

# LEAN CONSTRUCTION THEORY AND PRACTICE: AN IRISH PERSPECTIVE

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## ABSTRACT

Ireland is emerging from a deep recession following a 75% reduction in Architectural, Engineering & Construction (AEC) output, causing reduced demand, employee redundancies, workforce emigration and company closures. This paper proposes Lean Construction (LC) as an antidote. However, LC theory is not widely taught in Irish universities and field research and case studies are very limited – sector research is 0.002% of industry research expenditure. LC is in its early stages in Ireland and is gaining momentum thanks to the Lean Construction Institute Ireland (LCII) Community of Practice (CoP). This paper looks at professionals understanding of lean and LC and compares LC theory with current practice. Research was gathered through a literature review, three surveys (n=48; n=42; n=116), three focus groups (n=22) and eight interviews (six expert) and was analysed through NVivo Computer Aided Qualitative Data Analysis Software (CAQDAS). The main findings show that LC theory does not compare strongly to practice. However, lean tools in large companies (200+ employees) appear widespread. While LC is far from commonplace, practitioners are focused on “wins” and “proof” rather than the management philosophy that is LC. Future education, training and increased research will show a different perspective – practice relating more strongly to theory.

## KEYWORDS

Lean, lean construction, theory, Community of Practice, thematic analysis

## INTRODUCTION

This research began in 2012 following a long, tough recession which hit the Irish AEC sector, resulting in a 75% reduction in output, peaking at €38.1 billion in 2006 (23.8% GNP) which reduced to €9.4 billion in 2013 (6.6% GNP) causing a 65% reduction in direct construction employment (DKM, 2015). Participants to date have

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included a broad range of national and international AEC professionals. This paper focuses on professionals' understanding of lean and outlines the research carried out to date including the initial findings from primary and secondary research in Table 1. These findings are presented for further discussion by the IGLC community.

The concept of lean is not new having been around over 25 years (Liker and Rother, 2014). While lean manufacturing is more common, LC is only beginning to take a foothold. However, in Ireland, LC is gathering interest and momentum. Much of this can be attributed to the collective effort to raise awareness and promote LC since 2013 by LCII CoP and the wider community including CITA (Construction Industry Technology Alliance), CIF (Construction Industry Federation), CIL (Construction Innovation Lab) and Dominic Greensmith and John French from the Intel Ireland Construction Management Team. Since 2014, articles to promote LC and the LCII CoP were published in journals, trade magazines and newspapers by Ebbs, Egan and Turner (2014); Ebbs and Turner (2014); Foley (2014a, 2014b); Intel Newsroom (2014a, 2014b); Lehnane (2014); McNieve (2015) and Walsh (2015).

## **THE IRISH AEC SECTOR**

The Irish AEC Sector has experienced tremendous growth followed by extraordinary reduction over the last decade. During times of growth, waste was masked by the abundance of work and plentiful resources. The Irish banking crisis together with the over-production of residential units resulted in many ghost estates and bankrupt AEC companies during the recession. Dissatisfaction with the status quo of the Irish AEC sector was evident. Time for change was ripe. By illustrating the extra value and attraction that lean thinking can bring to the Irish AEC sector, export potential and opportunities for native Irish AEC companies providing products and services in other markets – especially the UK – will be boosted. Additionally, this will attract increased foreign direct investment (FDI) in line with Intel's \$5 billion investment announced for Ireland in 2014. There is a "win-win" scenario if the Irish AEC sector adopts lean "together". The more value for money (VfM) the AEC sector can deliver, the greater the amount of FDI that can be attracted, thus growing the AEC sector again.

### **Lean Construction Institute Ireland (LCII) Community of Practice (CoP)**

The LCII CoP was established in April 2014 by a core group of volunteers committed to improving the way capital projects are planned, designed, delivered and operated. The LCII Vision is to make Ireland a centre of excellence for LC. The mission statement states: "*lean thinking will benefit the Irish construction industry and wider economy and the LCI CoP is the way to deliver it.*" The primary aim of the CoP is to encourage the adoption of lean into the Irish AEC sector by raising awareness of LC philosophy, principles, and practices and also provide a platform for companies to share their direct experiences of why and how lean just "works". Seven events have taken place since April 2014 with over 1,300 attendees. The LinkedIn "Lean Construction Ireland" Group has grown steadily since April 2014 and currently has 1,162 members. To date, LCII has been publically endorsed by Enterprise Ireland for the efforts made to improve both the Irish AEC sector and the competitiveness of Ireland Inc. Keegan (2015) stated "*by taking the lead in lean construction, the LCI Ireland CoP is providing an invaluable support to the sector to help it adopt and adapt best practice to ensure sustainable development.*" Commenting after the 5<sup>th</sup> CoP event, Shaw (2015) described the 260 delegates as "*the most engaged and*

*attentive construction audience I have spoken to... there is much that the wider western European construction sector could learn from the Irish intent and drive to remain competitive.”*

## **LEAN THEORY**

The term ‘lean’ has been around for 25 years (Liker and Rother, 2014). However, there has been a shift in how the theory has been applied in practice during that time (Liker, 2014a). Rother (2010) detailed in “Toyota Kata” how the management of organisations has changed over the past 60 years and stressed how we need to move from Managing by Objectives (MBO) – or results – to Managing by Means (MBM) – the capability of people. Luckman (2014) added the need to move from “*doing lean*” (using tools to reduce waste) to “*becoming lean*” (people and problem solving centric).

Construction theory combines Transformation, Flow and Value (TFV) theories with each being complementary rather than contradictory. Their practical application is task, flow and value management. Furthermore, projects need to be treated as production systems. (Koskela, 2000)

How people, think, act, communicate and learn in a system is critical. If you want to know how to fix something you must understand how it works. Therefore, if you are going to use LC sustainably, both the theory and what lean means for each stakeholder needs to be understood. Lean means different things to different people depending on their perspective to a situation - similar to “value.”

### **What lean is not?**

Before looking at what lean and LC are, it is important to understand what lean is not. Lean is not best practice but better practice. It is not a quick fix, it is a journey of lifelong learning and continuous improvement. Lean is not a silver bullet or a magic wand – effort and buy-in from all levels is required. Nor is it a car wash, you cannot just run your company through a lean training programme and come out the other side claiming to be “lean”, otherwise known as “Hollywood Lean” or lean for show. LC is not just a set of tools but is a paradigm shift how capital projects are planned, designed, delivered and operated. Lean is not a tool to cut jobs, it is a philosophy used for company growth and expansion through the development of people and processes.

### **What is lean?**

There is a myriad of definitions of lean. Keegan (2011, p.2) maintains “*lean starts from the point of knowing what a customer wants, values and needs. It then works to find the best way to deliver that to the customer.*” Likewise, Liker and Rother (2014) cited a “first definition of lean” from the February 2014 edition of Quality Progress: “*lean is the permanent struggle to better flow value to each customer.*” Mossman (2014) stated “*lean is a philosophy, a way of thinking about the management of work in projects.*” However, he drew caution to defining it too closely as two things can happen - “*you create schisms and you alienate people, and stop innovation... as soon as you create schisms the community falls apart and the community is critically important.*” Liker (2014b, p.32) defined lean as “*a strategy for Operational Excellence based on Clearly Defined Values to Engage People in Continuously Improving Safety, Morale, Quality, Cost and Productivity.*” Trachilis (2014) posits “*lean is about an entire organisation living the core values of that organisation to*

*improve safety, productivity, cost, quality and human resource development. Living the core values is key, with a focus on True North.*” Both Liker and Trachilis argue that one cannot use the elimination of waste as the singular strategy to a successful company. This concurs with Keegan (2014) who said *“I take a non-traditional definition to lean. I understand lean is about pull and it’s about standardisation and about all those good things. To me lean is all about building the capability and capacity of people and processes using good practice.”* Ebbs (2011) cited Cooke and Williams (2009) who defined lean as *“the elimination of waste from the production cycle”*. While this is not technically incorrect eliminating waste only relates to the “Flow” element of TFV theory (Koskela, 2000). There are many other nuances to lean which equate to far more than eliminating waste. Howell (2013) described LC as *“a new way to see, act and understand the world.”* Howell (2014) added that *“lean is a management philosophy supported by a coherent set of conceptual foundations, basic principles, fundamental practices and a common language”*.

In other words, lean is a term that relates to a proven way of doing business, entirely focused on maximising customer value through relentless elimination of all forms of process waste and ensuring that value-adding activities in the value stream are completed in the most efficient and time-effective manner. Keegan (2014) referred to a counterfactually econometric analysis on the impacts of Enterprise Ireland’s Lean “Start” “Plus” and “Transform” programmes on the companies involved. What they found was a 20% increase in productivity which was equivalent to a €660 million annually delivered in addition to an 11% increase in employment (6,000+ jobs) across these companies - clear evidence that lean is a mechanism for growth and expansion not job losses. Umstot (2014) described lean as *“a transformation in the way you approach and think about the way you deliver your work and is not just about eliminating waste or just about creating value, but it’s a mind shift, which will allow you to look, listen and learn and basically continuously improve through a set process.”* Put simply, Keegan (2014) defines lean as *“Better, Faster, Cheaper...Together.”* Akers (2012) argues that *“lean is simple: fix what bugs you.”* However, Christian (2014) added that *“lean is the hardest simple thing you will ever do.”* Ballard (2014) maintains that the purpose of lean is:

- to optimise the whole project not the piece;
- to transform management to facilitators - a manager in a lean system is there to ‘teach & coach’ not lead;
- to get more ‘value’ for owners’;
- to provide more profit for contractors’ and designers’;
- that it makes people want to come to work.

## **RESEARCH METHODOLOGY**

### **AIM AND OBJECTIVES**

The aim of this research is to identify how the theory of Lean Construction (LC) compares with current practice in the AEC sector. The objective is to investigate and examine professionals understanding of lean and LC theory.

## **DATA GATHERING**

The primary data was gathered through a mixture of 80 hours observational research, three surveys (n=42; 48; 116), three focus groups (n=22) and eight interviews.

The observational research was spent between three construction sites shadowing management to remove any biases and to establish if the researchers own experience expending resources “fire-fighting” was reflected by others. It was shown to be the case. Two surveys relating to Building Information Modelling (BIM) being ‘the’ tool to implement LC identified that respondents understanding of LC and BIM is not succinct. These were sent to the Irish market (n=48) and US Academics (n=42). The survey results helped form the basis of the questions for three focus groups that took place before a guest lecture by Howell (2013). The same questions were asked to each group and subsequent interviewees (n=2). The questions were semi-structured but focused on:

- What is your understanding of lean?
- Is there a need for lean in the Irish AEC sector? Could you explain your answer?
- What is the value of introducing lean into the Irish AEC sector?
- How could we embed lean into the Irish AEC sector?
- What challenges might arise if embedding lean into the Irish AEC sector?

Six expert interviews were undertaken to triangulate the responses of the other participants and the literature. The main questions mirrored above, but they were asked:

- How do you define lean?
- How have the attitudes to LC in the US/UK changed in the past 20 years?

During the interviews, themes that emerged included the Community of Practice, the promotion of LC (getting the message out there), motivation, and the effect of lean on employee wellbeing (H&S), employment and attrition. Another survey which was conducted at the launch and inaugural event of the LCII CoP in 2014 (n=116) by Egan, Tolan and Ebbs (2014) identified the use of lean tools in companies with 200+ employees is widespread.

## **DATA ANALYSIS**

A thematic approach was chosen to analyse the qualitative data in conjunction with NVivo Computer Aided Qualitative Data Analysis Software (CAQDAS). Systematically and thematically sorting the data into codes allows appropriate data analysis to be conducted, condensed and generalised into specific codes (Naoum, 2007).

### **Thematic Analysis**

Braun & Clarke (2006) defined thematic analysis as the search for patterns or themes in a defined set of data. It is a qualitative analytic method. They advocate in regard to qualitative research that thematic analysis is a useful and flexible method of analysis. Ryan and Bernard (2000), Boyatzis (1998) and Holloway and Todres, (2003) all argue that thematic analysis should be used as part of a broader qualitative study. However, Braun and Clarke (2006) maintain that thematic analysis is a method on its

own similar to grounded theory but with fewer complexes. Braun and Clarke (2006) analysis consists of six stages to analyse qualitative data from the observations, surveys, focus groups and interviews. The stages are 1) transcribing and reading over interview notes; 2) generating initial codes; 3) searching for themes and developing sub-codes; 4) reviewing themes; 5) defining and naming themes; and 6) producing the report.

### **Coding**

Braun and Clarke (2006) argue that thematic analysis supports a flexible theoretic approach towards analysing qualitative data and that there is no right or wrong approach. An inductive or theoretical approach can be taken or indeed a combination of both. The inductive approach is otherwise known as a ‘bottom up’ method and the themes will be heavily linked to the data – similar to grounded theory. On the other hand the theoretical (deductive) way is driven by the researchers experience with theory and helps to provide a more detailed analysis. This research combines both inductive and deductive methods. The coding was divided into four main themes: Challenges (12/616), Drivers (13/545), People (12/723) and Embedding (13/844). The first number in the brackets relates to the sources including surveys (n=2), focus groups (n=3) and interviews (n=8). The number of references to each theme is the second number in each bracket. These themes were then subdivided into 219 sub codes. Table 1 outlines some of the codes that were generated and the analysis of qualitative data. Where applicable, the number of sources and references are shown in brackets on the right of Table 1.

### **INITIAL FINDINGS**

Initial findings (outlined in Table 1) suggest LC theory does not compare strongly to practice and the participants understanding of LC mainly focuses on eliminating waste, adding value and continuous improvement. There is much more to LC than this which concurs with Umstot (2014) who stressed “*the more you know about lean the more you realise there is to learn*”. Many nuances and soft skills associated with lean appear to be neglected in favour of the participants need for certainty (proof/evidence) before they will commit to becoming lean (change). It appears that participants favour easy wins and tick the box solutions that produce results (20<sup>th</sup> Century lean) over “real lean” (21<sup>st</sup> Century lean). Table 1 synthesises the analysis of literature and primary data (observational research, surveys, focus groups and interviews - including thought leaders). It illustrates inconsistency between lean theory and current practice. The left column shows how the theory applies, while the right column captures the reality or people’s perceptions of the application of lean and LC. Table 1 is divided into six broader codes: Principles; Pillars; Culture; Contracts; Understanding and Project Goals. This paper concentrates on professionals understanding of lean and LC theory and how this compares to current practice. Further research and data will be gathered through semi-structured interviews and observational and ethnographic research. A year spent training, coaching and facilitating teams involved in the procurement, design and construction of capital projects in the USA will form the basis of future research.

*Table 1: Summary of research - lean construction theory versus practice*

<u>Theory</u>	<u>Feature</u>	<u>Current Practice</u>
Transformation Flow Value (stream) Standardise (task) Waste Visualisation Perfection	<b>Principles</b>	1. Waste (12/145) 2. Value stream (12/118) 3. Value (12/111) 4. Perfection (12/103) 5. Standardise (7/136) 6. Flow (9/34) 7. Visualisation (2/5)
<u>Theory</u>	<u>Feature</u>	<u>Current Practice</u>
H&S Quality Sustainability Time Cost	<b>Pillars</b>	1. Cost (11/166) 2. Time (10/111) 3. Quality (7/43) 4. Sustainability (5/39) 5. H&S (6/17)
Trust and no blame (why) Helps projects flow None/root cause analysis Continuous learning/5 why's Timely problem solving Developing/Empowering Last Planner ® System (Pull) Reliable Natural Everyone Facilitator Command intent - Best for project Decentralised	<b>Culture</b> <b>Trust</b> <b>Blame</b> <b>Problem solving</b> <b>Conflict resolution</b> <b>People</b> <b>Planning</b> <b>Promises</b> <b>Collaboration</b> <b>Coordination</b> <b>Project Manager</b> <b>Synchronized action</b> Alberts and Hayes, (2003) <b>Decision making</b>	Mistrust and blame (who) Difficult in practice Someone Fire-fighting/5 who's Disputes/litigation Control/Constrain/Hierarchy Critical Path Method (Push) Unreliable Forced Management & Planners Directive (Taylorism) Commanders intent - Best for PM Centralised
Relational (IFOA/Alliancing) Flexible Target Value Design & Choosing By Advantages Lowest cost over lifecycle BIM - 7D Shared/transparent	<b>Contracts</b> <b>Specifications</b> <b>Costings</b> <b>Total Cost of Ownership</b> <b>Digital Project Delivery</b> <b>Information</b>	Transactional Strict (5/99) Quantity Surveying & Lowest bid Typically looking at first cost BIM - 3D Hoarded
Go and see Means Top down & bottom up Intrinsic Uncertainty (Experiment) Mentor/Sensi (All levels)	<b>Understanding</b> <b>Management</b> <b>Buy-in</b> <b>Motivation</b> <b>Commitment</b> <b>Coaching</b>	Get it done Results Top down Extrinsic (8/45) Certainty (Proof) (7/66) Consultant (Top levels)

Serious Games Less focus (10%)	<b>Training</b> <b>Tools</b>	Behaviorism More focus (90%)
Conception to abandonment	<b>Project Goals</b>	Max profit/min cost
Optimize the whole	<b>Productivity</b>	Optimize the piece
Collaborative	<b>Research</b>	Private
Internally	<b>Benchmarking</b>	Externally (others)
Process/Forward looking	<b>Metrics</b>	Results/Backward looking

## CONCLUSIONS

There are many nuances and definitions relating to the theory of lean and LC. Defining exactly “what is LC?” is almost impossible and also may not be helpful. LC is a philosophy, therefore, it is open to interpretation depending on each discipline’s viewpoint. Asking “how do you implement LC?” is another difficult question and similar to “how do you become happily married?” AEC projects and marriages are both usually one-off prototypes involving a unique set of people with different personalities. No single project or marriage will be the same. What works for one may not for another.

Rother (2010) cautioned against “implementing” lean as this implies certainty how it can be done. Rather, the path ahead is unclear. Successful AEC projects and marriages require teamwork and there will be challenges along the way. Simply implementing LC does not guarantee success. Project success is dependent on team success and collaborating together (Phelps, 2011).

Changing organisational culture and mind-sets is difficult. The brain naturally finds it hard to change our routines (Rother, 2010; Liker, 2014a). Transforming organisational culture is not a task that can be delegated to a single entity or an outside consultant. Leaders need to be developed at all levels in an organisation. Committing to self-development is another important initial step in any lean journey (Liker, 2014b). Engaging people at all levels helps to build a better, safer and happier environment for everyone to work in. To assure lean is sustained, the soft skills relating to the theory of LC such as leadership, empathy, motivation and collaboration will be required. The analysis detailed in Table 1 strongly suggests that current practice does not follow lean and LC theory as strongly as it should. A paradigm shift is required towards the current approach to planning, designing, delivering and operating AEC projects. While LC is far from commonplace, practitioners are focused on “wins” and “proof” rather than the management philosophy that is LC. Future education, training and increased research will show a different perspective – practice relating more strongly to theory.

## ACKNOWLEDGMENTS

Many thanks to all who participated in surveys, focus groups and interviews including LC and lean thought leaders Greg Howell, David Umstot, Dan Fauchier, Alan Mossman, Tariq Abdelhamid, Richard Keegan, George Trachilis. Special thanks to Ben Meehan for research methodology and NVivo analysis assistance and to

Umstot Project and Facility Solutions, LLC and The ReAlignment Group of California, LLC.

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