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Center for Real Estate

Construction in the Age of AI

AN INDUSTRY WHITE PAPER AND RESEARCH ROADMAP

Construction in the Age of AI

Construction productivity has been stagnant for decades, with industry fragmentation and historically limited technology investment among several contributing factors. Amid soaring demand and cost pressures, rapid improvements in artificial intelligence started to reshape the industry by improving how projects are designed, approved, procured, planned, manufactured, and delivered.

To understand its transformative potential, Suffolk and Massachusetts Institute of Technology Center for Real Estate and Media Lab City Science Group have partnered to explore the implications of AI for the construction industry, combining MIT's academic research with Suffolk's industry expertise.

This white paper identifies six major categories of AI-enabled value levers:

Design Automation	**Scheduling**
Offsite Manufacturing / OSM	**Skilled Labor & Subcontracting**
Permitting	**Supply Chain and Procurement**

and evaluates how they may reduce cost, compress schedules, and improve project delivery. While still suggestive rather than definitive, a review of early-evidence academic literature drawn from Architecture, Engineering, and Construction (AEC) and adjacent industries, along with documented case studies, structured interviews and survey responses and roundtable discussions with over 50 industry experts suggest reported efficiency gains ranging from 15 percent to 40 percent and cost savings from 8 percent to 21 percent. Even more intriguing is what this could mean for total building cost and schedule – for a sample multifamily project in San Francisco, a model developed by Suffolk estimates that the total impact can be 17–20 percent total cost savings and 22–25 percent total schedule savings. To our knowledge, this is among the first attempts to piece together disparate evidence to arrive at a directional view.

For developers, the implication is not only lower cost and faster delivery for clients, but materially stronger project feasibility. In one sample multifamily project, Suffolk's internal model estimates that the combined AI-enabled levers could increase unlevered IRR by 5–6 percentage points, for example – from 15-20 percent to 20–25 percent, and yield on cost by 1–2 percentage points, for example – from 6–7 percent to 7–9 percent. For many projects, that level of improvement can be the difference between a project that does not meet investment thresholds and one that is financially feasible to build.

In short, this paper presents a vision of what construction could be in the age of AI. To substantiate the findings and understand how to capture the savings, a broader research and industry engagement effort will be necessary.

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"If our era is the next Industrial Revolution, AI is surely one of its driving forces."

Fei-Fei Li, Founding Co-Director of Stanford's Human-Centered AI Institute

"AI is not about replacing people. It is about giving our people better tools, eliminating inefficiencies, improving decision-making. Most importantly, AI allows builders to spend more time building."

John Fish, Chairman and CEO, Suffolk

Construction is one of the world's largest industries, accounting for approximately 13 percent of global GDP, and one of its least productive industries. An American construction worker in 2020 produced less value than a counterpart in 1970. In contrast, manufacturing productivity grew by 290 percent over the same period. The Organization for Economic Co-operation and Development (OECD) found that construction productivity declined in 40 percent of 29 countries studied between 1996 and 2019.

This is not a technical problem alone. It is a structural, cultural, and data problem. The industry is fragmented, contract-driven, and historically resistant to technology adoption. Construction firms have spent, on average, less than one percent of revenues on IT, which is a third of what is common in automotive and aerospace. Change management is difficult across project portfolios. Institutional knowledge is rarely codified. Data is siloed across owners, contractors, subcontractors, and regulators.

AI does not resolve all these structural challenges, but it introduces, for the first time, tools capable of operating at the scale and speed the industry requires. Machine learning models can analyze patterns across thousands of projects. Generative AI can produce and iterate design options in hours rather than months. Natural language processing can navigate thousands of pages of building codes and permit requirements. Computer vision can monitor construction progress in real time. These opportunities allow for new ways of cooperation across traditionally siloed domains, that can improve processes, improve delivery expectations and reduce risk.

The convergence of these capabilities with an industry under unprecedented pressure creates both an imperative and an opportunity. This white paper is a call to the entire industry—owners, contractors, subcontractors, designers, regulators, technology providers, and capital allocators—to work together to enable the AI transformation through shared standards, aligned incentives, integrated workflows, and coordinated adoption across the full project lifecycle.

The MIT Center for Real Estate, MIT Media Lab City Science group, and Suffolk have partnered precisely because this challenge requires the combination of academic thinking and research, technological frontier expertise, and on-the-ground construction practice. To take advantage of the opportunities AI and data-driven processes offer, this effort needs cooperation by all industry stakeholders. Launched in October 2025, this research examines how AI and emerging technologies can improve construction performance, drawing on academic literature from similar AI applications across different industries, industry case studies, expert interviews and surveys, and insights from the March 2026 MIT–Suffolk "Construction in the Age of AI" roundtable with over 50 experts from across the industry. Through structured deliberation, the project converged on six priority domains where AI holds the greatest near-term potential to reduce costs and compress schedules:

Domain	Example AI Application	Potential Efficiency Gains (maximum)*
Design Automation	Generative design and BIM AI	Up to 39 percent reduction in design cycle time and up to 21 percent design and engineering cost savings.
Offsite Manufacturing (OSM)	AI-optimized factory prefabrication	Up to 32 percent reduction in project timelines and up to 14 percent total cost savings.
Permitting	Automated code-compliance review and application preparation	Up to 24 percent reduction in project time and up to 8 percent cost savings.
Scheduling	ML-driven sequencing and optimization	Up to 18 percent reduction in project timeline and up to 11 percent total cost savings.
Skilled Labor & Subcontracting	AI trade development, coordination, and performance management	Up to 17 percent project time savings and up to 13 percent total cost savings.
Supply Chain and Procurement	Predictive lead time, delivery optimization and process automation	Up to 15 percent reduction in total project time and up to 10 percent total cost savings.

**Potential Efficiency Gains are estimated from a comprehensive review of existing literature of means and methods applied, in Architecture, Engineering, and Construction (AEC) and adjacent industries predominantly from early-stage pilots (so they should be treated as directional rather than construction-validated benchmarks), as well as means from survey respondents anchored to a $180M multifamily San Francisco project.*

With examples of demonstrated savings in time and cost across these six levers, it now raises a larger question – what is the total benefit in terms of cost and time of development, and what will this do to increase feasibility for construction? The project improvement with the levers should be interpreted as an integrated, system-level opportunity rather than a simple addition of six independent savings categories. The six levers are interdependent: gains in areas such as design certainty, procurement and supply chain, field execution can reinforce one another, while some effects overlap.

As an initial indication, a first-pass model developed by Suffolk, building on the joint research effort and informed by Suffolk's project delivery experience, suggests that the combined application of the six levers could generate approximately 17–20 percent total cost savings and 22–25 percent total schedule savings on the sample multifamily residential project analyzed. If achieved, this level of improvement could materially increase developer IRR by approximately 5-6 percentage points (unlevered), for example from 15–20 percent to 20–25 percent, and increase yield on cost by 1-2 percentage points, for example from 6–7 percent to 7–9 percent, which can be the difference between housing being built and housing not being built.

To further define the answer to this question with the rigor required for academic research, the work is necessary across larger project datasets, geographies, asset classes, and delivery models, as outlined in Appendix Roadmap. We invite the industry to engage in this next phase by contributing data, implementation experience, and project-level evidence.

To understand the integrated financial benefits, we used a sample residential housing project completed between 2021 and 2024 in San Francisco and assessed how applying modern AI technologies could accelerate the project, optimize total construction cost, and improve project predictability. This evaluation is grounded in tools and technologies that are already being piloted or implemented at different stages of construction but are not yet fully integrated into a single delivery system.

This transition to an AI-enabled delivery model can improve collaboration between the project stakeholders and strengthen performance across every phase of development:

- **Entitlement** AI reduces uncertainty created by diverse local requirements, as the U.S. has more than 20,000 independent permitting jurisdictions, each with its own zoning codes, submission requirements, review processes, and timelines. AI can help regulators and project teams run compliance reviews, define preapproved design standards, and identify likely approval issues earlier in the process.
- **Design** AI already compresses the path from concept design to engineering and manufacturing by automating technical review, clash detection, and design generation with AI agents. Integration between design and preconstruction systems allows the industry to move toward true target value design and design-option testing, where developers can optimize design earlier for target cost, duration, and project return.
- **Preconstruction** AI can accelerate preconstruction by automatically turning design information into visualizations, budgets, schedules, bid packages, procurement plans, and trade scopes. This reduces manual work, improves quality, identifies scope gaps earlier, and helps teams resolve emerging risks before they reach the field. It can also improve cost and schedule forecasting before construction begins.
- **Construction** AI supports construction execution by resolving constructability issues earlier in the design phase, automating manual tasks for supply chain and procurement, financial workflows, and trade coordination, integrated with real-time field monitoring. It can streamline RFI and submittal review and link automated progress tracking to the schedule. These capabilities can also improve safety by identifying site risks earlier and helping teams manage high-risk activities. While OSM and prefab are not pure AI levers, they are substantially supported by recent innovation in AI for design and data integration between trade partners and the general contractor, so they were included in the analysis. OSM and prefab shift work into more controlled environments and help realize cost, schedule, and safety benefits at the job site.
- **Financing and cost escalation** Accelerating the project helps reduce total financing costs, shorten exposure to cost escalation, and bring revenue-generating assets online earlier.

TABLE 1 | Applying AI levers for sample project

	Cost Savings			TIme Savings		
Phase	**Cost Baseline USD m**	**Cost Savings USD m**	**%**	**Time Baseline months**	**Time Savings months**	**%**
Acquisition	27	0	-	3	0	-
Entitlement	1.4	0.05	4	11	2	19
Design	6	1.2	20	24	7	30
Precon	3	0.3	10	9	1	14
Construction	128	28	22	30	7	14
Finance	7	1.2	17	-	-	-
Cost Escalation	7	1.2	17	-	-	-
Total	**179**	**32**	**18**	**51***	**11***	**22**

*Doesn't equal to sum of previous lines due to overlap of project phase

The resulting improvement in returns suggests that AI-enabled delivery can materially improve project feasibility. By reducing costs, compressing schedules, lowering execution risk, and improving capital efficiency, AI can help projects clear investment thresholds that might otherwise prevent them from moving forward. This is especially important in geographies where housing and infrastructure needs are acute, but development is constrained by high construction costs, long approval timelines, labor shortages, financing pressure, and uncertainty around delivery. In those markets, even modest improvements in IRR and yield on cost can translate into more projects being built.

Realizing these potential savings will require coordinated action across the full project ecosystem. No single participant – owner, general contractor, subcontractor, designer, or technology provider – can unlock the full value alone, because the largest gains depend on shared data, integrated workflows, and integrated decision-making across project phases. As Jit Kee Chin, Chief Technology Officer at Suffolk noted – the industry needs to work together across the value chain to collectively unlock the value, and by doing so, usher construction into the age of AI.

This white paper should be viewed as the foundation for a broader research effort. The savings estimates and implementation pathways or levers need to be refined through additional analysis across more projects, geographies, asset classes, and delivery models, supported by larger datasets, peer-reviewed research, and broader expert survey work. As this evidence base expands, the industry will be able to better quantify where AI creates the greatest impact on cost, schedule, productivity, and integrated project delivery.

02 The State of the Industry

2.1 The Productivity Gap

The construction industry's productivity problem is both persistent and well-documented. Seventy-five percent of construction projects experience delays or cost overruns. McKinsey analysis finds that construction became 1 to 3 percent more expensive each year over the past two decades while other industries drove costs down through technology and process innovation. A 2019 study of 2,700 projects found that 44 percent ended at a loss. The industry wastes an estimated $30-$40 billion annually in the United States alone through labor inefficiency.

At the same time, demand is increasing. The Infrastructure Investment and Jobs Act has injected hundreds of billions of dollars into construction capacity. The data center construction boom, driven by AI infrastructure requirements, is creating demand that far outstrips current supply. The housing shortage in the United States, Europe, and across global markets requires a step-change in delivery velocity. The industry is being asked to do more, faster, with fewer workers.

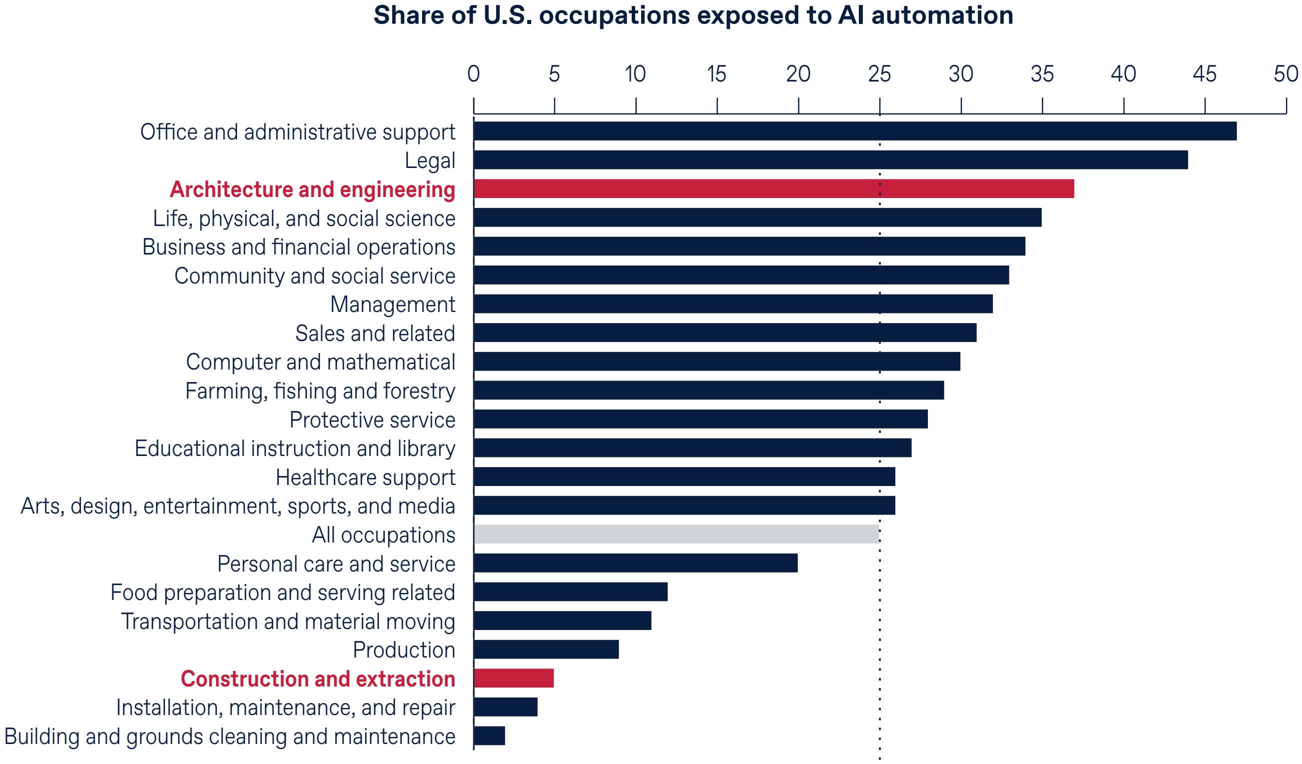
2.2 Why AI, Why Now

Three concurrent developments make the present moment distinctive. First, AI model capabilities have crossed meaningful thresholds: Generative AI (GenAI), including Large Language Models, can now parse complex regulatory documents; computer vision systems can track construction progress at the site level; generative design tools can evaluate millions of design permutations in hours. Second, GenAI can find patterns in workflows given the volume of construction data available for model training, making it possible to simulate the effects of decisions or changes across multiple disciplines – improving decision making and minimizing risk. And third, the economic pressure on the industry is sufficiently intense that the cost of inaction now exceeds the cost of adoption for many firms.

Statistic	Value	Source
Projects with delays or cost overruns	75 percent	Procore / IDC, 2021 Owners Survey
Annual wasted labor (U.S. construction)	$30-$40 billion	FMI, 2023 Labor Productivity Study
U.S. skilled worker shortage	456,000 additional workers needed in 2027	Associated Builders and Contractors, 2026 Labor Shortage Analysis
Projects ending at a loss	44 percent	Journal of Building Engineering, 2019
IT spend as share of revenue (construction)	<1 percent	McKinsey
AEC tech investment 2020–2022	$50 billion	McKinsey

Key industry statistics. Sources: McKinsey, AGC, Construction Dive, Journal of Building Engineering.

FIGURE 1 | Construction Automation Opportunities



Source: Haver Analytics, Goldman Sachs Research

AI and new technologies are already being implemented across the sector, improving productivity in several directions:

- **Automating knowledge work**, especially in architecture and engineering, preconstruction, and project controls, where AI can perform technical review of drawings and models, check for clashes, omissions, and constructability issues, and generate schedules, budgets, procurement packages, and draft responses to RFIs, submittals, and related coordination workflows.
- **Improving project control**, where AI can forecast schedule risk, run what-if scenarios, optimize sequencing as project conditions change, and provide earlier visibility into delays, cost overruns, labor constraints, and material bottlenecks. This also includes the use of computer vision to track site progress, compare installed work against plan, identify deviations earlier, flag unsafe conditions, and create a more objective real-time view of project status.
- **Enabling new operating models** by integrating design, manufacturing, logistics, and construction execution into a more coordinated workflow, which in turn supports larger-scale prefabrication and offsite manufacturing, greater customization within standardized systems, and more real-time supply chain management.

McKinsey estimates that AI and generative AI could unlock up to $18 billion in value for U.S. home builders alone, which is approximately 10 percent of that sector's revenue. These are not theoretical gains. They are beginning to emerge in firms that have committed to systematic AI adoption, underpinned by investment in data infrastructure and change management.

03 The Six Lever Domains

The roundtable participants, drawing on collective experience across hundreds of billions of dollars in construction value, converged on six lever domains where AI has the greatest near-term potential to create measurable value. Each lever domain is defined, its AI application explained, and the research questions that require larger datasets to answer are set out below.

3.1 Design Automation

Potential
- Speed up timeline by 35-40 percent
- Reduce project cost by 10 percent[1]

Generative AI and machine learning tools enable architects, engineers, and contractors to explore thousands of design options in the time it previously took to develop one. These tools evaluate options against multiple objectives including cost, code compliance, energy performance, structural efficiency, schedule, and aesthetics simultaneously to name a few. Reported benchmarks suggest design cycle time reductions of up to 35–40 percent, with additional value from fewer change orders, reduced rework, and earlier identification of coordination issues.

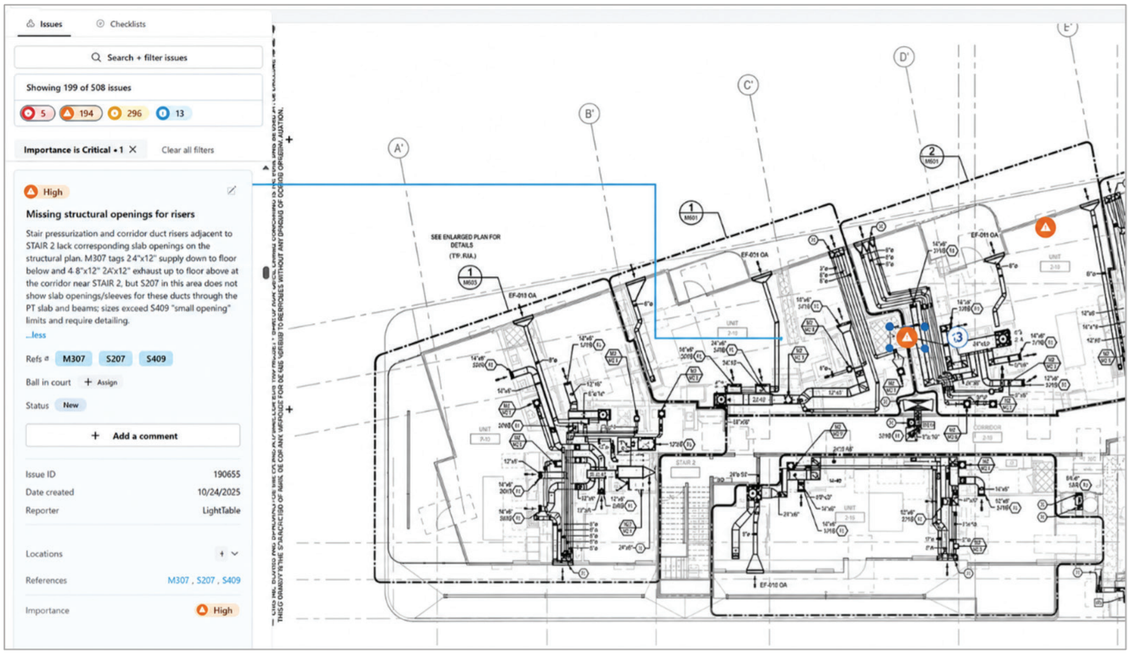
Industry participants identified **five high-value AI capabilities within design automation**: target value design, generative and augmented design engineering, early clash detection, design for manufacturing and assembly, and predictive total cost of ownership. Among these, target value design and generative design were viewed as especially impactful because cost modeling remains a major blind spot during early design. By connecting rapid quantity takeoff, near-real-time estimating, schedule modeling, clash detection, and BIM-based option testing, teams can move from “design first, price later” to continuous optimization of design, cost, and schedule. Directional use cases suggest up to 10 percent construction cost savings through structural design optimization, while AI-assisted estimating has been reported to reduce budget and timeline deviations by 10–20 percent and engineering hours by 10–30 percent[2].

GenAI tools are beginning to make this shift tangible in practice. Thornton Tomasetti’s CORE studio, for example, developed its Asterisk platform to generate and compare structural concepts from an early massing model using machine learning and computational geometry. Autodesk is extending a similar logic across early-stage planning and design through AI-enabled tools such as Forma, while cove.tool is rebuilding all design process with AI to build design options in days not months.

Multiple tools such as LightTable and BuildCheck emerged for technical value review (TVR) to reduce RFIs, change orders, and coordination cycles. Application of AI in design also supports fabrication-ready BIM, prefab and robotic construction strategies, and lifecycle analysis that considers operating, maintenance, and energy costs.

1,2 10 percent assumption is applied to total project cost in the integrated model. Literature reviewed for this white paper reports potential savings of up to 21 percent within the design and engineering scope; that phase-specific finding is not applied to the full project cost base.

FIGURE 2 | Early clash detection example with LightTable AI engine



3.2 Offsite Manufacturing (OSM)

Potential
- Speed up timeline by 32 percent

Offsite manufacturing, including prefabrication and modular construction, is not new: Roman legions used standardized approaches to assemble fortified camps rapidly in the field. Today, the same basic logic is being transformed by AI, design automation, robotics, and digitally coordinated logistics. In practice, modern offsite manufacturing can take several forms, from fully finished rooms with interior finishes, fixtures, and furniture, to bathroom pods, utility pods, corridor racks, MEP assemblies, and other major building modules. By shifting work from variable site conditions into controlled production environments, offsite manufacturing can improve quality, reduce rework, and compress delivery.

Industry participants identified five high-value AI capabilities within OSM: component standardization, geographic wage and skill optimization, design for manufacturing and assembly, modular construction, and robotic fabrication. OSM typically provides major project schedule savings, while cost savings are market dependent, driven by union structure, field labor cost, and logistics distance. Volumetric Building Companies (VBC), one of the leading U.S. producers of full volumetric buildings, reports up to 47 percent schedule savings across geographies.

Offsite manufacturing is advancing along two main paths. First, major specialty contractors are scaling prefab at the component and system level to shift work into controlled shop settings and reduce field congestion, coordination risk, and rework. Power Design, for example, has expanded cross-trade prefabrication and in-house logistics, while McCusker-Gill has advanced BIM- and VDC-enabled fabrication in sheet metal and HVAC systems. Second, a set of firms is scaling multi-trade and fully volumetric delivery, producing at scale the buildings which can be assembled at the jobsite.

The strongest offsite manufacturing results come when the project team can closely control the design, standardize assemblies, and optimize the boundary between what is fabricated offsite and what remains in the field. This requires early design commitment, repeatable building components, fabrication-ready models, and integrated logistics planning. AI can strengthen this model by identifying prefabrication opportunities earlier in design, optimizing production schedules, coordinating logistics, and aligning factory output with site readiness.

FIGURE 3 | Full modular construction – Mercy Housing (LA, California)

3.3 Permitting

Potential
- Speed up timeline by 24 percent
- Reduce project cost by 8 percent

Permitting is one of the most persistent bottlenecks in U.S. construction because approval is fragmented across thousands of local jurisdictions, agencies, codes, and review processes. The United States contains more than 20,000 independent permitting jurisdictions, each with its own zoning codes, review processes, and approval timelines. Boston alone divides its 48 square miles into 429 separate zoning districts, governed by a code of nearly 3,800 pages that has not been fundamentally revised since 1964. Forty-two percent of Boston parcels are non-conforming under current lot-size requirements, meaning projects require variance approval before a single permit is filed. For large projects, transportation, water and sewer, historic preservation, environmental review, zoning, and building code compliance can all operate on separate clocks, making development timelines difficult to predict.

AI can reduce this uncertainty by turning permitting from a late-stage, document-heavy review into a more iterative and data-driven process. **The four highest-value capabilities are**: preapproved design standards, AI code compliance, digital permit management and automated RFI retrieval, predictive timeline modeling. Reported benchmarks in the current analysis suggest permitting automation can contribute up to 24 percent reduction in project time, with additional value from fewer resubmissions, shorter review cycles, and more predictable project starts.

Several examples show how this shift is beginning to take shape. PermitFlow and Pulley are AI-enabled permitting platforms that help project teams navigate jurisdiction-specific requirements, prepare and track submissions, and reduce the manual research and coordination work required before filing. Paces adds a complementary layer of site and jurisdiction-risk intelligence, helping teams evaluate parcels, zoning, utility and interconnection conditions, and permitting risk before committing capital, rather than focusing only on workflow automation for an active permit. PermitFlow has built a database of approximately 15 million permitting data points across U.S. jurisdictions, helping project teams reduce the manual research and administrative work required before filing. Multi-AR in Canada is a BIM-based automated review system that reads building models and checks them against applicable zoning and code requirements before formal submission; where requirements are sufficiently quantified, it shows the potential to compress approval timelines from months or years into minutes. CivCheck is a pre-submission compliance tool that guides applicants through code checks, flags missing documents, and identifies likely compliance issues before a formal permit application is filed. Honolulu deployed CivCheck to reduce review cycles and cut the back-and-forth with applicants that historically extended permitting timelines by months.

The State of California launched eCheck for Los Angeles City and County in April 2025 for fire reconstruction approvals; the system uses computer vision, machine learning, and rulesets to test designs against local codes before formal review, and Austin has adopted it as a pre-check for single-family permits. Singapore uses its national digital permitting platform CORENET, which supports BIM-based electronic submissions and automated compliance checking against building regulations; its newer CORENET X platform uses machine intelligence and algorithms to detect compliance issues across BIM models before agency review and is expected to become mandatory for ongoing projects in Singapore by October 2027. The lesson is that AI does not replace regulators; it reduces repetitive review work, incomplete submissions, and avoidable resubmission cycles so human reviewers can focus on policy, safety, and judgment-heavy decisions.

3.4 Scheduling

Potential
- Speed up timeline by 15 percent[3]
- Reduce project cost by 8 percent

AI and machine learning can improve project scheduling by moving teams from static schedules to dynamic project controls. Instead of treating the baseline schedule as a document that is updated after delays occur, AI-enabled scheduling can generate scenarios using historical lessons learned, test sequencing options, forecast risk, and recommend recovery plans as conditions change, solving the historical issue with low predictability in the construction (75 percent of construction projects experience delays or cost overruns). Industry participants identified several high-value **AI capabilities within scheduling**: schedule optimization to reduce duration/cost, automated schedule and budget generation, collaborative/integrated scheduling, as well as schedule visualization and conflict detection. Together, these capabilities allow project teams to compare different paths before work begins, understand which activities are most likely to threaten the critical path, and update the plan based on actual site progress.In this role, the schedule acts as an integration backbone for project delivery ensuring close coordination of design, submittals process, procurement and deliveries, trades coordination.

FIGURE 4 | Automatic schedule update with computer vision and robotics – SPOT walkthrough at an airport

3 The 15 percent scheduling assumption used in this analysis is based on several studies; supporting literature reviewed for the white paper reports potential schedule reductions of up to 18 percent.

Several successful examples show progress in implementing AI for schedule optimization. ALICE Technologies is an AI scheduling platform that allows teams to generate and compare construction sequences, test what-if scenarios, and resequencing work when conditions change; in one large solar farm application, AI-based planning tools reduced costs by up to 30 percent through optimized labor and equipment use. nPlan uses machine learning on historical construction schedules to forecast delay risk and give project teams a probabilistic view of schedule outcomes rather than a single deterministic finish date.

OpenSpace is broadly used in the construction industry, and it uses computer vision and reality capture to track installed work against the plan, helping teams understand what is complete, what is missing, and where schedule risk is emerging. This enables near-real-time tracking of the project progress, understanding risk, and resolving risks and issues early.

Practical examples in the industry show this shift moving from software concept to operating practice. Cleveland Construction uses BIM, VDC, and AI-enabled platforms to connect planning with real-time jobsite productivity. Harkins Builders adds a complementary analytics-driven model for early identification of schedule risks. Suffolk applies an integrated approach by tracking critical-scope elements from design release through prefabrication, logistics, and installation, while using computer vision to monitor construction progress on site.

3.5 Skilled Labor & Subcontracting

Potential
- Speed up timeline by 17 percent
- Reduce project cost by 13 percent

Skilled labor and subcontracting are central constraints on construction productivity. The U.S. construction sector faces a shortage of 456,000 skilled workers in 2027, making labor availability not only a workforce issue but a delivery-capacity issue. AI can help by improving how projects forecast labor needs, match skills to tasks, structure subcontract packages, and support workers in the field. The opportunity is not to replace skilled trades, but to make scarce labor more productive, better coordinated, and less dependent on informal knowledge transfer.

Industry participants identified five high-value AI capabilities within skilled labor and subcontracting: AI-automated trade coordination, performance and quality control, contracting strategy, subcontractor prequalification, strategic trade development.

Trade coordination is a major pain point in project delivery because owners, designers, general contractors, trade partners, and manufacturers must continuously align design intent, engineering details, construction sequencing, cost exposure, and field changes. A typical large project can generate hundreds of RFIs and change requests, biweekly and monthly progress updates, and submittals with hundreds of pages of supporting data. AI tools are beginning to reduce this coordination burden by turning fragmented project information into searchable, structured workflows. Enterprise platforms like Procore leverage deep project context across drawings, specifications, submittals, and RFIs to power a native suite of specialized agents. These agents execute autonomous in-platform actions - such as validating technical queries, deflecting unnecessary RFIs, and drafting documentation directly within core workflows. Point solutions like TrunkTools address specific coordination steps, e.g., TrunkRFI agent is designed to identify potentially unnecessary RFIs and draft RFIs when clarification is needed. Clearstory addresses downstream change management by centralizing change-order requests, connecting field changes to cost exposure, and maintaining an audit trail.

AI also supports performance and quality control using computer vision and sensor data. For example, the NavVis platform uses laser scans to compare as-built conditions with design intent, identify deviations, document issues, and share findings with VDC and field teams.

3.6 Supply Chain and Procurement

Potential
- Speed up timeline by 15 percent
- Reduce project cost by 10 percent

The materials procured and managed through the supply chain account for roughly 40 percent of commercial construction costs, making it one of the largest single cost drivers in any project, yet the process remains fragmented, project-specific, and often reactive. Materials, equipment, subcontract packages, and supplier commitments are frequently managed across disconnected systems, limiting visibility into cost, lead times, risk, and availability. AI-enabled procurement can improve this by aggregating spend data across projects, benchmarking contracts, forecasting demand, identifying supplier risk, and helping teams make earlier purchasing decisions. Reported benchmarks suggest supply chain and procurement improvements can contribute up to 15 percent reduction in total project time and up to 10 percent total project cost savings, depending on project type and market conditions.

Industry participants identified several high-value **AI capabilities within the supply chain**: lead time and delivery optimization, consolidated volume buying, procurement process automation, supplier performance and partnership management, as well as material price forecasting. The largest value comes when procurement shifts from a transactional function to an intelligence layer connected to design, estimating, scheduling, and field execution. For example, AI can flag long-lead materials during design, compare supplier pricing against historical benchmarks, monitor the supply chain in real time (e.g., Kaya AI), predict shortages before they affect the schedule, manage construction site delivery (e.g., Voyage Control), and recommend purchasing timing based on market trends and project sequencing. Spend analytics and contract optimization alone have demonstrated savings of approximately 8 percent through supplier consolidation and renegotiation, while broader AI-driven procurement use cases have reported savings of up to 25 percent of material cost in selected case studies.

The strongest results require clean cost history, structured material data, supplier performance records, and close coordination between owners, general contractors, subcontractors, and suppliers. AI tools can automate parts of the procurement process, but the real value comes from connecting procurement decisions to the schedule and field plan: buying the right materials earlier, from the right suppliers, with better visibility into delivery risk. Actual savings will vary by market volatility, material category, supplier depth, contract structure, project complexity, and the degree to which procurement data is integrated with estimating, scheduling, and project controls. Where subcontractors buy materials directly, the value of AI-enabled procurement depends on early trade-partner data sharing and clear visibility into purchasing commitments, substitutions, and delivery constraints.

04 Interconnectivity: The Multiplier Effect

One of the most significant dimensions of AI in construction is the interconnectivity of these six lever domains. The greatest value creation comes not from AI applied in isolation, but from integration across domains where levers are mutually dependent and their gains compound with one another. To explore these interdependencies empirically, an adjacency matrix, Borda analysis, and causal claim extraction were developed from the Roundtable, expert interviews, and survey data (more information on the results and methodology can be found in Appendix, Section 2).

Design Automation is the clearest upstream enabler. To achieve a functional OSM system, AI-enabled design must first produce a kit of parts and kit of rules against factory capabilities that unlock downstream offsite practices. This dependency extends through to labor as Doug Harrison, VP of Corporate Operations at Suffolk, noted during the Roundtable "design is the first unlock for a lot of what subcontractor management can actually deliver on site." The Borda data supports this framing since Design Automation ranks first on raw scores (206 total points), though 89 of those are self-votes from the design cohort, suggesting its value is most clearly understood by those closest to it and most felt by those downstream.

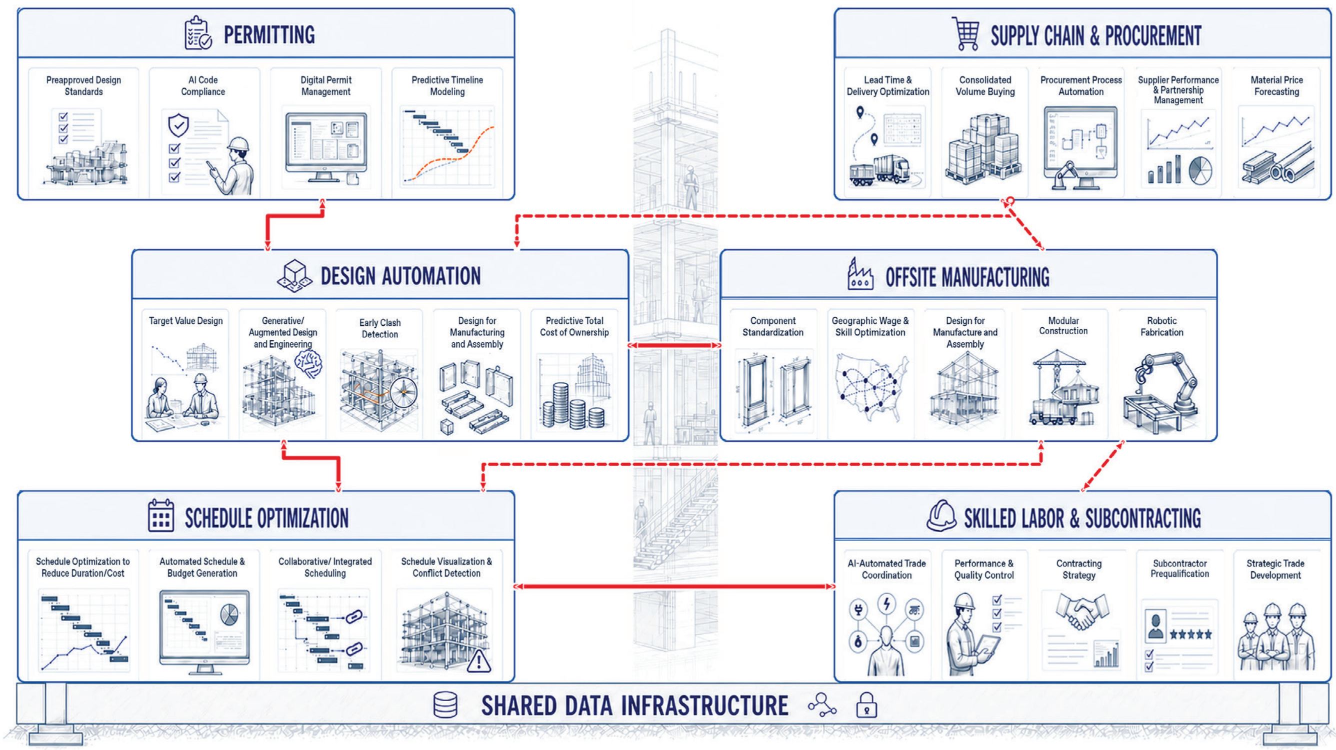
An extraction of interdependency claims from expert interviews and the Roundtable reinforces the compounding effect. Design Automation appeared as an explicit dependency in more cross-lever relationships than any other lever, functioning as the data foundation on which permit compliance checking, procurement automation, schedule generation, and subcontractor coordination all depend. Clean, structured BIM output is the shared input every downstream lever requires to operate. The full dependency matrix is provided in Appendix, Section 2.

Once design intent is locked, Schedule Optimization emerges as the coordination hub through which upstream gains must pass. When self-votes are excluded, Schedule Optimization ranks first across every expert group (163 cross-group points), meaning practitioners in every discipline, regardless of specialty, identify scheduling as the lever where the most value can be unlocked. For example, a BIM-complete design model enables generative scheduling without manual data preparation and procurement trigger dates feed directly into the sequence. Then, when material lead times shift, AI can re-sequence activities in real time. The bidirectional Supply Chain and Schedule Optimization link is one of the most critical interdependencies in the system. This was identified at the Roundtable as a common pain point where value is currently being lost, highlighting the need for implementing these levers together.

The Skilled Labor group's scores also provide a telling signal. Their ratings are nearly flat across all six levers (19–26 points), in contrast to every other group's self-selection bias. Rather than concentrating value in their own domain, Skilled Labor practitioners spread their votes out across other levers which supports the view that skilled labor productivity is unlocked upstream, after design, scheduling, and procurement, before a single worker arrives on site. Subcontractors are typically engaged later in the project cycle, missing the early collaboration phase required for much of the cross-lever integration.

Interdependency is also apparent in the relationship between Supply Chain, Offsite Manufacturing, and Schedule Optimization. For example, prefabricated components must arrive at a site precisely when installation crews are ready. If they arrive too early components stockpile in warehouses increasing storage costs, and too late and crews sit idle and fall behind schedule. AI tools that connect procurement lead times to live schedule data, such as systems that load both the project schedule and external risks to the procurement log, represent early implementations of this integration. At scale, the compounding effect across these three levers alone significantly exceeds what any one lever can deliver independently.

Illustrative AI integration chain across priority domains.



Suffolk's Mission Control processes job-site data across hundreds of projects by feeding predictive models to connect schedule, procurement, and field performance. Internal financial modeling presented at the Roundtable suggests that coordinated application of the six levers could increase illustrative unlevered IRR by approximately 5-6 percentage points on the sample project. However, that figure assumes the levers can talk to each other. Capturing that value requires a shared data infrastructure layer, something the levers themselves do not provide, that standardizes outputs at every handoff and gives every actor in the chain — owner, general contractor, subcontractor, supplier — a centralized system and industry data reporting standards to build on. Building it is the prerequisite to capturing the multiplier effect at scale, and the most consequential near-term opportunity the industry has on which to act.

05 Integrated Financial Model: Impact on Sample Project

In analyzing multiple AI levers across the construction process, it is important to recognize that they do not operate independently. Their effects are interconnected, and improvements in one area can strengthen outcomes in others. To demonstrate this combined impact, Suffolk developed an integrated model using a sample construction project to illustrate how the levers work together rather than in isolation. The project is a multifamily development of 180,000 square feet, completed in 2024, with a total duration of 4.5 years (from initial design to commissioning and closeout).

Using this project as a reference case, we modeled the impact of the identified levers on overall project performance. The analysis looks not only at individual savings, but at their combined effect on cost, schedule, and investment return for the developer. The goal is to show how AI can influence the economics of a real project when design, permitting, procurement, scheduling, labor coordination, and offsite strategies are considered together as part of one integrated delivery model.

To illustrate this, Figures 5 and 6 apply the optimization levers to a representative project budget and schedule. Figure 5 allocates the project budget across major development phases: acquisition, finance, entitlement, design and engineering, preconstruction, and construction. The relative area of each phase corresponds to its share of total project cost, while the dashed zones indicate where AI-enabled optimization, standardization, or process redesign may create measurable value. Figure 6 then shows the same logic through time, illustrating where schedule compression may occur across entitlement, design, preconstruction, and construction.

The purpose of this exhibit is not to assert a final savings estimate for every project type. The phase-level percentages shown across the lever sections should not be added together as some effects overlap and some depend on sequencing. The integrated model reconciles those interactions for specific type of project rather than treating them as independent savings.

The exhibit below provides a practical framework for understanding where savings are likely to be realized and how the levers interact across the development lifecycle. This white paper assumes that value realization from AI-enabled construction will be shared across the project ecosystem rather than captured by a single participant.

By reducing non-value-added activities – including manual coordination, late-stage redesign, procurement delays, schedule conflicts, and avoidable rework – AI can allow designers, general contractors, subcontractors, and manufacturers to perform more work with the same or fewer constraints. The resulting value proposition is therefore twofold: improved affordability and feasibility for owners and developers and expanded productive capacity for the firms and workers responsible for project delivery.

FIGURE 5 | Project Budget

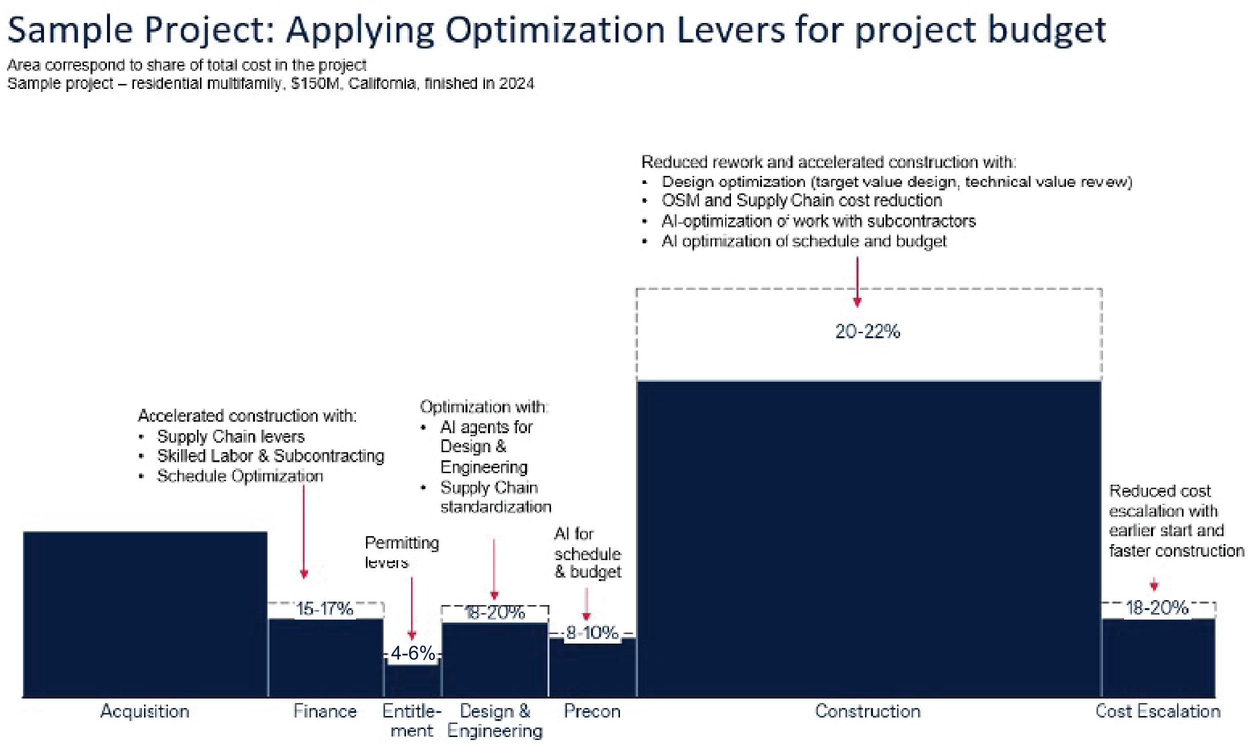
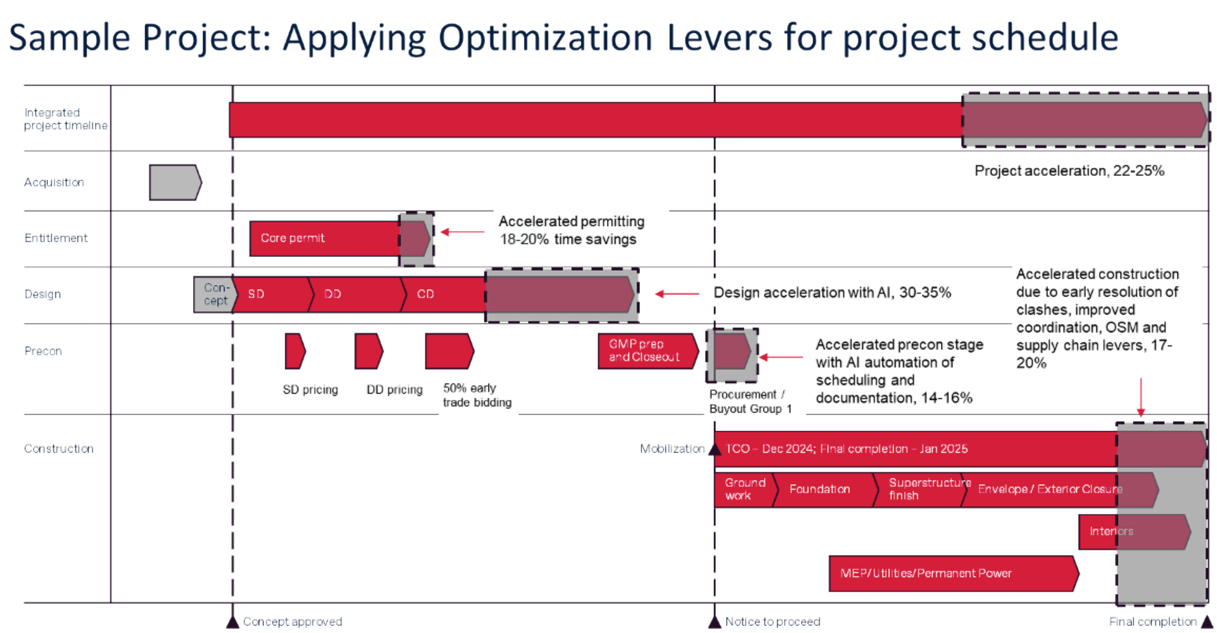


FIGURE 6 | Project Schedule



Across the sample project, AI-enabled value emerges across the full development lifecycle by improving speed, certainty, and coordination. In finance, shorter timelines, reduced execution risk, better procurement visibility, and more predictable schedules can lower capital exposure, financing costs, contingency requirements, and delayed revenue risk, although offsite manufacturing may require earlier cash commitments for design freeze, deposits, and production slots. In entitlement, AI-supported code analysis, jurisdictional mapping, automated documentation, and BIM-based compliance can make approvals more collaborative and iterative, helping teams resolve issues before formal submission while allowing regulators to focus on judgment-heavy decisions. In design, engineering, and preconstruction, AI agents can generate and test options against cost, schedule, code, constructability, and coordination requirements, producing earlier budgets, baseline schedules, and more buildable design packages with fewer downstream RFIs, change orders, and rework. During construction, the largest execution-stage value comes from reducing friction in the field through schedule optimization, real-time progress tracking, supply chain visibility, and labor coordination, enabling crews and subcontractors to work with less waiting time, fewer conflicts, and greater productivity.

Taken together, the budget and schedule exhibits show an opportunity to achieve a 17–20 percent improvement in project cost, and 22–25 percent improvement in project duration, including AI implementation, improved coordination in the industry, and new business models. In the sample project, those improvements translate into a meaningful developer return impact: illustrative unlevered IRR increases by approximately 5–6 percentage points, for example from 15–20 percent to 20–25 percent, while yield on cost increases by approximately 1–2 percentage points, for example from 6–7 percent to 7–9 percent. For many projects, that level of improvement can be the difference between a project that does not meet investment thresholds and one that is financially feasible to build.

This change requires improving the project delivery system. That means aligning owners, designers, general contractors, subcontractors, suppliers, manufacturers, regulators, and technology providers around shared data, earlier decision-making, clearer project constraints, and more reliable execution plans.

This opportunity should be understood as a productivity opportunity rather than a simple fee reduction. In a more intelligent delivery model, the total price per square foot may decrease, while project participants can still benefit through higher throughput, lower rework, reduced risk, and the ability to deliver more work with the same organizational capacity. The commercial objective is not to transfer value away from one participant to another, but to reduce waste across the system and share the resulting value among the participants who contribute to the improvement.

06 Call to Action

This white paper serves as a call to the industry. The transformation described in this roadmap can only succeed with the collective buy-in from the construction ecosystem of industry stakeholders, institutions, and regulators.

The transformation requires industry stakeholders to commit to an AI-enabled flow of data (in a structured manner) and intelligent automation across the value chain to fundamentally increase productivity, supported by a commitment to investing in and adopting AI tools, contracting differently to enable the interconnectivity benefit, and thoughtful incentivization of different players in the value chain.

While advancing AI-enabled construction, the industry must also acknowledge the inherent risks that accompany its use in a critical, high hazard environment. AI outputs may be incomplete, inaccurate, or based on unreliable project data; they can expose proprietary design, commercial, and site information; and they can blur accountability in decisions. These risks require secure data practices, transparent and auditable use of AI, and accountable professional judgment at every stage of project delivery.

Additional research could also be embarked upon to generate more evidence and perpetuate industry momentum in AI adoption. This research requires data that only practitioners hold, a willingness to share that information in structured ways, and a commitment to implementing AI tools with the rigor needed to generate the evidence base the industry requires. Organizations interested in contributing data or participating should contact the report authors.

OWNERS & DEVELOPERS

- Mandate AI readiness in contractor pre-qualification, not as a compliance exercise but as a genuine assessment of capability and data infrastructure.
- Fund AI adoption pilots with outcome measurement built into the project brief from day one, so that evidence of impact is systematically generated.
- Commit to sharing project AI implementation case studies and project outcome data including cost, schedule, and quality metrics on a consistent and structured basis regardless of financial performance.
- Engage with the MIT research team as advisory panel members to ensure the research agenda reflects owner priorities and real-world constraints.

DESIGNERS, ARCHITECTS & ENGINEERS

- Deliver open, machine-readable design information including BIM model, using appropriate open standards alongside native design files.
- While leveraging AI for improvement of the delivery, ensure accountable professional review of AI outputs.
- Design for manufacture and assembly, leveraging repeatable assemblies, practical tolerances, and fabrication-ready information that support prefabrication.
- Bring contractors and trade partners into design decisions early enough to test constructability and understand initial cost of the construction, and time required.
- Create a verified feedback loop, incorporating as-built, commissioning, and project-performance findings into design standards and libraries.

MANUFACTURERS & SUPPLIERS

- Publish standardized, machine-readable product data providing structure properties, classifications, dimensions, performance requirements, and digital product models using consistent industry definitions.
- Work with designers, contractors, and trades to identify standardization, DfMA, prefabrication opportunities.
- Share current supply and commercial constraints for trade partners with availability, manufacturing capacity, regional coverage, lead time.
- Measure and share product outcomes, tracking delivery reliability, substitutions, installation time, defects, rework, commissioning and maintenance performance.

GENERAL CONTRACTORS & SUBCONTRACTORS

- Invest in data infrastructure and data platforms that will make AI tools effective. A project management platform that captures consistent, clean data across every project is the foundation for everything else.
- Designate AI champions within the organization and not only technology officers, but also field leaders who can bridge the gap between AI capability and site-level practice.
- Contribute project-level data to the MIT research dataset. The firms that contribute most will benefit most from the benchmarks, playbooks, and comparative analysis the research will produce.

TECHNOLOGY PROVIDERS

- Commit to interoperability. The interconnectivity gains are only realizable if AI tools across domains can exchange data without manual intervention. Open APIs and shared data standards are preconditions for industry-level transformation.
- Invest in tools for smaller contractors and sub-contractors, not just tier-one GCs. The productivity gains available in the long tail of the industry are large but only accessible with tools designed for firms without dedicated technology teams.
- Share AI outcome data from your client base in anonymized, aggregated forms, with the MIT research program. This is the fastest path to independent validation that will accelerate adoption of your tools.

REGULATORS & PUBLIC AUTHORITIES

- Invest in digitizing permit requirements and building codes to a level of quantitative precision that enables automated compliance checking. This is a public good that benefits owners, contractors, and municipalities alike.
- Pilot BIM-based permit submission and automated review in partnership with willing jurisdictions.
- Engage with the research program to contribute permitting outcome data, enabling analysis of AI's impact on approval timelines across jurisdictions.

ACADEMIC & RESEARCH INSTITUTIONS

- Join the MIT research advisory panel and contribute to the survey design, analytical framework, and peer review process.
- Contribute institutional datasets including historical project records, labor market data, and technology adoption surveys that can enrich the research database.
- Publish findings that challenge as well as support AI adoption, so that the industry receives honest evidence rather than technology advocacy.

Appendix

Methodology & Data Requirements

This whitepaper is a methodology statement, not a definitive causal analysis. The directional findings and benchmarks are based on three initial evidence sources: a structured industry roundtable held on March 11, 2026; a preliminary literature review; survey results and qualitative input from senior executives across the construction, development, and technology sectors. The literature review catalogued 178 unique sources, including case studies and peer-reviewed scholarly papers, and the findings were informed by pilot and technology-implementation experience shared by participating companies. The illustrative financial model was applied to a multifamily residential design-build project as an example. The approach is transferable to other design-bid-build and design-build projects, subject to project-specific conditions and further validation.

These sources are useful, but they are not yet sufficient to support statistically significant, causal conclusions about AI adoption at scale. The full research program will require:

- **Structured project-level datasets** covering cost, schedule, labor, procurement, and permitting outcomes across a minimum of several hundred projects, spanning diverse geographies, project types, and delivery methods.
- **Controlled or quasi-controlled comparisons** between AI-assisted and conventionally managed projects, controlling for project complexity, geography, delivery method, and owner type.
- **Longitudinal tracking** of AI adoption journeys at willing firms, capturing both productivity gains and the transition costs that precede them.
- **Domain-specific data partnerships** with permitting authorities, labor unions, material suppliers, and insurance providers.
- **Interconnectivity data** that captures the degree to which gains in one domain create downstream efficiencies in others, and the system-level conditions under which that integration occurs.
- **Expert interview**s with leading researchers and industry practitioners focused on quantitative estimates of time and cost savings, specific implementation tactics, barriers to adoption, and the roles best positioned to drive technology uptake.

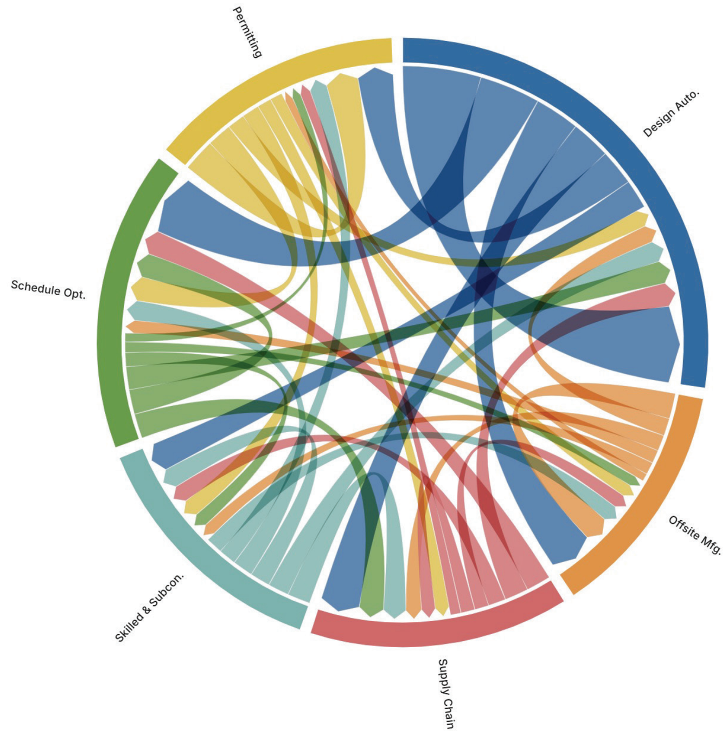
The MIT research team is actively designing the data collection instruments and industry engagement framework. Firms and institutions that wish to contribute project data, participate in structured surveys, or join the research advisory panel are invited to register their interest through the MIT Center for Real Estate.

Levers Interconnectivity

The project analyzed lever interconnectivity using an adjacency matrix and network diagram built from 123 directed causal claims: 94 structured claims from 18 expert interviews and survey responses, plus 29 claims identified through keyword analysis of multi-lever comments in the roundtable corpus. Each claim records a directional dependency between two of the six AI levers, showing which lever enables, precedes, or amplifies another. Edge weights represent raw claim counts, and network edge thickness scales proportionally.

The adjacency matrix shows broad consensus that Schedule Optimization is the lever most likely to be transformed by AI. It receives the highest cross-group Borda score (163 points excluding self-votes), with every expertise group rating it relatively highly. Design Automation also scores well, though its result is partly driven by a large number of self-votes (89 of 206 total). Most groups show some self-selection bias, rating their own lever near the top. The exception is the Skilled Labor & Subcontracting group, whose scores are nearly flat across all levers (19-26), suggesting participants see AI impact as systemic rather than concentrated in one domain.

Detailed Levers Description



The roundtable participants, drawing on collective experience across hundreds of billions of dollars in construction value, converged on six lever domains where AI has the greatest near-term potential to create measurable value. Each lever domain is defined, its AI application explained, and the research questions that require larger datasets to answer are set out below.

Design Automation

Generative AI and machine learning tools enable architects, engineers, and contractors to explore thousands of design options in the time it previously took to develop one. These tools evaluate options against multiple objectives including cost, energy performance, structural efficiency, schedule, and aesthetics simultaneously.

Looking ahead, MIT and Suffolk identified five high-value AI capabilities for the Design Automation lever once the required data foundation is in place:

- Target value design — real time cost/time feedback during the design phase
- Generative / augmented design and engineering
- Early clash detection to reduce rework and contingency
- Design for manufacturing and assembly to optimize prefab/robotic construction
- Predictive total cost of ownership considering operating, maintenance, and energy cost

TARGET VALUE DESIGN

Target value design allows teams to use AI to optimize design, cost, and schedule together in real time, giving architects, engineers, and contractors the ability to test multiple buildable options before the project gets locked.

Rather than designing first and pricing later, the goal is to make cost and delivery consequences visible while the design is still evolving. In the interviews, target value design is identified as one of the most important Design Automation capabilities, because cost modelling during design remains a major blind spot and teams are often surprised by what is actually driving cost at key reviews.

Directionally, the design automation use cases reviewed in this work suggest the potential for major gains, including up to 10 percent total project cost savings through structural design optimization. Full implementation, however, requires a mature stack of connected AI capabilities: rapid quantity takeoff, near real-time budget and schedule estimating, technical value review, clash detection, and BIM-based option testing that can happen in hours or days rather than weeks.[4]

4 The 10 percent assumption is applied to total project cost in the integrated model. Literature reviewed for this white paper reports potential savings of up to 21 percent within the design and engineering scope; that phase-specific finding is not applied to the full project cost base.

GENERATIVE / AUGMENTED DESIGN AND ENGINEERING

AI tools are shifting from reactive to proactive, allowing for additional recommendations before the design begins instead of validating after the fact. AI-driven BIM creates dynamic digital twins that update in real time as site conditions change. As Professor Christoph Reinhart, MIT School of Architecture and Planning, stated "The autogeneration of complete BIM files is where I see the most potential. For the last decades, BIM hasn't lived up to its full potential because the files are not properly being built." With the autogeneration of complete BIM files, valuable AI capabilities will be unlocked.

Several AI platforms like Autodesk's Project Discover or Consigli AS could be a solution, which demonstrated generative design at scale, creating thousands of viable floor-plan configurations for a 60,000 square foot office project by processing employee preferences and adjacency requirements. AI-integrated BIM environments now allow clash detection and construction sequencing to occur simultaneously with design, compressing what was historically a sequential process into a parallel one. The Deloitte-cited estimate that AI-assisted estimating can reduce budget and timeline deviations by 10–20 percent and cut engineering hours by 10–30 percent represents a meaningful productivity baseline. Achieving these gains in practice requires a precondition that the industry has not yet met. Clean, centralized and structured training data is required for generative design and value engineering. Generative design tools can only optimize against what they can measure, and much of what drives cost and schedule in construction sits in fragmented project records.

As John Ochsendorf, Professor at MIT School of Architect and Planning, pointed out: "You can't reduce what you don't know. Material quantities, structural systems, and installation times aren't captured in existing datasets. Data centralization before training is the prerequisite."

Data management is the critical path for the Design Automation lever. Until this bottleneck is addressed, AI and automation in design will be limited by data quality rather than technological capabilities.

EARLY CLASH DETECTION

Early clash detection allows teams to use AI to review drawings, models, and specifications before coordination problems become RFIs, change orders, or field rework. The goal is to identify inconsistencies early across architectural, structural, and MEP systems, when they can still be resolved quickly and at lower cost. The use cases reviewed in this work suggest that AI-driven validation with tools such as LightTable and BuildCheck can reduce RFIs and change orders while compressing review cycles to days.

Another critical area is shop drawing review and digital coordination, both of which are important for smooth project delivery.

DESIGN FOR MANUFACTURING AND ASSEMBLY TO OPTIMIZE PREFAB/ROBOTIC CONSTRUCTION

Design for manufacturing (DfM) allows teams to use AI to design buildings in ways that are easier to fabricate, transport, and install, so that prefab and robotics become part of the design logic from the beginning rather than an afterthought during construction. Rather than designing for a conventional field-built process and then trying to adapt the design later, the goal is to embed manufacturing constraints, tolerances, sequencing, and installation logic while the design is still evolving.

In practice, this means moving from bespoke detailing toward repeatable systems, shared digital templates, and standardized assemblies that can be produced with much greater certainty. Goldbeck Germany is a strong example of this model: its product-based approach relies on a standardized base offering, and internal case references describe the company as achieving roughly 20 percent cost efficiency versus competitors, primarily in garages, making it a credible benchmark for standardized, offsite delivery. On the software side, platforms such as Autodesk and MOD are beginning to support this transition to DfM by identifying prefab opportunities directly from architectural designs and helping organize the supply chain around them. The most promising use cases are not only full modular rooms, but also repeatable elements such as MEP rooms, utility pods, corridor racks, and assemblies of components that can be manufactured as an assembly-style process.

The full implementation of the lever requires high level of collaboration between manufacturers, trades, GC, and architects – using kit-of-parts rules, integrated logistics planning, early creation of fabrication-ready BIM models.

PREDICTIVE TOTAL COST OF OWNERSHIP CONSIDERING OPERATING, MAINTENANCE, AND ENERGY COST

As the industry transitions from 3D BIM models to 4D models with schedule and 5D models with cost and schedule, 6D BIM is the next stop - building models that incorporate operating, maintenance, and energy cost across the full asset lifecycle. AI enables teams to evaluate design options not only for initial cost, schedule, and constructability, but for their long-term impact on maintenance burden, replacement cycles, energy use, and overall building performance.

This shifts the optimization problem from minimizing upfront capital expenditure to minimizing total cost of ownership, which is often the more important metric for owners and long-term investors.

Offsite Manufacturing

Offsite manufacturing, including prefabrication, is not a new concept. The Roman legions assembled fortified camps (Castra) using standardized, modular components to assemble fortifications quickly after transport. Another documented design was by Leonardo Da Vinci in Romorantin, France where he proposed that timber houses be built in pieces in open spaces and then assembled at the site of their permanent installation.

Today, factory-controlled prefabrication and modular construction, optimized by design automation, AI-driven production scheduling and robotic assembly, can compress project timelines while improving quality consistency. AI enables just-in-time material flow, automated quality inspection, and real-time coordination between factory production and on-site installation.

For cost savings, the economic logic is finding arbitrage between labor and shipping costs. As Vaughan Buckley, Founder and CEO of Volumetric Building Companies (VBC), a vertically integrated modular manufacturer, framed it "Offsite manufacturing is arbitrage between the efficiency of the labor in the factory that you're performing and the cost of the labor on the site, minus the transport." Buckley's framing, validated across markets, was that schedule gains are reliably achievable. He reported that his company achieved up to 47 percent schedule savings across geographies, while cost savings remain market-dependent, driven by union structure, field labor cost, and logistics distance.

The modular construction model faces a structural challenge: in most implementations, approximately 75 percent of costs are incurred in the field, with only 25 percent in the factory. Achieving the cost benefits of offsite manufacturing requires inverting that ratio which demands AI-enabled coordination across design, manufacturing, logistics, and on-site installation. AI systems capable of optimizing across all four dimensions simultaneously represent a frontier application that is only beginning to be deployed at scale. This high-variance aspect of OSM makes it distinct amongst the other levers as it is not a universal cost saver, but is a conditional one based on the specific project and market conditions.

MIT and Suffolk, through discussions with practitioners and leading academics, identified five of the most valuable AI capabilities for the Offsite Manufacturing lever:

- **Component standardization** — economies of scale through cross-project repeatability
- **Geographic wage & skill optimization** — factory labor in lower-cost locations
- **Design for manufacture and assembly** — designing with prefabrication intent
- **Modular construction** — full rooms manufactured offsite, installed onsite
- **Robotic fabrication** — human-robot collaborative or automated production

During the roundtable survey and expert interviews, experts were asked to rank the Offsite Manufacturing AI capabilities from most to least useful. Component standardization and geographic wage & skill optimization resulted in the two highest ranked capabilities. This is consistent with the arbitrage logic, that through economies of scale and geographic wage optimization, labor costs will decrease at a rate faster than shipping costs increase. Design for manufacturing and assembly ranked third in usefulness and depends on Design Automation as a prerequisite. The key takeaway for this dynamic is that specific constraints, such as a kit of rules and a kit of parts must be put in place early in the design phase in order for offsite manufacturing to be successful.

COMPONENT STANDARDIZATION

This capability allows teams to drive economies of scale by producing factory-built components that can be customized and used across multiple projects, reducing the per-unit cost through economies of scale. The goal is to establish a catalog of components (MEP, structural, architectural etc.) that can be manufactured and delivered with consistency, rather than designing and manufacturing each component from scratch for each project.

The economic gain would not be realized from a single project, but from a compounding effect through higher volume and repeatability across multiple projects. For example, McCusker-Gill, a full-service HVAC sheet metal contractor based in Hingham, Massachusetts, has achieved economies of scale through automation of ingesting CAD files, then processing them in Stratus (a cloud-based software platform) enabling design-build automation. Stratus takes high-detail BIM data from CAD files and converts it into work packages for the shop floor, connecting directly to shop equipment and sending cut list and assembly instructions without the need for manual entry. This supports the workflow of large components of HVAC systems that can be assembled offsite then shipped to the build site.

As Larry Sass, Professor of Architecture and Director of the Computation Group in the Department of Architecture at MIT, articulated the long-term vision of component standardization, "This would be the death of distance. If you could exchange CAD files for manufacturing [data] you could have micro-manufacturing everywhere — each trade with their own small facility delivering to the job site. Assembly-only construction sites."

That vision requires a component library to ensure that any fabricator working from the same CAD specifications could produce parts that are interchangeable with other fabricators supplying the same project.

This process is dependent on the "design for manufacture and assembly" AI capability, so that CAD files can be designed in a way that allows for standardization. VBC illustrates one path toward this state. Buckley described VBC's transition from a traditional engineer-to-order model to a configure-to-order approach where a fixed base platform with a set module width and structural span is combined with flexibility on the end wall, where balconies, and façades can be customized without disturbing factory tooling.

GEOGRAPHIC WAGE & SKILL OPTIMIZATION

This capability enables owners and general contractors to access manufacturing labor in locations where wages are lower and skilled factory workers are more available. This allows for two benefits:

1. shifting from high-cost labor markets to regions where costs are lower and
2. allowing for complex construction projects where skilled labor resources are limited or non-existing.

Where union rules apply in both the manufacturing location and the project site, the economic case must be made on quality, schedule, or both rather than labor cost alone.

Sławomir Tadeja, a Postdoctoral Researcher at MIT, identified a structural demographic driver of this capability: a large portion of the current manufacturing workforce is approaching retirement age[5], with an insufficient pipeline of younger workers entering the trades. A recent McKinsey article highlighted that the proportion of US manufacturing employees over the age of 55 has more than doubled in the past 20 years, increasing from about 10 percent in 1995 to

5 Brooke Weddle, Nick Mellors, Alina Malinauskaite, Andy Voelker, and Sean Cassady, *"Investing in the manufacturing workforce to accelerate productivity"*

about 26 percent in 2025. Tadeja identified that "Manufacturing/construction workers, unlike IT workers, are geographically anchored — most are concentrated in specific regions and are not willing to relocate for work."

The implication is that production may need to move to where workers are, rather than the reverse, accelerating geographic arbitrage as a potential strategy. Full implementation of geographic optimization requires logistics modeling, transport cost calculation, and long-term supply chain relationships that can reliably and affordably ship assembled structures for this model.

MODULAR CONSTRUCTION

Fabrication techniques span a wide range from full build-on-site through to multi-trade volumetric modularization off-site. The more complex types of modular construction like multi-trade and full volumetric buildings typically require higher levels of upfront investment in areas such as planning, purchasing, engineering, and warehousing.

A useful example of the gradient logic is multi-trade corridor work. When built on-site, rack systems need to accommodate multiple trade products such as HVAC ductwork, plumbing, electrical wiring, and fire protection into single overhead assemblies. This could create a coordination problem where each trade needs access to the same overhead space, in the same time window, with conflicting routing requirements.
A solution to this is multi-trade fabrication and multi-trade modularization. When the project design calls for a pre-engineered multi-trade rack to be built in a factory, the coordination problem can be solved by trades working with a shared digital model rather than coordinating routing in real time on site.

The benefits of multi-trade modularization also include schedule compression through simultaneous delivery. In a hospital project, for example, an HVAC subcontractor can be installing ductwork in one finished volumetric module while electricians install low-voltage cable in another, while the site team is still pouring slabs into new modules. This converts a sequential field workflow into a parallel multi-station factory workflow.

ROBOTIC FABRICATION

Robotic fabrication positions AI-driven robotics as the next logical step for high-volume, high-repetition, and/or high-risk construction tasks. For example, repeatable rebar assembly would be a prime application, while human workers focus on judgment-intensive tasks that robotics cannot yet perform reliably.

This capability is placed in the OSM lever rather than treated as a standalone construction technology because currently robotic fabrication performs best in controlled environments. Factory floors, dedicated prefab facilities, and protection from the environmental elements provide the consistency, and controlled conditions that current robotic systems require.

Open construction sites with their weather variability, potentially confined spaces and dense human traffic do not. The controlled environment requirement is why the development of robotic fabrication must start in a factory.

After the academic literature review of over 30 peer reviewed papers, roundtable discussions, and expert surveys, interesting findings emerged for this capability. While aggregated evidence from academic literature was most optimistic about the time savings for this lever out of all the OSM levers, the voice of industry was more skeptical, ranking it last amongst the OSM sublevers. This gap reflects the difference between performance measured under controlled conditions and the effort required to implement robotics in a real project. The academic studies, such as robotic assembly of a timber pavilion in a dedicated fabrication setting, measure performance under the conditions robotics requires. Industry practitioners, who foresee the cost of creating those controlled conditions on chaotic production sites, are pricing in what the literature controls out.

The gap between literature optimism and industry skepticism likely can be traced back to three implementation barriers that the surveys raise:

1. **BIM-to-robot translation.** Yijiang Huang, incoming Assistant Professor at the National University of Singapore, identified the binding constraint as *"BIM models today are not formatted for direct robot execution... For maintenance and development, you need professionals to connect and code what you want to achieve. It's a translation of domain knowledge. You talk to a robotics expert, but they may not know about the construction domain and the parts that are needed."*

   The research has proven that the concept is technically possible, but no contractor can yet plug into it without significant custom integration work. Quite simply, roboticists need more construction-domain knowledge to apply their systems to real project conditions, while architects and civil engineers need more robotics knowledge to design in ways that translate to fabrication robotics.

2. **Hardware capex**. "*Hardware investment is a high barrier*," Huang observed. "*Of course, there's companies that do robot as a service, but we still have to convince the owner of the factory that investing this actually has enough ROI in a short term — which is very hard to calculate at this moment.*"

3. **Project variation**. "*Even in infrastructure such as tunnels and bridges, there's geometric variation of these pipes. With this variation, we still cannot achieve a fully automated pipeline to assemble them, because the automation pipeline that we have right now... just cannot adapt.*"

Each of these is a barrier with operational friction that controlled-environment academic projects, by design, control out. The literature, in short, is not wrong but it is reporting performance under conditions that exclude the friction that chaotic production sites introduce. Industry's lower ranking of robotic fabrication reflects what gets added back when those conditions are relaxed.

Robotic fabrication and human-robot collaborative assembly potentially carry the greatest long-term impact on time and labor cost savings out of any OSM capability, especially as the labor workforce volume and productivity decline.

The structural barrier is initial capital expenditure, which is significantly higher than for the other capabilities because a controlled studio needs to be developed.

The case studies that have crossed from theory to fabrication have done so by building controlled environments, not by deploying into live build sites. Capability is, however, advancing in specific construction methods. McCusker-Gill, the Boston-based HVAC sheet metal contractor, illustrates factory development through fifteen years of sustained investment. Kevin Gill Jr, CEO of McCusker-Gill described the operational result as "We're making 70 percent of our connections off site... 15 different connections that will cap with plastic, put on a mobile cart, deliver to the job site, so that the workers go into the room once, hoist that up, walk away." On the academic frontier, ETH Zürich's robotic fabrication research, including the distributed robotic clamps system for integral timber joints developed by Leung, demonstrates that complex, non-repetitive structures are buildable when the kit-of-rules described in the DfMA section extends to the robot-executable instruction level.

The dependency on Design Automation is the foundation as full-scale robotic fabrication requires BIM models to carry not only geometric data but also robotic path planning, material handling sequencing, and assembly instructions — all encoded at the design stage rather than re-programmed at the factory.

The robotic fabrication chapter therefore closes the same way the DfMA chapter opened: with the kit of parts and the kit of rules, extended one layer deeper into the production pipeline to the fabrication process. Nearer-term robotics opportunities are likely to cluster around repetitive, quality-sensitive, or labor-constrained tasks such as layout, drywall finishing, painting, scanning, cleaning, floor preparation, material movement, and prefab installation support.

Permitting

The permitting bottleneck in US construction is a political problem that technology can help navigate. The United States contains more than 20,000 independent permitting jurisdictions, each with its own zoning codes, review processes, and approval timelines.

There is no national standard governing how local permitting jurisdictions communicate, submit, or share data — what GAAP does for standardizing financial reporting, construction permitting has no equivalent across agencies. Boston alone divides its 48 square miles into 429 separate zoning districts, governed by a code of nearly 3,800 pages that has not been fundamentally revised since 1964.

Forty-two percent of Boston parcels are nonconforming under current lot-size requirements, meaning most projects require variance approval before a single permit is filed. Within any single jurisdiction, a large project routinely touches transportation, water and sewer, historic preservation, environmental review, and building code compliance simultaneously — each agency operating its own submission requirements, its own reviewers, and its own clock. This unpredictability makes reliable development planning impossible.

The result is that permitting timelines for comparable project types in Boston have ranged from weeks to years, as one roundtable participant described as taking sometimes 90 days, sometimes 1,400 days. That unpredictability more costly than the slow timeline itself; a process that unpredictably varies from three months to four years destroys the ability to underwrite a project at all.

Chris Gordon, President of Development at Wynn Resorts, framed this as *"I'd much rather get a fast 'no' than a two-year 'yes'."*

AI platforms that automate building code compliance review, permit application preparation, and inspection scheduling can dramatically reduce the time and cost of project approval. Natural language processing tools parse complex, jurisdiction-specific building codes; BIM-integrated compliance engines provide real-time feedback during design development.

PermitFlow, has built a database of approximately 15 million permitting data points across US jurisdictions. Its AI agents navigate municipal websites, extract requirements, prepare applications, and coordinate inspections.

The Multi-AR system in Canada demonstrated that BIM-driven automated permit review could compress years of approval time into minutes for projects where regulatory requirements are sufficiently quantified.

From the Roundtable survey and expert interviews, the Permitting lever ranks third most valuable lever among the six levers studied. However, when only looking at the cross-group pattern (each expert's votes for their own primary lever are excluded), Permitting drops to the least valuable lever.
This means that the Permitting expert group has unusually strong self-advocacy — practitioners who work in permitting understand its issues and believe AI can address them.

The wider group of practitioners working within permitting constraints rather than on them, see this political bottleneck as a cost rather than a solvable problem. This raw-versus-cross-only gap is the largest gap of any lever in the study. It surfaces a challenge where the people closest to the permitting problem believe most in AI's potential to address it while the people outside it are the most skeptical.

MIT and Suffolk, through discussions with practitioners and leading academics, identified four of the most valuable AI capabilities for the Permitting lever:

- **Preapproved Design Standards** — streamlined permitting through standardized, pre-vetted designs
- **AI Code Compliance** — automated plan review and compliance verification
- **Digital Permit Management** — electronic submission, automated RFI retrieval
- **Predictive Timeline Modeling** — forecasting permit durations, identifying risk

PREAPPROVED DESIGN STANDARDS

Preapproved Design Standards allows teams to use AI to match proposed designs against a library of pre-vetted, code-compliant templates which serve as a kit of rules during the design process. This reduces permitting from a review of each unique project to a conformance check against the kit of rules, with the goal of eliminating individual project reviews which can take much time to complete.

Building codes already use streamlined processes to a degree, such as preapproved structural systems to reduce the review burden. What AI adds is the capacity to automatically generate preapproved design templates at a scale that manual standards-setting cannot match.

With AI, the amount of materials and configurations pre-approved will increase significantly. The most instructive case study emerged not from an AI deployment but from a disaster reconstruction program — one that demonstrates what preapproved design standards can achieve manually which AI is positioned to scale.

Following the January 2025 fires in Pacific Palisades and Altadena which destroyed more than 13,000 structures, Autodesk partnered with The Foothill Catalog Foundation, a nonprofit offering low-cost, custom-designed plans to fire survivors. With $1M of state funding, they built a database of pre-approved residential designs tailored to the architectural style of each affected neighborhood. Because designs are pre-approved before any application is filed, the Foundation states that "permits can be issued in as few as 15 days" at a flat-rate licensing fee of $5 per square foot, compared to $50,000–$120,000 for a custom architect. By late 2025, rebuilding permits across the region were being issued "nearly three times the speed prior to the fires," with permits approved "in less than 90 days" on average. The LA reconstruction case demonstrates how the permitting timeline drastically shortens when urgency overcomes the political red tape.

Russ Wilcox, Founder and CEO of ArtifexAI, framed the policy logic of scaling that approach, "The biggest lever is pre-approval of building typologies at the state level. If Massachusetts said these ten building designs are pre-approved for these zone types, you'd eliminate a huge chunk of discretionary review. Los Angeles did this after the fires and cut timelines dramatically."

The key is consolidation where instead of each project finding a path through city-specific requirements, having a state-approved library to set a standard once and allow project teams to match it. The prerequisite of getting states to adopt and maintain such libraries is nontrivial but the LA case demonstrates that pre-approval is achievable at scale.

Yasushi Sakai, Research Scientist at the MIT Media Lab, described a precursor to state-level preapproval systems: a parametric design engine capable of generating code-compliant designs automatically, producing outputs that are aligned with applicable codes from the start rather than requiring verification later.

The design engine is not a preapproved library, but it illustrates the upstream opportunity of AI tools that generating code-compliant designs from constraints and creating a pre-approved design library.

Thus, the Preapproved Design Standards capability is dependent on the Design Automation lever. Preapproved templates can only automatically populate if the design process produces clean, structured BIM output that can be cross-referenced against the building codes.

A parametric design engine like the kind Yasushi describes requires AI-complete BIM models as an input. Without structured design data aligned with the building codes in a structured format, no preapprovals can be triggered automatically. Design Automation is the upstream dependency, and until BIM output is sufficiently structured and standardized, the preapproval library operates as a policy tool rather than an automated workflow.

AI CODE COMPLIANCE

This capability is bi-directional. Supporting developers and designers, AI Code Compliance allows teams to use AI to review designs against specific codes before submission to surface conflicts, eliminate the most common causes of application rejection.

On the regulatory side, AI Code Compliance helps regulators analyze existing codes against contemporary safety technology to identify where rules are outdated or unnecessarily restrictive.

DEVELOPER SUPPORT

The developer and designer application allows AI to read BIM models and map it against applicable codes to return a compliance report before the application is even filed. This can save months of project schedule by removing lag time between the application submission and a surprise permitting denial. There are at least two examples of U.S. deployments illustrating this capability at scale: CivCheck and California's eCheck.

- **CivCheck** guides applicants through every code check before submission, and flags missing documents and compliance issues ahead of a formal submission. Honolulu deployed CivCheck in December 2025 after years of permit backlogs and the city's Department of Planning and Permitting described the tool as reducing review cycles by cutting back-and-forth with applicants before submission. This does not approve or reject permits directly, but it reduces the back-and-forth that historically extended timelines by months.
- **California eCheck** was developed by Archistar and uses computer vision, machine learning, and automated rulesets to instantly check designs against local codes. Governor Newsom launched eCheck free of charge to LA City and County in April 2025 to accelerate fire reconstruction permit approvals, and subsequently procured it for statewide use. Austin, Texas has separately adopted it as a pre-check for single-family home permits.

Singapore's Building and Construction Authority has operated CORENET, a national automated code compliance system, since the early 2000s which requires BIM-based electronic submissions and automating compliance checks against Singapore's building regulations at the point of submission. Its newer platform, CORENET X, soft-launched in December 2023 uses machine intelligence and algorithms to detect compliance issues automatically across BIM models before formal agency review. By October 2027, CORENET X will be mandatory for all ongoing projects in Singapore, making automated code compliance a legal requirement for the entire construction sector.

REGULATOR SUPPORT

The regulator-side application uses AI to review existing codes against contemporary safety data to surface where restrictions are no longer justified by their stated safety rationale due to modern building technology making buildings more safe.

Single-egress reform is an excellent example of AI-supported code modernization. Boston's zoning code, fundamentally unchanged since 1964, illustrates the cost of codes that have not been modernized. The triple deckers, one of Boston's defining building types, were built mainly before the 1964 code and are now largely illegal to replicate under current zoning requirements.

Single-egress reform would unlock new possibilities for missing-middle housing stock.

Dual-egress requirements force larger floor plates, thereby blocking the narrower buildings from being constructed.

A February 2025 study by the Center for Building in North America, found that single-stairway buildings of four to six stories with sprinklers present no higher fire safety risk than dual-stairway construction, undermining the safety justification that has kept these typologies illegal for six decades.

An October 2024 analysis by the Harvard Joint Center for Housing Studies, identified 4,955 underdeveloped parcels within transit distance across Greater Boston that could conceivably accommodate more than 130,000 new housing units under single-stair construction.

Single-egress is one instance of a broader pattern. The building code contains restrictions whose safety justifications have not been revisited since adoption.

As Kevin Crossley, Deputy Director of Planning at the City of Boston Planning Department put it directly: "People know what to change. It's not like there's a shortage of ideas. There's a shortage of the democratic process." The barrier is political, not informational. But identifying which code provisions are candidates for reform by testing whether their original safety rationale is the kind of analytical work that regulators do not have the bandwidth to perform manually. Crossley illustrated the gap: air quality impact standards written around car exhaust remain on the books even though emissions technology has dramatically improved.

“The city shouldn’t, doesn’t need to be reviewing that anymore… we kind of know that, but we don’t do it.” The analysis that took years of advocacy to assemble in the single-egress could be structured as an automated code audit: identify the restriction, test the safety claim against current data, flag other jurisdiction updates and generate a reform plan.

AI-assisted code review gives regulators a mechanism to surface those candidates proactively before advocacy coalitions have to do it for them.

While AI Code Compliance can accelerate the process, it maybe not enough to support faster permitting. One of the experts noted “Technology can get us faster, but then you’re going to have to deal with the policy decisions that come with it. Everyone knows what to change. It’s a political process, not a knowledge problem.”

DIGITAL PERMIT MANAGEMENT

A large development project can involve the Planning Department, the Inspections Department, Transportation, Public Works, Water and Sewer, and Historic Preservation simultaneously. Each agency runs their own review track, and often not sharing a common system that tracks who is working and who is waiting.

With dozens of parties exchanging complex design documents across workflows, version control can fail and the question of whose turn it is to act next becomes genuinely unanswerable. The problem is the absence of a shared system of record.

Crossley, described the consequence of years managing it: “ We just don’t meet our required timelines. The process and review became so fractured that… when you tried to zoom out a level and say, is the city like on the clock or not, you couldn’t even say.”

Digital Permit Management allows teams to use AI to centralize permit tracking, submission, and agency coordination across all parties — replacing fragmented parallel communication with a shared system of record that makes clear, at any moment, which party holds the next action.

Roundtable participants from Session 1 identified three structural components of permitting.

- The first is pre-development research such as historically, design, environmental review, and zoning which can happen sequentially. Today, practitioners run everything in parallel from day one.
- The second is internal operations automation such as document preparation, submission, and compliance checking. Roundtable participants identified this as the biggest lever for speed within an agency’s control.
- The third is external review and agency response, which has the highest variance and is by definition least controllable by private practitioners. James McWalter, Co-Founder and CEO of Paces, framed the strategic implication directly: “if you can automate everything that the computer and a phone is doing, then you leave a lot of resources for the actual PR and the person who knows the mayor.” AI handles the deterministic layer; human relationships handle the discretionary one.

Andreas Rotenberg, Co-Founder & COO of Pulley, a permitting technology company, described the approach of his digital permit management tool: focus on the second half of the permitting process, where the work is more rules-based; capture undocumented standards into structured systems before submission; and identify ambiguities early enough to escalate to the authority having jurisdiction before they create downstream delays.

The principle is that a significant portion of permitting delay is caused by the mechanical failure to know what is expected, when it is expected, and which party is responsible. AI-powered permit management addresses that failure by automating document routing, version control, and agency status tracking.

Roundtable participants noted that public officials reviewing permits face no mandatory deadlines in most US jurisdictions. AI-powered permit tracking creates the data infrastructure that makes accountability enforcement possible: logged response times, reviewer change records, and delay across agencies give project teams evidence to identify where the system is failing and who is responsible. ArtifexAI illustrates what that intelligence layer looks like in practice by ingesting permits, zoning records, meeting minutes, and inspection records across a municipality, then applying mathematical models to surface patterns no human team could read systematically. This can produce insights such as assessment irregularities, ghost inspections logged without site visits, and community sentiment at public hearings.

Paces, founded by James McWalter who participated in the Roundtable, applies pattern recognition across zoning records, permitting data, and proprietary project outcomes to score townships on current and future permitting risk. It flags moratoriums, maps allowed and forbidden zones, and produces parcel-level reliability scores before a developer enters a jurisdiction.

Its AI agents monitor correspondence with permitting authorities, flag milestone delays, and automatically update timeline and risk scores as new information arrives.

McWalter framed the logic directly at the roundtable: rather than optimizing the process inside a specific permitting office, the goal is systematic intelligence about which permitting offices are worth entering in the first place.

For a developer evaluating hundreds of potential sites, the platform collapses months of manual jurisdiction screening into minutes by identifying whether a jurisdiction is a 90-day process or a 1,400-day one.

PREDICTIVE TIMELINE MODELING

Predictive Timeline Modeling allows teams to use AI to forecast permitting durations by analyzing agency workloads, historical review cycles, and project-specific complexity. This generates a quantified range that developers can incorporate into project underwriting.

Roundtable participants noted that a developer can build a financial model around a six-month permitting timeline if it is reliably six months. The same developer cannot build a viable model around a process that unpredictably ranges from three months to more than a year. Boston's documented range, sometimes 90 days, sometimes 1,400 days, is a predictability problem that prevents rational capital allocation at preconstruction.

The investment implications compound the scheduling impact. Sakai, noted that shortening the permitting timeline carries significant capital efficiency implications when measured against project IRR. RAND Corporation, a nonprofit research organization for the US Armed Forces, published an analysis in April 2025 and found that California's average construction timeline was 22 months longer than Texas's. This report also noted that while holding other factors constant, the timeline reduction would reduce total development costs by around 8% in California.

When predictive tools can accurately forecast where a project falls in the permitting timeline distribution before entitlement begins, developers can model that cost exposure explicitly rather than absorbing it as an unpriced variable.

A reliable predictive permitting timeline is a prerequisite for an accurate construction schedule. When AI can generate a reliable estimate of permitting duration at preconstruction, the project schedule can incorporate buffers rather than optimistic plans that collapse when the process extends beyond expectation.

The Permitting to Schedule Optimization interdependency link is directional: permitting uncertainty is a primary source of schedule risk in the preconstruction phase, and predictive permitting tools are the mechanism through which that uncertainty becomes quantifiable before it becomes consequential.

Scheduling

Machine learning scheduling platforms analyze historical project data to create optimized construction sequences, model what-if scenarios, and resequence work in response to delays. AI-driven 4D BIM enables teams to simulate the full construction sequence before breaking ground.

Of all roundtable participants and expert interviewees, Schedule Optimization is the second most broadly agreed-upon AI lever, after Design Automation. The cross-group finding sharpens that picture as when each expert's ranking of their own primary domain is excluded, Schedule Optimization ranks first.

One explanation is that scheduling tools are among the most mature AI applications available in construction today. Practitioners across disciplines have direct experience with measurable results.

Tools such as ALICE Technologies already automate scenario exploration, testing sequential options and generating schedules that maintain critical path integrity. ALICE Technologies' AI platform has demonstrated the ability to resequence tasks in real time when conditions change, proposing new schedules that maintain critical path integrity.

Applied to large solar farm construction, AI-based planning tools reduced costs by up to 30% through optimized labor and equipment use.

The barrier constraint, however, is that the system is only as good as the data that is fed into it. Fragmented, incomplete or delayed information is the main blocker into expanding Schedule Optimization, not computing power.

In fact, during the roundtable discussion it was mentioned "Schedule optimization is primarily a communication and coordination problem, not a technology problem. Cascading effects from changes are hard to foresee, and getting all parties onto a shared picture remains the core challenge."

Thus, expanding the capabilities of Schedule Optimization is a data coordination task, especially in an industry where data is fragmented and players are not incentivized to share proprietary information amongst one another. Schedule Optimization is therefore not only a calculation engine; it is the integration backbone for project delivery for design, manufacturing / prefab planning, procurement, trades coordination.

MIT and Suffolk, through discussions with practitioners and leading academics, identified four of the most valuable AI capabilities for Schedule Optimization lever:

- Schedule Optimization to Reduce Duration/Cost — rebalancing sequences, crews, constraints
- Automated Schedule & Budget Generation
- Collaborative / Integrated Scheduling — one system for all parties
- Schedule Visualization & Conflict Detection

SCHEDULE OPTIMIZATION TO REDUCE DURATION/COST — REBALANCING SEQUENCES, CREWS, CONSTRAINTS

This capability allows teams to use AI to continuously rebalance sequences, crews, and constraints — evaluating thousands of sequencing alternatives to identify paths that minimize duration or resource cost while respecting the project's full constraint set.

Across the literature review and expert interviews, the savings from this capability are magnified on complex projects in tightly confined build sites, where scheduling interdependencies are dense and the cost of sequencing errors is high.

Aleksey Chuprov, Senior Vice President of Data & IT at Suffolk, noted during the roundtable that AI could deliver 20–25 percent time savings by helping crews work at the right time and place. Labor costs rise when crews are underutilized because materials, access, or predecessor activities are not ready.

That scheduling failure compounds into a labor-productivity problem. Schedule Optimization addresses the issue at the source by aligning resource allocation with realistic activity sequencing.

Realizing the full potential of Schedule Optimization depends on structured, machine-readable design data with detailed material inventories. Chuprov identified the goal as connecting BIM and drawings with scheduling software without spending hundreds of hours on manual linking.

AI tools are advancing for data collection and cleaning, but have not yet automated at the project level. This capability is dependent on the Design Automation prerequisite. Until AI-complete BIM models can be output from the design phase, generative scheduling tools will require higher manual data preparation before optimization can begin.

AUTOMATED SCHEDULE & BUDGET GENERATION

This capability allows teams to use AI to generate integrated construction schedules and budgets by simulating thousands of sequencing and resource scenarios to produce an optimized resourcing plan. The starting point for automated scheduling is a look-ahead work plan.

Patrick Hennessy, Planning & Analytics Executive from Harkins Builders, shared an example on what is immediately possible. He described a model that breaks hundreds of scheduled activities into a three-week window, builds a risk register, and shares the result in a format that is easy for superintendent to read.

"Getting superintendents to generate the weekly look-ahead — breaking down to a weekly task and communicating that — it's a really hard, tedious task," Hennessy observed. *"That tool helps get their time back and focus on running the project."* The prerequisite for this is structured input data.

As Don Jacob, the Co-Founder and CIO at Bluebeam described *"If we force people to put structured data in, it's huge opportunity. Like, Swiss cheese — the info might have holes, but the context is complete."*

nPlan, A Suffolk Technologies portfolio company, illustrates what generative scheduling at scale looks like when the training data requirements are met. The company's predictive AI is trained on more than 780,000 real past project schedules, enabling it to generate activity-level forecasts that account for how contractors deliver. An LNG Canada case study involved an infrastructure project team using nPlan to perform more than 30 schedule risk analyses over two years, then focused on the top 0.5 percent of risky activities each time. This ultimately mitigated approximately 150 days of avoidable delay.

The Automated Schedule & Budget Generation capability connects directly to Supply Chain lever via procurement trigger dates. Kaya AI, another Suffolk Technologies portfolio company, exemplifies this connection. The tool loads both the project schedule and the procurement log, connects them to real-time material lead times, and identifies which activities are at risk due to delivery changes. Hennessy described the implementation challenge: "There are hundreds of procurement activities in the schedule — procurement takes forever to link in. Then you have match with real-time lead times and what activities that's going to affect."

The linking between a generated schedule and a live procurement process is the mechanism through which AI Schedule Optimization can create Supply Chain value.

COLLABORATIVE / INTEGRATED SCHEDULING — ONE SYSTEM FOR ALL PARTIES

This capability allows teams to use AI to synchronize trade schedules, crew assignments, and data across all project parties through a centralized system of record. This eliminates the gaps that arise when each party plans independently, optimizes for its own constraints, and communicates updates through manual processes too slow to keep pace with the field. No single scheduling system currently spans GCs, subcontractors, procurement teams, and developers simultaneously.

Thiago da Costa, SVP of Data and AI at Procore, highlighted how platform data unification and frictionless field capture solve the persistent gap between daily jobsite reality and scheduled intent: "True optimization isn't possible until live field conditions, trade capacity, and project records are continuously aligned on a single, connected intelligence layer. Today, teams report field events after the fact, leaving AI models to reason over outdated information. That's why we have to remove friction for field teams and make real-time data capture effortless as work happens on site. To execute reliable, agentic workflows, we must unify that real-time field data with core project controls so AI can proactively flag schedule drift and reconcile trade handoffs as they occur." The data layer must therefore be resolved before collaborative scheduling can move from aspiration to practice. The next decade of construction may see new site roles emerge specifically dedicated to real-time field data capture, such as professionals whose function is not to build but to record, structure, and feed observed site conditions back into AI systems continuously. At the industry level, shared data-governance standards may also be required to define how field events are captured, structured, and reported across parties, making project data interoperable beyond a single firm.

Da Costa pointed to the upstream data disconnect in design-build workflows: "A primary cause of downstream friction is advancing design to 70 percent completion without integrating the trade contractors who execute the work. When trade expertise is excluded from early planning, missing details inevitably lead to scope gaps and change orders. Procore addresses this by providing a connected platform where stakeholders are unified upfront, ensuring downstream AI scheduling tools operate on buildable context rather than static assumptions."

SCHEDULE VISUALIZATION & CONFLICT DETECTION

Schedule Visualization & Conflict Detection allows teams to use AI to visualize schedules in time and space for identifying clashes, bottlenecks, and trade conflicts before they reach the field. The core mechanism is 4D construction sequencing: linking the three-dimensional BIM model to the project schedule so that the sequence of construction can be simulated visually, allowing planners to see conflicts between trades, clashes with existing infrastructure, and sequencing gaps before ground is broken or floors are framed.

Computer vision integration into the build site can then allow for real-time feedback to flag schedule conflicts as they occur. For example, computer vision could track the amount of timber available on site and the rate of depletion, and flag that an early order of more material is needed before the supply in depleted.

Sławomir Tadeja, a Postdoctoral Researcher at MIT, ranked Schedule Visualization as the most valuable Schedule Optimization capability. His rationale is rooted in how humans process complex scheduling information: "Visualizations are important to humans.

For the planner, for the people on the job — it's much easier for the human to spot conflicts on a visualization than from a textual description or a schedule spreadsheet."

As Thiago da Costa, SVP of Data and AI at Procore, observed regarding high-dimensional AI planning engines: "Generative engines can produce exponentially more schedule permutations than a project team can feasibly evaluate or implement. The role of AI is not to flood teams with options, but to reduce cognitive load. Procore AI synthesizes complex project data into clear, grounded insights, empowering project leaders to make fast, confident decisions backed by human-in-the-loop controls." Data fragmentation and limited incentives to share information further constrain adoption. Incomplete project information and misaligned incentives are therefore primary barriers. Expanding this lever's impact is a data-infrastructure and communication challenge before it is a technology challenge.

Skilled Labor & Subcontracting

Construction of the Empire State Building began on St. Patrick's Day, 1930. With 3,400 workers on site at peak production, the 102-story steel frame rose at four and a half stories per week and the building opened on May 1, 1931, a full month ahead of schedule. The total time from first column to opening day was one year and 45 days. Nearly a century later, Salesforce Tower in San Francisco at 61 stories, roughly half the height, broke ground in 2013 and opened in 2018. It took five years for a building half the size. The industry has more computing power, more sophisticated equipment, and more advanced materials than anything available in 1930. This is not a technology gap but a productivity gap.

Between 1970 and 2024, aggregate labor productivity in the US more than doubled. Over the same period, labor productivity in the construction industry declined by 30%. Since 1965, labor productivity in US construction has been falling at an average pace of 0.6 percent per year, while productivity in the wider economy has been growing at about 1.6 percent per year. On most large commercial construction sites today, three trades could arrive simultaneously to use the same hoist. Material could be staged on the wrong floor has to be moved before installation can begin, or does not arrive in time.

A fundamental economic problem of Skilled Labor & Subcontracting is that the United States faces a shortage of skilled trades, with the construction workforce gap estimated at 456,000 workers in 2027. Nearly 40 percent of skilled construction workers are now over the age of 45, and apprenticeship programs typically require five to seven years to produce fully skilled workers, leaving a growing gap as experienced workers exit faster than they can be replaced. The National Center for Construction Education and Research estimates that approximately 41 percent of the current construction workforce will retire by 2031. AI augmentation of existing workers is therefore both a productivity and a capacity strategy. Miller Electric's collaboration with Augmenta demonstrated a 40 percent reduction in electrical engineering design time effectively adding the equivalent of two to three engineers without hiring them.

Current workers on site lose significant portions of every day to a coordination system that is fragmented. General contractors and subcontractors operate through a web of separate scheduling tools and change-order processes that move slowly. AI's role in this lever is therefore different from its role in the other five levers in this study. It is not compressing a process that already has a defined logic, the way Design Automation speeds compliance review, but its function is reducing coordination friction across a fragmented system of parties.

AI Skilled Labor tools make it cheaper and faster for GCs and trades to share information, validate quantities, sequence handoffs, and manage change. The roundtable's practitioners, who manage subcontractor relationships daily, put the thesis plainly: "The biggest near-term value is not replacing field labor, but removing friction around logistics, sequencing, documentation, and approvals."

AI workforce planning tools match labor availability, skills profiles, and task requirements to generate optimized crew assignments and subcontract packages. AI-enabled digital apprenticeship systems deliver role-specific guidance to workers in the field, capturing institutional knowledge and reducing dependence on experienced supervision.

Skilled Labor & Subcontracting ranked last among the six levers in the Roundtable and Expert surveys with a mean score of 4.0. This consensus reflects not pessimism about the labor shortage itself, but skepticism about where AI creates real value in this space. The most extreme group rating in the entire dataset belongs to Design Automation experts, who ranked Skilled Labor last with a mean of 4.63. The survey pattern is consistent with a structural logic articulated by Doug Harrison, VP of Corporate Operations at Suffolk, "Design is the first unlock for a lot of what subcontractor management can actually deliver on site." The implication is that upstream interventions such as DfMA ready designs and prefabrication reduced field labor scope. This addresses the labor constraint more than AI tools applied to the coordination of labor already on site.

MIT and Suffolk, through discussions with practitioners and leading academics, identified five of the most valuable AI capabilities for the Skilled Labor lever:

- **AI-Automated Trade Coordination** — synchronizing schedules, handoffs, RFIs across trades
- **Performance & Quality Control** — reducing errors, enforcing consistency from bid to close
- **Contracting Strategy** — bundled vs. unbundled contracts, delivery models, risk allocation
- **Subcontractor Prequalification** — capability, capacity, safety, financial health screening
- **Strategic Trade Development** — identifying capability gaps and performance trends

AI-AUTOMATED TRADE COORDINATION

AI-Automated Trade Coordination allows teams to use AI to synchronize schedules, logistics, scope handoffs, and communication across trades in real time by targeting the coordination failures that consume superintendent time before they develop into cost and schedule damage.

Thiago da Costa, SVP of Data and AI at Procore, captured how platform-native agents resolve daily jobsite coordination breakdowns: "When daily trade handoffs break down – whether from shifted crew counts, inspector timing, or delayed materials – the ripple effect threatens the entire critical path. When AI relies on manual, retrospective updates, it optimizes against yesterday's jobsite. Connecting real-time field activity directly to platform data allows specialized agents to proactively flag handoff risks and recommend corrective actions before minor variances compound into major delays."

The target is to remove friction between parties such as three trades arriving at the same hoist, material staged on the wrong floor, change-order approvals stalled at the management level. The roundtable's most actionable near-term finding was trade sequencing.

Staggering trade starts, rather than allowing all trades on site simultaneously, is a high-return operational fix. AI's role is to make it less dependent on a single superintendent's daily judgment calls. Harrison, framed the goal as "Automate those complex interactions across the board to coordinate schedule, logistics, materials." For example, AI can remove bottlenecks through tracking equipment reservation systems for lift idle time to see where daily friction is highest.

PERFORMANCE & QUALITY CONTROL

Performance & Quality Control allows teams to use AI to reduce errors, enforce consistency, and validate quantities across trade work. Rather than catching deviations during inspections or handoffs, AI enables identification in real time during installation when corrections are still inexpensive.

The most immediate application roundtable practitioners identified is change-order quantity validation. Change orders are slow and adversarial not primarily because of price disagreement, but because validating underlying quantities and labor hours is a manual process that both parties approach with strategic skepticism. AI tied to BIM model changes, field capture, and installed-work records could resolve this by producing before-and-after quantity deltas that are not subject to negotiation, making change orders faster, clearer, and more defensible. An enabler is pre-negotiated unit pricing, because when unit pricing is established up front, change orders become much easier to process. AI's contribution is not to replace negotiation but to make quantity validation faster and more transparent.

Owner decision-making speed is a second bottleneck, and it sits upstream of any AI tool. The challenge is often approval timing, as owner reps are sometimes far removed from the field. This creates a gap between work being done and the funding decisions required to authorize it. A root cause is scope instability: when design scope remains open past contract execution, approval decisions carry risk that owners are rationally reluctant to absorb. Scope freeze — locking a baseline scope at contract execution — removes that ambiguity and creates the stable reference point against which field deviations and change orders can be objectively measured. With scope frozen, AI can further help by surfacing the consequences of delayed decisions before they compound, reporting schedule impact, labor inefficiencies, and downstream system effects in a format that makes the cost of inaction visible. Harrison identified one application already in use: OpenSpace reality capture enables a general contractor to verify quality and document installed work before walls close, ensuring compliance and reducing rework at precisely the moment corrections remain feasible.

Design Automation is the upstream prerequisite for all of this. AI-driven quantity validation depends on clean, structured BIM models as the baseline against which field installation is measured. Without AI-complete BIM output carrying geometric and material data, automated quantity validation has no reference point to track changes. Design Automation enables Performance & Quality Control.

CONTRACTING STRATEGY

Contracting Strategy allows teams to use AI to evaluate delivery models, risk allocation structures, and historical contract outcomes. The aim is to leverage AI to recommending contracting frameworks that minimize disputes and align the incentive structure before a project begins.

Harrison identified time and material (T&M) as the clearest case for AI-assisted contracting strategy: "Our biggest inefficiencies we see is when we start to open up for T&M slips. There's no incentive for anybody at that point to continue to work faster. And ultimately, it's not an efficient method of change management on sites."

Pre-established scope baselines, verified by AI systems that confirm what was bought versus what was changed, create conditions for more work to be executed on a lump-sum basis rather than T&M. This shifts the incentive structure back toward speed and efficiency.

Contracting structures that establish pre-negotiated pricing and delivery timelines create the data foundation that Supply Chain & Procurement AI systems need to function. When material procurement is governed by an established pricing contract rather than negotiated ad hoc throughout the project, Supply Chain optimization tools can work from more stable inputs. This makes Contracting Strategy a data prerequisite for Supply Chain performance.

SUBCONTRACTOR PREQUALIFICATION

Subcontractor Prequalification allows teams to use AI to continuously assess trade partner capacity, financial health, safety records, and historical performance.

The economic problem that Subcontractor Prequalification addresses is the hidden risk embedded in trade selection. General contractors typically select from a network of known trade partners, choosing based on relationship familiarity, competitive pricing, and stated availability.

The risks embedded in that process such as a financially distressed subcontractor that cannot sustain a multi-year project, are often visible in data that already exists but is not analyzed. Emrah Ergelen, Principal at Frux Consulting, found that contractors operating at 0.7 times their annual turnover capacity are 24 percent more competitive than those at 1.2 times capacity.

The backlog analysis that Ergelen's research applies to a contractor's own bidding strategy can be inverted: a general contractor using AI to assess the backlog, financial health, and workload of trade candidates is applying exactly the same logic to select partners more likely to perform.

Subcontractor Prequalification extends to multi-project selection into what Harrison called "continuous partner embedding" that ensures that trade partners have the financial stability and performance record to deliver on the projects they are bidding on.

A fully realized prequalification system would serve both directions: general contractors assessing trade capacity and reliability, and subcontractors assessing GC payment history, scope discipline, and relationship fairness.

STRATEGIC TRADE DEVELOPMENT

Strategic Trade Development allows teams to use AI to identify capability gaps and performance trends across a trade partner portfolio. This enables general contractors and developers to host training and investment rather than cycling through under-performing trades on a project-by-project basis.

Strategic Trade Development ranked last of the five capabilities, tied with Subcontractor Prequalification. This capability does not create value within a single project's scope and budget. Training compounds across projects and relationships over many years. Larry Sass, Professor of Architecture and Director of the Computation Group in the Department of Architecture at MIT, identified digital literacy as the most fundamental constraint on AI adoption across the construction workforce: "Digital media literacy. Elevating the level of the construction worker — making them understand digital tools — is the foundational gap."

Sass's framing lays out the Strategic Trade Development problem at its most basic level. Workers cannot benefit from AI tools if they lack the digital competency those tools require to implement. The industry's adoption barrier is not only a technology problem, but a literacy problem that runs from the field worker through the project management layer and constrains every AI capability in this lever.

Ergelen's longer-horizon framing points to a tactical application for AI supporting that digital literacy training: "AI-powered headsets uploading trade knowledge through computer vision. Take unskilled labor, give them a headset, and they can perform skilled tasks. How to lay cables, install pipes — uploaded."

The adoption barrier Ergelen identified runs deeper than digital literacy. "The concern people have is that AI may replace professions. It's not clear to what extent. This leads to negative feedback and opposition."

Trade development programs and digital literacy initiatives are the mechanism through which the industry can address this resistance over time by demonstrating that AI capabilities support and upskill skilled workers rather than replace them, and building those capabilities allows workers to be more productive.

Supply Chain and Procurement

Supply chain and procurement account for roughly 40 percent[6] of commercial construction cost making it one of the largest single cost drivers in any project. On an eight-hour work day, approximately five hours are productive and around 75 percent of the three lost hours are attributable to material not being on site when it is needed. That inefficiency makes Supply Chain & Procurement one of the highest-leverage levers for improving project economics. Between COVID-19, global canal disruptions, and tariff escalation on construction materials, unpredictability accelerated sharply. The Associated General Contractors of America, in its analysis of January 2025 to January 2026[7] producer price index data, reported that steel mill products had risen 20.7 percent and aluminum mill shapes 33 percent year-over-year, the largest single-year increases since the supply chain disruptions of 2022.

The consequence has been a shift away from a just-in-time inventory model toward upfront purchasing and warehousing of materials.

During the roundtable, Raghu Kutty, Chief Technology Officer of Power Design, one of the nation's largest multi-trade MEP contractors, described the response that has become standard in his firm: buying panels, breakers, and lighting fixtures months before they are needed and warehousing them rather than ordering for delivery. "It's a completely different business model. COVID told us that, and the tariffs keep sending that message back and forth."

The market logic of supply chain AI is volatility management: maintaining cost certainty and schedule predictability. Construction procurement is characterized by fragmentation, opacity, and adversarial dynamics between general contractors, subcontractors, and suppliers.

AI platforms address all three dimensions: aggregating spend data across projects to enable strategic sourcing; providing real-time visibility into supplier performance; and automating the transactional elements of purchasing. Roundtable participants made it clear that they will pay a premium for predictability.

Often, the cost of buying materials early through warehousing, or paying for expedited shipping when a vendor delays could be less than the cost of a delayed project.

AI-driven procurement platforms automate supplier selection, contract benchmarking, inventory management, and demand forecasting. Machine learning models assess supplier risk in real time, predict material shortages, and optimize purchasing timing.

Automated purchase order processing eliminates manual data entry and accelerates transaction cycles. Spend analytics and contract optimization alone have demonstrated savings of 8 percent through supplier consolidation and contract renegotiation, with total AI-driven procurement savings of 25 percent of material cost reported in detailed case studies. In construction, those savings are most achievable when the party using the AI tool has visibility into actual purchasing commitments.

Where subcontractors buy materials directly, AI value depends on early trade-partner data sharing, structured supplier records, and agreement on which substitutions or buying decisions can be made centrally.

MIT and Suffolk, through discussions with practitioners and leading academics, identified five of the most valuable AI capabilities for the Supply Chain and Procurement lever:

- **Lead Time & Delivery Optimization** — warehousing versus just-in-time delivery prediction
- **Consolidated Volume Buying** — aggregating demand across projects to secure volume discounts
- **Procurement Process Automation** — automated RFP generation and bid evaluation
- **Supplier Performance & Partnership Management** — long-term relationship optimization and dynamic sourcing
- **Material Price Forecasting** — AI-based forward pricing using market signals and demand trends

The roundtable's respondents ranked Lead Time & Delivery Optimization the most valuable Supply Chain capability, with a mean score of 2.00 on a scale where 1 is most useful and 5 is least useful.

6 Francisco Marques, Gonçalo Ribeiro, and Erik Sjödin, "*The strategic era of procurement in construction*"
7 *Associated General Contractors of America (AGC)*

What's interesting is the expert survey ranking placed Material Price Forecasting last at 4.00, however this capability was the most thoroughly researched application in academia. **That dynamic uncovered an interesting finding that the roundtable practitioners' highest concern is predictability of delivery, not the ideal purchase price.**

The explanation on why academia has a much larger research corpus on material price predictability could be driven from progress in other industries. The industries where AI price forecasting research is most applicable, such oil, automotive, and commodities, procure from more homogeneous material baskets.

A coal plant procures essentially one input. Whereas a commercial construction project procures hundreds of unique materials across fragmented supply chains for specific one-off project needs. There are fewer instances of economies of scale for price predictability. Practitioners ranked price forecasting last because their highest concern is predictability of delivery, not optimization of purchase price. That priority is precisely what Lead Time & Delivery Optimization addresses, and precisely why it ranked first.

LEAD TIME & DELIVERY OPTIMIZATION

This capability sits at the intersection of the Supply Chain and Schedule Optimization levers and allows teams to use AI to predict material arrival and optimize delivery timing so that materials are on site when the crew is ready to install them.

Roundtable practitioners ranked it the most needed AI capability in construction. Patrick Hennessy, Planning & Analytics Executive at Harkins Builders, described a transformer replacement project in West Virginia where in April, the team secured a six-week lead time on structural steel.

By December, the steel contractor reviewed the order details and found custom angle clips with a twenty-week lead time. The schedule slipped by months. The failure was an information gap as the lead time did not reflect its least visible component. "How can AI do that extra check," Hennessy asked, "to make sure all details are accounted for in the estimate? The need is for AI to flag 'hey, you might want to check in on this — this is an upcoming risk.'"

Kaya AI, a Suffolk Technologies portfolio company, is one tool for this capability. Parker Mundt, Partner and Head of Platform at Suffolk Technologies, described how Kaya began by automating the procurement and delivery log from project specifications, then expanded to provide substitute material options with real-time pricing, availability, and lead time comparisons.

These are ranked and priced before the design team commits to a specification. The system extended to manage end-to-end delivery with real-time logistics tracking. For critical-path items that could delay the schedule, Kaya surfaces the conflict to the project manager for approval and, can automatically update the base schedule.

The binding constraint on tools like Kaya is data quality. As Mike Rascona, VP of Technology Operations at E-J Electric Installation, put it: "Do you have enough data? No... It's not consistent, it's not organized in a fashion that can be shared."

Project timelines of multiple years create slow learning loops, and the COVID disruption resulted in data that's difficult to use as a training baseline. Variability across firms compounds the problem as individual estimators record data in different ways, making it difficult to establish the consistent baseline a predictive model can learn from.

CONSOLIDATED VOLUME BUYING

This capability allows teams to use AI to aggregate material demand across multiple projects, time periods, or subcontractor scopes in order to secure bulk pricing. Rather than treating each project as a standalone purchase, the logic is to treat a pipeline of projects as a platform to support purchasing that earns discounts unavailable to any single job.

The AI role in this capability is to identify across a project portfolio where demand aggregation creates enough leverage to justify bulk purchasing commitment from a manufacturer. Roundtable participants pointed to an emerging practice outside of construction, where hyperscale data center buyers use data across hundreds of facilities to negotiate directly with manufacturers to source equipment.

The construction equivalent could be a GC or developer with a large sufficient pipeline of predictable project types using AI to surface what materials could be sourced in bulk and stored rather than ordering job by job at prevailing rates.

PROCUREMENT PROCESS AUTOMATION

Procurement Process Automation uses AI to streamline the bidding and sourcing cycle by generating RFP packages, comparing bids and submittals against scope requirements, identifying missing qualifications, and linking specifications, quantities, lead times, and supplier performance history.

The implementation of this capability depends on high quality data for design, specifications, historical information about the projects, product data from manufacturers and suppliers.

SUPPLIER PERFORMANCE & PARTNERSHIP MANAGEMENT

Supplier Performance and Partnership Management uses AI to analyze supplier track records, risk signals, capacity trends, and delivery reliability. This builds data-driven partnerships that reduce reliance on informal relationships so that partnership decisions are informed by documented performance rather than by recency or familiarity alone.

The most precisely quantified finding in the Supply Chain research and discussions for supplier performance prediction comes from an expert interview with Ergelen. His Harvard Business Review publication "*How the Construction Sector Is Using AI to Cut Waste and Fraud*," found that contractor-side AI tools can predict tender outcomes with accuracy as high as 96 percent by incorporating contractor backlog, regional experience, project-type specialization, and alliance status with local partners.

Ergelen's workload competitiveness found that contractors operating at 0.7 times their capacity are 24 percent more competitive than those at 1.2 times capacity. The training data needed to set this up, such as historical project types, bid outcomes, workload at submission, and relationship patterns is typically already held by the general contractor, giving this capability one of the easier adoption paths.

MATERIAL PRICE FORECASTING

This capability allows teams to use AI to predict price movements using AI driven algorithms, historical price patterns, commodity features, global events and demand data. The goal is to allow procurement teams to secure favorable material prices. Of the five capabilities in this lever, Material Price Forecasting ranked last in the survey.

Of the five capabilities in this lever, this resulted in the largest body of peer-reviewed research to investigate. The literature analysis identifies material price forecasting as a high-value AI target; however most projects focused on other industries with more homogenized procurement baskets.

For example, a coal plant procures essentially one input, coal, whereas a real estate general contractor may need to procure hundreds of project-specific goods across many different supply chains. As such, practitioners ranked this capability as the least useful amongst the others in Supply Chain, as these models require structured data and market conditions that do not frequently experience disruptions. The past five years delivered a pandemic, simultaneous canal blockages, multiple wars, and abrupt tariffs in rapid succession. The contingency for AI implementation across the Supply Chain lever is one that John Ochsendorf, Professor of Civil and Environmental Engineering at MIT, identified: *"Data collection and benchmarking are incomplete across the industry. AI cannot help until the numbers exist."*

Roadmap: A Path to Greater Intelligence

The roadmap below sets out the structured program of research, data collection, industry engagement, and knowledge dissemination that MIT and Suffolk propose to pursue over the next 18 months. It is designed to transform the directional framing presented in this methodology statement into the empirically grounded, industry-validated guidance that the construction sector requires.

☑ PHASE 1 | FOUNDATION | Q4 2025 – Q3 2026

Launch structured industry survey targeting more than 200 respondents across owner, contractor, subcontractor, designer, and technology-provider communities.

Form a research advisory panel drawing on roundtable participants and broader industry leaders.

Publish preliminary survey findings to sustain industry engagement momentum.

☑ PHASE 2 | DATA COLLECTION | Q4 2025 – Q2 2026

Collect project-level data across cost, schedule, labor, procurement, and permitting outcomes from partner firms.

Conduct structured interviews with AI deployment leads at 20+ firms to capture qualitative adoption experiences, barriers, and success factors.

Establish controlled comparison framework: matching AI-assisted projects with conventional comparators by project type, geography, and size.

Initiate interconnectivity analysis: documenting integration architecture at firms using AI across multiple domains simultaneously.

Expand international data collection to include UK, European, and Asia-Pacific construction markets.

☑ PHASE 3 | ANALYSIS | Q2 – Q3 2026

Statistical analysis of project-level outcome data to establish AI impact across each of the six priority domains.

Econometric modelling of the interconnectivity multiplier effect to facilitate quantifying compound gains from cross-domain AI integration.

Peer review of preliminary findings by academic and industry advisory panels.

Development of domain-specific AI adoption playbooks for each of the six priority areas, tailored to firm size and project type.

Development of AI readiness assessment tools for construction firms.

Identify live projects that can serve as validation test cases and define the measurement approach before implementation; track success through cost, schedule, quality, labor-productivity metrics.

☐ PHASE 4 | DISSEMINATION | Q4 2026 and ongoing

Publication of a composite MIT/Suffolk academic paper with peer-reviewed findings.

Industry conference presentations and briefings for owners, contractors, and technology-provider communities.

☐ PHASE 5 | FUTURE VISION | Q1 2027 and ongoing

Open-access publication of anonymized benchmark datasets to enable further research by the academic and industry communities.

Develop standardized data schema for project-level AI adoption and outcome tracking.

Establishment of annual AI in Construction benchmark survey to track adoption, outcomes, and emerging domain priorities on a longitudinal basis.

Development of an AI Construction Intelligence Index to create a composite measure of industry AI maturity to track progress over time.

What is possible today

Building the next generation of construction will require collaboration across the full project ecosystem, and the transformation will happen progressively. Still, owners, designers, contractors, trade partners, and manufacturers can already take practical steps toward a more connected, intelligent, and efficient delivery model.

This list captures next-generation practices that use proven technologies to accelerate that shift now.

Next Generation Practice	Primary Owners					
	Regulator	Developer	Architect	GC	Trade	Manufac-turer
Permitting						
Accept BIM models in lieu of paper drawings	X					
Use AI-assisted code checking to speed up approvals	X					
Design						
Maintain a shared, integrated BIM model / digital twin for the full facility up to fabrication level (LOD 400) in a common data environment accessible to all core parties with planned installation order		X				
Complete constructability review of construction documents before issuance for construction, using AI and/or an independent reviewer informed by a lessons-learned database			X	X		
Incorporate approved fabrication and submittal and shop drawing information into the coordinated BIM model and resolve critical clashes before construction starts		X		X		
Cooperate with critical trades early to support integrated design and project planning, improving constructability, coordination, prefabrication strategy, and logistics decisions			X	X	X	
Optimize design for cost of construction and maintenance		X	X	X		
Budgeting and Scheduling						
Automate quantity take-off with AI				X		
Move from semi-manual scheduling to automatically generated schedules based on project profile, quantity takeoff, and project databases				X		
Create and maintain a reference pricing catalog across all jobs that is continuously updated based on market conditions				X		

Next Generation Practice	Primary Owners					
	Regulator	Developer	Architect	GC	Trade	Manufac-turer
Bidding and Trade Selection						
Determine the optimal level of prefabrication / offsite manufacturing based on site constraints, schedule priorities, labor strategy, and design repeatability		X		X	X	
Maintain and continuously improve a prequalified trade partner pool based on project performance, delivery capability, and alignment with quality standards				X		
Complete sequence modelling (4D BIM) for critical path scope before mobilization				X	X	
Continuously evaluate manufacturers and build preferred relationships that improve quality, reliability, lead time, and overall project value				X	X	
Field Execution						
Ensure all parties on site have real-time access to BIM model with integrated shop drawings, project documentation, and AI assistance				X	X	
Use an integrated Procurement & Delivery log with delay-risk simulations				X		
Ensure weekly update of the actual project schedule based on reality capture data				X		
Provide developers a live project dashboard with continuous data refresh, integrated forecasts (cost, schedule, procurement), critical decision milestones, and configurable KPIs/alerts		X		X		
Identify and manage quality issues in real time in single data environment – minimizing the need of punch list				X	X	
Run integrated digital requisition process for smooth acceptance and payment process between parties				X		
Verify critical installation against coordinated model with reality capture				X	X	
Close Out						
Deliver an accurate as-built digital record reflecting approved field changes				X	X	
Transfer owner-ready turnover information as digital asset including O&M data, warranties, commissioning records				X	X	

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