

THE EMERGING DISCIPLINE OF OWNER INTELLIGENCE

# The Owner's Guide to Construction Intelligence

A framework for connecting fragmented project information, recognizing emerging pressure and making better capital-project decisions

Ten intelligence domains | Five decision lenses | One connected system

## SIGNAL

Research and intelligence for capital-project owners

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## Executive summary

Construction projects do not generally fail because nobody produced a schedule, cost report, risk register, inspection record or set of meeting minutes. They fail despite producing all of them.

The problem is rarely an absolute absence of information. It is that information is created by different organizations, for different contractual purposes, at different intervals and in different formats. Each record may be locally accurate while the overall picture remains incomplete. A schedule update can show a milestone holding while lookaheads reveal deteriorating work readiness. A cost report can remain within budget while unresolved changes accumulate outside the approved forecast. Inspection records can appear manageable in aggregate while failures cluster around a particular trade, system or handoff. Meeting minutes can document decisions without showing whether the downstream consequences were ever incorporated into design, procurement, schedule and cost.

Owners therefore face a structural gap between **having project information** and **possessing decision-ready intelligence**.

This report defines **Construction Intelligence** as:

The systematic collection, connection, interpretation and governance of market, portfolio, project and asset information so that capital-project participants can understand conditions, anticipate consequences and make better decisions across the asset lifecycle.

Artificial intelligence, business intelligence, building information modelling, project controls and reporting all contribute to Construction Intelligence. Each covers only part of the system.

This guide proposes ten primary intelligence domains:

1. Market and macro intelligence
2. Capital and portfolio intelligence
3. Feasibility, scope and stakeholder intelligence
4. Design and technical intelligence
5. Regulatory and approvals intelligence
6. Commercial and procurement intelligence
7. Supply-chain and workforce intelligence
8. Execution, schedule and quality intelligence
9. Cost, financial and assurance intelligence
10. Asset-performance and learning intelligence

Five lenses should operate across every domain: **risk and resilience, safety and human impact, value and economics, evidence and confidence, and performance and learning**. Several specialized forms, including claims, funding, community, sustainability, commissioning and operational-readiness intelligence, sit within or between the primary domains.

The framework matters because project outcomes emerge from interactions between domains. Labour scarcity becomes consequential when it affects procurement. A late procurement becomes dangerous when it compresses installation. Compressed installation creates trade stacking, which affects safety, quality and inspection capacity. Those effects may create rework, claims and financial exposure. No individual report necessarily describes the whole pathway.

Construction Intelligence is the capability to see that pathway early enough to act.

## By the numbers

Several findings help explain why the category matters. They should be read as indicators from specific studies, not as universal benchmarks:

- **3,900+ professionals:** the sample in Autodesk and FMI's global construction-data survey.
  - **12 percent:** respondents in that survey who said they always incorporated project data into decisions.
  - **1,081 projects:** the project sample covered by the Construction Industry Institute's long-running front-end planning research, representing a reported value of **\$96.5 billion**.
  - **6 to 25 percent:** the range of cost differences CII reported in assessments of projects with effective front-end planning.
  - **6 to 39 percent:** the corresponding range of schedule differences.
  - **Ten domains, five lenses:** the Vantage Signal framework proposed in this report for organizing owner-level Construction Intelligence.
- 

## 1. Construction's information problem is more complicated than it appears

Construction has spent decades digitizing its records. Drawings moved from paper to coordinated models. Schedules became dynamic databases. Field observations moved into mobile applications. Cost reports, requests for information, submittals, deficiencies, photos, daily reports and change records increasingly live in cloud platforms.

That progress matters. ISO 19650 formalized principles for managing information over the lifecycle of built assets using building information modelling. The U.S. National BIM Standard describes BIM as a shared knowledge resource that can support decisions from inception onward, well beyond its use as a three-dimensional model. Both point toward a lifecycle view of information instead of a collection of isolated files. ISO 19650-1 National BIM Standard - United States

Digitization alone does not produce intelligence.

A digitized document can still be inaccessible, late, inconsistent or disconnected from the decision it should inform. A common data environment can improve access while leaving interpretation fragmented. A dashboard can make measures visible without establishing whether they are meaningful, reliable or causally connected. An artificial-intelligence system can summarize thousands of records while reproducing gaps and assumptions embedded in the source material.

An Autodesk and FMI study of more than 3,900 construction professionals estimated that inaccurate, incomplete, inconsistent, inaccessible or untimely data imposed very large costs on the global industry. The underlying finding is more useful than the headline estimate. Only 12 percent of respondents said they always incorporated project data into decision-making. Organizations with deliberate data strategies reported more consistent use of data and better outcomes. Because the study was vendor-sponsored, its global cost estimate is best treated as directional, not as a universal project benchmark. The practical conclusion still holds: collecting more data does not automatically improve decisions. Autodesk and FMI, *Harnessing the Data Advantage in Construction*

## Consistent data use remains uncommon

Selected findings from a 2020 global survey of more than 3,900 construction professionals

### SHARE OF ALL RESPONDENTS

#### Always incorporate project data into decisions



### PRACTICES REPORTED BY CONSISTENT DATA USERS



#### Interpretation

Technology adoption and disciplined data use are different capabilities. The survey was sponsored by Autodesk and FMI.

Source: Autodesk and FMI, *Harnessing the Data Advantage in Construction (2021)*, reporting 2020 practices.

**Figure 1:** Selected findings on construction data practices

For owners, the deeper problem is fragmentation across five boundaries:

### Organizational boundaries

Designers, contractors, subcontractors, consultants, authorities, lenders and owners create records for different purposes. Contractual reporting lines shape what is recorded, when it is escalated and how it is framed.

### System boundaries

Schedules, cost systems, document platforms, field applications, email and spreadsheets often use different identifiers and structures. The same issue may appear under a room number in an inspection, a specification section in an RFI, an activity code in a schedule and a cost code in a change record.

### Time boundaries

Information is produced at different cadences. Daily field conditions, weekly lookaheads, monthly cost reports and quarterly governance reviews describe different versions of the project. By the time a monthly report confirms a pattern, the operational choices that created it may be weeks old.

### Incentive boundaries

Project participants have different interests and thresholds for escalation. That is a feature of the delivery structure, not evidence of bad faith. Information inevitably passes through the filters of role, responsibility, commercial position and professional judgment.

## Lifecycle boundaries

Market assumptions made during business planning may not follow the project into procurement. Design rationale may not survive turnover. Lessons from operations may not shape the next capital plan. The project closes, the team disperses and much of the learning remains trapped in documents or individuals.

Construction Intelligence is the discipline of connecting information across these boundaries without erasing the context in which it was produced.

## 2. Data, reporting, analytics and intelligence are not interchangeable

The language of digital construction often collapses several distinct capabilities. Owners should separate them.

| Level               | Function                                                      | Example                                                                                                                  |
|---------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Data</b>         | Records a fact, event, observation or estimate                | An inspection failed on August 12                                                                                        |
| <b>Information</b>  | Organizes data into context                                   | Four inspections failed in the same area                                                                                 |
| <b>Reporting</b>    | Communicates status against an expected structure             | The monthly report shows 92 percent inspection pass rate                                                                 |
| <b>Analytics</b>    | Identifies patterns, relationships or deviations              | Failures are concentrated after one trade handoff                                                                        |
| <b>Intelligence</b> | Interprets evidence in relation to decisions and consequences | Repeated handoff failures may threaten close-in work and should trigger targeted review before downstream trades proceed |

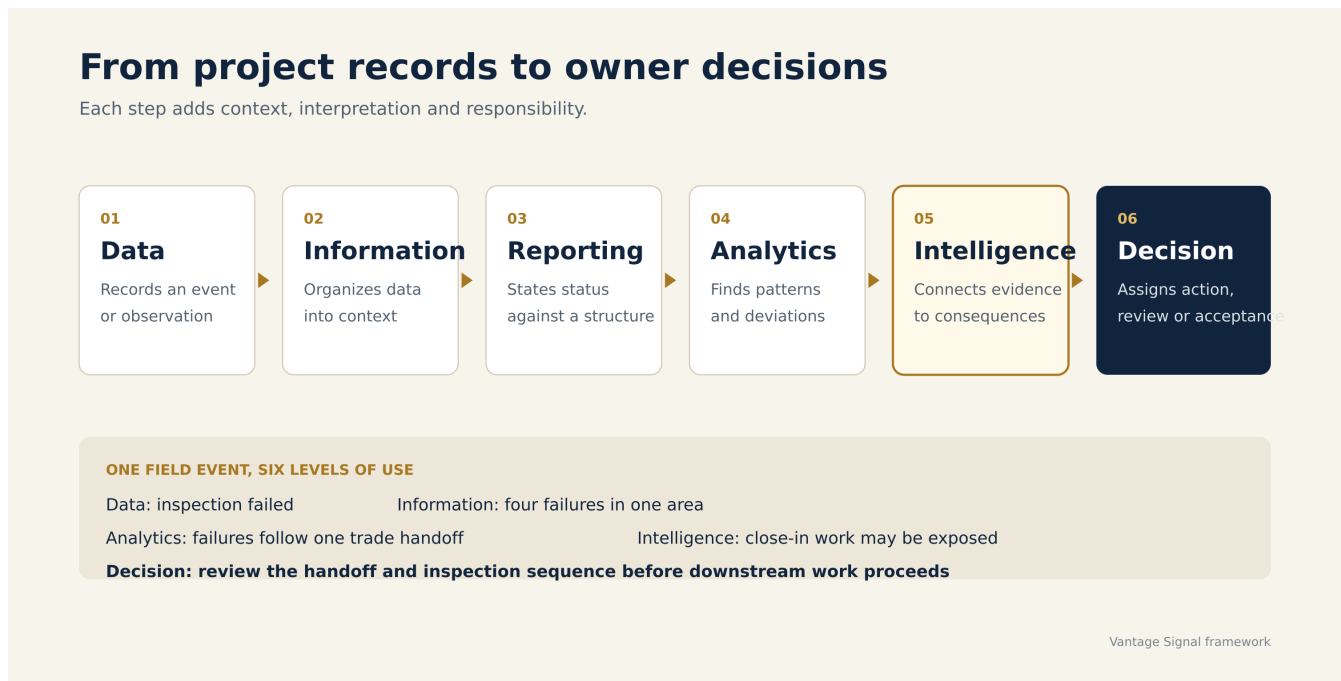


**Figure 2:** From project records to owner decisions

Reporting asks, **What is the stated condition?**

Analytics asks, **What pattern exists in the available data?**

Intelligence asks:

- What appears to be happening?
- What evidence supports that interpretation?
- What evidence is missing or contradictory?
- Why does the condition matter?
- What could it affect next?
- Which decision, intervention or closer review may be warranted?
- How confident should the decision-maker be?

The last question is essential. Capital projects operate under incomplete information, and intelligence cannot remove that uncertainty. A mature system makes it visible instead of hiding it behind precise-looking metrics.

### Professional judgment remains essential

Construction Intelligence should strengthen the work of project managers, designers, quantity surveyors, schedulers, inspectors, superintendents, legal advisers and operators. A model cannot determine contractual entitlement, certify work, direct means and methods or assume the responsibilities of a licensed professional.

Its immediate value lies in **attention allocation**. It helps people decide what deserves review, what evidence should be gathered and where an emerging condition may cross organizational boundaries.

### Monitoring needs a defined purpose

More monitoring can increase noise, administrative burden and distrust when it lacks a defined decision purpose. Owners should be able to explain why information is being collected, how it will be interpreted, who may use it and what safeguards apply.

## Hindsight is cleaner than live intelligence

After a delay or dispute, it is relatively easy to reconstruct a clean story from the surviving record. Live projects are harder. Signals are incomplete, causation is uncertain and multiple futures remain possible. Good intelligence preserves that ambiguity while still helping decision-makers act proportionately.

## 3. The ten domains of Construction Intelligence

Vantage Signal proposes the following taxonomy as a practical, owner-oriented framework. It is not an industry standard. It organizes established disciplines into a connected system of decision support.

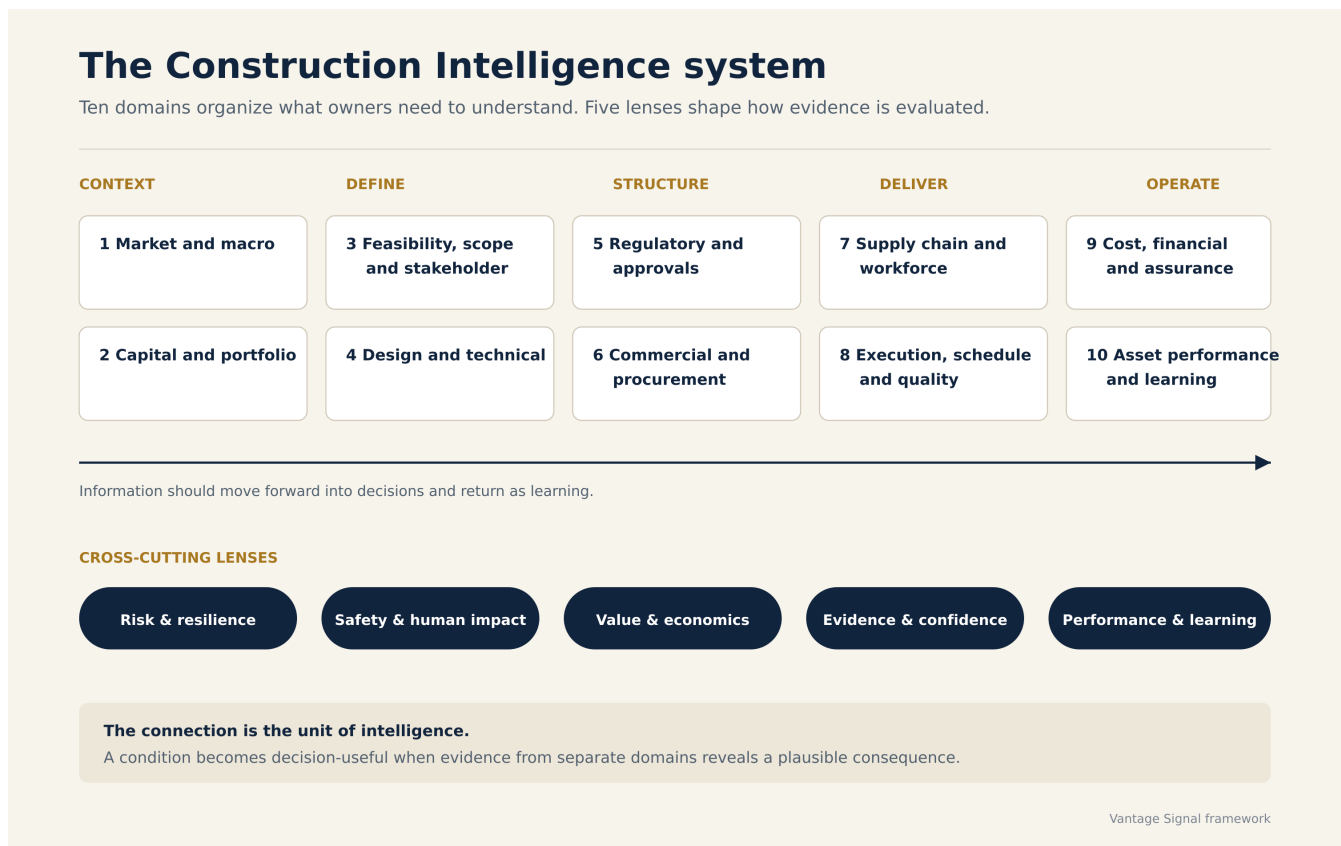


**Figure 3:** Ten domains and five cross-cutting lenses

### 3.1 Market and macro intelligence

Market and macro intelligence examines the external environment in which capital projects are conceived and delivered.

It includes:

- Construction-price escalation and material volatility
- Interest rates, credit conditions and financing availability
- Regional labour availability and wage pressure
- Contractor and subcontractor capacity
- Commodity, energy and transportation conditions

- Permit volumes and competing project demand
- Public investment, grants and infrastructure programs
- Regulatory, political and demographic change
- Climate and extreme-weather exposure

Owners need to know more than whether an index moved. They need to understand how that change affects a specific portfolio and the decisions in front of it.

A general labour shortage may have little significance to a project whose critical packages are already secured. The same shortage can materially alter a project that is approaching tender with an aggressive schedule in a constrained regional market. Intelligence emerges when external conditions are translated into project-specific exposure.

Market intelligence should inform capital timing, escalation allowances, packaging, delivery-model selection, bid strategy and contingency. It should also challenge stale assumptions. A business case approved eighteen months earlier may be operating in a materially different market by procurement.

### 3.2 Capital and portfolio intelligence

Portfolio intelligence shows whether individual projects are performing and whether the capital program as a whole is coherent and deliverable.

It includes:

- Project prioritization and sequencing
- Capital allocation and funding constraints
- Portfolio capacity and organizational workload
- Cross-project risk concentration
- Standardized performance comparisons
- Dependencies between programs, sites and assets
- Aggregate contractor, geography and supply-chain exposure
- Scenario planning and deferred-investment consequences
- Benefits realization across the portfolio

A portfolio can contain projects that each appear manageable while collectively exceeding the owner's decision capacity, cash requirements or access to qualified delivery partners. Conversely, a troubled project can consume attention disproportionate to its strategic value.

Portfolio intelligence must avoid crude league tables. Projects differ in complexity, maturity, delivery model and risk. Benchmarking is useful only when comparisons are normalized and context is retained.

### 3.3 Feasibility, scope and stakeholder intelligence

This domain asks whether the project is sufficiently understood before commitments become difficult to reverse.

It includes:

- Business need and intended outcomes
- Options analysis and feasibility
- Site and existing-condition knowledge
- Requirements definition
- Scope completeness and exclusions
- Stakeholder alignment
- Community and Indigenous engagement
- Operational constraints

- Early risk allocation
- Affordability and schedule realism

The Construction Industry Institute defines front-end planning as developing strategic information to identify risk and determine the resources needed to mitigate it. Its long-running research program studied more than 1,000 projects and linked effective front-end planning with materially better cost and schedule performance, although the range of results reflects project and sample differences rather than a guaranteed benefit for every project. Construction Industry Institute, Assessment of Effective Front End Planning Processes

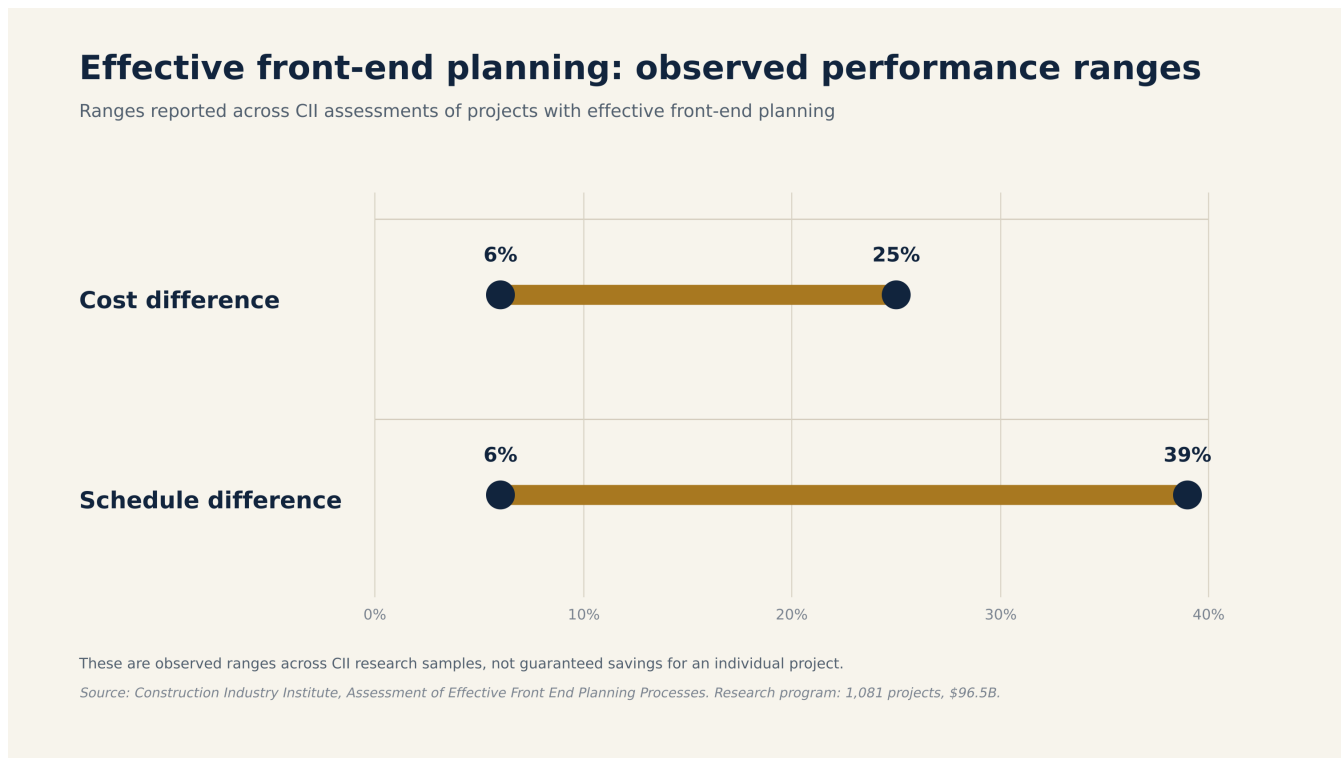


**Figure 4:** Observed performance differences associated with effective front-end planning

Uncertainty cannot be eliminated before approval. The useful work is to distinguish **known scope**, **assumed scope**, **deferred scope** and **unknown scope**, then make the consequences of each visible to decision-makers.

Stakeholder intelligence belongs here because requirements are not purely technical. Public acceptance, user operations, political commitments, Indigenous rights, adjacent property interests and internal owner alignment can affect feasibility as directly as site conditions.

### 3.4 Design and technical intelligence

Design intelligence assesses whether the developing solution remains aligned with requirements and whether its interfaces are sufficiently resolved for the next commitment.

It includes:

- Design completeness and maturity
- Multidisciplinary coordination
- Constructability
- Requirements traceability
- Design changes and decision latency

- Model and document consistency
- Technical risk and system interfaces
- Value engineering and lifecycle trade-offs
- Design-to-budget alignment
- Commissioning and operational requirements

Percent-complete measures can create false comfort. A design can be nominally advanced while a small number of unresolved interfaces carry disproportionate schedule or cost consequences.

Design intelligence focuses on the **quality and consequence of unresolved information** alongside the volume of completed documents. It connects open decisions to procurement lead times, field sequencing, approvals, cost and asset performance.

BIM and common data environments can provide critical infrastructure for this work, but model availability alone does not establish decision readiness. Information must be current, governed, interpretable and connected to the decisions it supports.

### 3.5 Regulatory and approvals intelligence

Regulatory intelligence tracks the obligations, dependencies and decision pathways that determine whether work can legally and practically proceed.

It includes:

- Planning and development approvals
- Building and trade permits
- Environmental reviews and conditions
- Utility and transportation approvals
- Code compliance
- Authority comments and resubmissions
- Funding or government-imposed conditions
- Inspection prerequisites
- Occupancy and commissioning approvals
- Regulatory change

Approvals are often shown as isolated milestones, although they function as networks of prerequisites, submissions, reviews, responses and evidence. A late approval is only one possible signal. Unstable submission information, unclear responsibility or timing that no longer aligns with procurement and field need dates may reveal the greater exposure.

For public and institutional owners, regulatory intelligence also includes transparency, reporting and public-accountability obligations. Compliance should not be treated as a final administrative check. It can shape delivery strategy from the outset.

### 3.6 Commercial and procurement intelligence

Commercial intelligence examines how delivery strategy, contracts, procurement decisions and incentives shape project behaviour and exposure.

It includes:

- Delivery-model selection
- Packaging and bid strategy
- Market engagement
- Bid coverage and competitiveness
- Contractor and consultant capability
- Scope gaps and overlaps

- Contract terms and risk allocation
- Insurance, bonding and security
- Change mechanisms and notice requirements
- Commercial incentives and behaviours

Procurement converts assumptions about scope, risk, capacity and accountability into enforceable relationships. Obtaining a price is only one part of that process.

The UK Project Routemap treats procurement, governance, requirements, risk, organizational capability, systems integration and asset management as connected project-set-up concerns. Its central insight is relevant beyond UK public infrastructure: delivery arrangements must be proportionate to project complexity and owner capability. UK Infrastructure and Projects Authority, Project Routemap

Commercial intelligence must also distinguish price certainty from outcome certainty. Transferring a risk contractually does not guarantee that the market can price, control or absorb it. Risk that is transferred to a party without the capability or information to manage it can return through contingency, claims, failure or reduced competition.

### 3.7 Supply-chain and workforce intelligence

This domain asks whether the people, materials, equipment and productive capacity required by the plan will actually be available when needed.

It includes:

- Trade and subcontractor capacity
- Labour availability, skills and productivity
- Crew loading and mobilization
- Long-lead materials and equipment
- Fabrication status
- Logistics and transportation
- Supplier concentration and financial health
- Substitution exposure
- Technology and training readiness
- Ethical sourcing and supply-chain sustainability

A procurement schedule may show an award date without revealing whether fabrication capacity is reserved. A contractor may have strong corporate credentials while the specific project team is stretched across multiple commitments. A material can be technically approved but exposed to logistics or geopolitical disruption.

Supply-chain intelligence connects market conditions to named packages, need dates, alternatives and downstream consequences. It also avoids equating contractor size with available capability. What matters is the capacity actually committed to the project.

### 3.8 Execution, schedule and quality intelligence

Execution intelligence examines how work is progressing, how reliable the near-term plan is and where pressure is forming across interacting field systems.

It includes:

- Baseline and updated schedules
- Critical and near-critical paths
- Float consumption and milestone movement
- Lookahead reliability and constraint removal

- Trade flow, handoffs and workforce readiness
- Production and productivity
- RFIs, submittals and design dependencies
- Inspections, testing, deficiencies and rework
- Change activity and disruption
- Weather, access and logistics
- Safety conditions and leading indicators
- Daily reports, photographs and field observations

Traditional project controls remain essential. But a schedule is a model of intended and forecast activity, not a complete representation of field reality. Monthly updating can also conceal the speed at which operational pressure forms.

Execution intelligence connects multiple weak signals. Consider a simplified pathway:

1. A design decision remains unresolved.
2. A submittal is delayed.
3. Material release moves beyond its planned date.
4. Installation loses float.
5. A successor trade is compressed into the same area.
6. Inspection demand clusters.
7. Deficiencies increase and close-in work is threatened.
8. Recovery measures increase cost and claims exposure.

No single step proves that loss will occur. Together, they justify closer review earlier than a lagging cost or milestone variance might.

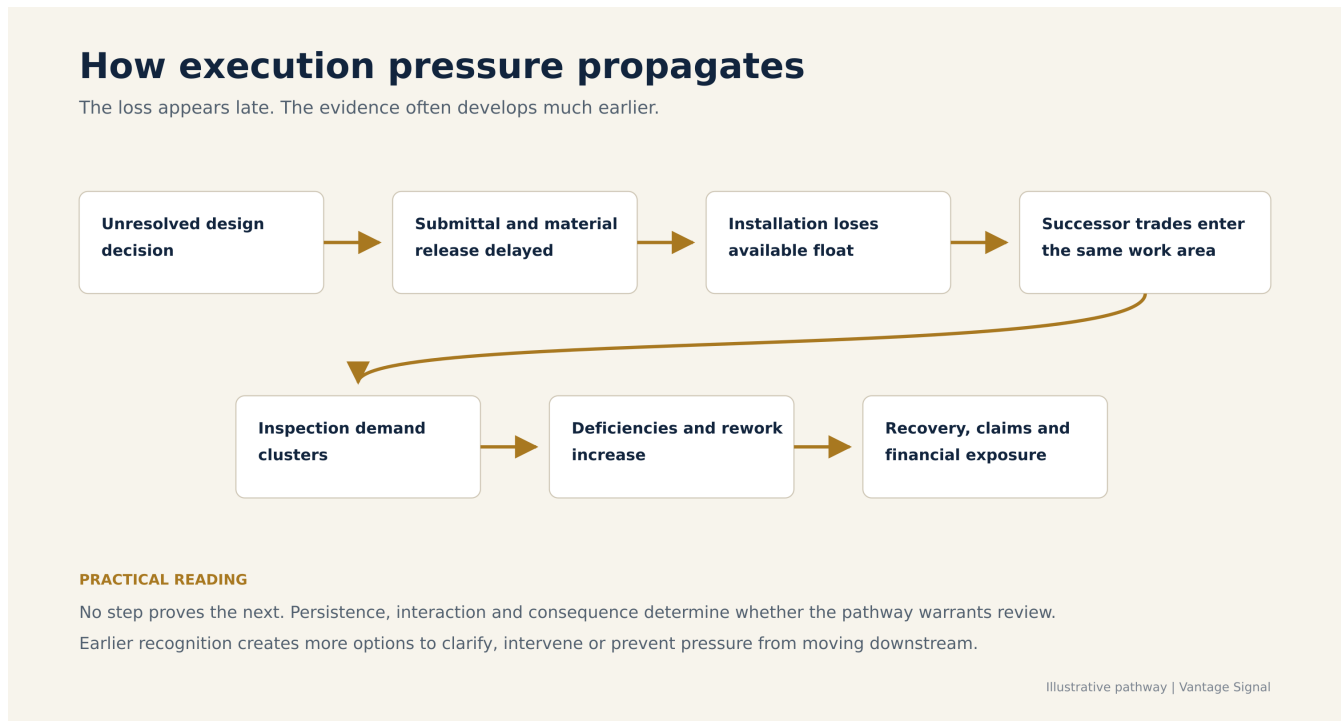


**Figure 5:** Connected execution-risk pathway

Quality intelligence is especially important because aggregate pass rates can conceal spatial or systemic concentration. Owners should ask where defects occur, after which handoffs, under what schedule conditions, and whether closure evidence is complete.

Safety intelligence should likewise extend beyond incident counts. Design choices, congestion, over-time, sequencing, supervision ratios and trade stacking can change exposure before an incident is recorded.

### 3.9 Cost, financial and assurance intelligence

Cost intelligence connects project events to present and future financial exposure.

It includes:

- Commitments, actuals and forecast-at-completion
- Contingency drawdown and adequacy
- Change requests and potential changes
- Allowances, provisional sums and scope uncertainty
- Cash flow and draw timing
- Earned value and progress validation
- Funding conditions and grant compliance
- Lender and insurer requirements
- Claims and dispute exposure
- Benefits, value and affordability

The key distinction is between **recorded cost** and **emerging exposure**. Approved changes are visible. Unpriced directives, unresolved design conditions, productivity effects, pending claims and forecast assumptions may not yet be.

Financial intelligence should avoid presenting every risk as a deterministic dollar amount. Early estimates may be ranges with explicit assumptions and confidence levels. False precision can be more dangerous than acknowledged uncertainty.

Assurance belongs in this domain but operates more broadly. It asks whether decision-makers can rely on the evidence, controls and governance supporting reported status. The UK Infrastructure and Projects Authority notes that poorly designed governance is a common contributor to major-project failure and emphasizes clear accountability and empowered decision-making. Infrastructure and Projects Authority, Project Routemap: Governance Module

Independent assurance tests whether important conclusions are traceable, current, consistent and proportionate to the decisions being made. It begins with verification, not an assumption that the project team is wrong.

### 3.10 Asset-performance and learning intelligence

The ultimate product of construction is an asset expected to deliver outcomes over time, not a completed project report.

Asset and learning intelligence includes:

- Commissioning and operational readiness
- Turnover-document completeness
- Deficiencies and warranty performance
- Energy, carbon and resource performance
- Reliability, maintainability and lifecycle cost
- Occupant and user outcomes
- Benefits realization
- Recurring failure patterns
- Project and portfolio lessons
- Feedback into standards, designs and future capital plans

The information handover at completion is often treated as an administrative deliverable. In an intelligence system, it is the bridge between delivery and operation. The National BIM Standard's lifecycle framing is useful here: facility information should support the many participants who create, finance, operate, regulate and ultimately renew or dispose of an asset. National Institute of Building Sciences, NBIMS-US V3

A lessons-learned workshop has little value if the findings disappear into an archive. Lessons must be structured, retained and reintroduced at the point of future decisions. Otherwise the organization repeatedly learns the same lesson while institutional memory leaves with project teams.

## The ten domains in practice

The following examples show the kinds of owner questions each domain should produce. They are illustrative and deliberately short. A live finding would also need sources, dates, confidence and response ownership.

| Domain                                    | Illustrative owner situation                                                                                    | Intelligence question                                                                                                  |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>Market and macro</b>                   | Two major regional projects enter procurement while the owner is preparing to tender a hospital expansion.      | Will competition for mechanical and electrical capacity reduce bid coverage or require a different packaging strategy? |
| <b>Capital and portfolio</b>              | Five projects plan commissioning and occupancy within the same quarter.                                         | Does the owner have enough internal, consultant and authority capacity to govern all five transitions?                 |
| <b>Feasibility, scope and stakeholder</b> | A recreation facility is approved before operator requirements and community access commitments are settled.    | Which unresolved requirements could alter area, cost, operating model or approval conditions?                          |
| <b>Design and technical</b>               | Design is reported as 80 percent complete, but controls interfaces and equipment loads remain unresolved.       | Do the remaining interfaces carry more consequence than the completion percentage suggests?                            |
| <b>Regulatory and approvals</b>           | A building-permit milestone is holding, although authority comments depend on a revised life-safety submission. | Is the milestone supported by a complete response path, named owners and realistic review durations?                   |
| <b>Commercial and procurement</b>         | A critical scope sits between two trade packages and neither bidder has included it clearly.                    | Who owns the interface, and what schedule or change exposure will arise if it remains unresolved at award?             |
| <b>Supply chain and workforce</b>         | A selected subcontractor is mobilizing on three projects at once and has not confirmed the named crew.          | Is corporate capacity being mistaken for capacity committed to this project?                                           |
| <b>Execution, schedule and quality</b>    | Float is declining while trade density, inspection demand and deficiencies rise in the same work areas.         | Is local schedule compression beginning to affect quality, safety or downstream access?                                |
| <b>Cost, financial and assurance</b>      | The approved change log remains stable while directives, quotations and potential changes accumulate.           | How much emerging exposure sits outside the current forecast, and what assumptions support the estimate?               |

| Domain                                | Illustrative owner situation                                               | Intelligence question                                                                                     |
|---------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Asset performance and learning</b> | Similar control-system failures recur during warranty on three facilities. | Which design, commissioning or procurement standard should change before the next project reaches tender? |

## 4. Specialized intelligence areas

Not every important capability requires a separate top-level domain. The following specialized areas operate within or across the ten-domain system.

### Claims and dispute intelligence

Connects notices, instructions, contemporaneous records, schedule effects, causation, quantum and contractual requirements. It supports early issue resolution and evidence preservation but should not be confused with a legal determination of entitlement.

### Funding intelligence

Connects project scope and outcomes to grant criteria, lender covenants, reporting obligations, draw conditions and funding milestones. It matters before an award, during delivery and at closeout.

### Sustainability, climate and environmental intelligence

Traces carbon, energy, climate adaptation, water, waste, biodiversity and environmental commitments from business case and design through procurement, construction and actual asset performance. This work tests whether stated targets remain technically achievable, contractually assigned and supported by evidence. It also identifies where resilience requirements affect capital cost, operating cost, approvals, insurance or long-term service continuity.

### Community and stakeholder intelligence

Tracks commitments, concerns, impacts and decision dependencies among users, communities, elected officials, Indigenous groups, neighbours and affected organizations. Sentiment alone is not intelligence; context, representation and materiality matter.

### Operational-readiness intelligence

Connects commissioning, training, staffing, systems integration, documentation, occupancy approvals and transition planning. A project can be physically complete without being operationally ready.

### Information and evidence intelligence

Assesses whether records are complete, current, consistent, attributable and usable. It includes data lineage, version control, missing evidence, contradictory sources and decision traceability. This is foundational to every other form of intelligence.

### Organizational-capability intelligence

Examines whether the owner and delivery organizations possess the governance capacity, experience, resources and decision speed required by the project. A sound technical strategy can fail when organizational capability is insufficient.

## 5. Five lenses that should cross every domain

The ten domains organize what an owner needs to understand. The five lenses determine how that information should be evaluated. Each lens asks a different question, and together they prevent a finding from being reduced to a status update or isolated metric.

### Risk and resilience

**Owner question: What could happen, and how well could the project absorb it?**

This lens examines uncertainty, exposure, dependencies, consequence and recovery capacity. It connects registered risks to current evidence and tests whether mitigations are changing the underlying condition. Resilience adds a second consideration: the ability of the project, organization or asset to continue functioning when disruption occurs. A project may face unavoidable uncertainty and still be resilient if alternatives, contingency, capacity and decision rights are in place.

### Safety and human impact

**Owner question: Who could be affected, and how?**

Construction decisions affect workers, occupants, operators, neighbours, communities and the public. Safety belongs within this wider human context. Leading conditions such as congestion, fatigue, sequencing, supervision, access and temporary operations can be more useful than incident counts alone. Human impact also includes accessibility, service disruption, community commitments, work-force conditions and the consequences of delay for the people expected to use the asset.

### Value and economics

**Owner question: Does the decision still make economic sense?**

This lens considers affordability, capital efficiency, lifecycle cost, cost of delay, opportunity cost, benefits realization and risk-adjusted value. It is broader than cost reporting. A recovery plan may increase construction cost while protecting revenue, public service, financing commitments or operating continuity. Economic intelligence makes those trade-offs explicit. For public projects, value may also include social, regional and service outcomes that cannot be reduced to short-term financial return.

### Evidence and confidence

**Owner question: What supports the conclusion, and how sure are we?**

Every material finding should disclose supporting evidence, contradictory information, source dates, assumptions and the judgment applied. Confidence should reflect the quality and completeness of the evidence rather than the forcefulness of the language. A low-confidence signal can still warrant review when the possible consequence is severe. A high-confidence finding should remain open to correction when newer evidence appears.

### Performance and learning

**Owner question: Is the project producing the intended result, and what should change?**

Performance should be assessed against requirements, plans, comparable projects and intended asset outcomes. Benchmarking belongs here as a disciplined comparison method, provided definitions and contexts are compatible. Learning closes the loop. It tests whether project and asset outcomes

are changing standards, procurement choices, contingencies, governance and future capital plans. Documenting a lesson is only the first step. Evidence of learning appears in the next decision.

## 6. The unit of intelligence is the connection

The ten domains are useful for organizing responsibility. They become valuable when connected.

Consider a hypothetical municipal recreation facility:

- Market intelligence shows strong regional demand for mechanical trades.
- Portfolio intelligence shows three owner projects will require the same commissioning resources within one quarter.
- Scope intelligence reveals that operator requirements are still evolving.
- Design intelligence identifies unresolved controls interfaces.
- Regulatory intelligence shows occupancy depends on integrated testing.
- Procurement intelligence reveals fragmented responsibility for controls integration.
- Workforce intelligence shows the specialist subcontractor has limited local capacity.
- Execution intelligence detects late submittals and compressed commissioning activities.
- Financial intelligence shows contingency remains nominally healthy, but acceleration and extended occupancy costs are not yet forecast.
- Asset intelligence shows similar interface failures occurred on a previous facility.

Each item may sit in a different report. Read separately, they describe normal project friction. Read together, they expose a narrowing decision window. The owner still has options, but those options become more disruptive and expensive as commissioning approaches.

The intelligence finding is the connected interpretation:

Unresolved operator requirements and fragmented controls responsibility, combined with constrained specialist capacity and late submittals, are compressing integrated testing. This may threaten occupancy and create acceleration or temporary-operating costs. Similar failures occurred on a previous project. Executive review of interface ownership, testing sequence and operational contingency is warranted.

The statement does not predict certain failure. It makes a defensible case for attention and identifies the decision that cannot wait for certainty.

### From signal to owner decision

An owner-grade review would separate what is known from what is inferred before deciding whether to intervene:

| Decision element               | Recreation-facility example                                                                                                                           |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Observed condition</b>      | Operator requirements remain unsettled; controls interfaces and submittals are unresolved; integrated testing has less time.                          |
| <b>Supporting evidence</b>     | Requirements log, design-action register, submittal status, commissioning schedule, subcontractor resource plan and prior facility lessons.           |
| <b>Counterevidence to test</b> | The controls contractor may have unreported recovery capacity, testing may contain hidden contingency, or occupancy may not depend on every sequence. |

| Decision element              | Recreation-facility example                                                                                              |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Plausible consequence</b>  | Late integration could delay occupancy, compress defect correction and create acceleration or temporary-operating costs. |
| <b>Decision window</b>        | Confirm interface ownership and the credible testing sequence before downstream commissioning dates become fixed.        |
| <b>Proportionate response</b> | Convene a focused interface review, require an evidence-backed recovery plan and test an operational contingency.        |

This is where intelligence earns its value. It does not replace the project team or declare an outcome. It gives the accountable owner a traceable reason to ask a better question while useful choices remain.

### Reading the example across all ten domains

The same scenario can be read across all ten domains. A comprehensive report might contain every fact and still leave the relationships implicit. The intelligence task is to trace the decision path:

| Domain             | Signal in the scenario                                             | Possible decision consequence                                       |
|--------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|
| Market             | Specialist controls capacity is constrained                        | Alternative sourcing or earlier reservation may be required         |
| Portfolio          | Several owner projects need commissioning resources simultaneously | Executive sequencing or shared-resource decisions may be needed     |
| Scope              | Operator requirements continue to change                           | Testing criteria and operating scenarios remain unstable            |
| Design             | Controls interfaces are unresolved                                 | Submittals, programming and integrated testing may be affected      |
| Regulatory         | Occupancy depends on integrated testing                            | Delay can move directly into public opening and service commitments |
| Commercial         | Controls responsibility is fragmented                              | Gaps, duplicated effort or disputed responsibility may emerge       |
| Supply chain       | The specialist subcontractor has limited capacity                  | Recovery options may be narrower than the baseline implies          |
| Execution          | Submittals are late and commissioning is compressed                | Activities may stack and defect-resolution time may shrink          |
| Financial          | Acceleration and temporary operations are not forecast             | Reported contingency may overstate the owner's available protection |
| Asset and learning | Similar failures occurred before                                   | Existing lessons have not yet changed current delivery practice     |

### Correlation is not causation

Connected intelligence must remain disciplined. Two events occurring together do not prove that one caused the other. Systems should distinguish observed facts, inferred relationships, plausible consequences and confirmed causation.

## Weak signals can matter without becoming alarms

Not every deviation deserves escalation. Mature systems combine materiality, persistence, interaction and consequence. A single late submittal may be routine. A pattern of late submittals affecting near-critical work, combined with unstable design and limited trade capacity, is different.

## Contradictions are themselves signals

When the schedule, meeting minutes and field evidence describe different conditions, forcing premature agreement can hide the real issue. The inconsistency may indicate timing differences, scope interpretation, record quality or a deeper governance problem. Intelligence makes the contradiction visible and assigns it for resolution.

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## 7. What an owner-grade intelligence finding should contain

An owner-grade finding should include at least seven elements:

1. **Condition:** What appears to be happening?
2. **Evidence:** Which records, observations and dates support it?
3. **Counterevidence:** What information points in another direction?
4. **Interpretation:** Why might these facts be connected?
5. **Consequence:** What decision, milestone, cost, obligation or outcome could be affected?
6. **Confidence:** How strong and current is the evidence?
7. **Response:** What review, information request or intervention may be proportionate?

This structure prevents two common failures: unsupported alarms and passive summaries.

The response should normally be framed as a decision or review prompt, not an automated directive. For example:

- Confirm whether the material release date remains compatible with the field need date.
  - Reconcile the schedule status with daily reports before accepting the milestone forecast.
  - Review whether inspection capacity is sufficient for the planned close-in sequence.
  - Quantify exposure from unresolved changes separately from approved change value.
- 

## 8. Construction Intelligence maturity

The starting point is the owner's operating model, not a technology purchase.

### Level 1: Record-based

Project records exist, but access and quality vary. Decisions depend heavily on individuals locating and interpreting documents.

### Level 2: Reported

Standard reports, controls and governance cycles exist. Status is visible, but disciplines remain largely separate and reporting is primarily retrospective.

### Level 3: Connected

Common identifiers, governed information and cross-functional review connect schedule, cost, change, quality, design and field evidence.

### Level 4: Anticipatory

The organization identifies interacting leading indicators, tests possible consequences and directs attention before lagging outcomes are confirmed.

### Level 5: Learning

Project and asset outcomes continuously improve standards, benchmarks, procurement, planning and portfolio decisions. Confidence and intervention effectiveness are measured over time.

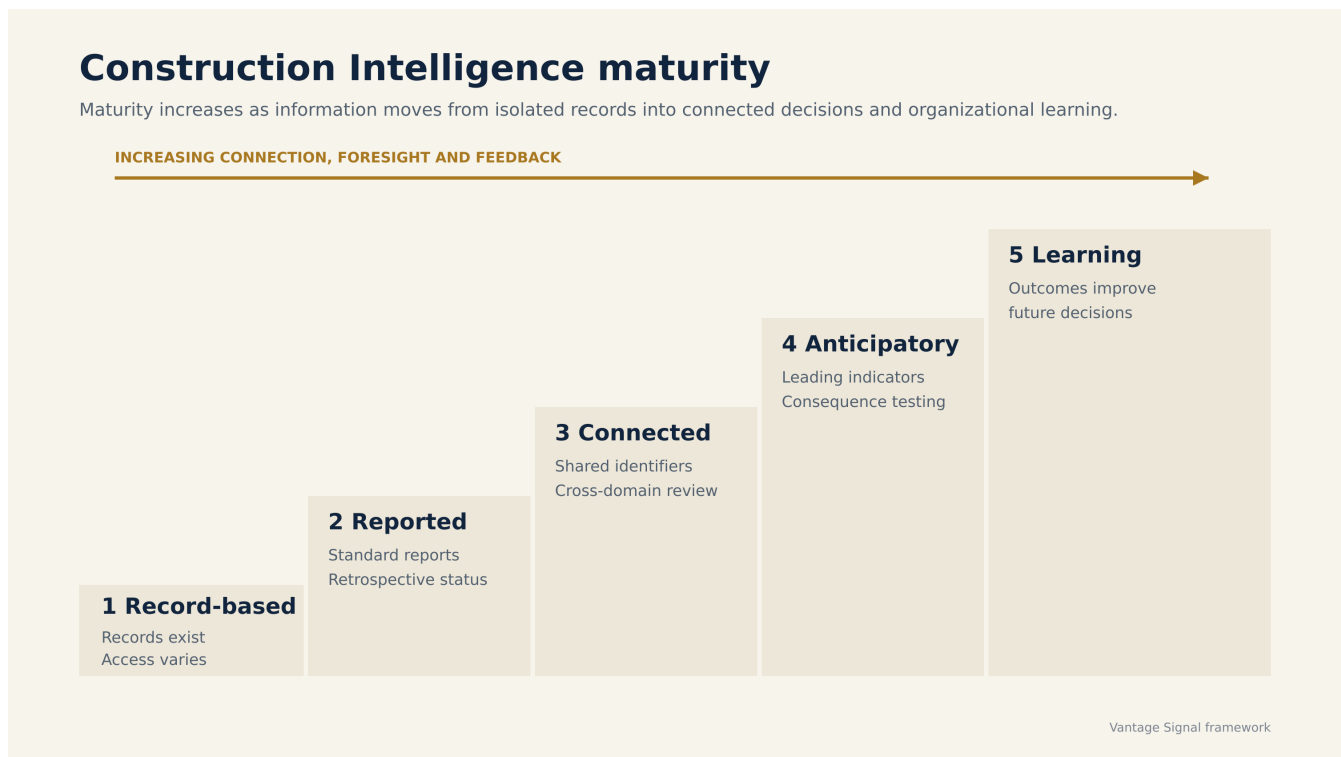


**Figure 6:** Construction Intelligence maturity model

Maturity varies by domain. An owner may have advanced cost controls and weak asset feedback, or sophisticated models and inconsistent scope governance. Each domain needs enough intelligence for the owner's complexity, exposure and decisions. Maximum technology is neither necessary nor useful.

### A practical owner assessment

Owners can begin with twelve questions:

1. Which decisions create the greatest irreversible exposure?
2. What information should inform each decision?
3. Who produces that information, and for what purpose?
4. How current must it be?
5. Can issues be traced across scope, design, schedule, cost and field records?
6. Are important assumptions explicitly recorded?

7. Are contradictory sources reconciled or merely reported separately?
  8. Can emerging exposure be distinguished from approved cost?
  9. Are governance thresholds based on materiality and consequence?
  10. Can leaders inspect the evidence behind a finding?
  11. Do lessons from completed assets alter future decisions?
  12. Can the organization measure whether earlier intervention improved outcomes?
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## 9. The role and limits of artificial intelligence

Artificial intelligence can materially expand Construction Intelligence by extracting information from unstructured documents, normalizing entities, detecting patterns, connecting records and producing targeted summaries. It may make forms of analysis economical that previously required extensive manual review.

But AI introduces its own governance requirements.

### Source traceability

Every material finding should link back to source evidence. A persuasive summary without traceability is not owner-grade intelligence.

### Temporal awareness

Projects change continuously. Systems must distinguish superseded information from current information and avoid combining records from different reporting periods as though they describe the same state.

### Role and contractual context

A statement in a contractor report, consultant certificate, owner email and site observation carries different meaning. AI should not flatten those distinctions.

### Uncertainty and abstention

Systems should be able to state that evidence is insufficient, conflicting or outside their competence. Forced conclusions create false confidence.

### Human accountability

AI can recommend attention. Authorized people must remain accountable for project direction, professional certification, contractual decisions and public-interest judgments.

### Bias toward what is documented

The formal record captures only part of the project. Important field knowledge may never enter a system, while heavily documented issues may appear disproportionately important. Intelligence programs must include human observation and structured challenge.

The practical near-term model is **evidence-linked human-machine collaboration**. Machines expand the volume and speed of review. People supply context, authority, skepticism and judgment.

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## 10. What Construction Intelligence should not become

As the category develops, owners should resist several failure modes.

### Another dashboard layer

Consolidating metrics can improve visibility, but a dashboard that reproduces disconnected measures does not solve fragmentation.

### A universal risk score

Simple scores can support triage. They can also conceal uncertainty, context and interaction. No single number should replace the evidence and reasoning behind it.

### Automated blame allocation

Early signals are often ambiguous. Intelligence should support intervention and evidence preservation, not assign responsibility before facts and contractual context are established.

### Data extraction without reciprocity

Owners benefit when delivery partners trust that information will be used consistently and proportionately. Intelligence governance should define access, purpose, correction and escalation rights.

### Technology-led operating design

Tools should follow decisions, roles and information requirements. Automating an unclear process can make confusion faster and more authoritative-looking.

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## 11. A practical operating model for owners

A Construction Intelligence function can start small, provided its mandate is clear.

### Define the decisions

Identify high-consequence decisions across approval, procurement, design release, change authorization, payment, schedule recovery, occupancy and portfolio funding.

### Map the evidence

For each decision, define the required sources, owners, cadence, quality criteria and escalation threshold.

### Establish common identifiers

Projects need durable ways to connect locations, systems, trades, schedule activities, cost codes, changes, inspections and documents. Perfect standardization is unnecessary, but some shared semantic structure is essential.

### Separate fact from inference

Findings should visibly distinguish source facts, calculated measures, professional opinions and machine-generated interpretations.

### Create an intelligence cadence

Not every signal belongs in a monthly report. Owners should align review frequency with the speed at which exposure can form. Near-term execution may need continuous or weekly review; portfolio allocation may be monthly or quarterly.

### Preserve challenge

Project teams should be able to correct data, add context and challenge interpretations. Independent review is strongest when it is evidence-led and procedurally fair.

### Measure intervention quality

Finding volume is a poor measure of value. Track whether findings were timely, whether they changed a decision, whether the anticipated consequence occurred and whether the intervention reduced exposure.

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## 12. The emerging Construction Intelligence system

Construction has many of the necessary components already:

- Project controls provide schedule and cost discipline.
- BIM and information-management standards provide structured lifecycle information.
- Field systems capture production, inspection and safety activity.
- Commercial systems manage commitments, changes and payments.
- Governance and assurance frameworks define accountability and decision gates.
- Asset systems retain operating and maintenance information.
- Market datasets describe labour, prices, permits, capital and supply conditions.

The emerging opportunity is to connect them around owner decisions.

Technical integration is only part of the work. The industry will also need common language, clear evidence standards, information rights, cross-project learning and governance models that preserve both independence and collaboration.

The category will likely develop in stages:

1. Better retrieval and evidence organization
2. Cross-system entity and issue connection
3. Continuous detection of patterns and contradictions
4. Consequence modelling and scenario analysis
5. Portfolio-level benchmarking and learning
6. Intelligence embedded directly into decision workflows

An autonomous project is not a credible destination. Construction is too physical, contractual, contextual and human. A more useful future would allow owners and project teams to see important conditions earlier, interrogate the evidence faster and carry learning from one decision to the next.

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## 13. Vantage's perspective

Vantage is developing an independent construction execution-risk intelligence layer for project owners. Its present focus is narrower than the full Construction Intelligence system described in this

guide: connecting schedules, changes, inspections, quality records, meeting minutes and delivery information to identify where execution pressure may be forming and why it matters.

That positioning is deliberate. No single platform should claim to own every form of Construction Intelligence. Market specialists, designers, project-controls teams, commercial advisers, inspectors, operators, public authorities and project participants each contribute essential knowledge.

Vantage's thesis is that the owner still needs a connected, evidence-backed view across those contributions, particularly where conditions interact and emerging exposure is not yet visible in conventional reporting.

Construction Intelligence should therefore be understood as a system, not a product category controlled by one vendor.

The measure of that system is straightforward:

Does it help the right person understand a material condition, its evidence and its possible consequences early enough to make a better decision?

If it does not, it may still be useful data, software or reporting. It is not yet intelligence.

## Research notes and selected sources

This report is a category framework and interpretive synthesis, not a systematic literature review. Quantitative findings should be read in the context of their original samples, methods and sponsors.

- Construction Industry Institute. Assessment of Effective Front End Planning Processes. Research summary drawing on a multi-year CII research program.
- Construction Industry Institute. Front End Planning: Break the Rules, Pay the Price. Research on alignment, scope definition, contracting strategy and early planning.
- International Organization for Standardization. ISO 19650-1:2018. Concepts and principles for information management over the lifecycle of built assets using BIM.
- National Institute of Building Sciences. National BIM Standard - United States V3. Lifecycle and interoperability framing for facility information.
- UK Infrastructure and Projects Authority. Project Routemap: Setting Up Projects for Success. Guidance spanning requirements, governance, procurement, risk, organizational capability, systems integration and asset management.
- UK Infrastructure and Projects Authority. Project Routemap: Governance Module. Guidance on accountability and decision-making for complex projects.
- Autodesk and FMI. Harnessing the Data Advantage in Construction. Global industry survey on data quality and data strategy; vendor-sponsored and used here with that qualification.

## Figure notes

- **Construction Intelligence system, information-to-intelligence model, connected-risk pathway and maturity model:** original Vantage Signal frameworks developed for this report.
- **Front-end planning outcomes:** visualizes the published CII ranges of 6 to 25 percent for cost differences and 6 to 39 percent for schedule differences. The chart does not present the ranges as guaranteed savings.
- **Construction data practices:** visualizes selected Autodesk and FMI survey findings. The denominator for the three practice measures is the group described by the study as respondents who consistently incorporated project data into decision-making. The chart identifies the study's sponsorship.