AUTODESK CONSTRUCTION CLOUD™

Handling Lean Construction from Beginning to End with Autodesk

DODGE DATA & ANALYTICS

Table of Contents

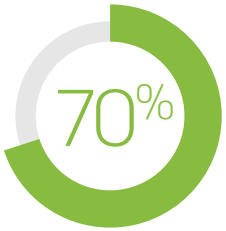
Introduction

The construction industry currently faces a number of well-documented challenges. According to research from the Lean Construction Institute, 70% of projects are over budget and delivered late.[1] At the same time, projects are becoming increasingly complex and include more stakeholders. As many countries focus on major infrastructure improvements and building stock expands in the coming years, demand for high-quality work will only grow—yet profitability remains difficult. According to Deloitte, firms report average earnings of only 5.5% of total sales globally, largely due to rising material and labor costs and rework expenses.[2] Even with modern improvements, an average of 57% of project spend is still lost to waste. With all these challenges, the construction industry needs solutions to improve efficiencies and final outcomes, especially on large projects.

Lean construction processes support general contractors and subcontractors to achieve better scheduling, win work, improve quality, enhance site safety, and reduce costs while minimizing waste. Given these benefits, it's no wonder construction professionals are actively seeking technology to accelerate their lean journey.

Dodge Data & Analytics recently partnered with Autodesk to study how global construction firms were embracing lean practices. The study surveyed 425 construction professionals in the US, UK, and France about their familiarity with specific lean techniques. The responses provide key insights into how the sector is currently benefitting from those techniques, how invested firms are in BIM-based technology, and how these trends will continue to grow.

Construction Industry Challenges

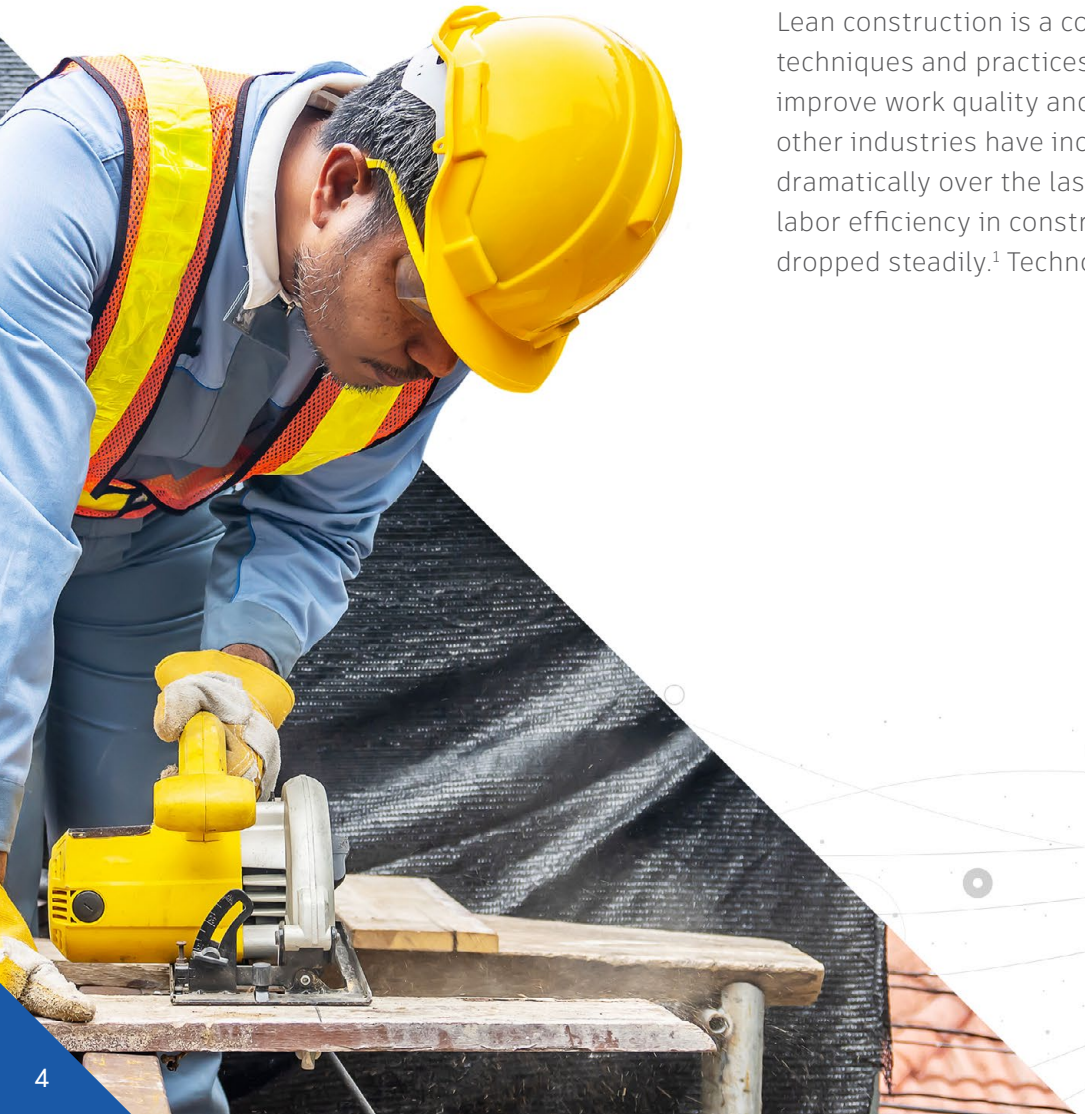


of projects are over budget and delivered late

average earnings from total global sales

of project spend is still lost to waste

What Is Lean Construction and How Can It Help?



Lean construction is a collection of techniques and practices designed to improve work quality and productivity. While other industries have increased productivity dramatically over the last few decades, labor efficiency in construction has dropped steadily.[1] Technology that enables lean construction, such as Autodesk's Construction Cloud™, supports reductions in wasted labor, cuts to unnecessary movement and costs, and maximization of the value of every team member's time. Lean construction also boosts project predictability and worksite safety.

3 Prominent lean practices offer a window into its benefits

1. Early Stakeholder Involvement

Early stakeholder involvement promotes collaboration between the construction crew and contractors from the beginning. Instead of placing bids and selecting contractors on cost alone, builders are chosen for the input they can give during the combined design–build stages.[3] Eliminating conflicts from the start can reduce total project waste and rework requests. Of the global contractors surveyed, only about half had a moderate or better familiarity with this lean construction process.

2. Pull Planning

Most projects rely on a linear planning process that starts from the beginning of preconstruction and then only adjusts timeframes as issues pop up along the way. This leads to bottlenecks, lost productivity, and weak profit margins. Pull planning is designed to address these issues. It's far easier to keep a project on schedule by defining the final deadline and then working backward to set deadlines for key milestones, project phases, and handoffs between activities. Schedule pull planning calls and hold weekly planning sessions to ensure the entire team stays on track with the overall project plan.

3. Weekly Work Planning and Percent Plan Complete

Percent plan complete (PPC) tracks the total percentage of assignments that have reached 100% completion. The number of planned or promised activities completed on the day stated is divided by the total number of promises made for each week. Between the PPC and the weekly work planning sessions, it's possible to track progress. Without these weekly updates, it's all too easy to fall off a schedule, diverge from the pull plan, and experience costly delays. For weekly work planning and PPC lean techniques to work best, they need to be shared among stakeholders at all levels, so each team can change on the fly and adapt with minimal interruptions.

Known Benefits of Lean Construction

The benefits of adopting lean construction techniques may vary depending on the size and location of the construction firm, but prominent benefits include:

Quality

- Reduced rework during construction
- Reduced disputes between stakeholders
- Reduced number of design issues onsite

Safety

- Reduced total number of workers onsite that could experience an accident
- Reduced incident frequency rate by minimizing mistakes through both automated and manual review

Cost

- Improved plan to actual ratios to reduce wasted labor and materials
- Improved cost control for higher profit margins

Schedule

- Reduced delays
- Improved plan to actual ratio for fewer scheduling conflicts
- Improved schedule control
- Improved resource planning and coordination

Winning More Work

- Increased number of successful projects
- Improved stakeholder engagement at all levels

Lean Construction Software

Most lean construction software products available today are single-point solutions, addressing a specific, limited piece of the puzzle. Adopting such solutions may be faster but fails to gain the biggest benefits offered by lean construction. Lean takes a holistic approach, and a comprehensive software stack that supports every project phase from start to finish is a far better choice for creating maximum value out of the lean construction journey.

Lean Construction Adoption across the Globe

The Dodge Data & Analytics and Autodesk study asked survey respondents about their familiarity levels with three specific lean construction techniques: PPC/ weekly work planning, early stakeholder involvement, and pull planning. The data reveals important insights into how contractors are currently leveraging lean construction, including:

- The biggest benefits of lean construction
- Current levels of lean construction adoption across the industry
- What lean construction practices are being prioritized by your peers
- Where your competition is investing in lean construction technology

Report Background

Answers from 425 respondents (205 from the US, 70 from the UK, and 150 from France) provided information for the study. All respondents were employed at a general contractor, construction management, design/builder, or specialty/ trade construction company. The majority of UK and French respondents were employed at very large (over 1,000 employees) or very small (under 10 employees) companies, while nearly a third of US respondents came from firms with annual revenue of $10–$50 million. Participating US contractors were primarily focused on vertical building markets, while UK and French companies were focused equally on vertical and horizontal construction/infrastructure.

425 respondents

- United States 205
- United Kingdom 70
- France 150

United Kingdom
France

The majority of respondents were employed at very large (over 1,000 employees) or very small (under 10 employees) companies

United States

1/3 of respondents came from firms with annual revenue of $10–$50 million.

United States

Contractors were primarily focused on vertical building markets

United Kingdom
France

Companies were focused equally on vertical and horizontal construction/ infrastructure.

How Familiar is the Industry With Lean Construction?

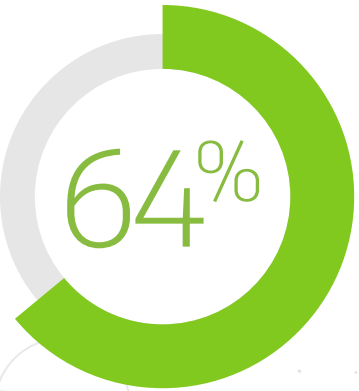
If you haven't begun your lean journey just yet, you might wonder how much of the competition has already embraced it. If you are already doing lean, are you investing in the right areas and implementing best practices across your teams effectively? The information below was provided by respondents to the survey.

Adoption across All Three Countries

Generally, between half and two thirds of contractors have at least a moderate level of experience with early stakeholder involvement (58%) and weekly work planning/PPC (64%). Fewer than half (45%) report experience with pull planning. Significantly more prime contractors than specialty trade contractors report a high level of experience with each of the three practices.

Early stakeholder involvement saw higher familiarity in the UK and US than in France. Pull planning was the least widely used technique in all three countries, but UK contractors tended to have at least moderate familiarity with the process. Weekly work planning and PPC saw the highest levels of use and familiarity across all three countries.

of contractors have experience with early stakeholder involvement



of contractors have experience with weekly work planning/PPC

United States

US Lean Construction

At least two-thirds of the US contractors had at least some experience with the lean practices included in the study. American contractors reported the highest level of experience with weekly work planning and PPC, and the lowest level of experience with pull planning. Among the contractors from the US, those with higher levels of building information modeling (BIM) involvement also tended to report greater familiarity with lean construction practices.

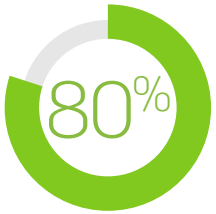
2/3

of contractors had at least some experience with the lean practices

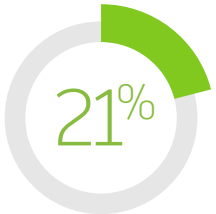
France

France Lean Statistics

Nearly 80% of respondents from France had experience with lean construction techniques. Only 21% of French respondents had no experience with PPC and weekly work planning. As with both UK and US survey respondents, pull planning was the least familiar to them.



of respondents had experience with lean construction techniques.



of respondents had no experience with PPC and weekly work planning.

United Kingdom

UK Lean Practices

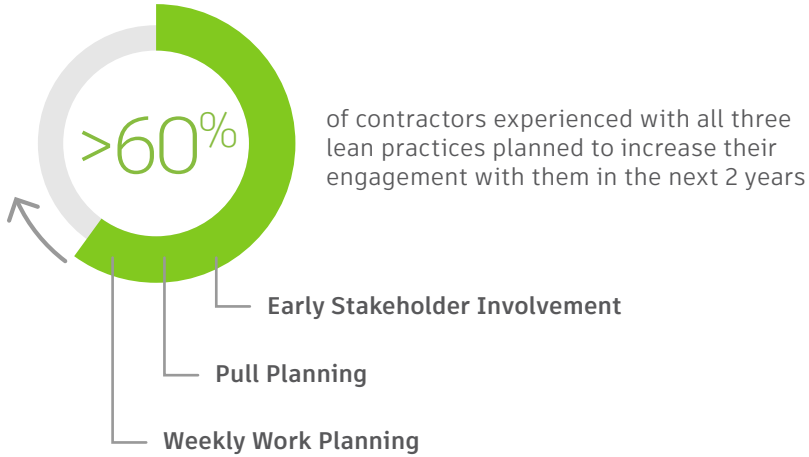
Of the UK respondents, 70% had experience with every lean practice included. They had the most experience with PPC and weekly work planning strategies, and the least with pull planning, just like US contractors.

had experience with every lean practice included

Future Engagement with Lean Construction

The second set of survey questions measured interest in further engaging with the processes. Altogether, over 60% of contractors experienced with all three lean practices planned to increase their engagement with them in the next two years.

How does your firm stack up? Regardless of your size or the type of construction you specialize in, your business can benefit from lean to boost your operational efficiency and competitive edge.



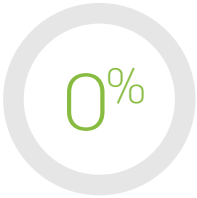
of contractors experienced with all three lean practices planned to increase their engagement with them in the next 2 years

United States

Weekly Work Planning & PPC

Over two-thirds of US contractors with experience in these practices expect to increase their engagement with weekly work planning and PPC in the next two years. No one planned to decrease it.

expect to increase their engagement



planned to decrease it.

Pull Planning

Sixty percent of US contractors with experience in pull planning expect to increase their engagement with it. Only 3% of contractors are still unsure of their plans for this lean technique.

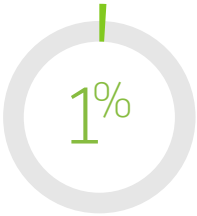
expect to increase their engagement

are unsure of their plans

Early Stakeholder Involvement

Over two-thirds of contractors expect to increase their engagement in early stakeholder involvement soon. Only 1% plan to decrease involvement within the next two years.

expect to increase their engagement



plan to decrease involvement within the next two years.

United Kingdom

Weekly Work Planning & PPC

Although most UK contractors expect to increase their level of engagement with the three lean construction practices, the majority expect to increase that engagement only slightly. For weekly work planning, 20% plan a significant increase in the next two years, and 50% plan a slight increase.

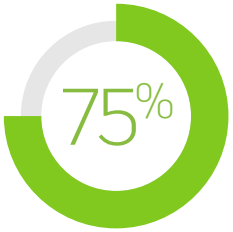
plan a significant increase

plan a slight increase

Pull Planning

No UK respondents plan to reduce their use of pull planning (nor with the other two main lean construction methods). However, 4% are still undecided about their strategy for using the method. Nearly 75% of respondents plan to increase their use of this method at least slightly in the next two years.

undecided



plan to increase use

Early Stakeholder Involvement

Nearly 50% of UK contractors plan at least a minor increase in early stakeholder engagement in the next 24 months, with almost a quarter planning a significant increase.

plan a minor incrase

plan a significant increase

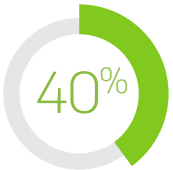
France

Weekly Work Planning & PPC

French contractors gave the most conservative responses across the board. Only 18% of contractors plan to significantly increase weekly work planning, 39% plan to slightly increase it, and 40% intend to maintain the same level of use for the next two years at least.

plan a significant increase

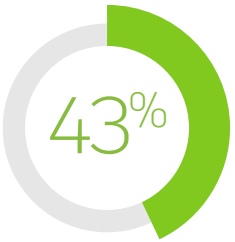
plan a slight increase



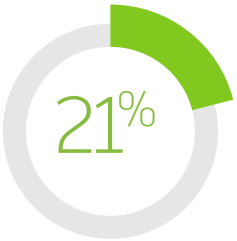
plan to maintain same level

Pull Planning

In France, 43% of respondents expressed the intent to slightly increase their use of pull planning, and 21% intend to achieve a substantial increase. This was the greatest total increase in any lean technique among contractors in this country.



plan a slightly increase



plan a substantial increase

Early Stakeholder Involvement

Over 40% of French contractors familiar with early stakeholder involvement intend to slightly increase its use over the next two years, with an additional 23% seeking significant utilization. A combined 8% intend to decrease or aren't sure how they'll use this technique for the next two years.

plan to slightly increase

plan a significant increase

intend to decrease or are unsure

What Are the Biggest Benefits of Using Lean Construction Technology?

The Lean Construction Institute has uncovered some compelling facts about the value of lean techniques. For example, compared with projects with less lean implementation, projects using a combination of different lean techniques are three times as likely to complete ahead of schedule and twice as likely to come in under budget.[4] The Dodge–Autodesk research revealed some of the mechanics behind those findings and identified the main benefits enjoyed by contractors who use supportive technology to implement the three lean construction techniques addressed above.

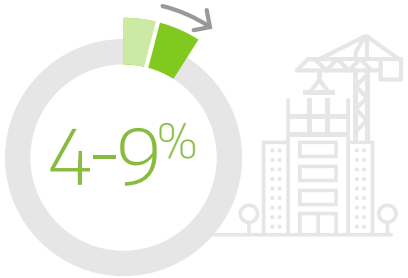
Reducing Clash and Rework

Contractors generally agree that reducing clash (and eventual rework) is the top benefit expected from investing in technology to improve early stakeholder involvement. US and UK contractors agree that reducing rework is the top benefit they'd expect from technology improving weekly work planning/PPC, but French contractors rank that benefit a distant third. On a related note, in the US and France, over half of responses identified reducing task clash (conflicts between tasks on the jobsite) as a top benefit of technology to support pull planning.

Rework requests alone can account for approximately 4–9% of total project cost[5]. Losing this much potential profit to rework expenses is downright painful. BIM-based technology allows for the automation of clash detection, making it easier to catch potential issues during model coordination and preconstruction planning.

Top Benefit

Reducing clash (and eventual rework)



of total approximate project cost comes from rework requests

Streamlining Logistics

Streamlining logistics came in a close second, with 53% of contractors in all three countries ranking it a top benefit of investing in technology to improve early stakeholder involvement. Considered together with just-in-time delivery to jobsite, streamlined logistics also ranks very highly as a benefit of technology supporting better pull planning in the US and UK. Reduced logistics is also noted as a benefit of technology for weekly work planning/PPC by around a third of contractors in all three countries.

Technology Benefits

Improved early stakeholder involvement and reduced logistics

In addition to the environmental impacts of transportation, logistics introduce complex management challenges on every construction project. Logistical issues add to wait times, delay critical tasks, and can have a significant disruptive ripple effect on the project schedule. For example, material delivered before it's needed has to spend time in laydown areas, where it risks being damaged and creates an obstacle to movement. Similarly, if a crane isn't on site when it is supposed to be, installation crews are idle. The crew gets paid even though they can't work, and the project timeline slips. Using technology to implement lean construction best practices prevents these types of costly and time-consuming errors.

Reducing Waste and Overages

Around half of French contractors look to technology for weekly work planning/PPC to reduce overages, a key improvement that ranks a distant second in the US, but does not rank in the top three in the UK.

Waste isn't only a problem for the environment; it's also a major profit drain for construction. Each framing assembly that goes unused for the final structure represents the potential for streamlined planning to prevent unnecessary losses.

While these may be the top ranked benefits identified by contractors in the study, respondents report enjoying a combination of these advantages and more.

Investing in BIM-Based Technology and Training to Support Lean

Technically, most lean construction methods can be handled with pen and paper alone, but such an approach is inefficient and error prone. To make the most of the philosophy, you'll need technology. If you've looked into lean construction technology in the past, you may have been disappointed or confused by single-point software solutions. Instead of building a collection of disparate software products, try a complete solution. A single connected platform can deliver an end-to-end lean construction workflow.

Over 60% of contractors experienced in at least one of the practices reported willingness to invest in BIM-based technologies to improve them, with the highest level of interest in software for weekly work planning/PPC. Your fellow contractors are likely to invest in training and technology soon in these fast-evolving and challenging markets, so make sure you're keeping up with them to win more work and maintain a cutting-edge workforce. As expected, contractors in each country varied a little in how they plan to adopt new technologies in the coming two years, but general willingness to invest in technologies is high for all the lean practices.

United States

US contractors are most interested in investing in BIM-based technologies to improve pull planning, with large contractors seeming to be the most motivated to adopt technology for these lean practices.

Greatest interest in using BIM-based technologies to:

improve pull planning

France

Half of the UK respondents to the survey had a moderate or greater interest in investing in BIM-based technology to support the three lean construction practices. Interest was spread fairly evenly across all three methods, with demand for technology supporting weekly work planning showing a slight lead over the other two. Pull planning managed to have both the most dedicated demand for expansion of use in the coming two years and the highest response rate from contractors unsure of the value of investing.

Greatest interest in using BIM-based technologies to:

support weekly work planning

United Kingdom

French contractors expressed a nearly equal interest in investing BIM-based technology to support the three main lean construction techniques. However, expanding use of weekly work planning and PPC methods was preferred over the others. Early stakeholder involvement saw the lowest intent to engage from French contractors. However, more than 50% of total respondents still had at least some willingness to invest in it in the next few years.

Greatest interest in using BIM-based technologies to:

expand use of weekly work planning and PPC methods

The Barriers to Increasing Use of Lean Construction Practices

If not all of the contractors surveyed by Autodesk and Dodge Data & Analytics intended to implement more lean construction practices, what is holding them back? The perceived barriers depended on the size of the contractor and their location, but interesting general trends emerged from the data.

Largest barrier to adoption

Lack of subcontractor buy-in

Lack of Subcontractor or Owner Buy-in

The largest reported single barrier to adoption of pull planning and weekly work planning/PPC was lack of subcontractor buy-in. If you're struggling to get trades teams onboard, highlight the benefits that subcontractors will receive from implementing lean construction practices. Explain how they can improve predictability and remove barriers to success by joining the planning process early on. Frame it as an opportunity to strengthen their reputation and share an industry best practice.

When it comes to early stakeholder involvement, lack of owner buy-in is the top obstacle, according to around half of all contractors. This response is very likely due to the higher first costs required to for meetings bringing together AEC disciplines: such engagements may be considered merely optional and too expensive.

Of course, early stakeholder involvement pays dividends in downstream efficiencies such as avoided clash, streamlined logistics, and increased use of prefabricated solutions, and is likely to offset increased first costs by a significant margin.

Time Commitments

Across the three countries, contractors reported the additional time commitment required as a significant challenge to increasing use of all three lean practices. Yet as reporting and benchmarking for projects becomes more standardized, the ability to measure and quantify the benefits of lean construction will improve—and the results will make the case for increased investment and additional support.

Summary

Lean construction clearly delivers an array of benefits to contractors in the US, UK, and France. It's a good option for revitalizing construction businesses, especially large firms struggling with productivity and growing project complexity. Lean construction techniques work best when practiced through complementary technology, and now is the right time to invest in lean construction technology solutions. Autodesk Construction Cloud offers an end-to-end platform to start and succeed in your Lean construction journey.

References

[1] Lean Construction Overview
Lean Construction Institute, 2020

[2] 2020 Engineering and Construction Industry Outlook: A midyear update
Deloitte, 2020

[3] Early Stakeholder Involvement
Lean Construction Institute, 2020

[4] Lean Projects are Three Times More Likely to Complete Ahead of Schedule According to Dodge Data & Analytics' Research
Lean Construction Institute, 2020

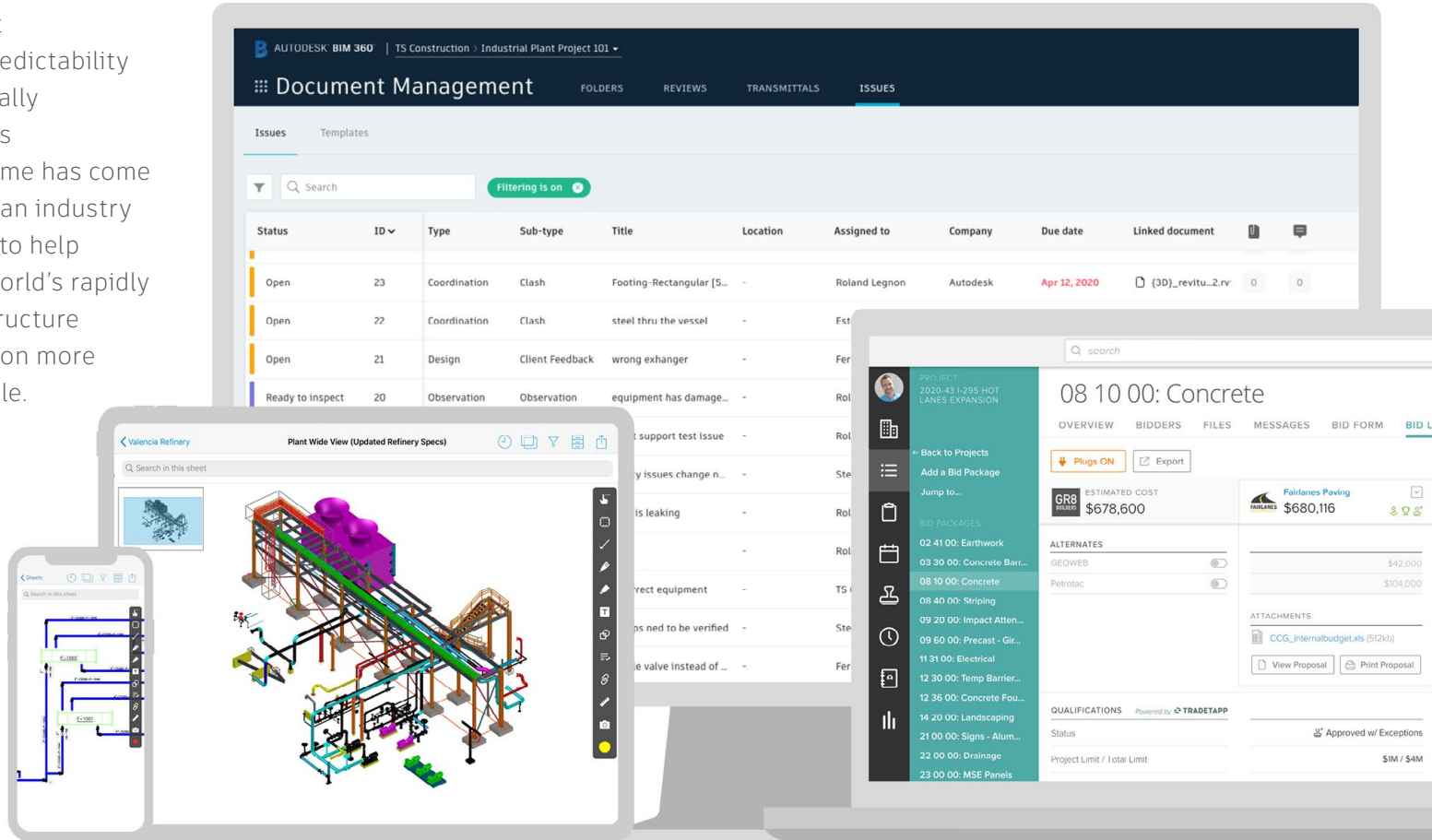
[5] The Impact of Rework on Construction & some Practical Remedies
Navigant, 2012

See the Future of Connected Construction

construction.autodesk.com

In 2018, Autodesk announced that construction would be a key focus area to help our customers on their design and make journey. To capitalize on the opportunity, Construction became its own CEO-staff level organization, Autodesk Construction Solutions. This unique structure is comprised of product development, customer success, marketing, and field operations. The organization is designed to move at the speed of the market and serve customers on a level playing field with other solution providers. Autodesk Construction Solutions offers products that cover the entire construction lifecycle, from design through plan to build and operate, including the Autodesk Construction Cloud which brings together our cloud-based solutions Assemble, BIM 360, BuildingConnected and PlanGrid.

Our vision is to create a vibrant construction industry where predictability and productivity are exponentially increased, while jobsite waste is proportionately reduced. The time has come for platform that will empower an industry transformation. Our mission is to help construction teams meet the world's rapidly expanding building and infrastructure needs, while making construction more predictable, safe and sustainable.



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With Autodesk software, you have the power to Make Anything. The future of making is here, bringing with it radical changes in the way things are designed, made, and used. It's disrupting every industry: architecture, engineering, and construction; manufacturing; and media and entertainment. With the right knowledge and tools, this disruption is your opportunity. Our software is used by everyone - from design professionals, engineers and architects to digital artists, students and hobbyists. We constantly explore new ways to integrate all dimensions of diversity across our employees, customers, partners, and communities. Our ultimate goal is to expand opportunities for anyone to imagine, design, and make a better world.

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