Design Intent as a Systemic Capability at Scale

Why outcomes degrade without anyone failing

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This paper is an observational analysis grounded in publicly sourced labor, regulatory, and production data spanning 1986–2024. The datasets were selected prior to and independent of the instrument developed to visualize them — the pattern preceded the framework, not the reverse. It does not present controlled experimental findings. It presents a documented pattern and the mechanism that explains it. The condition described is not regional — equivalent data from European construction markets reflects the same reorganization under identical mechanisms, with variation in timing but not in trajectory.

A companion diagnostic paper examines the same conditions through direct professional observation rather than sourced data.

Abstract

Construction productivity in the United States has declined continuously since 1987, falling from an index of 100 to 91.2 by 2024, while total construction put-in-place grew from $390 billion to $2.1 trillion over the same period. This argues that the primary driver of that decline is not technological inadequacy, labor shortage, or organizational failure, but the systematic elimination of the mechanism that once carried design intent reliably from formation to execution. Drawing on forty years of sourced labor, regulatory, and production data — including a reduction of 160,000 architectural and civil drafters from peak employment, a 15,000-fold increase in project management certification, a 637% increase in RFI frequency per million dollars of project value, and a 24-fold increase in ConTech venture capital investment since 2010 — it demonstrates that the industry has continuously scaled its compensating mechanisms while the root condition worsened. The analysis identifies four control functions historically embedded in drafting practice — compression, hierarchy, propagation, and constraint — and examines how their reorganization under digital workflows, layered delegation, and hyperscale delivery produces predictable outcome degradation without individual error or negligence. The owner is identified as the only party positioned above the discipline silos, delivery friction, and contractual defensiveness that prevent the system from correcting itself.

Preface

This paper examines the erosion of design intent as a systemic failure rather than a disciplinary one.

Design intent is the reason drawings exist at all. It is the continuous thread of decisions—proportional, relational, and contextual—that must survive translation across people, tools, and time. When that thread weakens, precision increases while clarity collapses.

The disappearance of formal drafting language did not eliminate the need for intent exchange; it eliminated the carrier. What replaced it—procedures, platforms, automation, and markup volume—has increased visible activity while quietly degrading outcomes.

This document is not a proposal, a critique, or a call for new systems. It is an observational note drawn from long exposure to engineering, construction, and production environments operating under pressure and at scale. The focus is not how work is performed, but how intent moves—or fails to move—through existing mechanisms.

Although examples are drawn primarily from structural practice, the conditions described are interdepartmental by nature. The failure is archetypal, not organizational. No discipline owns it—and none can repair it alone.

The sections that follow are arranged to be read sequentially, but each stands independently. Together, they describe why outcomes degrade even when competent people are doing their jobs—and why recovery depends less on innovation than on restoring a capability the industry once relied on, but no longer recognizes.

I — Design Intent Is the Reason Drawings Exist

Design intent is not an abstract concept, nor is it a project phase. It is the reason drawings exist at all.

In its classical form, design intent followed a simple trajectory:

- Intent was formed privately through sketching, calculation, and conversation.
- That intent was pressure-tested informally through proximity to fabrication, construction, and prior failure.
- Drawings translated intent into a shared language that allowed others to act without reinterpretation.

The depth of the designer's exposure mattered. It allowed engineers to confront the most obvious, expensive, tedious, and disruptive characteristics of a decision early—before scale multiplied cost. This was not adversarial review; it was collaborative protection of the work itself.

Today, design intent still forms—but it no longer travels cleanly. Intent is fragmented across models, markups, RFIs, and coordination cycles. It is inferred rather than declared. The drawing set no longer carries a continuous narrative of decisions; it carries the residue of many partial ones. This is not a failure of individuals. It is the result of a broken carrier.

The disappearance of drafting as a taught language did not eliminate the need for intent exchange—it merely removed the mechanism that once made it reliable. What remains is a process that produces drawings, but not always understanding. At scale, this distinction becomes material.

Design intent does not end when drawings are issued. It imprints itself—successfully or not—into every downstream action: detailing, procurement, fabrication, construction sequencing, and change management. When intent is incomplete or unstable, downstream teams are forced to reconstruct it under pressure. That reconstruction is expensive, conservative, and rarely optimal.

Owners already pay for design intent. When it fails to transfer, they pay for it again.

II — Design Intent Has Not Disappeared (Its Carrier Has)

Design intent did not vanish from practice. What disappeared was the mechanism that reliably carried it forward.

Historically, design intent moved through a narrow but continuous path: from private formation (sketching, calculation, reasoning), into shared representation, and then outward through drawings that embedded judgment, proportion, and expectation. That transfer relied less on tools than on exposure—direct, repeated contact with how decisions manifested downstream.

Designers occupied the center of this exchange. Their role was not procedural. It was connective. They translated intent into form while pressure-testing it against fabrication, assembly, sequencing, and constructability. Their authority did not come from licensure or hierarchy, but from proximity to consequence.

That role no longer exists as a coherent position.

Its responsibilities were not eliminated; they were distributed unintentionally across engineers, drafters, reviewers, BIM specialists, and managers. Each now holds a fragment of the original function, often competently, but without sufficient exposure to carry intent end-to-end. The result is not failure. It is diffusion.

Intent still originates, but it no longer travels intact. As it moves downstream, it fragments into representations, assumptions, reactions, and corrections. Where exposure once compressed feedback early, the system now relies on late discovery—through markups, RFIs, coordination cycles, and field clarification.

These mechanisms are not broken. They are simply being asked to perform a role they were never designed to carry. The disappearance of the carrier did not eliminate the need for intent exchange. It only made that exchange indirect, reactive, and increasingly expensive.

At small scale, this shift is tolerable. At hyperscale, it becomes structural.

III — Judgment at Scale: When Proportion Is Lost Before Anyone Is Wrong

As scale increases, judgment must move earlier — not become more conservative.
In practice, the opposite often occurs.

When design intent is incomplete or weakly transmitted, teams compensate by claiming space: increasing sizes, thickening elements, extending extents, and hardening assumptions. This behavior is not reckless. It is protective. Engineers and designers are trained to reduce risk when certainty is unavailable.

At modest scale, this tendency self-corrects. With time, exposure, and iteration, early conservatism relaxes. Dimensions shrink. Systems clarify. Economy emerges.

At large scale, that relaxation rarely occurs. Schedule pressure, parallel development, and fragmented responsibility prevent provisional decisions from being revisited. What began as caution calcifies into permanence. Quantities inflate. Redundancy accumulates. Entire systems are sized around early uncertainty that was never pressure-tested. This is not error. It is the predictable outcome of judgment operating too late.

To understand how these structural dynamics manifest in day-to-day practice, it is useful to examine how digital formation, delegation, and library structures collectively shape the transmission and realization of design intent.

Digital Formation, Delegation, and the Compounding of Conservatism

The transition to CAD-based production, combined with layered delegation and large, structured libraries, fundamentally reorganizes how design intent is transmitted and realized. Design work is formed in native digital environments and reviewed through secondary representations—PDFs, plotted sheets, or model visualizations. In most medium and large projects, the Engineer of Record does not directly manipulate the model on a daily basis and therefore cannot directly insert intent. Even when libraries, templates, or parametric rules are used, intent cannot be encoded; these systems reproduce geometry, enforce rules, and carry volume, but they do not carry judgment. Details default to conservative, low-risk solutions, selected from vast, highly structured repositories that require filing conventions, abbreviations, and syntax to remain navigable. These structures obscure original intent, freeze content from casual alteration, and disconnect the creator from the point of insertion. Importantly, these libraries are not live views of the model: any detail pulled is a static copy, which ensures that the first insertion almost always generates downstream adjustments or markups.

Delegation further separates authority from formation. Junior or embedded designers may be proximate to creation, but without judgment training and without authority, any adjustments they make are often ignored, reversed, or misapplied. Authority resides at higher levels—EORs or managers—who are increasingly removed from daily exchanges and cannot intervene within the short "flex window" when proportional judgment would be most effective. The combination of screen-mediated review, delegation, and static library usage compresses that window: by the time review occurs, work has hardened, repetition has amplified early conservatisms, and adjustments carry significant cost. Each of these mechanisms compounds across scale, projects, and prior work: small, conservative decisions accumulate like compound interest, producing systematic inflation of material, labor, and schedule even in the absence of error or negligence.

The result is a predictable structural outcome: design intent is displaced, conservatism multiplies, and judgment applied after formation is largely interpretive rather than authorship. This does not indicate incompetence or malfeasance; rather, it reflects the physical and temporal realities of modern digital workflows. Understanding these mechanics highlights why early, proximate intervention—the only method to act within the flex window—is essential to preserve proportional judgment and maintain the efficacy of intent at scale.

The Loss of Proportional Sense

Proportion is not optimization. It is recognition.

It is the ability to sense when something is "too much" long before it is demonstrably wrong. Excessive slab thickness at entries. Railings where walls already provide enclosure. Uniform solutions applied to dissimilar conditions. Reinforcement added because removal feels unsafe.

These decisions often pass review because they are defensible in isolation. The problem is cumulative. When repeated across hundreds or thousands of instances, small conservatisms become material events.

At hyperscale, proportion is no longer aesthetic or academic. It is economic.

Why This Escapes Review

Formal reviews are well suited to checking compliance, calculation, and coordination. They are poorly suited to questioning necessity.

Proportional judgment relies on exposure: familiarity with fabrication limits, construction sequencing, field tolerance, and historical precedent. When that exposure is thin or unevenly distributed, the safest path becomes adding rather than subtracting.

No single decision triggers concern. The aggregate does — too late.

A Quiet Shift in Responsibility

In earlier practice, designers served as the first line of proportional judgment. Their role was not to optimize, but to recognize when intent was drifting toward excess before it became embedded in drawings, schedules, and contracts.

Without that role, proportional sense is deferred downstream — to construction, procurement, and change management — where correction is costliest and most adversarial.

This is why owners increasingly experience conservatism as waste rather than protection. Not because teams lack skill. But because judgment is arriving after scale has already multiplied consequence.

While these constraints are pervasive, the structural analysis also suggests that the system's latent capacity for judgment could be harnessed if authority, proximity, and workflow were realigned, highlighting where interventions—either procedural or organizational—might most effectively preserve proportional intent before work hardens.

IV — Late Discovery and the Illusion of Progress

When intent no longer travels cleanly, the system prevents failure by discovering it late. That discovery most often takes the form of markups. Markups were never intended to generate design intent. They were intended to verify it.

In their classical role, markups confirmed clarity, resolved true conflicts, and fine-tuned communication. They occurred after intent had largely stabilized and were limited in number, scope, and authority.

Today, markups frequently perform a different function. They are used to discover intent after drawings already exist.

Why Markups Feel Productive

Markups generate visible activity. They produce movement, feedback, and iteration. They create the appearance of engagement and progress, particularly in distributed teams where other forms of exchange are limited. This makes them psychologically satisfying and managerially defensible.

But much of this activity is reactive rather than directional.

Instead of advancing clarity, many markup cycles correct presentation, relocate information, or adjust scope that was never fully formed. The same categories of issues recur across successive passes, often addressed by different authors without cumulative learning. Rework accumulates quietly.

The Shift in Responsibility

As markups expand in scope and authority, responsibility for intent shifts downward and outward.

Junior engineers and designers are asked to interpret and respond to marks without having participated in intent formation. They are expected to "fix" drawings rather than question what is missing. The safest response becomes compliance, not clarification.

This dynamic is particularly dangerous when combined with partial technical training. Untrained or under-exposed contributors may generate sketches, responses, or revisions that appear coherent locally but conflict globally.

The system absorbs these conflicts until it can no longer do so cheaply.

Tooling That Reinforces the Problem

Modern markup environments increasingly resemble drawing tools. Symbols, callouts, section markers, and pseudo-detailing features allow marks to look complete before intent is complete.

This creates the illusion of consistency while bypassing judgment.

When markup artifacts begin to resemble final documentation, the distinction between exploration and decision collapses. Cosmetic precision replaces conceptual clarity. The system becomes excellent at reacting to drawings and poor at driving them.

What Is Actually Being Measured

Markup volume is rarely analyzed. Patterns are rarely examined.

Because review comments are associated with individuals, examining them feels like personnel evaluation rather than production analysis. As a result, systemic signals remain buried inside private exchanges.

The organization becomes efficient at correcting itself — and inefficient at preventing the need for correction. This is not misuse. It is adaptation.

Markups have expanded to fill the void left by a missing carrier of intent. They work — but at increasing cost, diminishing clarity, and accelerating conservatism. The system survives. Outcomes degrade.

V — Why This Matters Now

The conditions that once absorbed intent loss no longer exist.

For decades, inefficiency in intent exchange was buffered by time, surplus capacity, and local correction. Printing cost money. Coordination was physical. Revision cycles were naturally constrained. Conservative decisions had room to relax before becoming permanent. Those constraints are gone.

- Printing is free.
- Iteration is frictionless.
- Parallel work is the default.

What was once self-limiting now scales effortlessly.

Scale Multiplies Small Decisions

At contemporary project scale—particularly in energy, industrial, and data center work—minor conservatisms are no longer minor. Steel mills roll in schedules, not on demand. Concrete is costly to transport and often produced on site under tight spatial constraints. Rebar, plate, and specialty sections are subject to lead times that cannot be negotiated away.

- When intent is unstable, early decisions default conservative.
- When conservative decisions persist, quantities inflate.
- When quantities inflate across thousands of repetitions, material availability becomes schedule.

Efficiency becomes speed.

In this environment, the difference between "enough" and "too much" is not academic. It is the difference between meeting demand and falling behind it.

Late Correction Is No Longer Benign

At hyperscale, correction does not merely cost money. It consumes capacity.

- Field changes displace labor.
- Rework disrupts sequencing.
- Clarifications stall parallel operations.

The industry has learned to tolerate this through contingency, change management, and contractual elasticity. But tolerance is not the same as sustainability.

The cost is paid twice: once in excess design, and again in downstream disruption.

A Structural Inflection Point

The industry is responding to these pressures with automation, offshore modeling, and increasingly elaborate review structures. These efforts improve execution speed but do not address the root condition.

Design intent is still forming. It is still needed. But its exchange mechanism has not adapted to scale.

- This is not a skills shortage problem.
- It is not a software problem.
- It is not a staffing problem.

It is a capability problem.

The systems now carrying intent were never designed to do so under these conditions. As scale increases, their limitations become unavoidable. This is why the issue is surfacing now—not because practice has worsened, but because consequence has grown faster than correction.

VI — A Different Way to Protect Outcomes (Without Owning the Process)

This is not a call for more tools, more reviews, or owner-imposed standards. It is a call to recognize when existing mechanisms are being asked to perform the wrong role.

In many cases, imposed standards worsen the problem by shifting focus from intent to compliance. They increase visible consistency while narrowing judgment, and they often substitute procedural correctness for conceptual clarity.

A more effective posture is intent stewardship.

Intent stewardship does not replace existing processes. It reorients how they are used. It emphasizes:

- early confirmation that design intent is sufficiently complete *before* scale multiplies cost
- focused review of decision clarity rather than presentation polish
- recognition of recurring markup patterns as system signals, not individual performance
- separation of production analysis from personnel evaluation
- restrained, intentional use of markups to preserve signal quality

Early confirmation is not finalization. It is a shared recognition that remaining uncertainty is bounded, visible, and intentional — producing the most honest conservative position, rather than the most defensive one.

Designers and engineers are trained to claim space early, particularly when modeling advances faster than analysis. Under stable conditions, judgment sharpens with time and scope relaxes toward economy. Under schedule pressure, that relaxation never occurs. Conservatism hardens. Quantities inflate. Provisional decisions calcify.

Intent stewardship interrupts that trajectory *before* it becomes irreversible.

It relies on informed judgment and shared accountability. It cannot be reduced to contractual checklists or automated enforcement without destroying the signal on which it depends.

This posture does not slow delivery. It restores direction.

VII — Stewardship at the Only Level That Can Restore It

Design intent does not erode because people stop caring. It erodes because responsibility for carrying it becomes diffuse.

When intent weakens, engineering compensates. When engineering compensates, conservatism spreads. When conservatism spreads at scale, outcomes degrade quietly and predictably.

- No discipline can correct this alone.
- No platform can automate it.
- No standard can enforce it.

Because the failure is archetypal.

Owners sit above discipline silos, delivery friction, and contractual defensiveness. They are uniquely positioned to *see* when intent begins to erode — and uniquely empowered to restore it once it does.

More importantly, they are the only ones who can do so without distortion.

Early confirmation of intent is not premature control. It is not interference. It is not optimization. It is recognition.

- Recognition that remaining uncertainty is bounded.
- Recognition that judgment has been applied where it matters most.
- Recognition that conservatism is intentional, not accidental.

Early confirmation will always yield the most conservative number. But it will also be the most honest one. The alternative is not flexibility. It is accumulation.

As projects grow larger, faster, and more parallel, reliance on late discovery becomes unsustainable. The industry cannot build its way out of intent loss with software, staffing, or review layers alone. What is missing is not innovation. It is stewardship.

The great drafting rooms of the past did not succeed because of tools, hierarchy, or nostalgia. They succeeded because they produced individuals who could carry intent across boundaries — people overqualified in everything except being engineers, yet indispensable to engineering itself. That persona disappeared. The need did not.

If restored — in any form that survives the next platform — it will not belong to one firm, one discipline, or one role. It will belong to the work. And to those willing to protect it before scale makes correction impossible.

Without deliberate stewardship, design intent is still paid for—only later, and at scale, in cost, delay, and permanent conservatism.

APPENDIX CLOSING NOTE

The datasets in this appendix were identified and assembled before the analytical framework of this paper was formalized. The convergence of independent variables across labor, regulatory, process, and production categories toward a single directional outcome was itself the observation that generated the argument. A companion dataset drawn from European construction markets — Eurostat, ECAB, and equivalent national productivity indices — reflects the same pattern with a time offset, suggesting the condition is structural rather than regional, regulatory, or cultural.