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ALIGNING RESEARCH AND ADOPTION THROUGH AGILE ROADMAPPING IN CONSTRUCTION INNOVATION

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ABSTRACT

Construction innovation initiatives frequently fail to achieve sustained adoption despite significant research investment. These challenges are driven less by technical limitations than by fragmented governance, misaligned incentives, and organizational resistance to change. This paper proposes an agile, evidence-based roadmapping approach that reframes roadmapping as a governance and change mechanism within construction innovation ecosystems. The approach integrates literature synthesis, benchmarking of innovation centers, structured stakeholder interviews, and foresight analysis to align research priorities with adoption readiness across short-, medium-, and long-term horizons. Illustrated through the Construction Innovation Center at the University of Alberta, the findings demonstrate how integrating diverse evidence streams enhances stakeholder alignment, reduces uncertainty, and shifts attention from research outputs toward adoption outcomes. The study contributes to the People, Culture, and Change track by positioning roadmapping as a dynamic coordination and learning process grounded in lean principles of pull-based prioritization, transparency, and iterative improvement.

KEYWORDS

Research roadmapping, lean construction, governance, innovation adoption, organizational change.

INTRODUCTION

Despite decades of investment in research and advanced technologies, the construction sector continues to struggle with productivity stagnation, uneven innovation uptake, and fragmented learning. Adoption failures are rarely attributable to technical feasibility alone; rather, they reflect governance misalignment, distributed decision-making, and institutional resistance (Simonse et al., 2015). Innovation adoption decisions are dispersed across owners, contractors, designers, regulators, and supply-chain actors operating under different incentives and risk tolerances. Small and medium enterprises (SMEs), which dominate many construction markets, often lack the absorptive capacity to experiment with unproven solutions (Siebelink et al., 2016).

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This research–adoption disconnect is conceptualized in Figure 1, which illustrates how traditional research-centric governance often separates knowledge production from implementation realities. The figure frames agile roadmapping as a governance bridge integrating research prioritization, delivery mechanisms, evaluation logic, and adoption readiness.

Research roadmapping has been widely used to align innovation agendas. Early construction roadmaps emphasized strategic coordination and long-term planning (Froese & Rankin, 2009). However, critiques of innovation discourse in the built environment caution against technology-centric approaches that overlook institutional and cultural constraints (Sharp, 2010). In uncertain environments, static roadmaps risk reinforcing push-based agendas disconnected from adoption realities.

Recent scholarship reframes roadmapping as a social and governance process supporting dialogue, negotiation, and iterative learning (Simonse et al., 2015). Building on this perspective, this paper proposes an agile, evidence-based roadmapping approach that integrates multiple knowledge sources to align research prioritization with adoption readiness.

Positioned within lean construction scholarship, the roadmap is treated as a visual management and strategy deployment mechanism enabling pull-based prioritization, transparency, and PDCA cycle (Plan-Do-Check-Act) learning across an innovation ecosystem. Prior IGLC research emphasizes that sustained change requires governance attention beyond technical solutions (Koskela et al., 2003; Henrich et al., 2006; Alarcón & Diethelm, 2002). Strategy deployment, A3 processes, and Obeya environments demonstrate how structured coordination mechanisms foster shared understanding and cultural alignment (Leth et al., 2019; Gupta et al., 2009; Salvatierra & Fuentes, 2020). The proposed approach extends this logic to ecosystem-level research governance.

The paper addresses three research questions:

1. How can multiple evidence sources be integrated to support change in construction innovation systems?
2. How can agile roadmapping address organizational and cultural barriers to adoption?
3. What transferable governance principles can inform research prioritization in construction contexts?

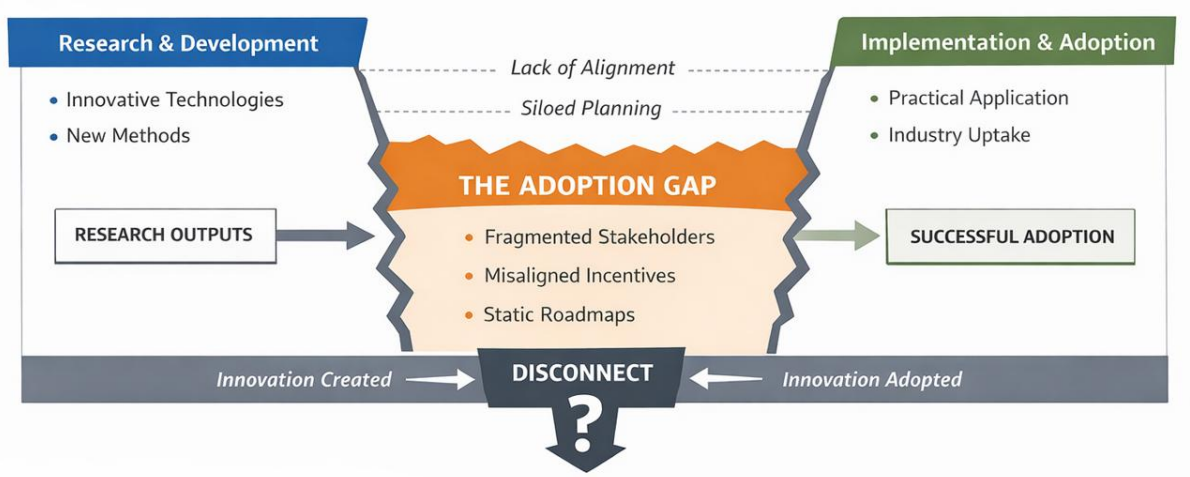

Figure 1: The Research-Adoption Disconnect in Construction Innovation

This study does not aim to empirically validate the effectiveness of the proposed approach in improving adoption outcomes. Instead, it demonstrates how an agile, evidence-based roadmapping process can be designed and operationalized as a governance mechanism within a construction innovation ecosystem.

Key cultural dimensions influencing adoption include risk tolerance, openness to experimentation, and cross-organizational trust.

LITERATURE REVIEW

INNOVATION ADOPTION AND ORGANIZATIONAL CHANGE IN CONSTRUCTION

Innovation adoption in construction is a socio-technical process shaped by organizational structures, contractual arrangements, and risk distribution (Loosemore, 2014). Temporary multi-organizational project structures limit cumulative learning and discourage long-term capability investment (Dubois & Gadde, 2002). Firms must balance novelty with implementation reliability, particularly in capital-intensive environments (Amara & Olmos Peñuela, 2016). Innovativeness may enhance resilience, yet its benefits depend on supply-chain interdependence and uncertainty (Gölgeci & Ponomarov, 2015).

These conditions reinforce conservative decision-making and uneven innovation uptake, especially among SMEs (Siebelink et al., 2016). Governance mechanisms that explicitly address risk-sharing, sequencing, and stakeholder alignment are therefore critical.

While SMEs face constraints related to absorptive capacity and risk tolerance, larger organizations may encounter challenges related to coordination complexity and legacy systems. These differences influence how innovation adoption strategies must be structured.

ROADMAPPING AS A CHANGE MECHANISM

Traditional roadmaps often assume linear progression from research to implementation. In construction, regulatory shifts, workforce dynamics, and market volatility challenge such assumptions. Contemporary literature positions roadmapping as a boundary object facilitating coordination among actors with divergent perspectives (Simonse et al., 2015). Iterative updating and stakeholder engagement enhance legitimacy and adaptability (Siebelink et al., 2016).

Construction roadmapping has historically focused on strategic coordination and long-term planning, often emphasizing technology development trajectories and sector-level priorities (Froese & Rankin, 2009). More recent approaches incorporate scenario-driven roadmapping and uncertainty management to support decision-making in dynamic environments (Siebelink et al., 2015). However, many existing roadmapping practices remain predominantly research- or technology-centric, with limited integration of adoption readiness, stakeholder alignment, and governance considerations.

The approach proposed in this study extends these methods by reframing roadmapping as a governance and change mechanism, integrating multiple evidence streams and explicitly linking research prioritization with implementation pathways and adoption outcomes.

The value of roadmapping lies less in prediction accuracy than in structuring learning and coordinating action. When integrated with lean governance logic, roadmapping becomes a strategy deployment mechanism that embeds feedback, alignment, and shared accountability.

EVIDENCE INTEGRATION AND PERFORMANCE LOGIC

Effective governance in innovation ecosystems requires integrating theoretical grounding, benchmarking insights, stakeholder knowledge, and contextual analysis. Performance measurement frameworks in construction research collaborations emphasize linking research activities to measurable adoption outcomes and impact metrics (Fayek & Golabchi, 2022). Embedding such performance logic within roadmapping aligns prioritization with value creation.

RESEARCH–PRACTICE GAPS AND GOVERNANCE CHALLENGES

The distinction between research-centric and adoption-oriented governance models is summarized in Table 1. The table clarifies how objectives, stakeholder roles, treatment of uncertainty, and evaluation criteria differ between these models. This governance reframing underpins the proposed agile roadmapping approach.

To operationalize this governance logic, multiple evidence streams were integrated as outlined in the role of literature synthesis, benchmarking, stakeholder interviews, and contextual analysis in the roadmapping process.

Table 1: Comparison of research-centric and adoption-oriented governance models

Governance Dimension	Research-Centric Governance	Adoption-Oriented Governance
Primary Objective	Advancement of knowledge and technical solutions	Uptake, use, and scaling of innovation in practice
Dominant Logic	Push-based research agendas driven by academic or institutional priorities	Pull-based agendas shaped by stakeholder needs and readiness
Role of Stakeholders	Consultative or episodic involvement	Continuous engagement as co-producers and decision participants
Treatment of Uncertainty	Often implicit or treated as a technical risk	Explicitly acknowledged and managed through iteration and learning
Decision-Making Focus	Project-level outputs and deliverables	System-level alignment across actors and time horizons
Evaluation Criteria	Publications, reports, and technical performance	Adoption readiness, learning, impact, and scalability
Time-Horizon Orientation	Short- to medium-term, project-bounded	Integrated short-, medium-, and long-term perspectives
Learning Mechanisms	Periodic reviews and post-project evaluation	Continuous feedback and adaptive adjustment
View of Implementation	Downstream activity following research	Integral part of governance and prioritization
Risk Distribution	Concentrated within implementing organizations	Shared across partners through staged and adaptive approaches

SYNTHESIS AND RESEARCH GAP

The literature highlights three key insights relevant to this study. First, innovation adoption in construction is fundamentally shaped by people, culture, and organizational context. Second, governance structures strongly influence whether research efforts translate into sustained practice. Third, roadmapping holds promise as a coordination and learning mechanism but is often underutilized as a tool for managing change.

Notwithstanding these insights, there remains limited empirical research on how roadmapping processes can be intentionally designed to integrate multiple evidence sources and operate explicitly as governance mechanisms in construction innovation ecosystems. In particular, few studies examine how such approaches can address adoption barriers, support learning across time horizons, and align diverse actors around shared definitions of value.

While prior research has examined roadmapping and innovation adoption separately, this study contributes by integrating these perspectives into a unified governance-oriented

framework that links evidence synthesis, prioritization, and adoption readiness across time horizons.

These insights directly inform the methodological design by justifying the integration of multiple evidence streams and the emphasis on stakeholder-informed prioritization and iterative validation.

RESEARCH METHODOLOGY

RESEARCH DESIGN

A qualitative-dominant multi-method design integrated literature synthesis, benchmarking, stakeholder interviews, and foresight analysis (Creswell & Clark, 2017). A case study provided a demonstration context for refining and illustrating the roadmapping process (Yin, 2018).

EMPIRICAL CONTEXT AND CASE STUDY PARAMETERS

The empirical context for this study is a construction innovation ecosystem operating within the Province of Alberta, Canada. Alberta provides a particularly relevant setting due to several contextual characteristics that shape innovation adoption, including a construction sector dominated by SMEs, strong exposure to resource-driven economic cycles that increase risk sensitivity, and ongoing pressure to improve productivity, safety, and decarbonization performance. Additional contextual factors include a regulatory environment shaped by both provincial and national codes and climatic conditions that place unique demands on materials, energy systems, and infrastructure resilience.

The empirical work was conducted through a construction innovation center acting as a neutral intermediary among industry, academia, government, and professional organizations. The center facilitated access to stakeholders, data, and governance processes necessary for the roadmapping exercise. However, the analysis deliberately abstracts from institutional specifics, using the center as a demonstration context to focus on process design and generate transferable insights rather than evaluate organizational performance.

DATA SOURCES AND EVIDENCE STREAMS

Four integrated evidence streams informed the roadmapping process. A literature review was conducted to identify key adoption barriers, governance mechanisms, and evaluation principles. This was complemented by benchmarking through a comparative analysis of more than 40 innovation centers to extract transferable governance patterns. In addition, structured stakeholder interviews were carried out with 73 participants from industry, academia, and government to assess challenges and prioritize research themes across short-term (1–3 years), medium-term (3–7 years), and long-term (7+ years) horizons. Finally, foresight analysis was used to stress-test priorities against long-term uncertainties, including decarbonization, workforce shifts, and digital transformation (Rohrbeck et al., 2015; Vecchiato, 2015). Qualitative data were analyzed using thematic coding following Braun and Clarke (2006), and prioritization was supported through weighted stakeholder aggregation, with contributions distributed as 50% industry, 30% academia, and 20% other stakeholders.

Benchmarking involved systematic comparison of governance structures, stakeholder engagement models, and funding mechanisms across selected innovation centers. Interview data were coded iteratively, with themes validated through cross-stakeholder comparison.

ROADMAPPING PROCESS AND ITERATION

The roadmapping process was structured into iterative phases, including contextual analysis, priority formulation, validation, and refinement. Research themes were organized across short-, medium-, and long-term horizons to reflect differences in readiness, regulatory dependency, and organizational capacity.

Delivery mechanisms and evaluation criteria were embedded directly within the roadmap to maintain alignment between priorities and implementation considerations. Figure 3 presents the agile, evidence-based roadmapping framework used in this study. The framework shows how academic and professional literature, benchmarking insights, structured stakeholder engagement, and foresight analysis are iteratively synthesized to inform research prioritization, delivery enablers, and evaluation criteria across multiple time horizons. Feedback loops emphasize learning and adjustment rather than one-time decision-making.

Figure 2: Agile evidence-based roadmapping framework

RIGOR, VALIDITY, AND LIMITATIONS

Rigor was supported through triangulation across evidence streams, iterative validation with stakeholders, and transparent documentation of assumptions and synthesis logic. While the study is grounded in a specific provincial context, the roadmapping approach and design principles are intended to be transferable. The prioritization outcomes, however, reflect Alberta's economic, regulatory, and climatic conditions and should be interpreted accordingly.

Moreover, stakeholder interview data were analyzed using a structured thematic coding approach following Braun and Clarke (2006), including initial coding, theme development, and iterative validation. Benchmarking analysis followed a comparative framework examining governance structures, funding models, and stakeholder engagement mechanisms across over 40 innovation centers.

RESULTS AND DISCUSSION

The integrated roadmapping process produced a structured set of research priorities across short-, medium-, and long-term horizons. Stakeholders assessed not only the relevance of research themes, but also their appropriate timing based on adoption readiness, regulatory dependency, organizational capacity, and contextual constraints specific to Alberta's construction sector. The resulting patterns are summarized in Figures 3 and 4.

Capability development mechanisms, including structured learning and engagement formats, are essential to sustaining cultural change. Recent IGLC research suggests that interactive and participatory training approaches can enhance lean adoption by strengthening engagement and shared understanding across organizations (Pütz et al., 2021). Embedding roadmap review cycles within such learning-oriented formats can further reinforce adoption readiness.

Figure 3: Sequencing of research priorities across time horizons

Short-term priorities cluster around operational, managerial, and workforce-related domains where implementation pathways are relatively well established and outcomes can be realized within existing institutional frameworks. These themes reflect immediate industry pressures, such as safety, workforce availability, materials performance, and process efficiency, and indicate a preference for initiatives that can deliver visible improvements and reduce perceived risk in the near term.

Medium-term priorities emphasize integration and capability development in areas requiring coordination across organizational boundaries, including digital transformation, performance monitoring, sustainability management, and climate adaptation. Stakeholders recognized that progress in these domains depends on sustained investment in skills, interoperable systems, and shared practices, positioning the medium-term horizon as a transition phase for learning and alignment.

Long-term priorities are concentrated in domains associated with systemic transformation, such as advanced construction technologies, regulatory and policy evolution, and decarbonization. These themes are less frequently associated with near-term action not due to lower importance, but because they depend on external conditions including standards development, regulatory reform, and supply-chain readiness. Smaller proportions of "not applicable" responses in some areas further indicate domains where shared understanding and implementation pathways remain underdeveloped.

Taken together, Figures 3 and 4 show that stakeholders clearly differentiate between what can be acted on immediately, what requires preparation, and what depends on long-term coordination beyond individual organizations. This horizon-based structuring reframes resistance to innovation as a rational response to uncertainty and dependency rather than a lack of willingness to change. From a People, Culture, and Change perspective, the results highlight the importance of sequencing: near-term priorities build confidence and legitimacy, medium-term priorities enable learning and integration, and long-term priorities maintain strategic direction without forcing premature commitment.

The results represent context-specific prioritization patterns rather than universally generalizable findings. Their value lies in illustrating how stakeholders differentiate priorities under varying levels of readiness and uncertainty.

Importance	Priority Research Themes	S	M	L
M	Sustainable and Net-Zero Construction Management	11	28	18
M	Digital Transformation in Construction	17	26	17
L	Advanced Construction Technologies	15	20	23
S	Workforce Development and Management	22	18	15
S	Advanced Construction Materials and Applications	27	10	20
L	Policy and Regulation in Construction	15	17	21
S	Health, Safety, and Risk Management	32	19	15
S	Energy-Efficient Systems and Construction Practices	22	15	20
L	Decarbonization of Construction Processes	17	20	22
S	Construction Supply Chain Optimization	21	19	20
M	Performance Monitoring and Data-Driven Decision Making	14	23	16
M	Climate Adaptation and Disaster-Resilient Construction	14	21	19
NA	Human-Centric Design and Well-Being in Built Environments	14	19	17
S	Lean Construction and Manufacturing	21	18	17
S	Automated and Generative Design	24	20	14
S	Smart Procurement and Contract Management	23	16	17
S: Short-Term, M: Medium-Term, L: Long-Term, NA: Not Applicable				

Figure 4: Stakeholder Prioritization Results

CIC CASE ILLUSTRATION

The CIC is an innovation hub that was established in 2019 at the University of Alberta in response to persistent challenges in the construction sector, including low productivity growth, slow innovation adoption, increasing sustainability pressures, and workforce constraints. These challenges are particularly pronounced in fragmented construction ecosystems where research, policy, and practice are often weakly aligned. The CIC was created to provide a coordinated platform through which academic research, industry needs, and public-sector priorities could be more effectively connected, with explicit emphasis on measurable impact and performance-based evaluation of research collaborations (Fayek & Golabchi, 2022; Golabchi et al., 2024).

This section provides a brief illustration of how the proposed agile, evidence-based roadmapping approach was applied within the CIC. The purpose of the illustration is not to evaluate institutional performance or adoption outcomes, but to demonstrate how the governance logic and sequencing principles described earlier can be operationalized in a real construction innovation ecosystem.

Within the CIC context, the roadmapping process was used to integrate inputs from scholarly and practitioner literature, benchmarking of peer construction innovation centers, structured stakeholder engagement, and contextual analysis specific to Alberta's construction sector. As illustrated in Figure 5, these evidence streams were synthesized through an iterative

process that aligned research priorities with delivery mechanisms, evaluation criteria, and adoption considerations across short-, medium-, and long-term horizons.

Presenting the CIC as an illustrative application, rather than a full case evaluation, reinforces the transferability of the approach to other construction innovation systems facing similar challenges of fragmentation, uncertainty, and uneven adoption capacity. While the specific priorities reflected local conditions, the governance structure and sequencing logic shown in Figure 5 are applicable beyond the CIC context.

The purpose of the illustration is not to evaluate adoption outcomes, but to demonstrate how the roadmapping process supports alignment, prioritization, and coordination among stakeholders under conditions of uncertainty.

Figure 5: Application of the agile roadmapping approach in the CIC context

CONCLUSIONS AND FUTURE RESEARCH

This paper examined how an agile, evidence-based roadmapping process can function as a governance and change mechanism in construction innovation ecosystems. Rather than treating roadmaps as static planning artifacts, the study reframed roadmapping as a process for aligning research priorities with adoption readiness, managing uncertainty, and coordinating action among diverse stakeholders. Using an empirical case as a demonstration context, the paper focused on *how* priorities are negotiated, sequenced, and legitimized, rather than on the specific content of a single roadmap.

The results show that stakeholders distinguish clearly between near-term initiatives that can be implemented within existing organizational and regulatory frameworks, medium-term initiatives that require integration and capability development, and long-term initiatives that depend on broader system-level change. This temporal structuring reflects rational responses to risk, dependency, and uncertainty, and challenges narratives that frame resistance to innovation as purely cultural or behavioral. By making these distinctions explicit, the roadmapping process supports alignment, builds legitimacy, and creates a shared basis for learning across organizations.

From a People, Culture, and Change perspective, the findings highlight the importance of sequencing in managing innovation. Near-term priorities help establish confidence and trust, medium-term priorities enable learning and coordination, and long-term priorities maintain

strategic direction without forcing premature commitment. In this way, roadmapping operates as a change mechanism that accommodates differing capacities, incentives, and risk profiles within the construction ecosystem. The approach also aligns with lean principles at the system level by reducing waste associated with misaligned research agendas, delayed feedback, and underutilized innovation.

While the study is grounded in a specific regional context, the approach and insights are transferable to other construction innovation systems facing similar challenges of fragmentation, uncertainty, and uneven adoption capacity. However, the prioritization outcomes themselves are context-dependent and should not be interpreted as universally prescriptive.

Future research should focus on longitudinal evaluation of how agile roadmapping influences adoption outcomes over time, including its effects on trust, collaboration, and learning across organizations. Comparative studies across jurisdictions and innovation ecosystems would further strengthen understanding of how contextual factors shape sequencing and governance choices. Additional work is also needed to explore how roadmapping processes interact with funding models, regulatory instruments, and performance measurement systems in supporting sustained change.

The findings should therefore be interpreted as analytical and process-oriented contributions, rather than as causal evidence of improved innovation adoption.

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