

TO IMPROVE PERFORMANCE IN COMPLEX ENVIRONMENTS, YOU MUST FIRST UNDERSTAND AMBIGUITY

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ABSTRACT

Construction delivery has traditionally treated ambiguity as a defect to be designed out through greater definition, risk transfer, and compliance to plan. Building on the IGLC complexity stream, this paper argues that this logic is increasingly inverted in major projects delivered through multi-organisation, multi-discipline systems. In complex work, ambiguity is not only a lack of information in documents, but a normal operating condition shaped by both indeterminacy in the work itself and divergent interpretations across dense stakeholder interfaces.

Drawing on Cynefin, Lean Construction complexity literature, and cognitive science, the paper explains why ambiguity persists even when technical scope is clarified, and how fragmentation of scopes, contracts, and responsibilities can stabilise local certainty while reinforcing cross-boundary misalignment. This misalignment may remain locally coherent yet systemically incompatible, accumulating as coordination debt that later appears as rework, delay, escalation, claims, and exhaustion.

The paper concludes that reducing ambiguity in complex work is not a one-time front-end task, but an ongoing need. LPS and Scrum are interpreted as recurring convergence mechanisms that use cadence, transparency, planning readiness, and learning loops to shorten the lifespan of misalignment and improve delivery reliability.

KEYWORDS

Last Planner® System, complex/complexity, psychological safety, agile/scrum, cognition.

INTRODUCTION

Projects are being delivered under increasingly complex conditions, including greater regulatory and compliance demands, more elaborate contractual and commercial arrangements, larger stakeholder environments, and denser interface structures (McKinsey Global Institute, 2017). In this paper, that increasing complexity is treated not simply as a matter of project size, but as a growing coordination challenge created by the number of parties involved, the interdependence of their decisions, the evolving conditions under which delivery must occur, and the increased pace enabled by digital technologies.

In 2003, Bertelsen & Koskela initiated the IGLC complexity stream, reframing construction through a complexity and chaos lens, highlighting projects as non-linear systems where feedback and interaction can destabilise traditional predict-and-control logics (Bertelsen, 2003a; Bertelsen & Koskela, 2003). Later work developed coping and reduction strategies to stabilise

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production and manage complexity's impact on flow (Bertelsen & Koskela, 2005; Miranda Filho et al., 2016). More recently, Kalsaas, Bølviken, & Skaar made the dual-strategy nature of complexity in construction explicit – distinguishing between efforts to transform complexity toward the complicated domain and the need to also operate effectively in complexity when it cannot be transformed away (Kalsaas, Bølviken, & Skaar, 2022).

While this literature has significantly advanced understanding of construction as a dynamic and interconnected system, directly comparable to theories on complex systems and chaos, less explicit attention has been given to ambiguity as the interpretive condition through which complexity is experienced and acted upon by project participants across organisational, disciplinary, and contractual interfaces. This paper responds to that underdeveloped area by extending the IGLC complexity stream through a more explicitly socio-technical framing. It treats ambiguity and misalignment as normal conditions in socio-technical systems and argues for recurring coordination loops that expose divergence early, support the development of shared understanding, and strengthen commitment before misalignment becomes embedded in delivery. In this sense, the paper connects the IGLC complexity discussion more directly to questions of interpretation, coordination, learning, and production reliability across project interfaces. Ambiguity has traditionally been treated as a risk in project delivery: the enemy of performance, the source of waste, a contractual exposure, and something to be designed out through clearer scope, tighter controls, and stronger upfront definition. In that worldview, better projects are simply those that achieve unambiguous clarity sooner.

This paper argues that this assumption is increasingly inverted in contemporary major projects characterised by multi-organisation, multi-discipline delivery systems. In complex project environments, ambiguity is not merely a failure of definition; it is a normal operating condition created by high interdependence, interface density, and the fact that different stakeholders interpret “what is happening” through different mental models. We develop this argument by: (1) explaining complexity through the Cynefin Framework and how the capacity to reduce ambiguity through up-front definition changes across domains; (2) introducing technical, cognitive, and social ambiguity, and showing why cognitive and social ambiguity rise as work becomes more interaction-dependent; (3) drawing on cognitive science to describe the brain as predictive and energy-conserving, and how this contributes to persistent divergence in multi-actor systems; (4) describing how traditional project management structures can delay, conceal, or widen these gaps; (5) explaining how LPS and Scrum reduce the lifespan of misalignment through recurring convergence loops; and (6) concluding that domain-aligned socio-technical systems that make ambiguity visible and manageable can improve both productivity and wellbeing outcomes in major construction delivery.

This paper adopts a conceptual review approach rather than a systematic or systematised review methodology. Sources were selected purposively based on their relevance to ambiguity, complexity, coordination, LPS, and Scrum.

THE CYNEFIN FRAMEWORK TO DEFINE COMPLEXITY

In this paper, we use the Cynefin domains as an interpretive lens for different ambiguity conditions, highlighting how decision logic shifts as ambiguity moves from low and controllable to emergent and destabilising.

Cynefin is a sensemaking framework that distinguishes contexts by the predictability of cause–effect and links each context to an appropriate response logic (Snowden & Boone, 2007). Sensemaking here refers to constructing a plausible shared interpretation of “what is happening” so that action fits reality, particularly when signals are ambiguous or contested (Weick, 1995; Weick, Sutcliffe & Obstfeld, 2005). Cynefin distinguishes ordered domains (where pre-definition is feasible) from unordered domains (where learning must occur through action). In Clear, a best practice can be applied through sense–categorise–respond. In Complicated,

expertise is required and the logic becomes sense–analyse–respond. In Complex, outcomes emerge through interaction, so teams must probe–sense–respond to learn what works. In Chaos, stabilising action comes first (act–sense–respond). The central Confusion/Disorder state describes misdiagnosis – being managed as if work is ordered while it is experienced as emergent (Snowden & Boone, 2007).

In major project environments, most downstream construction production is typically closer to the ordered (Complicated) domain, while design coordination and scope shaping often sits closer to the Complex domain – though both can shift as uncertainty rises or stabilises.

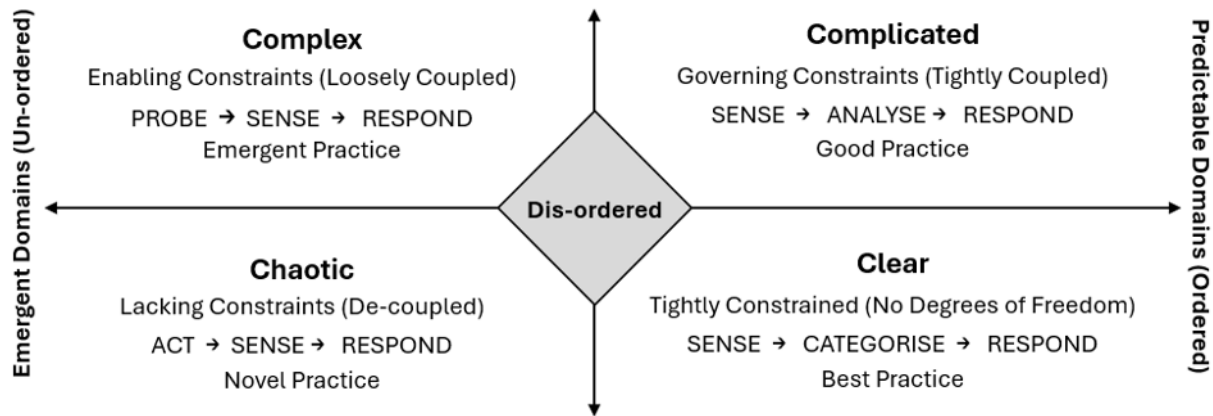


Figure 1: Cynefin sensemaking domains and context-appropriate response patterns (Snowden & Boone 2007)

HOW AMBIGUITY RELATES TO COMPLEXITY

In this paper, ambiguity is understood as having both ontological and epistemological dimensions. Ontological ambiguity arises where aspects of the work itself—such as scope, requirements, interfaces, or consequences—are not fully determinate in advance. Epistemological ambiguity arises because actors interpret project conditions through different experiences, assumptions, disciplinary lenses, and partial information. In project delivery, this allows multiple interpretations to coexist, so different parties proceed under different assumptions about what is likely, important, or correct. The paper focuses mainly on epistemological ambiguity as it is experienced in coordination and decision-making, while arguing that it is often intensified by ontological ambiguity in the work itself. For this paper, we introduce three types of ambiguity:

1. **Technical ambiguity** refers to contractual language (and linked instruments such as scope, assumptions, deliverables, exclusions, programme and risk allocation) that is “ambiguous or susceptible of more than one meaning,” such that reasonable parties can adopt different interpretations of what is required and who is responsible (Codelfa Constructions Pty Ltd v State Rail Authority of New South Wales (1982) 149 CLR 337).
2. **Cognitive ambiguity** concerns situations where the *same information or stimulus* can support multiple possible interpretations during sensemaking, because meaning is not fixed until an interpretation is formed (Weick 1995).
3. **Social ambiguity** is uncertainty about how other actors will interpret, value, or respond (their intentions, norms, preferences, and likely actions), because the meaning of the situation is shaped by human agency rather than only by impersonal technical facts (Li, 2020; Fiedler et al., 2024).

Figure 2 frames this relationship by treating the Cynefin domains as distinct states of work ambiguity, and by showing the corresponding shift in decision logic from “sense first” to “act

first.” In the Clear (or Simple) domain, interpretive ambiguity is minimal because cause–effect is obvious, meanings are stable, and standard work can be applied with minimal coordination overhead. Figure 2 frames this domain as having “low ambiguity”, because Epistemological ambiguity can still exist, even when Ontological ambiguity is removed.

In the **Complicated domain**, ambiguity is controllable, and while multiple solutions may exist, uncertainty can be reliably reduced through expertise, analysis, planning and specification. This matches the “Sense First / Pre-Definition” logic in Figure 2 where teams can define tasks and handoffs with sufficient clarity to execute predictably.

By contrast, in the **Complex domain**, ambiguity is normal because understanding is emergent. All work cannot be accurately specified upfront because the interactions between designers, stakeholders, constraints, and partial solutions *create and reveal* the real work over time. In this domain, ambiguity is not simply a planning risk to eliminate early; it is a normal condition of work in this domain. This is why Figure 2 shifts to “Action First / Post-Definition”: teams must probe reality through action, learn from feedback, and iteratively refine meaning and commitments. In the **Chaos domain**, ambiguity becomes chaotic because the environment is unstable; action is required first to stabilise conditions before sensemaking becomes possible.

Finally, Figure 2 highlights a critical failure mode: the **disordered** state. This is where teams experience both process (Cynefin domain) ambiguity and work ambiguity. In practice, this is a misdiagnosis problem because applying pre-definition logic to emergent work (over-specification, false certainty) or treating definable work as complex (excessive discussion and churn) creates confusion. This “confused definition” state is especially wasteful because it amplifies ambiguity rather than reducing it, eroding systems trust and creating misalignment, late rework, and coordination breakdown.

THE PREDICTIVE BRAIN, COGNITIVE AND SOCIAL AMBIGUITY

People coordinate through **mental models**: implicit assumptions about what matters, which constraints are real, what good work looks like, what others intend, and what success requires (Weick, 1995; Weick et al., 2005). When these mental models diverge, individuals and teams may continue to act confidently while operating within incompatible local realities. This is the basis of **social ambiguity**.

This is not mainly a moral failing or even a conscious choice; it is a cognitive default. Contemporary cognitive science describes perception and action as fundamentally predictive: people do not passively receive reality, but interpret it through internal models that are continuously updated (Friston, 2010; Rao & Ballard, 1999; Clark, 2016). This predictive strategy helps economise limited cognitive and metabolic resources by prioritising surprise or prediction error rather than processing every input from scratch (Clark, 2013).

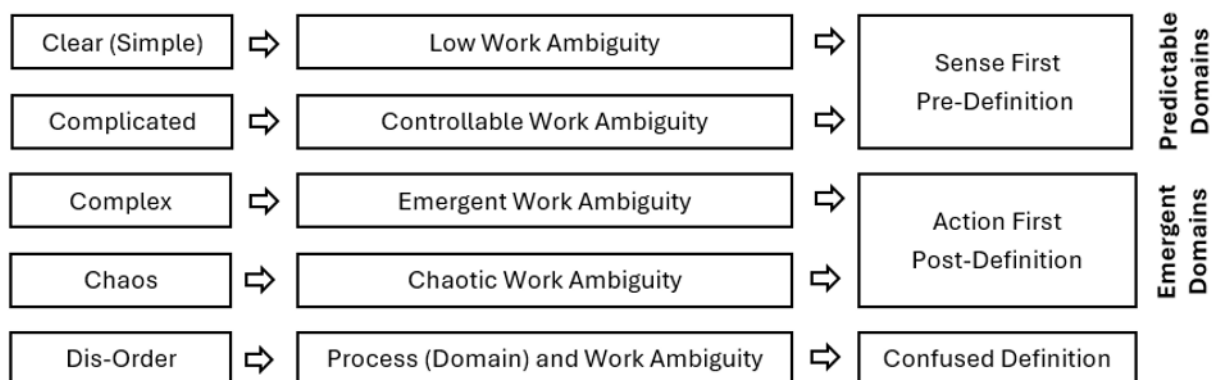


Figure 2: Cynefin domains expressed as states of work ambiguity

Under time pressure and high cognitive load, these predictive interpretations become more dominant because the brain is biased toward efficient, automatic processing rather than slower, effortful deliberation (Sweller, 1988; Kahneman, 2011). Misalignment is therefore often invisible from the inside: people experience their own interpretation as reality, and disagreement is easily seen as error, incompetence, or non-compliance in others rather than as a natural divergence between mental models (Ross & Ward, 1996).

In multi-organisation project systems—where work is spread across disciplines, contracts, shifting relationships, competing incentives, and increasingly different geographies and cultures—this cognitive dynamic becomes a structural risk because social ambiguity can become normalised (Bertelsen & Koskela, 2005; Chen et al., 2007). Social ambiguity is often more visible than cognitive ambiguity, but also more dangerous, because it can harden into group narratives about who is “right” or “wrong” even when each party sees only part of the system (Weick et al., 2005).

In complex delivery, reducing social ambiguity requires sensemaking: asking clarifying questions, surfacing uncertainty, and testing assumptions across interfaces so that parties can build a more shared understanding of what is happening and what action is needed (Weick et al., 2005). Yet these behaviours carry image and reputational risk in hierarchical and contractual environments, especially when asking questions is seen as ignorance or incompetence. When powerful observers interpret clarification this way, psychological safety falls and people learn tacit rules of self-censorship, withholding questions and concerns even when doing so harms the project (Detert & Edmondson, 2011).

ISSUES WITH CURRENT PM APPROACHES

Conventional project management (PM) in construction is largely designed as a predict-and-control system. Its logic is that uncertainty can be managed by decomposing scope into controllable work packages, assigning accountability, and tracking performance against baseline plans. This works well when work is predominantly complicated, where cause–effect relationships are broadly knowable, sequencing is stable, and variability is mainly local and reducible through standardisation and control (Miranda Filho et al., 2016; Kalsaas et al., 2022). It becomes brittle, however, as complex dynamics rise, because complexity is not simply more uncertainty but a different kind of system behaviour produced through interaction, feedback, and emergence (Bertelsen, 2003a; Bertelsen & Koskela, 2005).

PM TREATS AMBIGUITY AS A TECHNICAL RISK TO REMOVE UPFRONT

In conventional delivery models, ambiguity is primarily viewed as a front-end technical risk: managed by defining requirements, finalising designs, fixing scope, transferring risks contractually, and then executing through compliance to plan. This is controlled through governance instruments such as stage-gates, baseline schedules, cost plans, change control boards, and reporting systems that promote low variance-from-plan and conformance metrics.

The intent is rational: if ambiguity is removed early, downstream production becomes stable and controllable. But in complex project environments, this “design out ambiguity through definition” strategy often only addresses one dimension of uncertainty (the technical solution space) while leaving the dominant driver of instability unresolved: misalignment across stakeholders and interfaces (Bertelsen & Koskela, 2005; Kalsaas, Bølviken & Skaar, 2022).

BLIND SPOT ONE: AMBIGUITY PERSISTS AT THE SOCIAL LAYER

As interface density increases, so does the likelihood that teams will operate with divergent understandings of the same work (Chen, Reichard, & Beliveau, 2007). **Cognitive ambiguity** sits inside an individual’s mental models – holding different assumptions about what matters most, what constraints are real, and what “good” looks like (Friston, 2010; Rao & Ballard, 1999;

Clark, 2016). **Social ambiguity** emerges when those differences persist across stakeholders – where different parties attribute different meanings, intentions, and priorities to the same signals, and then coordinate as if they are aligned (Weick, 1995; Weick, Sutcliffe, & Obstfeld, 2005).

In complex delivery, this ambiguity is rarely loud; it is often quiet, rational, and locally coherent – even if systemically incompatible. The result is prolonged misalignment where work proceeds, but convergence on shared intent, shared boundaries, and shared commitments lags – often unknowingly (Bertelsen, 2003b; Kalsaas, Bølviken, & Skaar, 2022).

BLIND SPOT TWO: FRAGMENTATION REINFORCES MISALIGNMENT

Fragmentation—through scopes, roles, packages, contracts, reporting lines, and discipline boundaries—is a core project management device for decomposing large projects into manageable parts. Under the right conditions, it reduces cognitive load and makes accountability more tractable (Sweller, 1988; Miranda Filho et al., 2016).

In complex environments, however, the same fragmentation can become incoherent, weakening the trust structures needed for shared visibility and rapid feedback as teams stabilise local certainty while insulating the wider system from alignment (Bertelsen & Koskela, 2005; Kalsaas et al., 2022). Each fragment holds to its own perceived truth—assumptions, definitions, and priorities—while cross-boundary contradictions remain largely invisible (Martin, 2002). Because this misalignment is distributed across interfaces, it often sits below leadership’s line of sight until coordination debt has accumulated and can no longer be absorbed by buffers or explanation (Bertelsen & Koskela, 2005; Chen et al., 2007).

Under pressure—cost, time, or psychological—this designed fragmentation can shift from coordination aid to safe zone. Staying “in your lane” becomes rational because it lowers exposure, reduces blame risk, and preserves local certainty (Martin, 2002). The system then becomes implicitly incentivised to defend boundaries rather than surface and resolve emerging interface misalignment (Weick et al., 2005; Bertelsen & Koskela, 2005).

When fragmentation is coupled with power asymmetry, these effects intensify. Parties with greater authority can impose their interpretation as competence, while those with less power may defer, stay silent, or retreat into strict scope compliance (Edmondson, 1999). In such conditions, ambiguity is not resolved through shared sensemaking but suppressed or pushed downstream, where it reappears as conflict, rework, delay, or claims. What is often framed as performance failure may instead be the predictable result of unresolved cross-boundary misalignment (Bertelsen & Koskela, 2005; Kalsaas et al., 2022).

SYSTEMS THAT MANAGE SOCIAL AMBIGUITY WELL

The **Last Planner System (LPS)** and **Scrum** are two well-known sociotechnical production systems that improve productivity by stabilising interaction and production cycles around the people who have influence on how the work is effectively produced and improved. Although these systems generally originated in two very different environments (construction and software), they both improve delivery reliability by using stable and repeatable planning and resolution cycles to enable shared and continuous cross-party sensemaking to grow alignment and reduce social ambiguity over time.

This comparison is analytically useful because it shows that recurring coordination systems can improve performance not only by organising work, but by helping fragmented actors progressively converge around shared understanding and commitment.

THE LAST PLANNER SYSTEM (LPS)

In construction, LPS is most widely adopted in the more linear, execution-focused domain of physical delivery, where work is largely decomposable and can, in principle, be sequenced through reliable handoffs. Yet plan reliability has historically remained low even when the

technical pathway is broadly knowable (Ballard, 2000). LPS addresses this by using progressive planning by those closest to the work to convert intent into shared, realistic commitments based on what is actually ready and collectively achievable, rather than what was assumed in the master plan. By shifting planning from a one-off predictive exercise to a recurring collaborative practice, LPS enables foremen and trade leads to surface constraints, reconcile conflicting assumptions at interfaces, and stabilise handoffs through commitments grounded in current conditions (Ballard, 2000; Koskela, 2000). In this sense, progressive planning functions as an alignment control loop, reducing the time that mismatched interpretations can persist and improving reliability without perfect foresight (Ballard & Tommelein, 2021).

What is less often discussed is why this improves reliability. LPS does not primarily fix planning as a technical exercise; it reduces the social ambiguity beneath planning by managing conversations, commitments, and reliable promising across organisational boundaries (Ballard & Howell, 2003). Trades and supervisors often hold different interpretations of readiness, constraints, interface conditions, and the reliability of others. These mismatches can remain locally coherent and largely invisible until execution exposes them (Power, 2021). LPS improves reliability by institutionalising a recurring cadence that integrates these competing interpretations into a more workable shared view of what can be done next and how parties can coordinate to do it (Ballard, 2000; Ballard & Tommelein, 2021; Koskela, 2000).

SCRUM (AGILE FRAMEWORK)

In this paper, **Scrum** is used as the primary comparator to LPS. Scrum is a framework for developing, delivering, and sustaining complex products, and is one of the best-known methods associated with the broader Agile tradition (Schwaber & Sutherland, 2020). Scrum is most widely adopted in product and software development - work that, like **design engineering**, is highly information-intensive, iterative, and mostly non-linear, with requirements, constraints, and even conceptions of value evolving through learning. In such contexts, predictive plans often underperform because reliability depends less on sequencing logic alone than on the continual alignment of learning across stakeholders and technical interfaces.

Scrum also adopts progressive planning by those closest to the work to continually convert intent into shared, testable increments of value, based on current evidence rather than fixed assumptions. Like LPS, Scrum shifts planning from a one-off “get it right up front” exercise to a recurring, collaborative alignment practice where teams integrate different interpretations of priority, risk, and “done” into a workable shared direction (Schwaber & Sutherland, 2020).

This is important because even when the technical pathway seems plausible, delivery failure is often determined by social-layer ambiguity, where stakeholders hold different mental models about what is needed, what matters most, and what constitutes acceptable quality, progress or competence. Scrum improves reliability by institutionalising a cadence of transparency and feedback that reduces the time misaligned assumptions can remain latent in the system. By making work visible, engaging stakeholders frequently, and re-planning in short stable cycles mismatches can be exposed early – before they compound into large batches of rework (Schwaber & Sutherland, 2020).

SCRUM, LPS AND DESIGN PHASE AMBIGUITY

Design phases in major projects generally sit closer to Cynefin’s Complex domain than most downstream delivery work. This is not always because designers lack up-front documentation, but because the work is shaped by emergent understanding. Even where strong briefs, standards, and scope statements exist, they rarely eliminate all ambiguity about how constraints will interact, how interfaces will behave, or what trade-offs will prove acceptable once implications become visible (Snowden & Boone, 2007; Kalsaas et al., 2022).

Viewed through technical, social, and cognitive ambiguity, design in these settings is not only a technical problem but also a broader system-level coordination problem.

1. Technical ambiguity persists because complex interactions can produce non-obvious consequences until options are tested.
2. Social ambiguity persists because organisations and disciplines interpret intent, risk, and quality through different mental models shaped by incentives and experience.
3. Cognitive ambiguity persists because individuals must compress complexity into workable internal representations, which are necessarily partial and open to revision

In combination, these forms of ambiguity mean that what is being built, and how it will be built, cannot be fully stabilised through documentation alone, but must be progressively clarified through structured interaction (Friston, 2010; Rao & Ballard, 1999; Clark, 2016).

This is the deeper reason Scrum and the LPS matter in design. They can be understood as ambiguity-management systems that can institutionalise the repeated convergence of mental models using short-cycle rhythms to intentionally surface divergences in understanding, test assumptions against reality, and reset direction before misalignment hardens into rework. In design, where the primary risk is not late tasks, but instead incompatible understandings or expectations, cadence functions as a stable mechanism for sensemaking convergence, not as an administrative overhead (Ballard, 2000; Schwaber & Sutherland, 2020).

GREATER AMBIGUITY REQUIRES GREATER READINESS

As ambiguity increases, the delivery system must become more ready—not only in the Lean sense of being ready to execute, but in the wider socio-technical sense of being ready to converge. In Cynefin's Complex domain, work cannot be controlled primarily through prediction; it requires repeated sensemaking through probing and adaptation. The challenge is not just to plan work, but to create conditions in which interpretations and commitments can be realigned before misalignment hardens into rework (Snowden & Boone, 2007).

This requires readiness on two fronts. Teams must be ready to execute tasks, but also ready to collaborate: to surface assumptions, negotiate trade-offs, align definitions of done, clarify decision rights, and reconcile incompatible mental models before they become downstream failure modes. From this perspective, Scrum and LPS can be understood not only as planning systems, but as systems for managing ambiguity. Their distinctive value is not simply more frequent replanning, but the way cadence institutionalises predictable convergence points where readiness is checked, divergence is made visible, and commitments are reset against reality (Ballard, 2000; Schwaber & Sutherland, 2020).

Scrum ceremonies and LPS practices provide this structure by making readiness-to-collaborate part of production control. In this sense, cadence becomes a make-ready system for collaboration itself: it concentrates sensemaking at the right times, lowers the cost of cross-boundary alignment through predictability, and prevents ambiguity from silently accumulating across interfaces (Ballard & Howell, 2003).

In these systems, ambiguity is not resolved by demanding better documentation up front. Rather, its effects are reduced by embedding cadence, transparency, and adaptation into the operating logic of the project, so that emergent understanding becomes a shared system responsibility rather than a burden carried by individual designers.

THE COST OF PARTIAL READINESS

Figure 3 illustrates a simple but consequential logic: as work moves from the Clear to the Complicated, Complex, and Chaotic domains, the dominant mode of control shifts from rules, to plans, to engagement and validation, and finally to rapid reaction in unordered conditions.

Rising ambiguity therefore changes what readiness must mean. If a delivery system applies the wrong readiness mode for the domain—especially by treating Complex work as merely Complicated—not all parties in the engagement and validation system will be ready. Design teams may be ready to start tasks, but the wider system may not be ready to converge on shared meaning and commitments (Snowden & Boone, 2007).

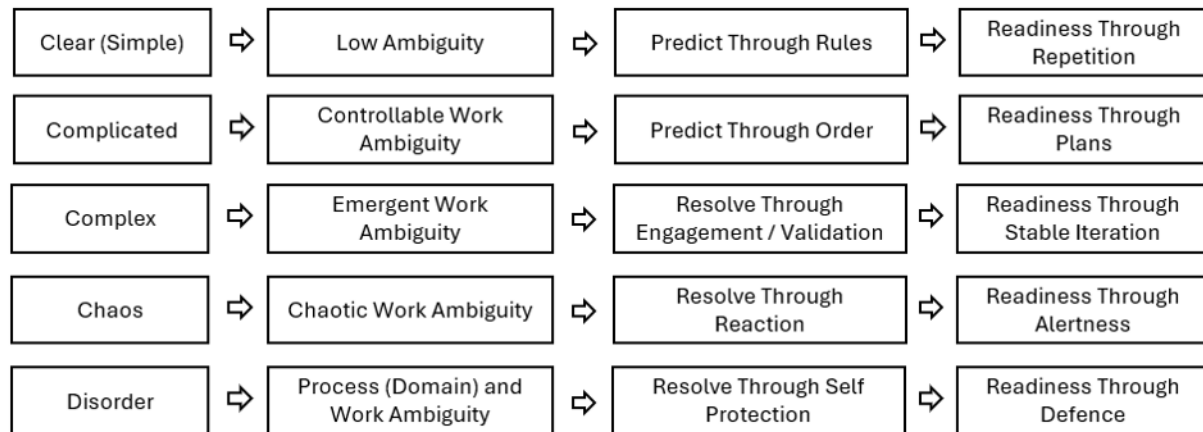


Figure 3: Ambiguity Response Effect and Readiness Approach using Cynefin Domains

Misalignment events are often underestimated because they appear as local technical issues: a clarification, a rework loop, or a delayed interface response. Their real cost, however, is systemic. Repeated unresolved divergence increases coordination load and reduces the reliability of cross-boundary coordination (Okhuysen & Bechky, 2009). As coordination reliability falls, trust erodes and stakeholders are more likely to retreat into safer, fragmented operating modes that reduce exposure to interdependence (Wolbers et al., 2018; Schilke & Lumineau, 2025).

This retreat into narrower, “stay-in-my-lane” behaviour should not be understood primarily as a behavioural failure. Under threat and uncertainty, stress responses bias attention toward protection and stability, narrowing attentional scope and reducing capacity for complex, socially demanding cognition (van Steenberg et al., 2011; van Ast et al., 2016). Under sustained misalignment, these short-term protective responses can scale into broader defensive behaviour or system detachment, because the effort of re-coordinating does not reliably reduce uncertainty, making collaboration feel high-cost and low-return (Wolbers et al., 2018; Schilke & Lumineau, 2025).

THE ROLE OF AI

A further implication of this argument is the potential role of AI in managing ambiguity. One pathway is through reducing ontological ambiguity by improving the structuring, checking, and development of scopes, requirements, and interface conditions across project documents (Norheim et al., 2024). Another pathway is through reducing epistemological ambiguity by freeing up more time and cognitive capacity for human sensemaking. By distilling large volumes of information, highlighting possible misalignments, surfacing alternative interpretations, and challenging actors’ assumptions, AI may help people engage more effectively in the interpretive work needed for alignment and convergence in complex project environments (Csaszar et al., 2024; Kabbara et al., 2025).

Taken together, these two pathways suggest that AI may shape project outcomes not only through efficiency, but through the stance a delivery system takes toward ambiguity. Used narrowly, AI may strengthen prediction and document completeness; used more broadly, it may also support human sensemaking, expose misalignment, and improve convergence under

complex conditions. This is an important area for further research, because how AI is positioned within the system—whether primarily as a control tool or as a support for convergence—may significantly affect coordination quality and delivery performance.

CONCLUSION

This paper argues that a dominant failure mode in modern project delivery lies in the limits of what specifications can capture, the ambiguity that persists in emergent environments, and the interpretive gaps that can endure between individuals, teams, and stakeholders well into delivery (Snowden & Boone, 2007; Kalsaas et al., 2022). Drawing on Lean Construction, complexity, and cognitive science, the paper argues that persistent misalignment is not an anomaly but a predictable pattern in fragmented, high-pressure project systems. Individuals and teams coordinate through predictive mental models, and because multi-organisation arrangements create protective boundaries, ambiguity can remain locally coherent yet systemically incompatible while work proceeds under divergent assumptions (Clark, 2013; Okhuysen & Bechky, 2009). The result is hidden waste: rework, delay, escalation, and exhaustion driven by high coordination effort without corresponding progress.

The paper further argues that ambiguity in complex work cannot be effectively reduced through one-time front-end definition alone. It is an ongoing system condition that must be deliberately managed through recurring convergence. From this perspective, LPS and Scrum can be understood not only as planning systems, but as ambiguity-management systems that use cadence, transparency, and adaptation to surface divergence, test readiness, and repeatedly realign commitments against emerging reality rather than assumed stability (Ballard, 2000; Schwaber & Sutherland, 2020; Snowden & Boone, 2007).

This paper is conceptual and theory-synthesising. Future research should test the mechanisms proposed here empirically, particularly the relationship between cadence-based convergence and coordination load, trust, rework, and fragmentation dynamics. Further work could also examine how ambiguity differs across project phases, how LPS and Scrum-type structures perform under different ambiguity conditions, and how AI may support both better front-end definition and faster human sensemaking in complex delivery environments. Another important avenue is the role of individual differences – such as prior experience, disciplinary background, and cognitive variation – in shaping how ambiguity is interpreted and acted upon across project systems.

For practice, the implication is not that projects can eliminate ambiguity, but that they can design systems that shorten its lifespan. Although this paper is situated within Lean Construction and project delivery, its implications extend more broadly to other complex, multi-actor work environments characterised by evolving information, multiple stakeholders, dense interfaces, and recurring coordination demands. In that sense, the contribution is not limited to construction but speaks more generally to how recurring coordination systems can support alignment and collective action under conditions of interpretive and emergent uncertainty.

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