A LEAN CONSTRUCTION MATURITY MODEL FOR ORGANIZATIONS

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Abstract: At IGLC 2014 a Lean Construction Maturity Model (LCMM) was introduced and at IGLC 2015 its validation was presented. The LCMM offers organizations in the AEC Industry to obtain a systemic and holistic overview of their current state of LC maturity and provides them with support in their maturation. This paper intends to motivate its implementation in practice in order to test and demonstrate the whole range of benefits and implications of the LCMM. Therefore, this paper proposes a self-assessment template of the LCMM with a two-step procedure to obtain the current maturity level of any organization with regards to Lean Construction (LC). It will enable practitioners to measure the gap between where they currently are as well as develop an improvement plan to improve their LC maturity.

Keywords: Process improvement, Lean Construction Maturity, LCMM, Maturity model, Organizational assessment

1 INTRODUCTION

The construction industry faces the central challenge of improving its productivity and innovation (Larsson et al. 2013). In consequence, many organisations are seeking to achieve the required improvement through consequently applying the management philosophy of LC as one of the most prominent improvement approaches within the construction industry (Sage et al. 2012).

To embed LC it is necessary to measure the gap between the current state in the organisations and where they want to be in terms of Lean (Meiling et al. 2012). In this context, maturity models (MM) represents a very useful tool. It has been widely acknowledged that these models provide organisations with such an assessment of the current state and serve as guidance and support when implementing a change or improvement strategy (Pennypacker 2005; Perkins et al. 2010a; Perkins et al 2010b).

In previous works (Nesensohn 2014a, Nesensohn 2014b, Nesensohn 2015) presented the development and validation of a LC maturity assessment framework labelled Lean Construction Maturity Model (LCMM). The LCMM defines 5 levels of maturity in terms of LC, these are: uncertain, awaking, systematic, integrating, and challenging. Figure 1 illustrates the definition of each maturity level.

Focus groups are considered as an appropriate method, through the production of a consensus of a group that experienced the phenomena (Morgan and Krueger 1993). The data collection through the focus groups involved five and six LC key informants respectively and semi-structured interviews with 11 informants.

Semi-structured interviews were adopted to strengthen the validity of the data from the focus groups (Smithson 2008).

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Maturity level	Definition
0-Uncertain	The Ideal Statement is hardly evidenced in action
1-Awakening	General awareness exists and the Ideal Statement is inconsistently evidenced in action
2-Systematic	The Ideal Statement is systemically evidenced in action
3-Integrated	The Ideal Statement is interrelated as a whole and happens automatically
4-Challenging	The Ideal Statement is status quo which is challenged to improve further

Figure 1: Definition of the Maturity Levels

They are a powerful and flexible method for understanding the experience of individuals (Fontana and Frey 1994, Kvale 2007). They also enhance the depth and breadth of the phenomenon under investigation, having been seen to be useful for research within the construction sector (Shehu and Akintoye 2010).

The validity was obtained through experts which were involved in the earlier data collection stage to ensure the interpretation of the data was accurate. This research proved the suitability of MM and the LCCM as an appropriate method to measure the current state of maturity and to support organisations in planning and directing their transformation towards greater LC maturity (Nesensohn 2014a).

This paper intends to present the LCMM and its assessment method for its implementation in practice. With that, it will be possible to test and demonstrate the whole range of benefits, and implications of the LCMM.

2   LC MATURITY ASSESSMENT

The inputs for any assessment of the LCMM are evidences, observed behaviours, and actions of the organization collected through a maturity assessment (Nesensohn 2014). A two-step maturity assessment procedure has been developed.

The first step is to recollect and analyse all evidence for the current state of LC maturity in the organisation. The second step is a comparison of the gathered evidence against the Ideal Statements and evaluation with the maturity levels. In the Appendix 01 at the end of this paper is presented a template with all the key attributes, behaviour, goals & practices and their ideal statements to determine the maturity of any organisation that intends to assess and improve their maturity in LC.

This will be done for each key attribute as part of the LCMM to determine a maturity level. This level is calculated by the lowest maturity level assigned amongst all behaviour, goals & practices within this key attribute as shown in the example within Figure 2.

	Lean Leadership		2
Leadership	1. Passion	Their leaders fundamentally own it and have a passion and tenacity about Lean so that they are doing it for themselves.	3
	2. True Understanding	A: Their leaders have a true understanding of Lean and see the big picture.	3
		B: Leaders make decisions with short-term pain to achieve long-term gain.	4
	3. Pre-set Position	Leaders have a internalised pre-set position that everything can be improved and they apply it to their own objectives.	3
	4. Walk the Talk	Their leaders drive, deploy and spread the new behaviour by being the example.	3
	5. Standard Work	All leaders conduct their day in a standard and systemic way.	2

Figure 2. LCMM assessment for the Factor - Leadership and the key attribute – Lean Leadership

After that, the overall maturity level can be calculated through the multiplication of the maturity level of each Key Attribute with a weighting factor whose total sum is divided by the total sum of the weighting factors. Each Organisation must weigh the key attributes, which they find most important to them. Nevertheless, there can be no weighting factor with "0" or higher than "4". This will generate a single score from 0-4 for the organisation's total maturity in LC as shown in Figure 3.

No.	Key Attribute	Initial Level	Weighting Factor	Result	Total maturity level.
1	Lean Leadership	3	4	12	
2	Customer Focus	2	3	6	
3	Way of thinking	2	3	6	
4	Culture & Behaviour	1	4	4	
5	Competencies	2	2	4	
6	Improvements Enablesrs	0	2	0	
7	Processes & Tools	2	2	4	
8	Change	4	2	8	
9	Work Enviroment	2	2	4	
10	Business Results	1	1	1	
11	Training & Competency Development	1	2	2	**2**
	Total:		27	51	1,9

Figure 3. LCMM assessment for Lean Leadership Key Factor

Since the framework identifies strengths and weaknesses in terms of LC maturity within organisations. The assessment above shown in table above illustrates gaps and areas with high and low maturity within the current state of LC maturity. AS the example shows, the assessed organization is mature in terms of Change (initial level 4) but lacks in terms of Improvement Enablers.

To obtain the greatest benefit of the maturity assessment, it is suggested to use the LCMM to guide the transformation efforts, and support decisions towards prioritising planned improvement actions with regards to the key attributes which have been rated lowest within the assessment. The information about a gap within can be used for instance to develop targeted interventions and workshops aimed at improving the maturity of a behaviour, goals and practices in the framework.

After the implementation of the improvement actions a re-assessment with the same model, will enable the organisation to monitor changes and improvements actions to identify achieved maturing and learning.

3   CONCLUSIONS

Whilst in many organisational disciplines MM have been tried and tested to measure the current state of maturity in order to enable businesses to direct and plan their move towards greater maturity; there is an absence in AEC companies of such a framework for improvement processes focused on LC.

This paper meets that gap by presenting such a MM together with a developed self-assessment. The MM is labelled the LCMM. The LCMM provides a holistic view of the current state of LC maturity within respect to: lean leadership, customer focus, way of thinking, culture & behaviour, competencies, improvement enablers, processes & tools, change, work environment, business results, and learning and competency development.

In so doing, this LCMM contributes to the body of knowledge in LC in two ways. Firstly, the development of a validated MM provides a verified method to measure the current state of LC maturity in organisations. Secondly, the data collected to inform the development of the LCMM reveals four main phenomena as the essence of maturity in LC. These are: 1) the crucial role of leadership in driving LC maturity, 2) the need to focus on culture and behaviour, 3) the requisite knowledge about Lean, and 4) the low resistance to change.

From a practical perspective, the research provides construction organisations with a method to identify specific strength and weaknesses of LC approaches which can support the planning and directing of transformative LC-based programmes.

Hence, the LCMM highlights gaps in capability, as well as evidence-based support to decision-making in terms of the prioritising of planned improvement actions towards greater LC maturity.

Therefore, the outputs from an assessment using the LCMM can be used to develop targeted interventions. To support such interventions workshops can be held with the aim of improving the maturity of behaviours, goals and practices associated with, specifically, a key attribute and, generally, overall LC maturity.

Finally, it is expected that the LCMM will further 'mature' through its utilisation in practice. This should be considered within a case study-driven research. The author invites organisations within the AEC Industry to test the LCMM and their current maturity and share their experience. Additionally, the generalisation of the emerged explanation of LC maturity as well as the 11 key attributes of LC can be further confirmed or disconfirmed through further empirical evidence.

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5 APPENDIX - – ASSESSMENT GRID OF THE LCMM

Factors	Key Attributes	Ideal Statements	

Leadership	**Lean Leadership**		
	1. Passion	Their leaders fundamentally own it and have a passion and tenacity about Lean so that they are doing it for themselves.	
	2. True Understanding	A: Their leaders have a true understanding of Lean and see the big picture.	
		B: Leaders make decisions with short-term pain to achieve long-term gain.	
	3. Pre-set Position	Leaders have a internalised pre-set position that everything can be improved and they apply it to their own objectives.	
	4. Walk the Talk	Their leaders drive, deploy and spread the new behaviour by being the example.	
	5. Standard Work	All leaders conduct their day in a standard and systemic way.	

Philosophy	**Customer Focus**		
	1. Understanding Customer Value	A: They understand that customer value involves the requirements of the chain of internal and external customers up to the end user.	
		B: It is accepted that customer value can be intangible and the value of customer A can be the waste for customer B.	
		C: They are focused on the value perception of the chain of customers to be clear what is the required value that needs to be delivered in the best possible way.	
	2. Identifying Ultimate Customer Value	A: They are outstanding in identifying real value for their customers.	
		B: They actively revise the identified value stream to react to any changes of the customer value and to tackle any waste in this sequence of processes to create the ultimate value.	
	3. Value Monitoring	They know their deviation from the customer value by monitoring the effectiveness of delivering this value.	
	4. Being "Customer Driven"	Leaders and managers focus on doing the best work for the customer and accept that being customer driven is no contradiction to the business driver such as satisfaction of the shareholders.	
	Way of Thinking		
	1. Systemic Thinking	They think systemically to see the big picture, the whole, the information flow within the system and establish links between every value stream and aspect of the business to create synergies. For example: they practise continuous improvement to see processes and customers in a systemic way.	
	2. Process Thinking	The people accept that value is created through processes and understand those processes and their relationships.	
	3. Scientific Thinking	They are rigorous in collecting information about variables to support the decision-making process and testing hypotheses in a scientific way.	
	4. Long-Term Thinking	They practice long-term thinking while they accept pain in short-term decisions, to not affect the long-term goal.	
	5. Thinking Teams	Everybody's activity is aligned in a direction of delivering improvement and challenging processes, from the top to the bottom regardless of the subject, department or processes.	
	6. Out-of-the-Box Thinking	There are some lateral thinkers who often go off the beaten tracks to find new solutions and challenge the leadership to deliver improvement.	

People	**Culture & Behaviour**		
	1. Communication	A: Everyone from top to bottom knows and understands the vision of their Lean journey and the role Lean plays in that.	
		B: Everyone have the clarity of their objectives & targets as well of their responsibility. And they know the value Lean offers for their role.	
	2. Trust & Collaboration	Everyone see trust and collaboration as enablers for LC and deploy it on a daily basis, especially for the managing of risks and planning.	
	3. Constancy of Purpose & Vision	The purpose to be on a Lean Journey is published and signed off from the management as a strategic vision, and they strive constantly towards it without changes.	
	4. Seeking Perfection	They are fanatical about perfection and practise continuous improvement as an incremental ongoing effort to improve the way customer value is delivered.	
	5. Performance improvement	They have an intrinsic passion to constantly improve the performance of delivering the corporate goals.	
	6. Philosophy	They encompass Lean as a philosophy for the whole business including the design and construction phases so that this philosophy is part of the organisational DNA.	
	7. Culture vs. Tools & Technique	They understand the importance of building a unique culture and behaviour side by side with the application of tools and techniques.	
	8. Commercial Approach	Their commercial behaviour focuses on the big picture consisting of the overall cost, quality, HSE and delivery of customer value.	
	9. Problem Solving	They recognise failure as a trigger for problem solving and effectively involve the workers and their inherent knowledge to identify the root cause to avoid the occurrence of problems in the future.	
	Competencies		
	1. Corporate Understanding	They have a common understanding of Lean and what it is able to give them so that they see everything as a process and Lean is part of it.	
	2. Terminology	Everybody understands and uses a common and shared language for LC.	
	3. Knowledge	The mass of the people really know and apply Lean including its tools, techniques, principles, culture, and behaviour on a daily basis.	
	Improvement Enablers		
	1. Long-Term Journey	They understand LC as a journey and have a intrinsic motivation to moving along this journey towards more maturity.	
	2. Knowledge Sharing	Everybody continuously engages in sharing knowledge and experiences of success and failure in the most effective way.	
	3. Working Together	Improvement is accomplished through managers working together with the people at the grassroots and what they already know.	
	4. Prioritising	They have the ability to systemically analyse the gap within their LC maturity so that priorities for their improvement actions can be set accordingly.	

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	Processes & Tools		
	1. Tools & Techniques	A: They choose accordingly the right tools and techniques to create synergy with the processes and the delivery of customer value so that they address specific problems and support people.	
		B: The chosen tools and techniques are systemically integrated.	
	2. Process Engagement	Processes contain standard ways of working to really encourage Lean thinking and be accepted throughout the organisation.	
	3. Alignment	Each process and tool exists to support the creation of internal and external customer value.	
	4. Simplicity	The processes and everything are simplified and standardised to improve whilst the value for the customer is maintained.	
	5. Visual Management System	Visual management and indications are utilised so that progress towards the value delivery is visualised and everyone understands their contribution towards the ultimate value.	
	6. Pull & Flow	All processes have a flow and produce only what the customer wants, when he wants it and the exact amount he wants.	
	7. Planning	A: Programm planning is done collaboratively.	
		B: Construction planning emerges alongside the design.	
		C: Production planning is done at the lowest possible level.	
	8. Risk Management	The managing of risks is done in collaboration.	
	Change		
	1. Incorporate Change Management	The senior management has adapted a course of action for the sake of becoming more mature in LC.	
	2. Attitudes Towards Change	A: Their individuals understand what is in it for them so that they have a low resistance to change.	
		B: For them change is a way of life because they are agile and have the flexibility to adapt to changes.	
		C: They see changes as opportunities to do things differently and make the best use of them to deliver customer value.	
	3. Supply Chain Engagement	They bring the supply chain early under an umbrella to receive their commitment towards the customer value and create synergies with them.	
	4. Dealing with Dissenters	The organisation and their teams have the momentum and the ability to detect and deal with individuals and groups who are against changes and the strategic Lean vision.	

(Processes & System spans the above)

	Work Environment		
	1. Innovative & Constructive	The work environment is truly supporting innovation and cooperation.	
	2. Confidence & Predictability	Managers have the confidence that individuals and teams inevitably solving problems and deliver customer value.	
	3. Health & Safety	Their projects are well planned so that people can follow their sequence and do their work in a non-chaotic and safe space and with greater health and safety.	
	4. Level of Stress	Everyone from the labour to the project manager experiences a reduced level of stress	
	5. Continuous Improvement	They are practising a constant and systemic continuous improvement which includes their supply chain / stakeholders.	
	1. Customer Satisfaction	They have happy clients and stakeholders through continually delivering what the customer wants, when he wants it and the exact amount he wants (customer value).	
	2. Performance Achievement	They set extreme but achievable goals for performance criteria to motivate individuals and teams.	
	3. Quality	They achieve the expected quality first time.	
	4. Cost, Time and HSE	They deliver customer value effectively, safer, and with less environmental impact because they challenge the original set criteria.	
	5. Competitive Impact	They have an enhanced reputation so that they stimulate extra work and being customer recommended.	
	6. Contingencies	They spent unused contingency on additional features or services that the customer values.	
	7. Partnering	A: They reduce the amount of contract claims and contract litigation through deep collaboration and the use of relational contracts.	
		B: They truly working in a partner relationship with their supply chain and stakeholders.	
	8. Customer Changes	They challenge the amount of customer changes through better collaboration	

(Outcomes & Outputs spans the above)

	Learning and Competency Development		
	1. Learning	A: They consistently demonstrate a focus on learning of individuals and really utilise lessons learned as fundamental for practising continuous improvement.	
		B: They have a structured approach regarding what they want to achieve with their learning.	
	2. Organisational Learning	A: They conduct experiments to learn from failure and success.	
		B: They have a commitment to unlearning knowledge and openness to the outside world and a mechanism for renewal themselves.	
		C: They effectively utilise what the organisation has learned.	
	3. Development of People	A: Their leaders develop the people through coaching, mentoring and the delivery of internal training.	
	4. Training	A: Training focuses on specific ways of working within the processes so that the developed competencies can be applied effectively.	
		B: They train new people according to a plan so that they take on their specific culture in an effective way.	

(Learning spans the above)