-89.
- Arbulu, Roberto and Glenn Ballard (2004). "Lean Supply Systems in Construction". *Proceedings of the 12th annual conference of the International Group for Lean Construction*, Elsinor, Denmark, August, 2004.
- Ballard, Glenn (2002). "Managing work flow on design projects: a case study." *Engineering, Construction and Architectural Management*, 9/3, June 2002, pp 284-291.
- Ballard, Glenn (2008). "The Lean Project Delivery System: An Update". *Lean Construction Journal*, 2008. Available at leanconstructionjournal.org.
- Ballard, Glenn (2006). "Rethinking Project Definition in terms of Target Costing". *Proceedings of the 14th annual conference of the International Group for Lean Construction*, Santiago, Chile, July 25-27, 2006, pp. 77-89.
- Ballard, G. and G. Howell (1998) "What Kind of Production is Construction?", *Proceedings*, 6th annual conference of the International Group for Lean Construction, Guaruja, Brazil
- Ballard, G. and Howell, G. (2003), "An Update on Last Planner", *Proceedings of the 11th annual conference of the International Group for Lean Construction*, Blacksburg, Virginia
- Ballard, Glenn and Paul Reiser (2004). "The St. Olaf College Fieldhouse Project: A Case Study in Designing to Target Cost". *Proceedings of the 12th annual conference of the International Group for Lean Construction*, Elsinore, Denmark, August, 2004.
- Clark, Kim B. and Takahiro Fujimoto (1991). *Product Development Performance*. Harvard Business School Press, Cambridge, MA. 409 p.
- Construction Task Force (1998) *Rethinking Construction*, London, Department of the Environment, Transport and the Regions
- Fujimoto, Takahiro (1999). *The evolution of a manufacturing system at Toyota*. Oxford University Press, Oxford, U.K. 380 p.
- Gordon, Robert Aaron and James Edwin Howell (1959) *Higher Education for Business*, Columbia University Press, New York, NY
- Kennedy, Michael N. (2003). *Product Development for the Lean Enterprise*. The Oaklea Press, Richmond, Virginia. 254 p.
- Kennedy, Michael N., Kent Harmon, and Ed Minnock (2008). *Ready, Set, Dominate: Implement Toyota's Set-Based Learning for Developing Products and Nobody Can Catch You*. The Oaklea Press, Richmond, Virginia. 296 p.
- Koskela, L. (2000) *An Exploration toward a Production Theory and its Application to Construction*, Technical Research Center of Finland, Espoo
- Koskela, L. and Ballard, G. (2006), "Should project management be based on theories of economics or production?", *Building Research & Information Forum*, 34(2), 154-163.
- Koskela, L.J., Stratton, R. and Koskenvesa, A. (2010), "Last planner and critical chain in construction management: comparative analysis" , in: *Proceedings of the 18th Annual Conference of the International Group for Lean Construction*, 14-16 July 2010, Haifa, Israel.

- Liker, Jeffrey K. (2004). *The Toyota Way*. McGraw-Hill, New York, NY. 330 p.
- Liker, Jeffrey K. and David Meier (2006) *The Toyota Way Fieldbook*, McGraw-Hill, New York, NY
- National Center for Manufacturing Sciences (2000). *Product Development Process-Methodology and Performance Measures*, research report available at [http:// www.ncms.org/ express/projects](http://www.ncms.org/express/projects)
- Nicolini, D., C. Tomkins, R. Holti, A. Oldman, and M. Smalley (2000) “Can Target Costing be Applied in the Construction Industry – Evidence from Two Case Studies”, *British Journal of Management* 11 303-24
- Ohno, Taiichi (1998), *Toyota Production System: Beyond Large-Scale Production*, Productivity Press, Portland, Oregon
- Parrish, Kristen, John-Michael Wong, Iris D. Tommelein, and Bozidar Stojadinovic (2007), “Exploration of Set-Based Design of Reinforced Concrete Structures”, *Proceedings of the 15th annual conference of the International Group for Lean Construction*, Michigan State University, East Lansing, July 2007, 213-222.
- Pierson, F.C. (1959) *The Education of American Businessmen*, John Wiley, New York, NY
- Sacks, Rafael, Lauri Koskela, Dave Bhargav and Robert Owen (2010) “Interaction of Lean and Building Information Modeling in Construction”, *J. Constr. Engrg. and Mgmt.* 136, 968 (2010)
- Sobek, Durward K. II, Jeffrey K. Liker and Allen C. Ward (1998). “Another Look at How Toyota Integrates Product Development”. *Harvard Business Review*, July-August, 1998.
- Sobek, Durward K. II, Allen C. Ward, and Jeffrey K. Liker (1999), “Toyota’s Principles of Set-based Concurrent Engineering”, *Sloan Management Review*, Winter 1995, 67-83.
- Vrijhoef, Ruben and Lauri Koskela (2000), “The four roles of supply chain management in construction”, *European Journal of Purchasing & Supply Management*, Volume 6, Issues 3-4, December 2000, pp. 169-178.
- Ward, Allen, Jeffrey K. Liker, John J. Cristiano, and Durward K. Sobek II (1995), “The 2nd Toyota Paradox: how delaying decisions can make better cars faster”, *Sloan Management Review*, Spring 1995, 43-91.
- Winch, G.M. (1994) *Managing Production: Engineering Change and Stability*, Oxford University Press, Oxford.
- Winch, G.M. (2002) *Managing Construction Projects: an Information Processing Approach*, Blackwell Science, Oxford, U.K.
- Winch, G. M. (2006), “Towards a theory of construction as production by projects”, *Building Research & Information Forum*, 34(2), 164-174.
- Winch, G.M. (Winch, G.M. (2010) *Managing Construction Projects: an Information Processing Approach*, 2nd edition, Wiley-Blackwell, Chichester, U.K.