LEAN: Introduction, Tools and Support

European Construction Institute

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Foreword

This document presents the reports of the ECI Lean Task Force's between 2010 and 2012.

Part 1 Introducing Lean
Part 2 Taking the Road to Lean (Tools & Support)

Part 1 describes the Task Force's research into the philosophy of lean, primarily through a Study Action Team ™ investigating Jeffrey Liker's book *The Toyota Way.* In this first report the Task Force considered what we mean by lean, why a lean philosophy might be beneficial to the construction sector, where waste was visible across the industry, and the documentation of 'lessons learned' in the form of a table of 'dos and don'ts' resulting from ECI members' experiences.

In Part 2 the Task Force has examined the tools, which support the implementation of lean and specifically, those that are best suited for the construction sector. The report also includes a brief section on behaviours, and how people in the work environment react emotionally to change. The primary focus of Part 2 is a section entitled '*Where are you on the road to lean?*'. This is a self-evaluation grid, which can be used to better understand the position at which an organisation exists in the transition from 'traditional' to 'lean'. It is important to recognise that this journey has no defined beginning or end - it is a journey of continuous improvement.

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ECI Lean Construction Task Force

Part 1: An Introduction to Lean

Key Thoughts from Members Five Months after Launch

”Lean isn't only tools or only elimination of waste... Lean is a way of thinking, philosophy and culture change by which continuous improvement will become a habit / a part of your life / a way you work.”
Sabine Verdickt - Project Engineer, DuPont

”.....if the industry is going to change it has to be a coordinated, continual and determined effort. Therefore this must be driven by the first tier suppliers through collaborating with their supply chains and forcing it to filter down..... for this to happen it must be pushed from top levels of management within each company.”
Ben Charles - KTP Associate, Continuous Improvement Engineer, Laker Vent Engineering Limited

”Lean is not only for manufacturing, it can be adapted to our service / project activity. There is no one technique for being Lean, it is a mindset supported by a catalogue of techniques.”
Arnaud Lemaitre – Veolia Water

”..... there are a number of like minded people who recognise that there is a prize to be gained to unlock the potential through lean construction, but we need to help each other to fully understand how to do this.”
Nigel Barnes - Managing Director, WSP CEL Limited

”The thing that stands out to me is the “buy-in” from the different organisations and individuals within the Lean Task Force. We have involvement from client, design & management and contractor organisations giving us a good representation of our industry - this has led to a confidence that Lean can be applied throughout the industry.”
Tom Ventre - Project Manager, Laker Vent Engineering

“I’ve gained a greater understanding of Lean principles and in so doing have greater confidence that Lean can be applied as effectively in a project and service environment as it has been in the manufacturing industry.”
Chris Brumby - Project / Construction Manager, AstraZeneca

”The concept of Lean is wholly transferrable to the engineering construction industry and cannot be dismissed as something suited only for the manufacturing industry.....it’s more about buying in to the philosophy of continuous improvement rather than merely applying a suite of tools .....”
Chris Mann - Head of Research & Development: Skills & Technical, Engineering Construction Industry Training Board

“The rewarding thing from my perspective has been to see the growing understanding of Lean as a changed mind set rather than the simple application of a set of tools. There is a clear appetite for the change required and an acceptance of the need for a continual search for improvement as opposed to a quick fix.”
Christine Pasquire, Professor of Lean Project Management, Nottingham Trent University & Director / Trustee of the Lean Construction Institute UK Ltd.

Acknowledgements

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Executive summary

ECI members have regularly asked:

- "Why Lean in construction?"
- "How do we start with Lean in construction?"

As a Task Force we have undertaken several activities to establish the levels of knowledge that exist on lean, and to better understand exactly what lean is. One of the activities has been a 'Study Action Team', which reviewed the book *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* by Jeffrey K Liker (2004).

The resulting document represents a first report (Part 1), developed by the ECI Lean Construction Task Force Team to provide answers to the first question, and presents the group's learning on Lean. We have summarised our answers under the headings: 'Why Lean?'; 'What Lean is / isn't'; and 'Dos and don'ts'. Furthermore, several examples of waste in context are given. In addition, we have described strong links with other ECI Task Forces, including Active, Collaboration, People, SHE and Young Professionals.

The main conclusion is that Lean can be used in construction. It represents more than simply a set of tools, and should be viewed as a way of thinking and working. The application of lean is something that the Task Force feels is necessary if the industry is to excel in the long-term.

The second report (Part 2) looks further at how to get started with lean in construction, with suggestions on how to optimise the information that is available on lean.

1. Introduction

1.1 Lean Construction Task Force

Members
Member companies that have been involved with this Task Force include: AMEC, AstraZeneca, BG Group, CB&I, Du Pont, ECITB, Fluor, Kingsfield Consulting International, Lean Construction Institute (UK), Loughborough University, Nottingham Trent University, Laker Vent Engineering, Sellafield Ltd, Veolia Water, WSP CEL.

Objective
The aim of the ECI Lean Task Force is to learn more about lean in construction and gather more data on specific lean tools and how lean can be smoothly implemented with the greatest reward. This knowledge is to be captured in ECI Lean Task Force guides and in workshops. Also, the experiences of Task Force (TF) members on their 'lean journey' will be shared to provide learning points for other members and to see the benefits. This will be achieved through gathering a case-book of lean experiences. Furthermore, the aim is to provide members with the means to promote Lean within their own organisations, within ECI and within the European Engineering Construction Industry.

1.2 What has the Task Force done up to now?

The Lean Task Force commenced in November 2010. The activities of the TF have been first of all to understand what lean is. This has been accomplished by a 'Study Action Team' that read the book *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* by Jeffrey K. Liker (2004). Furthermore, several Lean tools have been explained to the TF team members. This has enabled the TF to summarise the key learning, and focus on specific areas relevant to the Lean TF's key areas of interest. A first part of this key learning has been reported during ECI's Annual Conference on April 14th 2011, and compiled in this report: Why lean?, What lean is / isn't, Dos and Don'ts.

What Is a 'Study-Action Team'?[1]
A Study-Action Team™ (SAT) is an unconventional approach to creating the openness, tolerance for disagreement, and trust needed to confront the real issues that arise on the path to change. The members of an SAT perform a series of activities to fulfil their commitment to bring about the new ways of thinking and acting that must occur for change to become a reality in an organisation. First, they set a goal, select a book, and read and discuss it together in a structured way. Secondly, they participate in a planning session, applying the ideas gleaned from the book to their current work situation. Finally, they implement the plan, holding themselves accountable to a committed leader, monitoring progress and making adjustments as they go along.

Study-Action Team reading the book *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer by* Liker, Jeffrey K (2004)
The goal of SAT: to understand where to focus our effort for the ECI Lean Task Force.

The benefit of reading a book in a study action team is to keep reading the book in a short and dynamic way. It's more intense and absorbing due to the discussions with several people who go through the same stages during the reading. Each of the sessions enabled us to consider our understanding of Lean and it's applicability in a Construction Environment. Furthermore this book is an excellent introduction to Lean for a general audience that explains the management principles and business philosophy behind Lean. The book enabled us to also gain a broader understanding of Lean in terms of the fundamental requirements for Lean to be a success in an organisation and it's easy to read through.

[1] Study-Action Teams, Opening Minds for Organizational Change, CHRISTINE SLIVON AND HAL MACOMBER

2. Why Lean?

Whilst Lean is a term widely used, it is less understood and can almost become a barrier for others to begin a journey of applying Lean in the workplace. The Lean Task Force has endeavoured to capture the experiences of what Lean represents to its members. These are:

- An opportunity to enhance customer value whilst delivering more profitable outcomes across your Supply Chain.
- An opportunity to improve performance where there is no end point
- The world is changing, if we won't change we may be not a part of the future, as a business, a department of a business, as a supplier or a client.
- Why wouldn't we want to improve? With Lean "the continuous improvement" will be done out of habit and become a matter of routine.
- Lean has been used and has shown benefits in cost, safety, employment and retention, customer satisfaction, schedule reduction and improved quality - as a 'producer', why pay for producing something your client doesn't want and therefore should not pay for? To reap the highest profit / reward from a situation, you should only do exactly what is required to achieve the client's expectations. There are obviously 'nice-to-haves' which boost your position / situation / customer service / market differentiation. The client isn't going to pay for these so in effect they come straight off your bottom line.

3. What Lean is / isn't

Organisations more often than not wrestle with the basics and don't know how to begin; from the work that the Lean Task force has undertaken, it is clear that there is much evidence to provide encouragement and food for thought on how to begin the Lean Journey. Although there is a wide resource of literature that can be researched, one may argue that there is no real substitute for 'Learning by Doing'. Below are some thoughts from the Lean Task Force,- based on their initial learning experiences so far in attempting to provide some level of definition.

What Lean Is:

- A state of mind - it's a way of thinking, an opportunity to improve your business.
- Change management.
- A long term philosophy that shapes your business culture and becomes your corporate DNA.
- It's about people and processes (supported by tools) seeking to continuously improve and eliminate the waste (the Non-Value-Adding elements of what we do).
- It applies to construction, not just to manufacturing. There are good examples of where construction organisations have adopted Lean with outstanding results; you could become one of them.
- A way of examining what we NEED to do, and understanding what we DON'T NEED to do. It provides an opportunity to improve (an endless process) and to consider the number of repetitive tasks within your business.
- Lean is an approach to identifying and reducing waste - the client should not be paying for waste.

What Lean Isn't:

- It is not obvious what Lean is – it is necessary to start the journey and learn by doing
- Something that can be achieved without Senior Management Commitment
- Something that can be influenced from a distance - Senior Management need to be "Hands On", and "Go and See" what is happening within the business.
- Just another set of tools or quick fix, there is no 'silver bullet'.
- A short-term commitment. It requires a long-term vision, and shouldn't be undertaken in isolation. In implementing Lean, you need to respect your partners and work with your supply chain.

- To implement it properly, the root cause of waste needs to be tackled, rather than the effect of it. This may be considered one of the hardest areas to articulate - it isn't a short-term solution to anything.
- Lean doesn't only represent a set of tools (e.g. 5S) and the elimination of waste.
- Only for manufacturing.

4. 'Dos and don'ts'

When starting out in Lean Construction, the task force members have recommended a number of key considerations based on their own experiences:

Do	Do Not
Drive lean 'in the line', involving those who do the work.	Set up the project team in parallel to business, as usual delivery team.
Tightly couple learning with action, i.e. do it, don't just train.	Train without acting.
Involve top management in steering groups.	Try to do everything at once.
Plan.	Be pressured into starting before you have a plan.
Keep an open mind.	Dismiss lean as old ideas repackaged.
Start today – don't delay. Why would you want to?	Command and control.
Learn from mistakes.	Be afraid to make mistakes.
Build your own support group.	
Commit for the long term.	
Involve the whole system.	
Aim for some 'quick wins' in order to gain buy-in and win over the sceptics.	
Have senior management sponsorship and support.	
Keep daily progress meetings "short and sweet" and make the benefits visual.	

5. Examples of waste in context

The idea of removing waste is a compelling one – common logic dictates that not doing wasteful things will save time and money. Understanding what waste is may not be straightforward – the most efficient process is wasteful if it doesn't deliver anything of value. So, this conversation starts not with "what is waste?" but with "what is Value?". The separation of design from construction makes this a surprisingly difficult issue to deal with – construction activities are executed under the assumption that delivering the work as specified in the most efficient way is providing Value. This exposes an early source of waste in the design and the design process itself, but the topic of design is for another report. Here we are going to discuss waste as it affects construction productivity and we define productivity as the execution of the onsite construction / assembly and the flow of work. This has parallels with the Toyota Production System (TPS) which also relates to the assembly processes. The TPS identifies 7 types of activity waste which map fairly well to waste in construction activities, but the different nature of construction means there are other wastes that are not found in manufacturing. The purpose of this section is to illustrate waste in a construction context by the use of simple examples.

Toyota's 7 wastes (muda – associated with activities or processes)

1. Unnecessary movement – this is very common on construction sites where movement of personnel is frequently mistaken for productivity (being seen to be busy). A true lean site looks empty because everyone is at the place where the work is being done and not walking about. Traditional project managers find this very difficult and feel they have to fill the empty space with workers and materials – this must be resisted as it causes congestion, delays and extra cost. Unnecessary movement is any that takes a worker away from the work for example, finding and collecting materials and equipment. A Lean construction intervention for unnecessary movement includes materials logistics to ensure the worker is kept supplied at the work face and doesn't need to stop working to go and look for things. To implement a logistics system there has to be recognition of the cost of:

    a. Paying a skilled worker to find things;
    b. The delay in restarting work due having to review progress;
    c. The impact that stopping the work has on follow on activities;
    d. The impact on surrounding activities of having other trades moving through their work space on their trip to and from the stores etc; and
    e. The cost of buying in an "additional" activity of logistics to prevent a) – d).
    f. A case study of the use of logistics was presented by Chris Brumby, AstraZeneca, at the ECI conference in Amsterdam 2011 and can be reviewed in the conference report.
    g. A less visible effect of unnecessary movement is one associated with ergonomics – making the work fit the worker. So much of construction work is done overhead, requires frequent bending, twisting and lifting or is just difficult due to confined space. The consequences of these are two fold, firstly the accumulation of extra time for each of these movements and secondly the wear and tear on the worker themselves which at least slows them down as they tire during the day and at worst become a chronic health issue (bad back, hand arm vibration etc.) affecting the long term productivity of the industry.

2. Unnecessary transport – closely linked to movement of personnel, this concerns the movement of materials and / or equipment. It is common in construction to buy many materials in bulk in order to achieve supplier discounts. The consequence of this is that quantities of material are moved and moved again around the site and even within the storage compound as materials become inaccessible due to following deliveries – this happens even when there is good storage space. Equipment and plant can also suffer frequent movement from place to place especially if several workers are sharing or if it is left where it blocks the work of other trades.

3. Waiting – this is a controversial waste. It is clear that if personnel are waiting then they are not being productive so it is wasteful. Workflow should be planned so that workers are not idling with materials being delivered to the workface Just In Time. However, sometimes in a construction project it may be better to wait than find work to do for example:

    a. As construction work changes frequently, work completed ahead of schedule (to keep workers busy) may become obsolete and need to be removed;
    b. Work executed out of sequence may have unforeseen negative consequences for following activities; and
    c. If the relevant prerequisites aren't in place then it may be better to wait rather than risk defective work, work that can't be completed and requires revisiting later or causes an accident for example.

4. Inventory – again this has a different impact on construction. Unlike manufacturing, inventory does not really accumulate between activities on site as once materials are incorporated they are part of the final structure. Until paid for however, this constitutes Work in Progress (WIP) which has a cash flow impact if payment terms are not adhered to. Excess inventory occurs pre-installation as sites are commonly loaded out with materials, this ties up money just as it does in manufacturing. If the design changes these materials may become obsolete and need to be disposed of and materials stored on site may be damaged or stolen. However, some materials need to be freely available as their cost is too small compared to the cost of delaying the work if they are not available. Again the use of logistics for materials management is helpful in identifying and managing varying material requirements. In construction, the high number of trade contracts and activity interfaces cause an accumulation of money held in risk contingency funds by the supply chain organisations against the variation (uncertainty) in work flow, associated potential conflict and waste generally. The accumulation of this resource (money) is the construction equivalent (but for very different reasons) of the accumulation of the material resource named as inventory waste in manufacturing. If each supply chain organisation is adding a 30% risk contingency into its contract then that could be defined as an excessive total accumulating across the end to end construction process. However, this is controversial as the risk fund “bucket” often also contains the profit of the organisation. More research is needed to be better recognise, understand and manage this but the goal should be lower risk contingency, more certain profit and an overall reduction in cost to the client

5. Defects – these continue to be a challenge for the construction industry where a list of defects is often the first quality monitoring tool to be put in place on a project. The cost of going back to correct defects is hidden in the risk contingency and as such is covered by the customer and accepted as an unavoidable aspect. To adopt a right first time approach or measure defects in parts per million as in manufacturing is a long way off yet for the construction sector. A detailed understanding of the root causes of defects is needed for any significant advances in their reduction, these causes range from design through procurement to management and planning.

6. Over-processing – this involves visiting and revisiting the same activity without progressing it much towards completion. The most obvious examples of this exist in the administrative process where multiple signatures are required or the activity is passed through several departments or specialisms before the work is released. On site examples stem from the way operatives work, starting work and moving to the next task before fully completing is a deeply embedded way of working. It seems the driving motivation is to allow the next trade to start as early as possible – there is no recognition that revisiting the workface several times before the work is finished is wasteful as there is a genuine belief that early start of activities means early finish of project. These follow up visits take extra time in reviewing progress before starting the next piece of work, are disruptive to the planned schedule as well as adding the wastes of unnecessary movement and transport and are strongly related to the “making-do” waste of under- or inappropriate processing.

7. Over-production – this waste is very difficult to see in construction as most projects are commissioned rather than speculative unlike the mass production of manufacturing that may be ahead of customer demand. However, providing a higher quality than required or a greater quantity than required is an obvious example of this category of waste. More obscure is completing work ahead of schedule – this is often a caused by not wanting the workers or the work to wait (see 3 above). In general, this waste is more commonly found within and as a result of the design activities.

Other forms of waste:

1. Under-use of human potential – this is a common form of waste in construction where by the people who do the work are rarely consulted about how to do and improve the work. It is closely allied to the control and command form of management whereby work is executed simply by orders. Engaging people and allowing them to have conversations about the project promotes creative thinking – not to do this is wasting their potential.

2. Making do – this is the waste caused by starting work before all pre-requisites are in place. Causes defects and rework and is common in construction projects. One of the most serious is making do with insufficient or unsafe space in which to work including having too many trades sharing a working space especially at multiple heights.

Some member case studies are provided below to further illustrate aspects of these wastes within construction:

Examples of waste observed within an engineering construction pipe manufacturer / installer include:

- A site could be expecting some piping due for delivery as per the contract programme. The labour resource is employed, the plant & equipment is delivered, the access is co-ordinated ready for the piping to be installed. Unfortunately the workshop could have a "rush" job come in for a client on a shutdown and all workshop labour has to react to this work and therefore the expected piping is delayed. This has caused wasted time, effort & cost in organising the site work. It has caused wasted labour hours (downtime) in redirecting the site labour onto other works (that is if some other work is available).
- The workshop could be working hard to meet their delivery requirements from the contract programme. They have worked hard and delivered the piping to the scheduled date. Unfortunately the client has not arranged access because their priorities have changed. The piping will now sit in laydown on site and require double handling when installation is available. This has caused wasted time & effort for the workshop, wasted laydown space & wasted time in double handling.
- Deliveries could be late or installations put on hold due to items of plant or materials not being ordered because they have been overlooked or it was thought that it was "somebody else's responsibility". This causes downtime & reactive behaviour which has a knock-on effect to other jobs & tasks.
- We are installing piping on a project and another contractor is completing the electrical installation. We both have separate contracts that include for the provision of fixed access scaffold. Although the cable routes and piping routes are in the same areas separate scaffolds are erected at different times rather that one scaffold to suit both needs causing additional costs to the project. As well as this the cable and the pipe supports have been installed separately when in some cases, supports could have been designed and installed to accommodate both trades' services.
- A client tells us that there is a pipe line to run by a certain date and the design and details will follow. When the details (which include a P&ID, arrangements and isometric drawings) finally arrive we are told that we only have a short period of time to install the line. We reply and tell the client that we believe the date can be achieved however it will involve changing the route of the piping to make it simpler to install and support. The client agree to this but are disappointed about the wasted time & cost to provide the original design that could have been avoided if the routing was discussed with us at the design stage.

These examples need to be put into context with the seven wastes:

1. Transportation – the examples identify wasted transport of piping to site and double handling from laydown.
2. Inventory – the examples show examples of wasted laydown and the workshop working on piping that isn't ready for installation.
3. Motion – There are examples of avoiding motion waste by suggesting simpler installing routing. Also with piping & electrical contractors working separately leading to additional support installation in possibly difficult areas.
4. Waiting – The examples identify the site waiting and expecting piping that doesn't turn up. Also the piping & electrical contractors working separately could lead to co-ordination issues that result in one contractor being held up.
5. Over Processing – Could you use the wasted design from the client in the last example as too much information that wasn't required?
6. Over Production – Could you use examples of workshops sending piping to site before it is ready for installation?
7. Defects – There are many examples of defects that could be used. Design incorrect causing clashes, items not being checked following fabrication & installation..

It can be seen here that construction activities do not fall neatly into individual waste categories but are often examples of several different types of waste all at once. For this reason, the classification of waste although helpful to gain a general understanding, should not be used as a rigorous tool for project management. It is much more important to be rigorous in the definition of value and then allow waste to emerge from that understanding.

6. Links to other ECI Task Forces

Lean can be viewed as a 'state of mind', and has links to many other activities once it becomes a way of working. Within ECI there are several other Task Forces - in this section we explore how understanding the other Task Force initiatives and recommendations can help to embrace the complete benefits of lean.

6.1 ACTIVE

Background & Aims

The ACTIVE approach was developed as an initiative aimed at improving the performance and competitiveness of capital projects in the process, energy and utility industries. It was founded in 1996 with UK Government funding, and was re-launched as ECI ACTIVE in 2002. ACTIVE espouses eight principles of collaborative project management. ACTIVE supports these with a number of value-adding practices captured in a wide variety of training materials, tools, documents and benchmarking assessments.

The aim of the ACTIVE taskforce has been to continue to support and promote the use of ACTIVE throughout the European engineering construction sector. The Task Force's aims have been to:

- Examine cases that have used ACTIVE and understand what lessons can be drawn from these
- Work with other organisations and stakeholders in ensuring that ACTIVE adapts, and continues to represent the best way to run projects

Links to Lean Task Force

One aspect of successfully delivering Lean principles is in combining a number of different ways of working to add-value to the task in hand. ACTIVE is a key approach in assisting project delivery, and therefore represents an excellent complimentary activity to Lean.

6.2 Collaboration

Background to the Taskforce
The Collaboration Taskforce grew out of one of ECI's most successful Task Force initiatives of recent years - the Futures Task Torce. The Collaboration Task Force's approach was based on that, which has been used by PWC in its 11th annual CEO survey 2008. This highlighted the importance of collaboration in business performance. As a result, the Task Force examined what collaboration meant to the engineering construction sector.

Aims and Activities of the Taskforce
The aim of the Taskforce was to understand what collaboration meant to the engineering construction sector in five key areas:

- The supply chain.
- The pursuit of talent and retaining people.
- Regulatory harmonisation.
- Addressing major global challenges.
- Access to new markets.

The Task Force interviewed over twenty individuals from ECI member organisations. The sample included clients, EPCs and smaller contractors. The Task Force then analysed the responses in each of the five areas to understand collaboration in an engineering construction context.

Task Force Findings
Collaborating in the supply chain:

- The suitability of projects for collaboration does not lie in the characteristics of the product (e.g. complexity) but lies in having the right **relationships** in the project:
  - Clients and EPCs understand alliancing differently.
  - Trust is seen as the most important prerequisite for collaboration.

Links to Lean Task Force
As mentioned, the application of Lean principles works best when a number of areas of key activity are linked together. The collaboration Task Force findings on establishing the right relationships align well with the requirements necessary in implementing a lean approach. One of the key elements of successful collaboration is for all parties working together to form a trusting environment - again 'dovetailing' nicely with lean. Building a team involves the application of relatively new ideas and techniques.

6.3 People

Terms of Reference
The terms of reference of the Task Force were to identify best practice, create new knowledge, and to support its use in order to:

- Attract and recruit people.
- Train and develop people.
- Appraise and reward people in the European Engineering Construction Industry to enable the effective delivery of projects

Links to Lean Task Force
To date, an area that the Lean Task Force has considered is that Lean is more than just a toolkit of principles. More importantly, it is how they are used, applied and supported by the people implementing them. Having the right people involved is key, as established by the People Task Force - the Lean environment provides a supporting and nurturing arena for people development.

There is a strong link between ACTIVE, People and Lean Task Forces, through the right people working in the right teams in the right way.

6.4 SHE

Mission
The SHE Task Force's aim has been to provide guidance for ECI members on construction safety, and health and environmental issues in particular, from a pan-European perspective.

Objectives
- Provide a pan-European forum for its members for networking and developing a mutual understanding.
- In conjunction with the ECI Executive Board, define and champion SHE policy and strategic plans.
- Promote improvement programmes and actively encourage members' involvement in safety, health and environment.
- Enhance ECI's image and EU relations for the benefit of its members and the industry as a whole.

Main Activities
- Champion SHE issues, providing leadership and technical expertise to members.
- Develop SHE taskforce measurable objectives and incorporate into an annual SHE plan.
- Encourage regular individual member participation in the SHE Task Force meetings
- Liaise with regulatory authorities to ensure legal compliance and anticipate new legislative requirements.
- Monitor achievement of objectives against the annual SHE plan.

Links to Lean Task Force
Everything we do has to be done safely, and therefore it is key that the principles recommended or developed by the Lean Task Force form part of the remit of the SHE Task Force (and vice versa). Delivering projects through Lean techniques will show an increase in occupational health, ergonomics, safety statistics and reductions in waste and environmental impacts. This is as a direct result of the improvements, not only in speed of delivery, but also the way projects are delivered.

6.5 Young Professionals

The ECI Young Professional's Task Force is a group of talented and dynamic young construction professionals from across Europe. Activities that are currently being carried out by the group include:

- Providing additional fresh resource to ECI's highly regarded research Task Forces.
- Organising a programme of valuable learning opportunities, targeted at young construction professionals.
- Creating a strong young professional's network that will be both invaluable to the future of the ECI, and to the creation of high value relationships that will have a positive impact on parent organisations in the years to come

Links to Lean Task Force
A number of the principles of Lean challenge the traditional approaches in which the construction industry has operated. The best suited people to champion new ways of working are often young professionals as they begin their careers; therefore it is key that the principles of Lean are embedded into development programmes for young professionals. Lean will assist in involving young people in the development of their chosen industry, provide empowerment, and represent a long-term initiative.

Conclusions (Part 1)

The Task Force has investigated what lean means, what it is, and how it could be used to help improve the performance of organisations within the Engineering Construction sector. Following this investigation, an overwhelming consensus from the Task Force has been that the philosophy of lean is wholly applicable within a construction environment, from project concept, through design and construction, and on to delivery.

This initial report provides an overview - the Task Force investigation has clearly focused on lean philosophy rather than tools or processes. We have looked for examples of waste in a construction context (identified as a result of lean thinking) and discussed the issues affecting our own companies, which could have been addressed through a better understanding and adoption of the lean philosophy. Fundamentally, lean focuses on long-term business sustainability by better meeting the needs of customers. As a concept, it provides a philosophy and set of tools to enable any company to provide the best chance for success.

Industries and companies based in other sectors, such as manufacturing, have clearly adopted the lean philosophy to considerable good effect, however, it is sometimes difficult to visualise the transferability of these well-established processes. The proposition of recognition as a world-leading, value-enhancing partner of choice should be enough to attract the interest of most companies in the sector. Once that proposition has been coupled with demonstrable increases in safety, productivity, profit and stature, it moves from one of attraction to necessity in a demanding and competitive business environment.

Whilst the Task Force accepts that it is not easy to visualise exactly what a truly lean company in the sector might look like at this stage, it is convinced that moving towards a philosophy of continuous improvement, focused on customer value, offers significant benefits to clients, organisations, individuals and society.

The Lean Task Force will continue the investigation by focusing on how best to start the lean journey, how tools can best be used in a construction context, and what else needs to be achieved to enable the transformation process to be better understood and applied in a lean construction context.

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Slivon, C., & Macomber H, (2010), *Study-Action Teams - Opening Minds for Organizational Change,* Lean Project Consulting.

ECI Lean Task Force members involved with this publication:

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Sabine Verdickt	DuPont
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For further information about the LEAN Task Force and publications please visit:

http: / / www.eci-online.org / taskforces / lean /

ECI Lean Construction Task Force

Part 2: Taking the Road to Lean (Tools & Support)

Foreword

As the construction industry enters another phase of its life against a backdrop of economic constraints and limited resources, we can look back at the track record of the industry with pride at the achievements and advances made.

A large portion of construction projects confound all the prophets of doom by achieving successful outcomes when we look at the safety, quality, cost and time performance. Good examples of this in recent years have been Terminal 5 and the Olympics programme which have set new standards of delivery.

The construction market remains fragmented but there is a large element of the industry that has begun to work together toward successful outcomes and we need to build on these successes.

None of this could have been achieved by the construction industry itself, the achievements have been driven by many key people adapting the best practices of other successful industries and implementing new ideas through the construction supply chain.

Amongst the teams driving the change, the ECI stands out as a body that brings together like minded people who are interested in the continuous improvement and renewal of our industry. The ECI has several Task Forces running, including the Lean Construction Task Force which has shown leadership in firstly explaining the Lean principles and why they should be adopted. In this second report the Task Force explain how to begin with Lean and build the foundations for successful delivery.

I am confident that the work done will help you begin your Lean journey and through this report, give you some ideas and the confidence to improve your current competitive position.

John Oliver

Chairman ECI

Acknowledgements

Thanks to the following for their participation in trialling the road to lean grid:

- Members of the College Management Team – School of Architecture, Design & Built Environment. Nottingham Trent University.
- WSP CEL Project Management Group

Executive Summary

The initial Lean Task Force report (Part 1) stated that the most common questions asked by ECI members with regards to lean were: what, why and how? What is lean, why should we adopt a lean philosophy and how do we start in lean construction?

The initial report set out to answer the question of what lean is, and why it would benefit the construction industry. This report starts to consider how to begin a lean transformation. The report's aim is not to overwhelm the reader with information, however, it should be accepted that a good understanding of the philosophy, methodologies, tools and techniques will be of benefit. This report includes reviews and descriptions of articles, books and further resources that the reader should consider in order to gain a fuller picture of the tools and techniques involved.

The most important part of any lean journey is at the start. Once the threshold has been crossed, the journey of continuous improvement is open, and the challenges become more visible. Although on occasions, the rewards are instantly clear, it is often necessary to reflect on where we are, in order to understand where to 'aim'. With this thought in mind, the report includes a document called simply "*Where are you on the road to Lean?*" This document, in the form of a scoring grid, is not a route map to successful lean transformation, but a tool to use within your teams to assist in commencing an open and honest discussion about where your organisation sees itself, and where you might be going. It can be used by any organisation, at any stage of their lean journey, and should be regularly revisited.

1. Introduction

1.1 Lean Construction Task Force

Members
Member companies recently involved with the Task Force have been: AMEC, AstraZeneca, BG Group, CB&I, Du Pont, ECITB, Fluor, Kingsfield Consulting International, Lean Construction Institute (UK), Loughborough University, Nottingham Trent University, Laker Vent Engineering, Sellafield Ltd, Veolia Water, WSP CEL.

Objectives
The aim of the ECI Lean Task Force has been to learn more about Lean in construction, gather data on specific lean tools and better understand how the philosophy, principles and tools of lean can be smoothly implemented with the greatest reward in an engineering construction context. The hope is that we can learn from our own experiences and observations, whilst recording our findings for the benefit of the wider industry, through ECI Lean Task Force guides and in workshops. The experiences of Task Force members whilst on their 'lean journey' will be shared, to provide learning points for other members and to illustrate the benefits. Furthermore, the aim is also to provide members with the means to promote Lean and the benefits of improved productivity and customer value within their own organisations, within ECI and within the wider European Engineering Construction Industry.

1.2 What has the Task Force done?

The Lean Task Force was established in November 2010. The activities of the Task Force have been to firstly understand what lean is. This was initially accomplished by the formation of a study action team that analysed the book The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer by Jeffrey K. Liker (2004) under the guidance of Alan Mossman of The Change Business Ltd. Furthermore several Lean tools have been explained to the TF team members. All this has led to an initial report (Part 1): *Why lean?, What lean is/isn't, Dos and don'ts* issued in July 2011.

2. Books, Papers, Websites

2.1 Book List

Terry, Adrian & Stuart Smith (2011) *Build Lean -Transforming Construction using Lean Thinking, CIRIA*.
ISBN 978-0860176961

Liker, J K, (2004) *The Toyota Way*; McGraw-Hill.
ISBN 0-07-139231-9

Mann, David (2010) *Creating a Lean Culture*, 2e, CRC Press.
ISBN: 978-1-56327-322-3

Knott, Terry (1996) *No Business as Usual*, The British Petroleum Co.
ISBN 0 86165-202-9

Goldratt E J , Cox J, (2004) *The Goal*, Gower Press.
ISBN 978-0-566-08665-6

2.2 Book Reviews

Build Lean - Transforming Construction using Lean Thinking

Adrian Terry and Stuart Smith (2011), CIRIA

The narrative approach taken by the author means this publication can be singled out as a learning tool simply by reading and digesting the part of the 'lean journey' that the reader wants to find out about.

This readability should enable a better understanding of lean principles and with the case studies intertwined with the text, provides the construction examples needed to explain the lean methodology covered.

While this book lacks the hard facts of lean, it does relate lean directly to construction. The A3 Problem Solving Worksheets apply the "lean principles" with suitable sketches and diagrams, some being clearer than others to understand.

The matrix covering 20 keys of construction lean leadership is wide and provides a clear, specific statement in where your organisation is as it references the word "lean" whereas other matrixes may not.

Details on some of the many Case Studies referenced, in a separate annex with sufficient information to find out how lean had been applied on these projects, would have been useful.

CIRIA are formulating a follow-up publication, which will cover promotion, implementing, measuring, raising awareness and how lean can link into sustainability.

Reviewed By David Adamson

For another view of *Build Lean* read Howell, Greg (2011) "Book Review: *Build Lean: Transforming construction using Lean Thinking* by Adrian Terry & Stuart Smith"*. Lean Construction Journal* pp 3-8 http://bit.ly/build-lean

The Toyota Way

Liker, J K, (2004), McGraw-Hill

This book was the subject of the Study Action Group reported upon in the first Task Force Report and is recommended as a sound introduction to lean thinking. This book presents a number of important issues that are useful to explain why Toyota is a successful organisation – although they manufacture cars, these issues are presented in a more generic way enabling other sectors to access the learning associated with the company's outstanding performance. Liker identifies fourteen management principles that organisations can use to establish lean practice. These principles are collected under four categories, Philosophy, Process, People and Problem solving that must be tackled in this order if a lean transformation is to begin to gain purchase. Underpinning this pyramid of 4P's is the "Toyota House" a diagrammatic representation of the production system that shows the underpinning components of philosophy, visual management, stable and standardised processes and a levelled load all supporting the pillars of Just in Time and Built in Quality. These lead to the desired outcomes of better quality, shorter time, lower costs, better safety and higher moral. The diagram has people at its heart to drive continuous improvement through waste reduction and teamwork.

In the discussion on stable and standardised processes, Liker explains Toyota's understanding of waste. This of course includes the seven wastes associated with activities, but also tells how overburdening of people and machinery leads to breakdown causing often catastrophic waste. In a similar vein, unevenness in flow causes an increase in the seven activity wastes and is a deeper .

All in all, maximum benefit from reading this book will be achieved if time is allowed for reflection on how the principles and insights transfer to specific contexts. The relevance of the subject matter will be greatly improved if the applicability within context is discussed within a group and includes debating methods for adaptation within particular organisations.

Reviewed By Professor Christine Pasquire

Creating a Lean Culture

David Mann (2010) CRC Press, ISBN: 978-1-56327-322-3

This book moves towards addressing the issues of why a lean journey, once started, often fades away as the initial enthusiasm dissipates. At its heart it recognises that any lean transformation must include the whole organisational management and not simply the production work. In doing this, Mann elevates the issues of leadership and how it must change in order to sustain the lean efforts and embed the new philosophy into the organisational culture to become the way it does business. In simple terms, this leadership comprises of developing standard work that keeps management focused on the processes of production, monitoring the production through that standard work using visual management methods to reveal problems that can disrupt production and then acting to resolve those problems. For many businesses this is counter to standard leader practices that are more likely to focus on costs or resource utilisation. The book is full of examples of visual management techniques and approaches showing how they can be applied in many sectors outside manufacturing. Mann goes to some lengths to emphasise the discipline required to maintain the new lean management effort. As such this book provides a continuing inspiration to managers and leaders who struggle to change the way they manage operations.

Reviewed By Professor Christine Pasquire

No Business as Usual: An extraordinary North Sea Result

Terry Knott (1996) The British Petroleum Co. 174pp ISBN 0 86165 202 9

Commissioned by BP and copiously illustrated, *No Business as Usual* tells the story of the creation of the platform and subsea facilities for the BP Andrew and Cyrus fields in the UK sector of the North Sea between 1990 and 1996. These projects were distinctive because they were procured using an alliance, a form of relational contract, as a way to significantly increase the rate of return on capital employed.

Presented in three parts, the first deals with the back-story and how the eight-partner alliance was formed, the second with how the alliance worked and the third with the installation and commissioning phase. Within the second part there are important sections on the inter-related topics of safety, procurement and quality.

This is a fascinating insight into what is possible through an alliance. The lessons from Andrew were not widely adopted in Europe though they did influence what happened offshore in Western Australia and subsequently on public-sector infrastructure projects on the east coast of Australia.

These lessons are well worth reviewing and this book is a good place to start. BP and its partners had to learn it all from scratch. In addition to Andrew, we now have the benefit of the alliancing experience in Australia and Integrated Project Delivery (IPD), a similar approach used in building construction in the US, as well as established relational IPD and alliancing agreements to help us on our way.

Reviewed by Alan Mossman

The Goal
Goldratt E J, Cox J, (2004), Gower Press
Goldratt defined the theory of constraints as a principle of flow that explains how unevenness causes many problems. In this book he explores the effects of synchronisation of work and illustrates how the rate of work, the use of contingency and the consideration of interdependencies combine to deliver flow of work by using the difficulties associated with marching a scout troop across country as the example. This could not be further from a manufacturing analogy and allows everyone from any industry or sector to think about how the drum, buffer, rope system can be adapted to their specific context. Allied to this system are ideas around critical chains and the book leads the reader through a learning process using the journey of Alex Rogo into continual business improvement. Written as a novel, The Goal is very successful in carefully and meticulously guiding the reader into a learning process by not simply presenting the solutions. Goldratt understood that learning for oneself was key to achieving lasting change and although the style of his book has often been copied, these later author often lacked the deeper understanding of learning and were unable to resist the temptation to tell their readers what they should do. Professor Goldratt, who died in 2012, will be very much missed.

Reviewed By Professor Christine Pasquire

2.3 Papers

Reading text books provides a wealth of information to help you to understand lean production and lean thinking generally. There comes a point however when deeper questions need to be asked and answered. Academic papers and journals are a vehicle through which to do this. These publications also report specific aspects of research. Here we present three papers that complement each other helping to advance your understanding and knowledge further.

1. **The underlying theory of project management is obsolete** by Koskela L J & Howell G A; paper presented at The PMI Research Conference, June 2002, Seattle, Washington. Available to download at http://usir.salford.ac.uk/9400/

   This paper highlights how traditional Project Management approaches add waste to the project delivery and positions lean project production as a new and more effective method. The paper argues the need for explicit theory as it provides the foundation for common understanding for communication and subsequent learning. Koskela and Howell cite the PMBOK as representing the current (traditional) theory of project management and show how this rests on the transformation view of production. They go on to argue that the theory of projects as transformation is not the best available and that two other views, those of flow and value generation, should also be applied. This paper illustrates the lean construction developments coming from a theoretical perspective.

2. **Lean project management** by Glenn Ballard & Gregory Howell (2003): Lean project management, Building Research & Information, 31:2, 119-133. Available to download at http://dx.doi.org/10.1080/09613210301997

   In this paper, Ballard and Howell take a more applied view of project management and describe a lean project delivery system that continues to provide a fundamental model of lean construction. It is in this paper that the Last Planner System is introduced as the mechanism for production control and the idea of collaborative planning is presented. A comparison of lean and non-lean projects is presented and places the coupling of learning with action as a fundamental aspect of project management. This paper illustrates lean construction developments coming from an applied project perspective.

3. **Pull-driven scheduling for pipe-spool installation: simulation of a lean construction technique 1998** By Iris D. Tommelein, Associate Member ASCE Journal of Construction Engineering and Management, July / August 1998, 124 (4) 279-288**.** Available to download at http://mail.leanconstruction.org/pdf/PullDEV.pdf

   In this paper the materials-management process is modelled for a typical fast-track process-plant project. The concepts of push-driven and pull-driven process management are explained and contrasted providing some assistance in understanding one of the more difficult lean concepts – pull. The paper provides examples of mapped processes and looks at ways of modelling using determined or probable measurement. By the use of engineering construction examples the lean theories are illustrated and cause and effect measured. This paper delivers a grounded and practical explanation of the theoretical aspects.

4. **Target value design: using collaboration and a lean approach to reduce construction cost** 2012 by Daria Zimina, Glenn Ballard & Christine Pasquire in Construction Management and Economics, 30:5, 383-398. Available to download at http://www.tandfonline.com/doi/abs/10.1080/01446193.2012.676658

   This excellent paper, co-authored by a member of the Task Force and by a leading member of the global lean construction community, describes a process that was first articulated only 10 years ago and is already underpinning significant savings in the overall cost of construction. 20% savings are detailed in the paper and more recent applications are claiming significantly better results. While the results detailed are for complex buildings there is no reason to suppose that similar results cannot be achieved in engineering construction. My own limited experience of EPC procurement suggests that there are enormous savings to be made when engineers learn to talk openly with the constructor and the client together throughout the design process. APM.

2.4 Websites

http://www.leanconstruction.org - this is the website of the Lean Construction Institute (LCI) founded in 1997 in the US. The site includes papers and presentations, most by practitioners from the last 15 years. To access the more recent information you will need to join LCI.

http://www.leanconstructionjournal.org - a service of LCI and the honorary editors, the Lean Construction Journal's papers are free to access. Although this is an academic journal, one aim is to present ideas in ways that are accessible to practitioners.

http://www.leanconstruction.msu.edu/ - Prof Tariq Abdelhamid's Lean Construction Lighthouse™ site contains a variety of materials and links to other sites.

http://www.leanconstruction.org.uk - LCI-UK's site.

http://www.iglc.net- the site of the International Group for Lean Construction (IGLC) is a primarily academic group. The site holds copies of almost all the papers from past IGLC conferences.

http://en.wikipedia.org/wiki/Lean_construction - this Wikipedia site offers a general introduction to Lean Construction and Last Planner.

In addition to websites, there are a number of lean construction discussion areas on the web and particularly on Linkedin where you can raise questions and learn from the experience of others:

Lean Construction Institute - http://linkd.in/LCI-US
Lean Construction Network - http://linkd.in/lcnetwork
Lean Construction Institute UK - http://linkd.in/LCI-UK
Last Planner Users – http://linkd.in/lastplanner

Download a recent global list of lean construction groups on the web - http://db.tt/0xozjL5

3. Select list of tools and approaches

There is no such thing as a *lean* tool. There are lean processes and there are processes that are not-yet-lean. Some tools may help make some not-yet-lean processes leaner.

Toyota developed the tools it uses in response to specific problems it encountered. We encourage you to do the same – develop tools that respond to specific issues that you face in your organisations, projects and processes.

Just because Toyota, your closest rival, or some other designer or constructor uses a tool is no reason why you should use the same one. The only reason to use the same tool is because you experience similar issues/problems in your business. Begin by understanding your business, your processes and the problems therein.

Before you do anything with any of the ideas below, it is worth reading John Seddon's article *Watch out for the toolheads*, which you can download for free from http://www.systemsthinking.co.uk/6-23.asp. Then start by understanding your business and project processes. A good way to do that is to *map* your processes — a good guide to doing that is **Robert Damelio** (2011) *The Basics of Process Mapping* 2nd edn. Productivity Press. If you want to go a bit further read **Mike Rother & John Shook** (1999) *Learning to see: value stream mapping to add value and eliminate muda* Lean Enterprise Institute.

Alan Mossman 29 Sept 2011. alanmossman@mac.com

3.1 Some additional tools

This select list of tools are additions to those covered in **John Bicheno** (2008) *The New Lean Toolbox, 4th edn* Picsie Books

A3 report / process / Quality Story / - a validation, decision-making, teambuilding and personal development tool. A3 supports working in a group and helps to create robust proposals, continual improvement, decisions, problem solving. A3 contributes to transparency of decision-making process that involves thorough information analysis as well as allows documentation of analysis and learning. A3 serves for rationalisation of choice and reduces communication in group problem.

Benefit: concisely documents problem solving processes, proposals, *continual improvement* and decisions in an easy to read/understand way; a personnel development tool (see Shook (2008) *Managing to Learn* LEI)

ADePT – a design-work sequencing tool based on the design structure matrix. Find out more at: http://www.adeptmanagement.com/ourservices/adept.html

Benefit: helps clarify when it is important to collocate all or part of a design team so that critical inter-dependent decisions can be made.

Building Information Model (BIM) - a digital 3D/4D representation of physical and functional characteristics of a facility which serves as a shared resource for information about a facility. The model is collaboratively produced by the design team who share a single model. Most full BIM software incorporates clash detection. By incorporating time in the model (4D) it is possible to test constructability (= virtual design & construction VDC). 2D and axonometric drawings can be output from the model for fabrication; some constructors are making the model available at the workface allowing operatives to look at the model from a variety of viewpoints during construction. Clients are increasingly asking for BIM to simplify cost modelling (5D) and facilities maintenance (fm) (6D) during the operational life of the facility.

Benefit: significantly reduces errors in design; easy to check as built against the model; reduces design time:

Choosing by Advantages - a system and a set of processes for making decisions that focuses only on the valued advantages of the alternatives. It can help individuals and teams to improve quality of decisions. When documented on an A3 there is a full audit trail for the decision. http://www.decisioninnovations.com/

Benefit: improves the understanding of the decision, the criteria used to arrive at it and the quality of the implementation.

Concurrent engineering CE, Design for Construction and Maintenance – designing the production system while designing the product or facility itself. CE ensures that the design can be constructed. CE requires early involvement of constructors and fm.

Benefit: improved constructability, FM; reduced cost

Ergonomics – designing the work for the worker. Ensuring that the work is within the physiologic limits of the worker and that tools, materials, etc. are to hand when required so as to reduce damaging twisting, reaching, bending, etc.

Benefit: improved health and safety; less sickness and health absence

Evidence-based design EBD – exists to help designers make a connection between design and the outcomes that owners want from their buildings. Drawing on a growing research base EBD seeks to increase the chances that designs deliver what the customer wants. Still in its infancy, EBD is most fully developed in healthcare where evidence from clinicians is available.

Benefit: more productive facilities

Improvement kata – a systematic improvement / kaizen process developed within Toyota and first. The improvement kata is supported by a coaching kata designed to support those learning the improvement kata. Both are described in **Mike Rother** (2010) *Toyota Kata* McGraw-Hill.

Benefit: systematic and shared approach to solving problems within the business

Integrated Project Delivery IPD, Alliancing – procurement strategies that enable early involvement of constructors and designers joined in a multi-party *relational agreement* that encourages application of *Last Planner, TVD, concurrent engineering*, to design and construct a facility. Alliancing has its origins on the BP Andrew Project in the UK and was further developed in Australian and Finnish Public Sector projects. IPD has evolved in the US beginning in 2004 in California.

Benefit: reduces legal and insurance costs, increases value to owner at reduced cost.

Last Planner® System LPS – developed specifically for construction, LPS establishes a systematic commitment-based process of production planning and control that is focused on improving workflow reliability. Reliability is improved by enabling "last planners" (trade foreman and design team leaders) to make decisions about what work to commit to delivering within a given timeframe and within the context of higher-level plans that they have contributed to. LPS is a flexible system that absorbs uncertainty inherent in the construction processes. LPS uses Percentage of Promises Complete (PPC) as the principal metric to measure the quality of planning and studying reasons for late delivery and activities that went better than expected to learn how to plan better. Longer description at http://db.tt/SpA8GT6.

Benefit: more reliable and predictable production; uses social pressure rather than command and control; clear audit trail for commitments; manages in real time rather than after the event.

Last responsible moment – a point in time beyond which a decision will result in a delay in the overall project delivery date. Borrowed from software engineering the easiest way to establish it is in the context of collaborative planning – see Last Planner.

Benefit: focuses the mind in both design and construction; can be useful if you need to remind the client that s/he is about the delay the whole process.

Lean accounting – http://en.wikipedia.org/wiki/Lean_accounting an approach to management accounting that is designed to support and encourage continual improvement in lean operations by providing simple, visual, and low-waste information that helps management control, decision-making, understanding customer value, correctly assessing the financial impact of lean improvement.

Benefit: encourages continual improvement; supports lean operations

Long-term partnering – a business strategy that supports long term relationships with customers and suppliers Not to be confused with *IPD, Alliancing,* or *Relational contracting.*

*Benefit***:** it is much easier to keep a customer than to win one.

Off-site Manufacturing / Fabrication – using the advantages of factory based production to reduce the amount of detailed work done on site → site as a simple assembly area where fabrications are assembled and connected.

Benefit: improved safety, improved speed, improved quality

PDCA Plan-Do-Check-Act - a four-step problem-solving process also known as the ***Deming cycle*** - though Deming referred to it as the ***Shewhart cycle***. The four steps are: Plan - investigate the cause of a troublesome condition and create a proposal for its modification or resolution; Do - perform a test implementation of the plan; Check (or Study) - assess the results of the test for effectiveness; Adjust - if the results are unsatisfactory, modify the original condition or define a new standard procedure. If the results are not satisfactory, refine the plan and repeat the cycle until satisfactory results are achieved.

Benefit: basis for systematic, rigorous processes

Relational contracting / Alliancing / IPD – multi-party design and construction contracts that focus on communications and relationships between the parties as well as their specific rights, obligations and deliverables. The starting points for these agreements are that the parties are to be trusted and that we are agreed that the best way to do the work is by collaborating. [These are different from traditional, bi-lateral, transactional contracts that start with the assumption that the parties are not to be trusted].

Benefit: facilitate *lean* and collaborative working easier; experience suggests projects are more likely to be delivered on time and within budget with the full scope agreed with the client – often more; makes it easier to do *set-based design, TVD, CE, BIM.*

Set-based design SBD / set-based concurrent engineering - Set-based thinking develops sets of possible potential solutions far into the design process only narrowing choices at the *last responsible moment* (c.f. point-based design that quickly chooses and develops a single solution to the point where it is no longer workable – then moves to a new point). It requires comprehensive research and thorough documentation so ideas which are not chosen for this project can be recycled for use in future projects. *Choosing by Advantages* is a good way to choose between alternatives.

Benefit: faster design process (this is counter-intuitive for many); allows consideration of a wider range of options and enables synthesis of ideas to meet customer requirements more effectively.

Standard work/standardized work/standard operating procedure SOP – Standard work is a documented description of current good practice – the best, safest most reliable way we know to do a particular task. Standard work forms the baseline for continual improvement; measures of standard work enable those engaged in improving current standard work to answer the question "is this change an improvement?" As the standard is improved, the new standard becomes the baseline for further improvement, and so on. Improving standardized work is a never-ending process.

Benefit: standard work → predictable results; basis for improvement

Target Value Design TVD - a project delivery method that shares methodologies with Target Costing and Value Engineering, but is performed within the context of lean construction and *IPD*. TVD has generated first cost savings of approximately 20% on case-study projects. Starting with the project business case, the method establishes early scope (i.e. value) and a linked cost target for the project. Design proceeds on the basis of increasingly detailed and accurate cost estimates for delivering the required scope. TVD is integral to *Integrated Project Delivery* and requires *concurrent engineering*. For more information read Zimina, Daria, Christine Pasquire & Glenn Ballard (2012) Target Value Design; *Construction Management and Economics* 30:5, 383-398

Benefit: increased cost and time certainty; reduced cost; improved buildability.

4. Behaviour

Many of the Task Force members have been involved to a greater or lesser extent in lean construction exercises over the past few years, and through their experiences are convinced that there is tremendous benefit to adopting a lean approach. One of the key successes to achieving the benefits is delivered through the behaviours of all concerned.

When first adopting lean techniques, it must be recognised that the approach is a change to the traditional construction approach and therefore as well as managing a construction project, the delivery team must recognise that they are also delivering a change project at the same time.

This section is a reminder of some of the behaviours that are required to help the introduction, or further development, of lean to be a success and some of the behaviours that may be observed during this process.

It is worth noting that the true success of lean construction will only be delivered through engagement of the entire supply chain, specifically those that have any level of responsibility in ensuring the success.

Getting Started
The initial step will be to set the right environment for behaviours, through senior sponsorship of the changes required to illicit the maximum benefits from a lean approach. This senior sponsorship comes not only from the client, but from any of the leaders of the companies involved in the supply chain, through the creation of an 'environment of optimism' that the lean approach is worthwhile. Senior sponsors must create a burning desire for achievement, rather than a burning platform of threat.

In many organisations, facts and figures are required to show that it is worthwhile and there are many benchmark studies to show, not only a reduction in delivery time, but also a reduction in costs through this approach.

What does this report provide?
To set the right behaviours it is key that the scene is set, as noted above, to encourage understanding that the lean approach is worthwhile. Within this report there are many references that give all parties the knowledge required to undertake lean. The behaviours of senior leaders are then required in order to draw a path between the knowledge and the optimism, using the knowledge available.

Leading the right behaviour
Leading behaviours through setting a vision of what success looks like, and creating the desire in all parties to work together toward the common goal is important. The skills required to deliver in a lean manor are usually already evident within the supply chain. The leadership role is to make sure that the skills are aligned with the knowledge, and that there is a desire to make it all worthwhile.

Observations that will be made

There are two extremes of how things could progress. Everyone involved will realise how easy this new approach is, feel stimulated to join in and all the leaders need to do is behave in a manner that reinforces the lean approach. Alternatively, none will accept the change due to vested interests in a traditional approach, and everyone will revert to type. Reality says that it will be somewhere between these two and the behaviours need to reinforce moving toward the former outcome rather than the latter.

One key behaviour is the approach to mistakes. In most cases lean construction is new to an organisation. There is a lot of knowledge but not much experience of how it all goes together, and the best way to learn and fully understand is to make the odd mistake, but reflect and learn from the mistakes.

Mistakes are a vital part of the upward trajectory of any part of the supply chain, rather than part of the downward trajectory.

Creating the right behaviours to embrace and learn from mistakes is key, it is also key that introducing lean is a change to the traditional way of doing things and therefore the majority of people who are new to this process will experience emotions that are best highlighted by the change curve which was originally explored by Elisabeth Kubler-Ross, through her explanation of the grieving process and can be simply illustrated by the change curve.

Supportive Behaviours
The lean approach can be best described as a process that is implemented by people throughout the supply chain. Apart from being aware of setting the vision, creating the optimism for delivery and being aware of the impact of change, the senior sponsors must create an environment of learning which may require some form of training. It is also worth noting that not everyone will be ideal to work on a team delivering in a lean way and therefore picking and supporting the right individuals is absolutely key to success,

Behaviours Summary
You have read in this section about a Task Force, with experience saying that behaviours are key to guide the supply chain through this change process. This can be done through senior sponsorship highlighting data showing historical success and creating a vision of the way forward. There must then be an identity and alignment of skills where everyone should learn from mistakes. Focus should be given to manage the change process and providing the right training for the right people.

5. Where are you on the road to Lean?

5.1 Introduction

The purpose of this report is to help you learn so that you, your organisation and your supply partners can improve.

- Using it for any other purpose will compromise its ability to help you learn
- Use it to help you see where your organisation and/or your supply partners are on your/their lean journey.
- Use it regularly to track how you, your organisation and supply partners are changing and to assess your readiness for the next steps.

5.2 Working with the grid

In many organisations each division will be at a different stage; sometimes you will be at different stages with different clients. Decide where you want to focus your attention — the whole organisation, a division, a particular client, client group or supply team, even a single project.

Please write your agreed focus here:

_____

Work through the grid, section by section, row by row and choose the set of statements (A, B or C) in each row that most closely describes what happens wherever you have chosen to focus. Sometimes this will be difficult because you feel that statements in A & B for example are true for your focus. That is a good point to open up a discussion before you decide. We want you to choose whatever is most likely to happen. Tick the set of statements you choose and total the number of ticks in each column.

Get others within your organisation (and in the supply chain you have focussed on) to do the same — and then discuss your responses.

This document has been adapted from the maturity matrix developed by the UK Strategic Forum for Construction http://www.strategicforum.org.uk/sfctoolkit2/home/home.html.

Processes	A	B	C
Planning	• We use critical path method for planning • We manage each activity according to the contract programme • We find the same problems occurring on most projects	• We discuss the project programme with all our sub-contractors and suppliers • We use logistics for managing material delivery and site distribution	• We use collaborative pull planning for Just In Time delivery • We use root cause analysis to learn from plan failure • We focus on reliable promises to achieve reliable programmes
Improvement	• We seek to make each step as efficient and cost effective as possible • We always do the best work we can • We have procedures to track and allocate liability for errors and omissions	• We have regular improvement initiatives • We have specially trained staff who identify problem areas and lead improvement • We use safety, health and the environment as drivers of improvement	• We recognise errors and omissions as opportunities for improvement • We engage all staff in improving our processes recognising improvement suggestions wherever they originate • We involve our supply chain and our customers in this
Standard-isation	• We recognise that each project is unique • We expect our people to use their skills and professionalism to address the challenges they face in the most effective way • We meet all legal standards	• We comply with specifications and standards • We seek to repeat solutions from previous projects • We develop our own standards	• Write own standards and continually improve them • We use visual management to ensure everyone understands what is required • We ensure things are right first time
Production management	• We manage our supply chains through discrete work packages and programmes • We expect our supply chain to meet our programme • We execute all activities as quickly as possible	• We involve the supply chain in management of production progress. • We recognise that head office processes impact on production • We understand that space (?) both physically and on the programme is fundamental to work flow	• We consider the end to end process in deciding how best to make the work flow • We have a shared programme that we arrive at collaboratively to ensure smooth work flow • We use small batches to level workload
Waste	• We do not have a clear understanding of the different kinds of waste	• We understand there are many different types of waste	• We understand the different types of waste • We continually work on reducing that waste
Totals			

Knowing what's going on	A	B	C
Awareness	• We rely on our supervisors and managers to tell us. • Senior managers regularly ask questions of line managers and supervisors by e-mail or phone.	• Senior managers hold regular meetings with supervisors and line managers to better understand what is happening on site, • Meetings are informal to encourage open and honest debate.	• Senior managers regularly visit the site and mix freely with line managers, supervisors and workforce & supply chain. • Site visits are targeted at better understanding where issues are and where improvement can be made.
Understand-ing	• Our senior management team understand our business better than anyone else. • Our management team direct the organisation by issuing an annual operation plan which is followed by all	• Our senior management team communicate regularly with the workforce to ensure the strategy and direction are fulfilled. • Our management team consult with line managers and supervisors for their input onto the strategy and direction.	• Our senior management team work in partnership with the workforce to establish and promote strategy AND DIRECTION. • Senior managers work in close partnership with the workforce to better understand where issues and opportunities are likely to arise.
Differing perspectives	• Change is implemented by senior management or consultants.	• We recognise that change is sometimes necessary to improve.	• We recognise that frequent change is a part of continual improvement • We seek input from all members of the workforce to promote improvement and suggest change
Information & Data	• We gather reliable and accurate data and statistics about our business. • We rarely use data for decisions	• We often ask head/central office to confirm data and statistical information • Our processes or plans may be affected by head/central office data. • We base decisions on data when we have enough time	• We always confirm data and statistical information that will affect our processes or plans by discussing it with those who it affects. • We actively try and base all of our decisions on good data.
Risk	• We consider assumptions as a necessary part of any plan. • We recognise assumptions in our risk management deal with consequences as and when they occur.	• We always try to minimise the number of assumptions made in the planning process. • We recognise assumptions in our risk management and constantly revisit them prior to mitigate consequences.	• We always try to remove any assumptions by consulting widely across our workforce, partners, clients and supply chain. • We seek to fill any knowledge or experience gaps and constantly review assumptions. • We constantly work to understand the cause and effect of assumptions and seek opportunities to improve.
Totals			

Developing people & organisations	A	B	C
Grow Leaders	• Leaders emerge through the hierarchy of command and control and are often recruited from external sources. • We see our leaders as responsible for task completion. • Culture is task focused with a clear hierarchy of control and no shared values or beliefs.	• Leaders are developed according to their potential. • We expect our leaders to lead by example. • Values and beliefs are well publicised and not based purely on profit.	• We develop leaders internally who understand the work & the company ethos. • We see our leaders as role models for the company philosophy. • We have a strong stable culture in which company values and beliefs are widely shared.
Training & development	• We offer general training to our workforce • We expect our supply chain to manage their own training and development needs.	• Training and development is aligned to meet the needs of the business objectives. • We develop multi-skilled individuals. • We target supply chain training where there is a process overlap.	• We undertake specific training for individuals and teams to meet their immediate needs to suit the process. • We develop cross functional teams to optimise performance and teamwork. • We involve the supply chain in all aspects of process improvement.
Learning	• If our processes fail we correct them at the time and move on. • We rely on designated inspectors for verification and reporting. • We limit process improvement to our own responsibilities within the process.	• We hold regular lessons learnt activities but sometime fail to implement them. • Responsible manager's witness processes to advance understanding. • We consider process interfaces for improvement activities.	• We increase knowledge & develop competency by capturing learning, reflection and focusing on continuous improvement. • We encourage understanding by expecting everyone to go and see processes for themselves. • We focus on end to end process improvement.
Behaviour & engagement	• Processes are designed to hold people to account for failure. • Roles and responsibilities are clearly identified to support a command and control culture.	• We operate a fair and just culture • We consider improvement suggestions from individuals within the process. • We hold workshops to reflect on process improvement.	• We engage people by encouraging ownership, accountability and involvement alleviating the need for blame. • We empower our people by encouraging a questioning & listening culture. • We encourage our people to reflect on the shortcomings of their own work and strive to improve processes and quality.
Totals			

Costs & benefits	A	B	C
Cost Control	• We have effective procedures to minimise the cost of every aspect of the work • We use our purchasing power to lower costs • We set targets for all resource expenditure and require managers to deliver each below target • Maximising profit is the key commercial driver	• We cost work in collaboration with our sub-suppliers • We use purchasing strategies to support the project even if they reduce buying discounts • Reliable profit is the key commercial driver	• We move money within and between supply chain partners collaboratively to minimise overall project cost even if this increases specific element costs • Our key commercial driver is value delivery
Risk Management	• We push risk to the lowest possible level in the supply chain • We make sure we have contingency (money, materials and time) in place for our protection • We have maximum insurance and require our suppliers and sub-contractors to do the same. • We ensure all contractual events are properly notified clearly and efficiently	• Risks are identified through risk registers • We place risk with the party most able to manage it • We monitor the use of buffered time, material waste and cost contingency to ensure we don't exceed allowances	• We collaboratively manage risk & opportunity.
Accounting systems	• We have effective procedures to ensure we fully claim all payments due • We have effective procedures to ensure suppliers and sub-contractors are not overpaid • We ensure we hold maximum permitted retention • We do not pay suppliers and sub-contractors before the due date • We have effective procedures for contra-charging our sub-contractors and suppliers to minimise non-recoverable costs	• We have some preferred sub-suppliers with pre-agreed payment terms	• We have instant payment systems for our trade partners e.g. project bank accounts • Change is costed collaboratively • We automate the majority of payments • We share project insurance • We guarantee an agreed profit to our principal trade partners • We do not hold retention
Totals			

Strategy	A	B	C
Relationships	• We believe that the industry is made up of individual organisations who are only interested in their own activities. • The relation with our suppliers or customers is only determined by the current project. • We do everything in benefit for our shareholders while observing all the relevant health, safety & environmental regulations.	• We realise that we on the long-term can perform better if we understand how those close to us in the supply chain are involved. • We try to find ways of getting more benefit for the same cost, thus adding value. • We have framework agreements with one or more of our suppliers/customers. We assume that they have similar relationships with their next tier etc. • We see that we have impact on society. We see health and safety as a top priority on all our sites. We are beginning to understand society and environmental issues.	• We understand that the whole industry is interconnected and that most of what we and others do affects each other's performance. • We undertake activities that are in direct support of the long-term business needs. • We keep records to help us learn how we can improve the way the work works and to create documents which will have future operational value. • We build our long term relationships on trust and mutual respect. • We believe we have an absolute duty of care to ourselves, each other and society. We ensure we use resources as wisely as possible with minimal wastage and damage.
Attitude to competitive-ness	• Interaction between suppliers is considered inappropriate until appointments are confirmed/orders placed. • Our partners normally vary from project to project; it just depends on the prices offered. • Next tier suppliers are only brought in when they are needed.	• We often consult and we encourage our supply chain to discuss related issues with ourselves. • We recognise that developing collaborative partnership would benefit all	• We select the most appropriate organisations from our frameworks to provide the services required at the beginning of the project • Suppliers are actively encouraged to bring forward supply chain partners they feel will add the most value to successful delivery. • We actively work with all tiers in the supply chain to maintain relationships and seek more effective& efficient ways of working together
Contracts	• We initiate/participate in formal competitive tendering where the work is awarded to who offers the lowest price. • We believe we need a clearly defined contract identifying all duties and responsibilities. • We all work on minimal cost margins and so have to charge extra for anything additional to the tender. • We always ensure that anything we handover is documented to protect our interests	• We initiate/participate in limited competition with organisations from a short list of those who can provide high quality services within a set cost limit. • We believe a partnering is considered the most effective way of gaining commitment and support from the team • Procurement in our business is project specific. A number of the main players have some supply chain arrangements, which get considered for inclusion in the project. • We put out enquiries and appoint the next tier supplier who provides the best all round deal, within set cost limits.	• We have framework commercial arrangements in place before projects are considered • We work on an open book basis with agreed levels of overhead & profit. • We pay and are paid for what the team agrees needs to be done. • We have long duration agreements with most of our suppliers and/or customers.
Totals			

Quality & Safety	A	B	C
Defects	• We identify and correct defects on an ad hoc basis. • Processes exist for periodic or final "snagging" only.	• Standards are well defined and we have robust processes for identifying and correcting defects as work proceeds. • Steps are taken to avoid defects and to learn from experience.	• Defects are designed out and production processes mistake proofed wherever possible. • A culture of "right first time" exists across all activities and throughout the supply chain.
Continual Improvement	• We solve problems as and when they occur.	• We have procedures for investigating, correcting and sharing from quality failures. • We don't measure the effectiveness of these procedures.	• Procedures for investigating, correcting and sharing from quality failures. • The procedures are followed and their effectiveness measured and continually reviewed.
Cost/ Quality Decisions	• We make decisions on the basis of lowest cost. • We aim to drive down immediate and elemental costs. • We are not concerned with costs beyond the immediate project.	• We consider overall costs and avoid lowest costs solutions to reduce later problems. • We sometimes use value engineering/ value management for decisions on key components. • We may consider life cycle costs for the end customer.	• We consider cost as a component of value in relation to benefit to the client. • We base decisions on overall costs and consider impact on later stages of design and construction. • We consider lifecycle costs in our quality/cost decisions.
Managing defects	• We record and communicate defects using a report/ written note or similar. • We issue lists or instructions to rectify defects sometime after they have occurred.	• Defects are recorded and displayed for all to see in the site office. Visual means such as imagery are used to convey information. • The display is reviewed and status updated at regular meetings.	• Defects are recorded and displayed immediately upon discovery at the place of work activity. • Defects are resolved at the earliest possible time by the operative team.
Health and Safety	• We expect our workers to find safe and effective ways to do the tasks they have been given. • We expect our workers to use available equipment safely. • We cover the legal requirements	• We encourage our workers to take care of themselves and give appropriate training, information and support. • We expect them to plan their work and to use appropriate tools and equipment. • We cover the legal requirement and take moral consideration of ourselves and workforce	• We design out health and safety risks as much as possible and provide workers with the environment and equipment to carry out tasks in the most ergonomically effective way possible. • We place as much emphasis on the health of our operatives as we do on safety. • We cover legislation, consider ourselves and the supply chain and take moral considerations of all stakeholders, environment and society.
Quality Systems	• We carry out inspections to confirm product quality prior to handover. • We focus on releasing finished work and rarely investigate or assess deviations and quality complaints. • Our Quality Management System (QMS) is viewed as a barrier and adherence is poor.	• We have some quality control in process and support this with a 'final inspection'.	• Quality is built in at all design and production stages. • Focus is balanced on supply and quality considerations. Standardised tools are always used to address problems and drive to root cause. • Our Quality Management System is seen as supporting quality & improvement.
Totals			

Leaders	A	B	C
Grow leaders	• As our workload fluctuates, we resource accordingly and therefore we have to recruit and release supervisors and managers in line with the requirement of the business.	• We try to keep our labour turnover rate low. If we can, we keep hold of people for the long term so that they can integrate and grow within the organisation and fully understand our ways of working.	• We grow and develop our people. We do this so that they are fully integrated and understand our ways of working. • Our leaders are developed to live and breathe our philosophies so that they can act as a role model, teacher and coach to others. • Providing knowledge and training as well as continual development is key for us.
Our Desired Leadership Style	• We tell people within the business and through the supply chain exactly what we want. • Clear instruction is given and is monitored to prevent any deviation. • Our leaders hold a position of authority. • Managers are in that position to implement and make decisions.	• Leaders should be able to motivate & inspire others but at the same time direct and control to achieve results. • Our leaders understand our objectives and promote these throughout the organisation and supply chain. • Although our mangers hold a position of authority, they are approachable and interact with employees and other organisations.	• Our leaders have mainly grown through our organisation and conduct themselves in a way that earns them respect and inspires others. • Everybody within the business and supply chain is encouraged ask “why”, challenge the “norm” and drive to break away from “business as usual” and continually improve. • Our leaders, who live and breathe our philosophy, provide others with the information and tools required to carry out activities • They ensure that a pathway is clear and they “make ready” anything which may be required to perform tasks.
Leaders perspective	• Problems are caused by individuals making mistakes or not following systems. • We have clear disciplinary procedures in place and our management use these with individuals or organisations who don’t follow procedures, specifications and systems.	• If there are problems with performance these are discussed openly. This may result in the need for individual or system changes.	• Almost all problems are systems faults and we use these problems as opportunity to learn and improve our ways of working.
Totals			

Sub-contractors and suppliers	A	B	C
Commercial terms	• We seek to award contracts based on the lowest technically acceptable offering. • We use traditional transactional contracts	• Whilst price is important we consider other factors which are equally as important e.g. safety, environment, quality and Predictability of satisfactory Outcomes.	• We generally work under relational contracts.
Problem solving	• If we have problems with our sub-contractors and suppliers we look for alternative sources of supply.	• We work closely with our Supply Chain to understand their issues, what impact we have on their business performance and theirs on ours.	• We want our sub-contractors and suppliers to be successful however to succeed we must work together and resolve issues in an open and transparent manner. We encourage having the difficult conversations
Lessons learned	• We often refer to capturing lessons learned but more often than not our people have moved onto the next project and relationships with our sub-contractors and suppliers is strained.	• Lessons learned is firmly embedded in our core business processes as we strive for continuous improvement.	• Only when we can share our learning experiences both positive and negative with our Sub Contractors and Suppliers will we be truly successful.
Commercial philosophy	• We seek to maximise our profits by striving for the lowest costs from our sub-contractors and suppliers whom we have many.	• We recognise that our sub-contractors and suppliers have to make a profit therefore we seek to reward good performance	• Maximising mutual returns arising from exemplar performance should be a prime objective in developing long term strategic relationships with preferred Sub Contractors and Suppliers.
Totals			

Customers	A	B	C
View of customer	• We operate in a conventional industry where the client pays and we receive instructions.	• We are recognised for the value we can bring to the table in delivering our core skills	• We are treated as an equal in delivering customer focus across the entire value chain, in doing so our people are operating in a fully integrated manner
Alignment of objectives	• The Client, Sub Contractors and Suppliers all have different objectives.	• Our Senior Managers are fully aligned in the business objectives	• Workshops involving Client, Sub Contractors and Suppliers have been held to ensure the objectives of all are fully aligned.
Customer relationship	• Our customer focus is very much driven by the short term transactional business plan.	• We need to improve our customer focus if we are to be less transactional and more into developing relationships.	• Our goal is to have sustainable relationships with our sub contractors and suppliers underpinned by strong customer focus.
Learning with customers	• We send out a customer survey to find out how we can learn from what our customers tell us.	• We carry out a lessons learned session at the end of our programme of work.	• At frequent intervals we engage with our customers face to face and draw out the lessons to be learned and assign implementation owners.
Customer strategy	• We have been appointed through a widely competitive bid process on fixed price lump sum contracts against poorly defined scope.	• Scope better defined and bid list reduced to those who've expressed interest in forming strategic partnerships committed to developing more innovative commercial models	• The needs of all parties are fully understood and commitments made to develop long term relationships based on current benchmarking and by adopting Lean Concepts.
Totals			

5.3 Record Sheet

Write the number of ticks in each column in each section of the grid here and total your results:

	A	B	C
Processes			
Knowing what is going on			
Developing people & organisations			
Costs & benefits			
Strategy			
Quality and Safety			
Leaders			
Developing people & organisations			
Customers			
Grand total			

Now read the next page:

Relevance of Toolkit

	A	B	C
Summary	• If your highest score is in A then you are in the very early stages of your lean journey or you have the choice to start it	• your scores in this column represent the extent to which you are recognising some of the benefits of a lean approach and your first steps on a lean journey – there is still a long way to go as you and your company make the shift from traditional to lean thinking and the new ways of working that go with it.	• Scores in this area indicate a higher level of lean thinking in your organisation and even if this is your highest level scoring column there is still a long way for you to go. If in your organisation you believe the comments in this section most represents the way your company does business, then you are one of the few Companies who have.
Feedback	• If you conduct your business in the historic way then most of the Toolkit will be new to you. • Choose between focusing on assembling supply chains or focusing on creating Integrated Project Teams. To do both would be a huge step and therefore a high-risk strategy. • Get involved with one of the industry change agents or best practice clubs who can help you change.	• If your business is in the transitional phase then you will already be working in some of the ways described in the Toolkit. • There is plenty more for you to explore and lots of benefits on offer. • Decide if you are most advanced in integrated supply chains or Integrated Project Teams and whether you want to become expert in your strength or work to improve your weakness. There is value on offer for both types of integration but maximum value is available if you can achieve both.	• If you conduct your businesses in the aspirational way then you are ahead of the majority of the industry. You will already be sharing your experiences as you believe this is of the maximum benefit to you and your supply chains. • You may well have tools and techniques that could be made available to others via the Toolkit. • You are probably intimately involved with industry change agents and/or best practice clubs – if you are not, you should seek to join as you have much to teach others

For help and guidance on the maturity grid, toolkit use or learning to work more collaboratively please contact: eci@lboro.ac.uk.

Conclusion

This is the second report (Part 2) completed by the Lean Construction Task Force. It continues to provide further data and research on the information available, covering the methodologies, tools and techniques that will help an organisation adopt a lean approach. A book review by Task Force members is incorporated into the report to assist the reader in selecting the appropriate reading for their needs and interests. A comprehensive list of tools and approaches (in some cases web links) have also been provided within the report to assist the reader in optimising their knowledge.

Members of the Task Force have experienced success in their approaches to lean construction. The factors that drive this success are that:

- There is a need to be aware of what is available in terms of current thinking, tools approaches, articles and books, to help you apply the lean approach that suits your organisation.
- Senior management sponsorship or leaders of the company support the changes required to create an environment of optimism reinforcing the message that the lean approach is worthwhile.
- Recognition that behaviour plays a key part in adopting the lean approach and engagement of the entire supply chain will be needed to optimise the benefits.
- The lean approach may be new to an organisation and should be treated as a change programme, whereby mistakes will be made and continuous review and improvement needs to be accepted as part of the change process. Further skills training may be required to combat these mistakes.
- The ‘change curve’ will help the reader to understand the change process and the barriers that they may face when introducing lean tools and techniques disrupting the status quo.
- Before starting the journey utilise the Lean Maturity assessment grid within the report to help you find out where your organisation is in the lean process. This will also have the added benefit of starting the engagement between employees and the supply chain alike to generate the discussion required to identify what needs to be done to fully optimise the lean approach.
- Regularly revisit the assessment grid and note how your organization is changing, it is important to recognise where there is improvement and where further work should be focused.

For its third report, the Lean Task Force intend to investigate further the importance of behaviours in Lean implementation and focus on the leadership of change. Topics likely to be covered are the assistance of change in the workforce, inspiring successful change, dealing with resistance and how to better manage change and gain ‘buy in’ from the workforce, partners and customers.

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