

Lean Construction

What is lean construction?

Lean construction is a philosophy based on the concepts of **lean manufacturing**. It is about managing and improving the construction process to profitably deliver what the customer needs.

Because it is a philosophy, lean construction can be pursued through a number of different approaches. This fact sheet outlines the elements of lean manufacturing and suggests how these might be adapted to deliver lean construction in practice.

Lean manufacturing

Lean manufacturing was initially pioneered and developed by the large Japanese car manufacturers. It has been implemented by a number of Japanese, American and European manufacturers with considerable success, and has been widely applied outside the automotive industry.

The Lean Principles

- Eliminate **waste**
- Precisely specify **value** from the perspective of the ultimate customer
- Clearly identify the process that delivers what the customer values (the **value stream**) and eliminate all non value adding steps
- Make the remaining value adding steps **flow** without interruption by managing the interfaces between different steps
- Let the **customer pull** – don't make anything until it is needed, then make it quickly
- Pursue **perfection** by continuous improvement

Lean is about designing and operating the right process and having the right systems, resources and measures to deliver things right first time. Essential to this is the elimination of waste - activities and processes that absorb resources but create no value. Waste can include mistakes, working out of sequence, redundant activity and movement, delayed or premature inputs, and products or services that don't meet customer needs.

The primary focus is on moving closer and closer to providing a product that customers really want, by understanding the process, identifying the waste within it, and eliminating it step by step.

Production and management principles

Lean is focused on value, more than on cost, and seeks to remove all non-value adding components and (especially) processes whilst improving those that add value. It aims to define value in customer terms, identifying key points in the development and production process where that value can be added or enhanced. The goal is a seamless integrated process (value stream) wherein products 'flow' from one value-adding step to another, all driven by the 'pull' of the customer.

The idea of 'right first time' is essential to the lean philosophy. 'Right' in this context means making it so that it *can't* go wrong. This approach involves an extremely rigorous, questioning analysis of every detail of product development and production, seeking continuously to establish the ultimate source of problems. Only by eliminating the cause at source can the possibility of that fault recurring be removed.

Design and product development

Lean manufacturers have developed systems for product development which first identify the right product (in terms of customer needs), and then design it correctly so that it can be manufactured efficiently. 'Design', in manufacturing terms, is concerned with the development and integration of systems and components into coherent, efficient and buildable products, not just the styling of the exterior appearance, a task which is often undertaken by external agencies.

Tools have been developed to capture and analyse customer perceptions and requirements for product quality and performance. These tools also enable product development and manufacturing performance targets to be established. Design development targets include reductions in design changes and process iterations.

Critical success factors

- Design is informed by extensive data on the performance of products, systems and components
- Carry-over to new models of a high proportion of systems and components from previous models
- Front-loading of resources towards design to prevent problems during manufacture
- Concurrent working between manufacturer and supplier during design development

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Lean Production

Lean manufacturers arrange production in closely located 'cells' so that work flows continuously, with each step adding more value to the product. The standard time for all activities is known and the objective is to totally eliminate all stoppages in the entire production process. However, only optimum stocks of material are kept as buffers between processing stages.

For this system to be effective, every machine and worker must be completely capable of producing repeatable perfect quality output at the exact time required. Workers are responsible for checking quality as the product is assembled, and in some instances given authority to stop production if defects arise. In this way, quality problems are exposed and rectified as soon as they occur.

The workforce is kept informed of progress towards their production and cost targets by use of information displays so that everyone is able to see the status of all operations at all times. Work teams in lean manufacturing are highly trained and multi-skilled, and many of the traditional supervisory and managerial functions have been devolved to them.

Critical success factors

- In depth understanding of production processes and resources involved in them
- Responsibility and authority placed with the workforce
- Real time feedback on performance
- Training and multiskilling

Supply chain management & supplier relationships

Lean manufacturing is based on the elimination of waste, including time lost waiting for missed/delayed supplies, unnecessary storage and the value tied-up in large stocks of parts waiting for assembly. 'Just in time' (JIT) delivery is therefore a vital element, and to deliver this lean manufacturers have had to develop their network of suppliers. Significant efforts are applied to encourage them to adopt the same lean manufacturing principles and systems, often company-wide, rather than solely related to that part of the suppliers' operations that affect the manufacturer.

Lean manufacturers have moved away from traditional relationships with their suppliers to partnering arrangements with a smaller number based on good communications and open-book accounting. These relationships work by both parties sharing philosophies of continuous improvement (especially in the area of defect reduction, cost and timeliness of delivery) and sharing business and development strategies sufficient for both parties to know enough about each other to make forward planning effective.

Critical success factors

- The lack of reliance on formal contracts
- The use of benchmarking of suppliers' performance against each other on a range of generic criteria
- The development of close relations with first tier suppliers

Applying lean thinking to construction

The lean principles can only be applied fully and effectively in construction by focusing on improving the whole process. This means all parties have to be committed, involved, and work to overcome obstacles that may arise from traditional contractual arrangements.

Design

- Use of visualisation techniques such as Virtual Reality and 3D CAD to fully define the product requirements from the customer's perspective.
- Value Management to achieve more understanding and focus on client value.
- Use of integrated design and build arrangements (including partnering) to encourage close co-operation between designers, constructors and specialist suppliers.
- Design for Standardisation and Pre-assembly - both of components and processes to achieve higher quality and cost and time savings.

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Procurement

- Supply chain management and rationalisation of the supply chain to integrate all parties who contribute to the overall customer value into a seamless integrated process.
- Transparency of costs - the elimination of
- waste in both processes and activities requires a clear and complete understanding of costs to ensure decisions on customer value can be taken. Confidentiality of cost and cash flows must be addressed.
- The concept of partnering, all involved parties contributing to a common goal with the boundaries between companies becoming less critical.

Production Planning

- Benchmarking to establish 'best in class' production methods and outputs
- Establishment of a stable project programme, with clear identification of critical path.
- Risk management - to manage risks throughout the project

Logistics

- Just-in-time delivery of materials to the point of use eliminates the need for on-site storage and double-handling

Construction

- Clear communication of project plans
- Training, teamwork, multi-skilling
- Daily progress reporting and improvement meetings
- A well motivated, well trained, flexible and fully engaged workforce.

Applying Lean Thinking in construction

Pacific Contracting of San Francisco, a specialist cladding and roofing contractor, have used the principles of lean thinking to increase their annual turnover by 20% in 18 months with the same number of staff. The key to this success was improvement of the design and procurement processes in order to facilitate construction on site, investing in the front end of projects to reduce costs and construction times. They identified two major problems to achieving flow in the whole construction process – inefficient supply of materials which prevented site operations from flowing smoothly, and poor design information from the prime contractor, which frequently resulted in a large amount of redesign work.

To tackle these problems Pacific Contracting combined more efficient use of technology with tools for improving planning of construction processes. They use a computerised 3D design system to provide a better, faster method of redesign that leads to better construction information. Their design system provides a range of benefits, including isometric drawings of components and interfaces, fit co-ordination, planning of construction methods, motivation of work crews through visualisation, first run tests of construction sequences and virtual walk throughs of the product. They also use a process planning tool known as Last Planner, developed by Glen Ballard of the Lean Construction Institute, to improve the flow of work on site through reducing constraints such as lack of materials or labour.

Case study taken from Rethinking Construction, the Report of the Construction Task Force

Applying Lean Thinking in construction

The Neenan Company, a design and build firm, is one of the most successful and fastest growing construction companies in Colorado. The firm has worked to understand the principles of lean thinking and look for applications to its business, using 'Study Action Teams' of employees to rethink the way they work. Neenan's have reduced project times and costs by up to 30%, through developments such as:

- Improving the flow of work on site by defining units of production and using tools such as visual control of processes;
- Using dedicated design teams working exclusively on one design from beginning to end and developing a tool known as 'Schematic Design in a Day' to dramatically speed up the design process;
- Innovating in design and assembly, for example through the use of pre-fabricated brick infill panels manufactured off site and pre-assembled atrium roofs lifted into place;
- Supporting sub-contractors in developing tools for improving processes

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Applying Lean Thinking in Construction

The **Construction Lean Improvement Programme (CLIP)** was created in 2003 to support the UK construction industry in its drive, inspired by the Egan report "Rethinking Construction", to improve its financial performance, provide a better product and service to its customers, and cope with a skills shortage. CLIP operates across the whole construction supply chain, from raw materials processors to clients. It provides the knowledge and practical skills needed to make change happen and to bring about real business benefit.

CLIP has created a number of programmes, tailored to the needs of construction but based on a successful Common Approach used across UK industry, that enables companies to make real and measurable improvements to Quality, Cost and Delivery performance, and to improve partnerships with customers and suppliers.

The programmes share the common theme of being practical activities implemented at the workplace, from site to boardroom, delivered with a hands-on approach by dedicated CLIP Engineers. They work directly with the company's staff or project team members to create sustainable change and to communicate the benefits.

CLIP activities are tailored to the needs of the organisations we are working for. Typical products include:

- Product and process benchmarking and recommendations
- Strategy development programme – leadership, business planning tools, policy deployment
- Process improvement masterclass
- Supply chain and supplier development programme
- Communications, teamwork and team-leader training
- Lean assessment
- Company and project team roll-out programmes

The results of seven pilot projects based on real construction projects around the UK have demonstrated productivity improvements of up to 50% in key processes. Case studies of these projects are featured in the CLIP booklet 'Profit from Process Improvement', available to download from www.constructingexcellence.org.uk/service/clip, or hard copy Tel: 01923 664228. CLIP is managed by BRE in strategic partnership with Constructing Excellence

For further details of CLIP activities please contact Martin Watson CLIP Director, 01923 664638

For more detailed guidance

Accelerating Change

A report by the Strategic Forum for Construction
Chaired by Sir John Egan
This report outlines recommendations for creating a sustainable, customer focussed industry, that is vibrant, profitable, productive and competitive.

The Machine that Changed the World

By James Womack, et al
HarperBusiness (1991)
This book resulted from a detailed study into how Toyota radically reduced cost and increased quality by re-engineering its production system.

Lean Thinking

by James Womack and Dan Jones
Free Press (2003)

This second book defines the concept of lean thinking. In it, the authors set out to assess how widely the Toyota concepts had been adopted across manufacturing and what scope remained.