

# Discover Lean Construction: Why and how your construction teams should go Lean

The ultimate guide to lean construction



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# Introduction: Do more with less

Offered a way to make construction work faster, more efficient and more profitable, anyone in construction would seize it with both hands. That's why adopting lean construction principles makes absolute sense for everyone in construction from architects and designers to engineers and sub-contractors.

According to the Lean Construction Institute, projects that use lean are

- three times as likely to complete ahead of schedule
- twice as likely to come in under budget<sup>1</sup>

In a world of ever-more-complex construction projects, lean is all about maximising value, minimising waste and improving value to the customer. This happens through integrated and collaborative planning and project management, while making smart use of automation and data management best practices.

## Remarkable time and cost savings

According to McKinsey, projects that apply lean construction principles are more likely to be on time and on budget. In fact, the consulting firm says it has seen projects achieve 10 to 30 percent reductions in expected completion time and cost savings of 10 to 25 percent.<sup>2</sup>

Some companies have found using lean principles has literally cut their typical project timeline in half.<sup>3</sup>

# Why the construction industry needs to change

Construction represented 13 percent of global GDP in 2020, according to Oxford Economics, which says that is set to rise to 13.5% by 2030<sup>4</sup>. Shockingly, the Lean Construction Institute<sup>5</sup> estimates that 70% of construction projects go over time and budget.

Building projects have grown more complex and challenging over time with tighter timelines, regulations and budgets. Add in new materials, intricate processes, and customisation requests, not to mention ongoing skills shortages, and the potential for high costs, inefficiencies and waste is clear.

## **Productivity has flatlined**

It's no secret that productivity levels in construction have tanked in recent decades compared with manufacturing, information technology and other industries.

As McKinsey famously noted in 2017, average annual labour-productivity growth in construction globally has been only 1 percent over the past two decades, compared with 2.8% for the total world economy and 3.6% for manufacturing.<sup>6</sup>

Moreover, figures from the UK Office of National Statistics found output per hour worked across the whole UK economy rose by 28.8% between 1997 and 2020, but fell by 7.3% in construction. Specifically in the construction of buildings, output per hour dropped by 25%.

Part of the productivity challenge relates to non-productive work, such as trying to find project data, resolve conflicts or carry out rework that shouldn't have been needed.

## **High costs, low profits**

Low productivity leads to lower profits. In the UK, profit margins on some construction infrastructure projects can be as low as 0.7%, compared with typical manufacturing margins of 12%, according to the Construction Industry Training Board (CITB).<sup>7</sup>

As construction firms engage in ever more complex projects but also seek to boost margins, efficiency should be key. When the CITB ran a lean construction pilot on live projects for five construction companies, more than 40 different improvements cumulated in a total of £12.7m in cost savings.



## Sustainability isn't optional

With the European Union aiming for Net Zero emissions by 2050, the construction industry (offender) needs to step up. Not only that, but the building industry accounts for 50% of raw materials consumption in the EU – a figure that could be lower where it not for the extraordinary levels of waste.<sup>8</sup>

In lean construction projects, less waste and more efficient use of resources typically means enhanced sustainability and fewer emissions.

### Eight kinds of waste

Wasted expenditure, materials, time and effort is a huge problem in construction – by some estimates, over half of construction project spending is wasted<sup>9</sup>. Not only that, worldwide construction waste could nearly double to 2.2 billion tons by 2025, says Transparency Market Research, which is a crisis for the environment and for industry profitability.<sup>10</sup>

The Lean Construction Institute has identified eight different kinds of waste that occur during projects<sup>11</sup>:

1. Over/under production – when you don't have the right materials at the right time in a project
2. Waiting – when anyone can't move ahead with their work because they are waiting for materials, tools, colleagues or decisions
3. Unnecessary transportation – when people, equipment, parts or information have to be moved due to poor planning
4. Over/under processing – overprocessing is usually the issue, when there are unnecessary steps in a process
5. Excess inventory – holding too much inventory can lead to wasted time and money, whereas just-in-time materials delivery drives efficiency

6. Unnecessary motion – when workers and vehicles are moving around for reasons better planning would have prevented

7. Defects – defective information, materials or work leads to rework that should have been unnecessary

Unused creativity of team members – a type of waste that can be missed, involving lost time, ideas, skills, improvements and learning opportunities

The amount of waste in the lifetime of construction projects is nearly incomprehensible, but the upside is there are plenty of opportunities to improve efficiency and consumption.

# What is lean construction?

Lean construction is an integrated project management process, which challenges the old belief that there must be a trade-off between time, cost and quality.

It involves a collection of techniques and practices designed to improve work quality and productivity right across the entire project cycle from design to delivery. Above all, it aims to generate the most value possible for customers.

Lean philosophy transformed global manufacturing in recent decades, having been pioneered at Toyota in post-war Japan in the mid-twentieth century.

## How the lean approach works

Especially useful on complex, unclear and fast-track projects, the lean approach is all about moving from old-style, hierarchical, command-and-control models.

It involves a collaborative way of working, where transparency, accountability, consistency and efficiency are key. It's also about a continuous improvement mindset, where regular reviews and benchmarking mean the project team is constantly optimising how things are done.

Traditional construction tends to be siloed, which each stakeholder or contractor focused on optimising their own part of the work. In lean construction, each project and its delivery process are designed together, with the work process structured to maximise value and reduce waste.

## The benefits of lean construction

Lean construction boosts project consistency, predictability and productivity, by seeking to minimise waste and maximise value.

## Improved work quality

Lean construction projects always seek to drive up the quality of work. For example, this could involve monitoring repetitive on-site tasks, which McKinsey estimates can be as much of 80% of all on-site work<sup>2</sup>, and understanding how they can be streamlined and improved.

That could be through minimising things that don't add any value, such as waiting for deliveries to arrive, colleagues to be ready or tools to become available.

Across the board, this sort of operational improvement leads to:

- fewer scheduling conflicts and delays
- improved resource planning
- smoother work flows
- less fire-fighting
- less rework
- enhanced work quality



### **Increased collaboration and accountability**

Lean construction relies heavily on trust, respect and streamlined, open communication. Everyone is empowered to contribute to continuous improvement through collaborative problem-solving.

This not only saves time, money and rework, but also leads to fewer moments of conflict as everyone has clarity and a single source of truth.

“The main problems we have been trying to solve with Autodesk Construction Cloud have been the data silos, bad communication or collaboration between the stakeholders. With Autodesk Build, when we move from one phase to another, we don’t lose the data. It just keeps on growing.”

–Mauno Lounakoski, VDC Manager, SARA, Finland

### **Improved safety and reduced risk**

When risk management is folded into a lean construction approach and risks reviewed during weekly meetings, it tends to markedly reduce on-site risks and helps make significant savings in project costs.

Furthermore, it decreases the frequency of incidents, because communication and processes are clearer, and because lessons learned from incidents are incorporated as part of the process of continuous review and improvement.

### **Combatting labour shortages**

A lean approach helps to address the issue of skilled labour shortages, as the teams on the project are given what they need to work as efficiently and successfully as they can.

### **Boosting client satisfaction**

Lean construction teams can make smart decisions fast because they know what the asset owner values, wants and needs. Proactive work to resolve project blockers, along with decentralised decision-making, enables projects to stay on budget and move faster to completion – which means the asset owner will be happy.

### **Increased ROI**

Not only does better cost control and less wasted labour, materials and other resources mean a higher ROI, but the fact that lean principles drive up productivity also contributes to the bottom line.

### **Generating new business**

As lean projects typically come in on or under time and budget, along with keeping stakeholders at all levels satisfied, that in turn tends to provide repeat business and more invitations to bid.

# The Five Principles of Lean

These originate from a book titled *The Machine That Changed The World*<sup>12</sup> and they aim to enable project teams to optimise work processes and develop a continuous improvement culture.

## **1. Define value**

The first Lean principle defines value as the customer's needs for a product. It's vital to uncover what your customers want, how and why they want it, and the price they're willing to pay. It's vital to uncover this information by using qualitative and quantitative techniques (such as interviews, demographic information and online surveys).

## **2. Map the value stream**

It's crucial to define which steps in the construction process create value for the client and which do not – the latter is considered waste. For instance, installing cabinetry creates value, but moving it into storage because it's been delivered too early does not.

Track how each step contributes to the final product with a value stream map, which documents information flow, material flow, lead times, and process times. Reducing and eliminating waste where possible ensures your customer gets exactly what they want for the lowest possible cost.





### **3. Create work process flow**

Once waste has been removed from the value stream, the remaining steps must flow smoothly without delay or bottlenecks. Strategies to achieve this include:

- breaking down steps
- reconfiguring production processes
- levelling out the workload
- creating cross-functional teams
- training

### **4. Establish pull**

In a pull-based system, you manage inventory and in-progress work items to ensure materials and information are available when needed. Better workflows mean less time is needed to deliver the project to the customer.

A pull-based system allows for just-in-time delivery and manufacturing. Materials are delivered in only the necessary quantities and work is completed at exactly the right time for the next step in the process to begin.

### **5. Pursue perfection**

While the first four lean principles prevent waste, the fifth – continuous improvement – may be the most important. Pursuing perfection means making lean principles and process improvements part of your company culture. This empowers your entire team to strive for perfection and deliver exactly what your customer needs.

# Seven key steps to lean success

Lean construction is focused on predictability and flow. All stakeholders (owners, architects, contractors and so on) must work collaboratively and have clear goals, benchmarks and objectives throughout the build, rather than planning and operating in silos, as they would have done in the past.

## 1. Think long-term

To make lean truly work, remember it's a long-term strategy. It makes much more sense to apply lean techniques globally instead of on a project-by-project basis. Your teams will learn the benefits of Lean as they go and will thrive when they're empowered to act on lean principles.

We know lean works for people in the industry. Our research found over 60% of contractors experienced with lean practices planned to use them more in the next two years.<sup>13</sup>

## 2. Try integrated project delivery

This project delivery method is well suited to lean construction. It eliminates typical contract barriers and incentivises all team members to make 'project' decisions rather than 'trade' decisions.

IPD allows you to create a mini organisation for a specific project. Its main goal is to create a team that can work together well enough to power the project for success.

## 3. Involve stakeholders early

Ensure you involve all stakeholders and contractors from the outset. When choosing contractors, look at the insights they can offer during design and build, rather than deciding based on cost alone.

Getting buy-in from leaders means they can influence their teams and help promote collaboration and successful outcomes.

## 4. Educate teams

To make lean work for your company, it's vital to have a systematic approach to training and skills development. This applies both to the technical skills needed to do the work, but also to lean techniques, such as improved planning capabilities and root cause problem-solving.

Everyone should have a learning and development plan, from the most junior employees through to supervisors, managers and leaders.



## 5. Engage subcontractors

In previous research<sup>13</sup>, we found lack of subcontractor buy-in was one of the biggest obstacles to successful lean construction. How do you get them onboard? Share the advantages of Lean Construction from their perspective to get greater buy-in. This also gives you more time to get them up to speed on the collaborative technology you'll be using.

## 6. Adopt the Last Planner System

With this work plan method, you can proactively identify potential upcoming risks and eliminate them, rather than trying to firefight in a crisis.

Instead of contractors and sub-contractors having multiple different plans of their own that need to be synchronised, everyone co-operates on and works to one plan, which involves<sup>14</sup>:

- Creating a backlog of tasks that are ready to do
- Committing to achieving specific tasks in the next weekly or fortnightly sprint (work plan).
- Reviewing and assessing by:
  - fixing issues
  - sharing feedback and learnings

Use the percent plan complete (PPC) metric to assess how many tasks have been completed, and review any for which less than 80% of the planned work was done. By finding the root causes of these issues, you can get the project back on track and prevent similar issues occurring in future.

Industry expert Michael Carr breaks down and defines the five steps of The Last Planner System as follows:

### 1. Master scheduling

Build the master schedule as soon as possible, as all work will be based on this schedule. Capture the full project and make sure early phases are well defined from the outset.

### 2. Phase scheduling

This is a collaborative planning and sequencing of tasks to complete the phases of work defined in the master schedule. Get this done with pull planning, working backwards from clearly defined milestones to set key milestones, deadlines, project phases, and handoffs. This is instead of the old approach of linear planning, where projects start with design plans and work forwards.

### 3. Look ahead planning

Identify clear constraints that will prevent upcoming work from being done as planned. Try to mitigate them before they become a problem – ideally four to six weeks out.

### 4. Commitment planning

Meet weekly to discuss current and future work in progress. Aim to commit to completing all work scheduled for the upcoming week. Hold daily huddles to support the weekly meeting.

### 5. Learning

Foster continuous improvement by taking notice of what went well and what didn't, and manage projects accordingly.

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## 7. Consider prefabrication

Lean construction makes the most of prefabrication to pursue its overarching goals of minimising waste and maximising value. And positively, fifty-three percent of construction professionals say prefabrication has the greatest potential to reduce the industry's carbon emissions.<sup>15</sup>

This controlled production environment means more scrupulous oversight of materials and processes. That minimises the need for inventory and surplus materials, which generates substantial cost savings.

While the Nordics, for example, has a long tradition of prefabricating quality homes in an industrial way, there is still substantial room to make the process more efficient through design automation and data management.<sup>16</sup>





# How BIM enables lean construction

Our US study with Dodge found companies with a high level of building information modelling (BIM) adoption were also more likely to use lean methods – the two go hand-in-hand.<sup>9</sup>

Using BIM means all project stakeholders, including on-site teams and sub-contractors, can communicate and co-ordinate in real time, while referring to a single source of truth. This helps to create value, and avoid wasted effort and cost, while maximising every team member's time.

## Powering planning and iteration

Collaborative planning is at the core of lean construction and BIM enables excellence in scheduling, estimating and all other aspects of planning.<sup>13</sup>

Using an end-to-end construction software solution like Autodesk Construction Cloud™ allows up-front planning to be uploaded into easily comprehensible, visual models and workflow diagrams that are continuously updated and available to all.

Teams using BIM can harness the power of data analysis and artificial intelligence to radically improve project set-up and management. For example, they can run millions of permutations of how different actions could affect a project's schedule and costs, before a sod is turned on-site.

Rework requests alone can account for approximately 4–9% of total project cost<sup>5</sup>. BIM-based technology means clashes are automatically detected, so it's easier to catch potential issues during model coordination and preconstruction planning.

“We're able to use Autodesk Construction Cloud to design our assets better, meaning that we can identify clashes in the pre-construction phase of our projects as well as issues that could affect our activity on site.”

–Koenraad Belsack, co-CEO and Founder of Upgrade Estate, Belgium

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### **Streamlining processes and logistics**

A single connected BIM platform enables a seamless transfer of complex data from the design and planning stage to your on-site teams and eventually to the building owners and operators.

Moreover, using BIM and lean principles helps to prevent costly and time-consuming errors caused by logistical issues. These add to wait times, delay critical tasks, and can have a significant disruptive ripple effect on the project schedule.

### **Fostering transparency and accountability**

BIM's enhanced document management and reporting, enables a culture of commitment and accountability. Today's lean teams make the most of this technology to facilitate transparency and communication, including with the wider group of project partners.

The right technology also helps prevent digital waste. We found bad data cost the industry USD1.8 trillion in 2020<sup>17</sup>. A solid data strategy and the right tools to manage data are a must.

“We’re trying to solve disconnection in our world by using the cloud technology where everybody has the same truth, so you’re on the same page.”

–Gert-Jan Ditsel, Manager of Digital Construction, Dura Vermeer, Netherlands



# Conclusion: A new era of construction

Lean construction is enabled by three key changes to traditional processes:

- a better model for the interaction between project owners and contractors
- a strong performance management system to manage how the work is done
- a new focus on developing the capabilities of frontline staff and their managers

The potential rewards are compelling, but deciding to implement lean construction approach should not be rushed. It costs time and money, and you'll need to plan the rollout thoughtfully.

Think lean from the start and invite input from everyone that will be affected by the changes. A mindset shift of this magnitude may be a challenge, so getting buy-in from your team has to be a huge focus.

“If the solution had not been provided, we would have needed hundreds and thousands more hours to dedicate to manually identifying clash and issues detection to avoid the need for re-work on site. The team have been able to do this quicker and easier using Autodesk Construction Cloud not only saving valuable project time, but this has also led to reduced project costs in the long term.”

–**Michal Zajac, Senior Architect and BIM Manager for Blue Projects, Romania**

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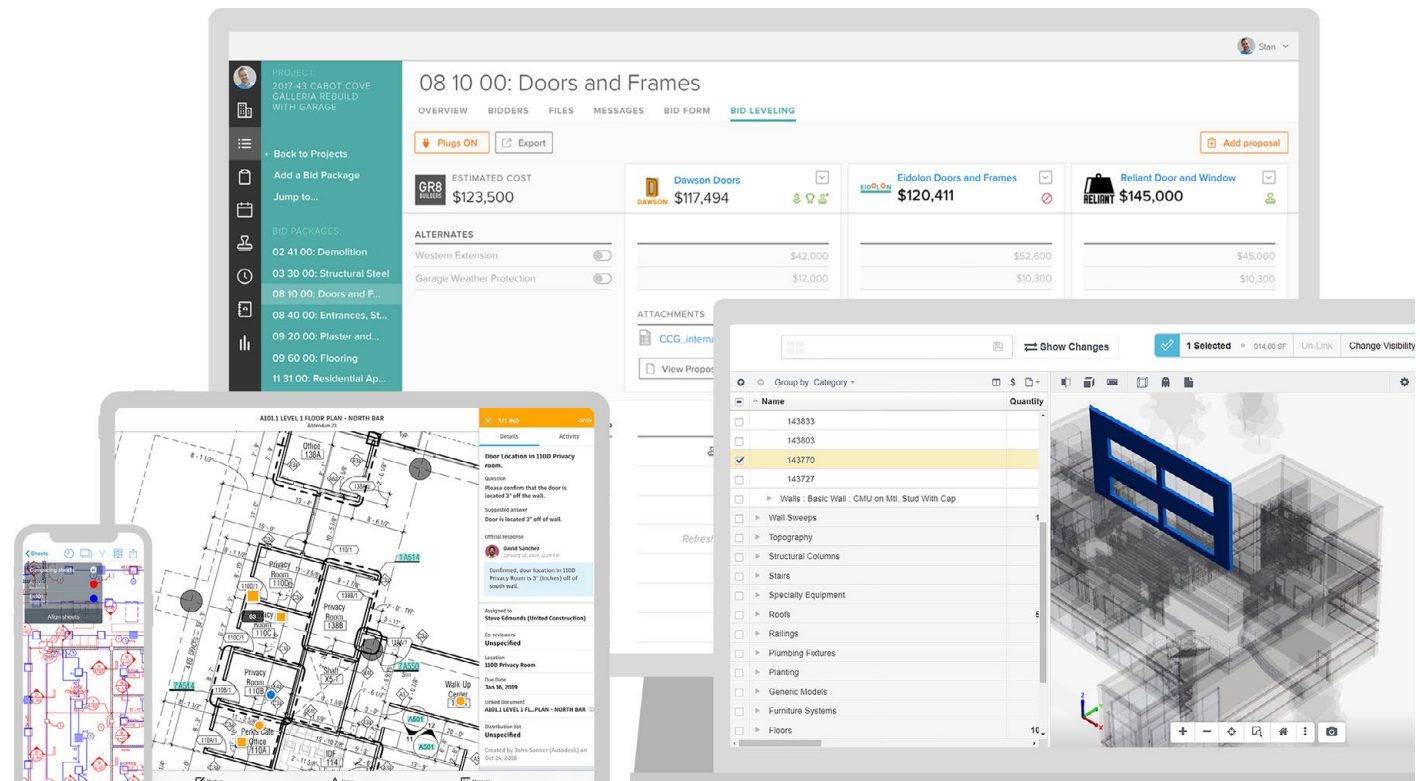
# See the Future of Connected Construction

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Our industry requires solutions that connect their information, teams, and technology –breaking down data silos and disconnected processes that hinder true transformation. As we navigate the ever-present push to do more with less, we need to uncover new ways of working, enhance connected digital workflows, and incorporate advanced analytics. To support us on this journey of transformation, we must lean into tools that connect construction – from design to plan, build, handover, and operations.

Built on a unified platform and common data environment, Autodesk Construction Cloud is a powerful and complete portfolio of construction management products that empowers general contractors, specialty trades, designers and owners to drive better business outcomes. Autodesk Construction Cloud combines advanced technology, a unique builders network and predictive insights to connect teams, workflows and data across the entire building lifecycle.

While the industry experiences unprecedented transformation, our mission remains the same: to help construction teams meet the world's rapidly expanding building and infrastructure needs while making construction more predictable, safe, and sustainable. And we've remained steadfast in our promise to deliver the industry's most compelling solutions, connecting data, teams and workflows from the site. This is our commitment to connected construction.







Autodesk is changing how the world is designed and made. Our technology spans architecture, engineering, construction, product design, manufacturing, media, and entertainment, empowering innovators everywhere to solve challenges big and small. From greener buildings to smarter products to more mesmerising blockbusters, Autodesk software helps our customers to design and make a better world for all. For more information visit [autodesk.com/construction](https://autodesk.com/construction).

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