

Resource Maximisation through Lean in Construction

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“ THE MAN WHO WILL USE HIS SKILL AND CONSTRUCTIVE IMAGINATION TO SEE HOW MUCH HE CAN GIVE FOR A DOLLAR, INSTEAD OF HOW LITTLE HE CAN GIVE FOR A DOLLAR, IS BOUND TO SUCCEED. ”

| Henry Ford |

Key Features of Corporate World Leaders

It is imperative that in any industry, the efficiency and effectiveness of projects and of the company are maximized. This is particularly so in the construction industry where projects run into millions of rupees, if not dollars. According to the Hackett's Grid, conceptualised by the Hackett Group, USA, corporate world leaders are those that maximize these efficiency and effectiveness. The former covers factors such as function and process cost as a percentage of revenue, application complexity and automation etc while effectiveness covers parameters such as accuracy of forecasts and predictions, industry excess return, percentage of time spent on analytics for decision making, quality metrics etc. Any project or company needs to focus on these core elements to excel.

Since construction industry plays a major role in every national economy and many sectors depend on this industry, increasing the productivity of this sector will lead to a great cost savings for the industry as well as the society. This applies very much to Sri Lanka, where GDP from Construction in Sri Lanka increased to an all time high of 163,120 LKR Million in the first quarter of 2016 from 95,189 LKR Million in the fourth quarter of 2015 representing a 71% growth. GDP From Construction in Sri Lanka averaged 49,049.82 LKR Million per year from 2002 until 2016 (all figures from Dept of Census and Statistics, Sri Lanka). Since construction contributes to about 22% of the Sri Lankan GDP, which is incidentally the highest in the SAARC region, productivity improvements in this sector will have significant multiplier effects within the industry and related sectors.

Adding Value Through Lean

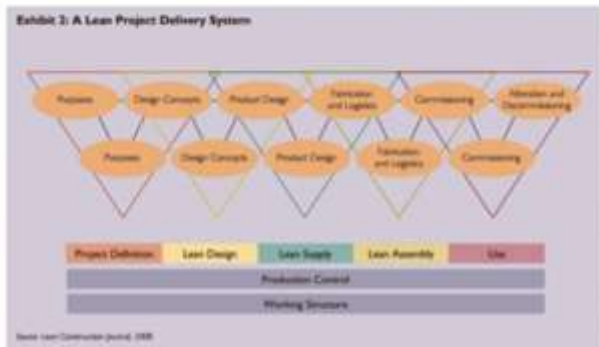


According to Mr Wijesiri's article in the Constructor magazine 2015, the construction industry is besieged by problems such as the late delivery of projects, cost escalations, and poor quality outcomes. This translates into millions of rupees of costs, that in fact need not be incurred. Indeed, these are problems that are faced in construction across the world.

So we need to be clear on what a client is paying for. The value that the client is paying for is that of delivering and installing the building within the time frame stipulated. This is what represents “value” to them. They are not paying for the construction company and the staff, its departments etc. Although this is of course critical, it is important to understand that the client is looking simply for the completion of their project within budget and the construction company is the facilitator of this. This is where the value of Lean concepts come in, as Lean specifically seeks out isolating and maximizing the value added in all the activities undertaken by the construction company.

Lean is one of the key tools in the Operational Excellence toolkit, which includes other concepts such as Six Sigma, TPM, TQM, TPS, Poke Yoke, Gemba, Kaizen, etc.

Lean is relatively new to South Asia, but this concept was popularized in the USA in 1990, when Womack, Jones and Roos published the book, "The machine that changed the world" highlighting how Lean production revolutionized the global car wars, which resulted in 'Lean' becoming a social-economic description of the way to describe value-adding business activities. At the time, the construction industry was not interested in any of the concepts used by the manufacturing sector, but through the '90's the awareness and use of Lean spread. In 2001, the Egan Report on construction was published and Lean was being recommended to the construction industry in the UK.



Lean Construction Methodology

In early 2000, the Lean Construction Institute, UK was formed, and similar forums and activities sprang up in Denmark and France and Russia. Today, LCI-UK shares information and experience through academic forums, workshops and Summits.

With regards to the value of these Lean concepts in South Asia and Sri Lanka, it is important first to understand how and why Lean concepts have been so beneficial to the construction sector and are now heavily used in developed countries. In fact, Lean Construction concepts have not yet been implemented systematically in the Asian region with the exception of India, where some of the larger companies have adopted some of these techniques such as Tata and Shapoorji Pallonji - companies who also sponsor Lean Conferences. The benefits of Lean are huge and the benefits can be reaped by all sizes of construction companies. It is of importance to note that the manufacturing industry has been using the Lean approach and other operational excellence techniques - the most famous of which is the Toyota Production Systems, to reduce waste, increase productivity and give the customer better value for decades. In addition, the Lean approach and other operational excellence techniques are very much used in the Asean region. In the construction sector, Lean can help identify what is valuable in a construction project and studies existing work processes to remove waste. Six Lean principles guide the modifications:

1. Identify value from the point of view of the customer.
2. Understand the streams of work by which value is delivered.
3. Achieve a smooth flow within work processes as waste is removed.
4. Employ pull planning so that nothing is made or delivered

until it is needed.

5. Make continuous efforts to improve existing processes.
6. Develop and use applied technology to improve access to and use of information.

The Lean Theory centres around "waste" or "Muda" as a separate concept and the Intelligent measurement of waste. Generally, in construction, one generally associates "waste" with the amount of material that goes to landfill, but in "Muda" which is the Japanese word for "waste," it is defined more broadly. Tackling waste is key to achieving Lean construction.

Lean in construction is involved in the designing and operating in continuous process flow or working with the right process and having it right the first time. Six Sigma techniques which can also be used with Lean, ensure that averages and variations are monitored. Waste is seen as activities and processes that consume resources yet do not add value. Hence any non value added activity or process is considered as waste. The essential focus of lean is to provide a product that the client truly needs, through identification and removal of waste in process in a step by step approach. In other words, the focus of lean is more on value than cost, which seeks to improve value added activities whilst eliminating non-value added ones.

Waste comes in many different forms:

- ▲ transport
- ▲ inventory
- ▲ motion
- ▲ waiting
- ▲ over production
- ▲ over processing
- ▲ defects
- ▲ skills

Once we can understand what "Lean waste" means, we can look at "waste" and then also address "waste removal" and also variability reduction which is very important in the construction sector. The latter concept means that we need to address unreliable workflow indirectly caused by variability as a result of single or multiple causes.

In the construction industry, sources of variability include late delivery of material and equipment, design errors, change orders, equipment breakdowns, tool malfunctions, improper crew utilization, labor strikes, environmental effects, poorly designed production systems, accidents, and physical demands of work.

Significant Lean Benefits for Construction Industries

Lean construction enables the contractor organization to :

1. Deliver client value
2. Reduce waste
3. Improve the flow of work

The benefits to the contractor are as follows:

1. Lean presents opportunity to construction businesses to deal with current economic challenges.
2. Lean is more than a set of tools and measures; it develops a philosophy, a mindset.
3. It is a good way to do business because it about eliminating waste and adding value.
4. It encourages collaboration, even with competitors, because the supply chain is shared and improvements are mutually beneficial.
5. It instills a commitment and understanding of Lean at a senior level.
6. It is a philosophy and approach that should be adopted throughout the organisation.
7. Clients can demand Lean operation in their supply chain, and contractors will be able to provide evidence of this.
9. The Lean approach resonates with the Government's and clients' demands of 'more for less'.
10. Lean commitment will translate into more buildings per dollar, better adherence to deadlines and a higher contribution to the GDP and productivity.

Tools Being Used

IPD and BIM

Integrated Project Delivery (IPD) is a delivery system that seeks to align interests, objectives and practices, even in a single business, through a team-based approach. The primary team members include the architect, key technical consultants as well as a general contractor and key subcontractors. The IPD system is a process where all disciplines in a construction project work as one firm, creating faster delivery times, lower costs, no litigation and a more enjoyable process for the entire team—including the owner.

IPD combines ideas from integrated practice and lean construction to solve several problems in contemporary construction such as low productivity and waste, time overruns, quality issues, and conflicts during construction among the key stakeholders of owner, architect and contractor. The growing use of building information modeling in the construction industry is allowing far greater information collaboration between project participants using IPD and considered an important tool to increasing productivity throughout the construction process.

Integrated Project Delivery (IPD) for Public and Private Owners, is a project delivery choice for the industry based on its "principles of trust and mutual respect, mutual benefit and reward, collaborative decision-making, early involvement of key project participants, early goal definition, intensified planning, and open communications."

Building Information Modeling (BIM) is an intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to

more efficiently plan, design, construct, and manage buildings and infrastructure. BIM is technology that supports the delivery of projects in a more collaborative and integrative way. Collaborative, integrated teams are using building information models in a collaborative, computable way to achieve better decision-making. Collaborative decision-making strategies are, of course fundamental to the IPD process. Even if, hypothetically, an IPD project may be delivered without using BIM and vice-versa, the real benefits will be seen only when BIM methodologies are applied to IPD processes.

The application of lean have led to the following quantifiable changes: significant (50% or better) reduction in work injuries, elimination of rampant waste, improved quality, completed on time or ahead of schedule, and significant cost savings (up to 20%).

Lean Makes Significant Impact at Project Inception

According to the research conducted, the key areas where Lean thinking has contributed has been first at the design stage and in the project inception process.

The process of design is a major cost in all construction projects. Variations in design due to errors are a major source of cost. This can be avoided by understanding exactly what the customer wants. Inefficiencies in taking an erroneous design forward to build, multiply thus incurring waste and cost. Miscommunication across a project, any delays in the design process, with either designers delivering late or waiting for the work of others, further contributes to expenditure. Lean is a means of avoiding these issues.

In the project inception process, the failings of most projects begin with inadequate preparations. Project success is not inevitable; it is planned. Taking the Lean approach, fees are worked out against milestones. There are regular stops at which they take stock. Reports are generated to fit with the reporting of the client. Careful consideration is given to the interface between different parties involved in different stages of a project, including internal teams. This avoids errors at these interfaces. The successes that Mott MacDonald has achieved at the project inception stage by implementing Lean are an improved process, reduction in errors and initial design concepts of at least 48 per cent, and improvement in time to complete in excess of 37 percent. The Lean approach enables the contractor to focus on the Big Picture and addresses both the design of the project and the processes by which the project will be realized, identifying the customer's objectives for the project and eliminating each element of the process that does not add value. Design and construction are understood and organized as a single, intertwined, continuous flow of work. The project team seeks to perfect the overall process and create a reliable production flow across the entire process, rather than isolating individual activities and focusing on the productivity characteristics of each element of work. In other words, the idea is to optimize performance at the project level, not on an individual, component-by-component basis.

Lean improves Cost and Time Delivery Schedules

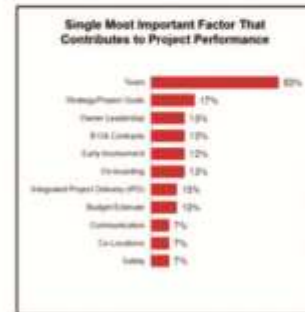
According to a study by the LCI, traditional projects have an average success rate of 54% in completing their weekly work plans. IPD (Integrated Project Delivery for Public and Private Owners) and Lean increases that percentage to between 85% and 100%. Improved project workflow, resulting in maintaining schedules and eliminating waste, are the significant outcomes of this process.

Applying Lean to construction, as opposed to manufacturing, brings unique challenges. Unlike manufacturing, weather conditions, geographic diversity and variety, and even ground conditions, all affect construction. For Lean to succeed, it is important that there is a commitment to Lean at an executive level. In companies where Lean has been successful, Directors and senior managers and senior project staff were briefed. Middle management were also being briefed through a series of workshops. Specific projects were targeted accompanied by detailed training on Lean, and supported by ongoing mentoring. There was respect for people and the engagement of the workforce. On site, this meant involving people through daily debriefs -reviewing progress and discussing the problems they encountered plus the good ideas – the essentials of visual management.

construction industry through Lean and other operational excellence tools. Whilst these tools cannot directly address issues such as labour shortages, high steel prices, delays in government approvals, etc it can enable maximization of productivity of all scarce resources within the organisation, drive down costs, improve profitability and improve time lines. These operational excellence tools are already being used in India and most of the developed countries and in the Asean region. Sri Lanka should not be left behind.

Organizational Aspects

- Owners identify **Project Team** as single most important contributing factor to performance



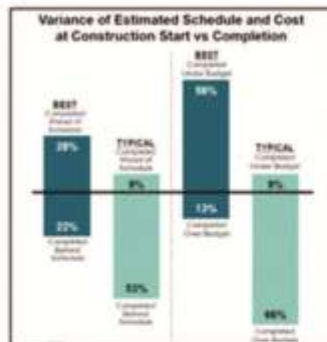
Takeaways

1. **Organizational transformations** enable project transformations
2. Earlier engagement requires **new training/ skillsets**
3. Project operating system **informs commercial** (contract)



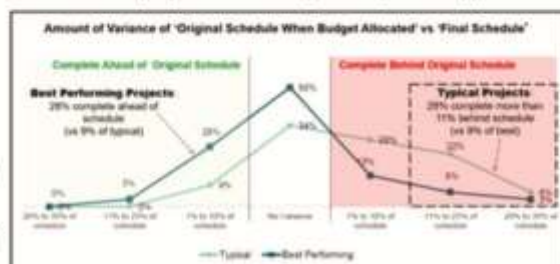
Performance: Cost/Schedule

- Most **Typical Projects** complete behind schedule, over budget
- Cost is improved more than schedule on **Best Performing Projects**



Performance: Schedule

- 28% of best projects finish early vs. only 9% of typical



References:

Applying lean thinking in construction and performance improvement

Remon Fayek Aziz *, Sherif Mohamed Hafez

Using Lean Design and Construction to Get More from Capital Projects

By Michael Bade and Christine Haas

Lean Construction Institute

IMPLEMENTING LEAN CONCEPTS ON INDIAN CONSTRUCTION SITES: ORGANISATIONAL ASPECTS AND LESSONS

LEARNED

N. Raghavan, Satyanarayana Kalidindi, Ashwin Mahalingam, Koshy Varghese and A. Ayesha

Transforming construction using lean thinking

Report of a min conference organised by CIRIA held at BIS, 1 Victoria Street, London