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Understanding How Theoretical and Conceptual Frameworks Inform Research Design: A Practical Approach

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Abstract

The integration of theoretical and conceptual frameworks into research design remains a persistent challenge across disciplines, particularly in applied and interdisciplinary fields such as construction management and engineering. While the existing literature provides definitions and distinctions between these frameworks, limited attention has been given to how they systematically inform methodological decisions. The study addresses this gap by proposing the Framework-Design Integration Model (FDIM), a structured approach that links theoretical anchoring, conceptual translation, research design, methodological mapping, and analytical coherence. The model was developed through a structured conceptual research approach involving synthesis of the methodological literature on theoretical frameworks, conceptual frameworks, research design, and methodology alignment. The FDIM is developed to provide a systematic and iterative pathway for integrating frameworks into research design. The proposed model was evaluated through analytical validation and illustrative application using construction and engineering research scenarios. The study further offers practical tools, including a step-by-step guide, a decision-making framework, and a diagnostic checklist. The study contributes by moving beyond conceptual clarification toward methodological operationalization, enhancing research coherence, rigor, and practical relevance.

Keywords: theoretical framework; conceptual framework; methodological coherence; research design; Framework-Design Integration Model; built environment; engineering

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1. Introduction

One of the important indicators of a well conducted study is the alignment of the research design with theories that framed the research. Researchers frequently struggle to translate theoretical and conceptual frameworks into explicit methodological decisions, resulting in weak alignment between theory, research questions, design, methods, and analysis. The existing methodological literature explains the purpose of frameworks but provides limited guidance on how they should systematically inform research design. In contemporary research, theories are frequently invoked but rarely used to the full potential [1]. Across disciplines, from engineering to the social sciences, it is not uncommon to encounter studies that begin with a well-articulated theoretical framework, only for the framework to fade into the background once methodological decisions are made [2,3]. This results in a persistent gap. Theory is presented, methodology is executed, yet the logical bridge between the two remains weak or, in some cases, entirely absent. The

gap is particularly evident in applied and interdisciplinary fields such as construction management and the built environment, where complex, real-world problems demand not only robust theoretical grounding but also methodological precision [4–6]. At the center of this challenge lies a longstanding ambiguity surrounding the roles of theoretical and conceptual frameworks in research design [7,8]. While theoretical frameworks are typically understood as the foundation that anchors a study in established knowledge [9], conceptual frameworks are often treated as flexible, context-specific representations of the phenomena under investigation [10]. In principle, these frameworks should work together to shape the entire research process, from the formulation of research questions to the selection of methods and the interpretation of findings. In practice, however, the integration is frequently superficial [11]. Researchers may adopt well known theories such as the Unified Theory of Acceptance and Use of Technology (UTAUT) [12] to justify a study yet fail to demonstrate how the constructs of such theories meaningfully inform sampling strategies, instrument design, or analytical techniques.

This gap is not merely a matter of academic rigor; it has substantive implications for the quality and credibility of the research [13,14]. When theoretical and conceptual frameworks are not systematically linked to methodological choices, studies risk becoming internally inconsistent [6]. Variables may be poorly operationalized, data collection methods inadequately justified, and analytical techniques misaligned with underlying assumptions. Such inconsistencies can ultimately weaken the explanatory power of research [15,16] and limit the contribution to both theory and practice [17,18]. For fields like construction and engineering, where research increasingly informs policy, innovation, and large-scale implementation of technologies such as 3D concrete printing (3DCP), the stakes are particularly high. The existing methodological literature has made important contributions by clarifying the definitions and purposes of theoretical and conceptual frameworks [7,8,11]. However, according to Hossan et al. [19] much of this scholarship remains descriptive rather than operational. While researchers are often told what these frameworks are, they are given limited guidance on how to use them as active instruments in designing research. As a result, early-career researchers and even experienced scholars may struggle to translate abstract theoretical constructs into concrete methodological decisions [20–22]. This challenge described as a "mayhem", Ogunkan and Akinpelu [6] is amplified in interdisciplinary contexts, where theories originating in the social sciences are applied to engineering problems without sufficient adaptation or methodological alignment.

The study makes the case that a clear, organized model that connects theoretical and conceptual frameworks to research design is necessary. Rather than treating frameworks as static components of a literature review, this study argues that the concepts are dynamic drivers of methodological coherence. The central premise is that theoretical and conceptual frameworks should not only inform what is studied [11] but also determine how it is studied [23]. By making these linkages explicit, researchers could enhance the transparency, rigor, and reproducibility [24] of a good study. The study aims to develop a structured model that systematically integrates theoretical and conceptual frameworks into research design. To achieve this aim, the study pursues four objectives. First, the study examines existing interpretations of theoretical and conceptual frameworks, highlighting areas of confusion and overlap. Secondly, it analyses the mechanisms through which frameworks should inform key methodological decisions, including sampling, data collection, and data analysis. Thirdly, it proposes a structured integration model that provides a clear pathway from theoretical grounding to methodological execution. Finally, it demonstrates the applicability of the proposed model through illustrative examples drawn from research in construction and engineering.

2. Literature

Despite the centrality of theoretical and conceptual frameworks to research design, the literature on methodology reveals a persistent gap between conceptual understanding and practical application. While numerous scholars have attempted to clarify the meaning, purpose, and distinctions between theoretical and conceptual frameworks [7,8,11,17,18] far less attention has been paid to how these frameworks should be systematically integrated into methodological decision making. The literature review examines existing approaches across the social sciences, engineering, and construction management, highlighting key limitations that set the tone for a structured integrative model.

2.1. Fragmentation Between Theory and Methodology

A critical limitation of existing approaches is the persistent fragmentation between theoretical grounding and methodological execution [4,5,25]. In many studies, particularly within applied disciplines such as construction management and engineering, theoretical frameworks are presented as standalone components that are not meaningfully connected to subsequent methodological choices. This fragmentation manifests in several ways. First, there is often a lack of explicit linkage between theoretical constructs and research questions [26]. Studies may cite established theories, including models such as the UTAUT, yet formulate research questions that are only loosely aligned with the constructs of the theory. This gap undermines the coherence of the study and raises questions about the validity of the theoretical grounding.

Methodological decisions such as sampling, data collection, and analysis are frequently justified in procedural rather than theoretical terms [27,28]. Researchers may select survey methods or statistical techniques based on convention or convenience, without demonstrating how the choices are derived or supported by the underlying framework. As a result, the methodology appears detached from the theoretical logic [29,30], weakening the explanatory power [15] of the theory. More so, the interpretation of findings often fails to reconnect with the theoretical framework [11]. Empirical results may be discussed in isolation, with limited effort to situate them within the broader theoretical context. This does not only limits the contribution of the study to theory development [18] but also perpetuates a cycle in which theory is treated as an initial requirement rather than an integral component of the entire research process.

2.2. Over Reliance on Borrowed Frameworks

Another notable limitation is the widespread reliance on established theoretical models without sufficient critical adaptation [31]. In interdisciplinary fields such as the built environment, it is common for researchers to adopt theories developed in the social sciences and apply them to engineering or construction contexts. While this practice can be valuable, it often leads to uncritical borrowing [19], where frameworks are applied without adequate consideration for contextual differences. For instance, models of technology acceptance are frequently used to study the adoption of innovations such as 3D concrete printing [32] and blockchain in construction [33]. However, these models were originally developed in contexts characterized by relatively stable organizational environments and individual-level decision-making [12]. When applied to the construction industry, which is inherently fragmented, project-based, and influenced by institutional and regulatory factors, the assumptions of the models may not fully hold. Without appropriate adaptation through a conceptual framework, the resulting research may fail to capture critical dimensions of the phenomenon.

The over-reliance on borrowed frameworks also contributes to theoretical stagnation [34]. By repeatedly applying the same models without modification, researchers risk reinforcing

existing assumptions rather than generating new insights. The lack of integration between theoretical and conceptual frameworks exacerbates this issue, as it limits opportunities for contextual innovation and theoretical refinement [35] leading to a weak operationalization of theoretical constructs.

2.3. Weak Operationalization of Constructs

A further challenge lies in the operationalization of theoretical constructs [36]. While many studies identify relevant constructs from established frameworks, the process of translating the constructs into measurable variables is often inadequately addressed. This weakness is indicative of a larger gap between approach and conception [35]. In some cases, constructs are operationalized using measurement instruments borrowed from prior studies without sufficient validation in the new context. Others times, variables are introduced that are not clearly derived from the theoretical framework [11], leading to conceptual inconsistency. A study may claim to be grounded in a specific theory but include variables that are not part of that theory, without providing justification for the inclusion. Such practices compromise construct validity [37] and reduce the reliability of findings.

The lack of rigorous operationalization of theoretical constructs is particularly problematic in interdisciplinary research, where constructs may have different meanings across domains. Without a well-developed conceptual framework to guide this process, researchers may struggle to ensure that variables accurately reflect the underlying theoretical constructs.

2.4. Methodological Incoherence and Justification Gaps

Closely related to the issues above is the problem of methodological incoherence [38]. In many studies, there is a lack of alignment between the theoretical framework, research design, and analytical techniques. This incoherence often stems from inadequate justification of methodological choices. A study grounded in a positivist theoretical framework may employ qualitative methods without clearly articulating how these methods align with the assumptions of the framework. Conversely, studies adopting interpretive approaches may incorporate quantitative techniques without sufficient explanation. While methodological pluralism [39] is not inherently problematic, it requires careful justification to ensure coherence. The absence of such justification creates what may be termed a "black box" in research design, where decisions appear arbitrary or disconnected from the theoretical foundation. This not only undermines the credibility of the study [40] but also limits the reproducibility [41], as other researchers cannot easily trace the logic behind the methodological choices.

2.5. Lack of Structured Integration Models

Perhaps the most significant gap in the literature is the absence of comprehensive models that explicitly link theoretical and conceptual frameworks to research design [7,11,42]. While individual aspects of this relationship have been discussed, there is a lack of integrative approaches that bring the elements together into a coherent structure. Existing guidelines often focus on discrete components, such as how to develop a conceptual framework [43] and how to select a research method [44], without addressing how these components interact within the broader research process. As a result, researchers are left without a clear roadmap for integrating theoretical and conceptual frameworks into their studies. This gap is particularly evident in applied fields, where the need for methodological clarity [45] is compounded by the complexity of real-world problems. In construction and engineering, for example, research often involves multiple stakeholders, diverse data sources, and context-specific challenges. Without a structured approach to integrating theoretical and conceptual frameworks to the research design, it becomes difficult

to ensure that studies are both theoretically grounded and methodologically robust. Table 1 presents a summary of current limitations.

Table 1. Existing models and their limitations.

Existing Models	Limitations
Research onion	Explains research design choices but does not explain framework integration
Theory-building models	Focus on theory generation but not methodological translation
Conceptual framework development approaches	Explain framework construction but not design alignment
Research design textbooks	Discuss methodology but treat frameworks separately

No existing model explicitly operationalizes the pathway linking theoretical frameworks, conceptual frameworks, research design, methodological choices, and analytical procedures.

2.6. Implications of Current Limitations

The arguments highlighted above have significant implications for research quality and impact [46]. The fragmentation between theory and method reduces the coherence of studies [25,29,30], while weak operationalization and methodological inconsistency undermine research validity [36,37]. The over-reliance on borrowed frameworks limits theoretical innovation [32,35], and the absence of structured integration models leaves researchers without practical guidance [40,42]. Collectively, these gaps contribute to a broader problem, the underutilization of theoretical and conceptual frameworks as tools for methodological design. Rather than serving as drivers of research coherence, theoretical and conceptual frameworks are often relegated to descriptive roles, diminishing the potential to enhance rigor and explanatory power.

In response to these limitations, this study advances a structured approach to integrating theoretical and conceptual frameworks into research design. Unlike the existing literature, which tends to treat frameworks and methodology as separate domains, this study emphasizes the interdependence and seeks to formalize the relationship through a coherent model. By addressing the gaps, the proposed approach aims to move beyond descriptive accounts toward a more operational and systematic understanding of how theoretical and conceptual frameworks can inform research design. In doing so, the study contributes to both methodological scholarship and research practice, particularly within interdisciplinary fields such as construction management and engineering, where the need for integrated approaches is especially prominent.

The novelty of the current study is not based on the nomenclature of the individual components of the FDIM; rather, it comes from the following:

- The integration logic: FDIM formalizes the relationship between the different stages.
- The traceability principle: Every methodological decision is linked back to Theory → Conceptual framework → Method.
- Backward integration: Most models terminate at methods. The FDIM includes:
- Theory → Design → Analysis → Theory refinement.
- Operational tools: The FDIM includes components which are absent in most framework discussions—decision framework, checklist, and implementation guide.
- The FDIM contributes theoretically by theorizing framework-method relationships, treating conceptual frameworks as translation mechanisms, positioning methodological alignment as a theoretical construct, and introduction of "framework coherence" as a measurable research quality dimension.

3. Methodology

3.1. Research Design

The study adopts a conceptual research design [36]. The aim is to develop a structured methodological model that explicates how theoretical and conceptual frameworks inform research design. Conceptual research is particularly appropriate when the objective is not to generate primary empirical data but to advance theoretical understanding, integrate fragmented knowledge, and develop new explanatory or procedural models capable of guiding future research [47]. Unlike empirical studies that seek to test hypotheses [48] or establish causal relationships [26], conceptual studies focus on synthesizing existing knowledge to generate novel insights and theoretical contributions [49].

The development of the Framework-Design Integration Model (FDIM) was motivated by a persistent methodological challenge identified across diverse academic disciplines. Although theoretical and conceptual frameworks are widely recognized as important components of scholarly inquiry, the existing methodological literature provides limited guidance on how these frameworks should systematically inform methodological decisions throughout the research process. Consequently, researchers frequently encounter difficulties in translating abstract theoretical constructs into coherent research designs, resulting in weak alignment between theory, conceptualization, methods, and analysis.

To address this gap, the study employed a theory-adaptation [50] and methodological synthesis strategy [3]. The objective is not to create an entirely new theory of research design but to integrate and operationalize existing methodological knowledge into a coherent framework capable of guiding researchers through the process of linking theoretical foundations to methodological execution.

3.2. Philosophical Positioning of the Study

The study is positioned within the pragmatist philosophy [51] which recognizes that methodological rigor emerges from the coherent alignment of theoretical assumptions, conceptual representations, and empirical procedures. Pragmatism is particularly suitable for methodological research because it prioritizes the usefulness and applicability of knowledge while accommodating insights from multiple philosophical traditions [52].

The FDIM therefore does not advocate a particular research paradigm. Instead, it seeks to provide a framework capable of supporting positivist, interpretivist, realist, pragmatist, mixed-methods, and experimental research traditions by focusing on the relationships between theoretical reasoning and methodological decision-making.

This paradigm-neutral orientation is important because the challenge addressed by the study transcends specific methodological traditions. The problem of framework-method alignment is equally pertinent in quantitative, qualitative, mixed-methods, and experimental research.

3.3. Theory Adaptation Strategy

The development of the FDIM was informed by a theory-adaptation approach [50,53], whereby existing methodological concepts were examined, refined, and integrated into a new conceptual structure.

Theory adaptation differs from theory generation in that it does not seek to develop entirely new theoretical constructs [35]. Instead, it focuses on extending, restructuring, and operationalizing existing knowledge to address previously unresolved problems. Within methodological scholarship, theory adaptation is particularly valuable when existing concepts are individually well established but insufficiently integrated.

The study identified four broad bodies of methodological knowledge that have traditionally evolved in relative isolation.

- The literature on theoretical frameworks.

- The literature on conceptual frameworks.
- The literature on research design and methodology.
- The literature on analytical and interpretive alignment.

While each of these streams provides important insights, the literature reveals limited attention to the relationships among them. Existing approaches typically explain what each component is, however, provide relatively little guidance regarding how they should interact during the design and execution of research.

The FDIM emerged through the systematic adaptation and integration of concepts drawn from these methodological traditions, with the objective of creating a unified framework capable of facilitating methodological coherence throughout the research process.

3.4. Literature Identification and Conceptual Synthesis

The development of the FDIM was based on a review and synthesis of methodological scholarship. Rather than conducting a conventional systematic literature review focused on a substantive research topic, the study undertook a methodological literature synthesis aimed at purposively identifying recurring concepts, principles, and relationships relevant to framework integration.

The literature examined included seminal and contemporary contributions on:

- Theoretical framework development.
- Conceptual framework development.
- Research design.
- Research paradigms.
- Methodological alignment.
- Theory building and theory application.
- Mixed-methods integration.
- Research quality and rigor.

Key methodological sources included studies addressing research design, conceptualization, theory development, framework construction, methodological coherence, and analytical rigor. Particular attention was given to studies discussing the relationship between theoretical assumptions and methodological choices, as these directly informed the objectives of the present study.

The review process focused on identifying:

- Common definitions and functions of theoretical frameworks.
- Common definitions and functions of conceptual frameworks.
- Mechanisms linking frameworks to methodology.
- Existing approaches to methodological alignment.
- Persistent challenges and inconsistencies reported in the literature.

Through iterative analysis, recurring themes were extracted and compared across sources.

3.5. Model Development Procedure

The FDIM was developed through a six-stage model construction process [49,53].

3.5.1. Stage 1. Concept Extraction

The first stage involved identifying recurring methodological concepts across the literature. Particular attention was given to concepts associated with:

- Theory selection.
- Conceptualization.
- Research design decisions.
- Methodological implementation.

- Analytical interpretation.

These concepts are used as the major components for the proposed model.

3.5.2. Stage 2. Comparative Analysis

The identified concepts were compared across existing methodological approaches, including research design frameworks, theory-building models, conceptual framework development approaches, and methodological alignment literature.

This comparison revealed that although existing approaches address individual elements of research design, few explicitly specify the pathways linking theoretical frameworks, conceptual frameworks, methodological choices, and analytical procedures.

3.5.3. Stage 3. Gap Identification

The comparative analysis identified three principal gaps:

- Fragmentation between theoretical and methodological domains.
- Lack of explicit translation mechanisms between theory and methods.
- Absence of structured procedures for maintaining alignment throughout the research process.

These gaps formed the conceptual foundation for the model development.

3.5.4. Stage 4. Structural Integration

The next stage involved organizing the extracted concepts into a coherent sequence representing the progression from theoretical abstraction to empirical implementation.

Five interdependent domains emerged:

- Theoretical anchoring.
- Conceptual translation.
- Design alignment.
- Methodological mapping.
- Analytical coherence.

Unlike traditional linear models, these domains were connected through iterative feedback loops, recognizing the dynamic nature of research design.

3.5.5. Stage 5. Model Refinement

The preliminary model was subjected to repeated conceptual evaluation to ensure:

- Logical consistency.
- Internal coherence.
- Distinctiveness between components.
- Applicability across research paradigms.
- Practical usability.

During this stage, overlapping concepts were refined and component boundaries clarified.

3.5.6. Stage 6. Analytical Validation

The final stage involved analytical validation through application to illustrative examples drawn from construction and engineering research.

Rather than serving as empirical cases, these examples functioned as demonstration scenarios used to evaluate whether the proposed model could systematically explain and guide methodological decision-making across different research contexts.

3.6. Model Evaluation Strategy

Since the FDIM is a conceptual model, the evaluation focused on analytical rather than statistical validation.

Three complementary evaluation criteria were employed.

3.6.1. Logical Validity

Logical validity [37] refers to the extent to which relationships between model components are theoretically coherent and internally consistent.

The model was evaluated by examining whether each component logically follows from the preceding stage and contributes to the overall objective of methodological alignment.

3.6.2. Explanatory Utility

Explanatory utility [25] refers to the ability of the model to explain how theoretical and conceptual frameworks influence methodological decisions.

The model was assessed against recurring methodological challenges identified in the literature, including:

- Weak framework-method alignment.
- Inconsistent operationalization.
- Poor justification of methodological choices.
- Fragmentation between theory and analysis.

3.6.3. Applicability Across Contexts

The model was further evaluated through illustrative applications in two distinct research contexts:

- Technology adoption research.
- Sustainability and geopolymer materials research.

These examples were deliberately selected because they represent different methodological traditions, including quantitative, mixed-methods, and experimental research designs.

The objective was to assess whether the model could provide a coherent explanatory structure across diverse disciplinary and methodological settings.

3.7. Ensuring Rigor and Trustworthiness

To enhance the credibility [54] of the proposed model, several measures were adopted throughout the development process.

Firstly, the model was grounded in established methodological scholarship rather than derived from a single theoretical tradition. Secondly, the synthesis process incorporated perspectives from multiple disciplines, including social sciences, management, engineering, and construction research. Thirdly, iterative refinement [3] was employed to reduce conceptual overlap and strengthen internal consistency [53]. Finally, illustrative applications were used to assess the practical relevance and explanatory capacity of the model.

3.8. Proposed Model

This study proposes the Framework-Design Integration Model (FDIM) as a structured and systematic approach for linking theoretical and conceptual frameworks to research design. The FDIM is proposed to address the critical methodological gap, namely the dearth of explicit and operational pathway that translates abstract theoretical constructs into coherent and defensible methodological choices. Rather than treating theory, conceptualization, and methodology as discrete stages, the FDIM conceptualizes research design as an integrated and iterative system in which each component is logically and functionally connected.

4. Results

The Section 4 presents findings from the methodological synthesis, model development, model explanation and operationalization, and illustrative validation.

4.1. Findings from the Methodological Synthesis

4.1.1. Fragmentation in Existing Methodological Approaches

The methodological literature reviewed in this study shows a persistent gap between discussions of theoretical frameworks, conceptual frameworks, and research design. Although these concepts are frequently presented as essential components of rigorous research, they are typically treated as independent methodological elements rather than as interdependent components of an integrated design process.

Theoretical frameworks are commonly discussed as explanatory structures that provide a lens for understanding a phenomenon, while conceptual frameworks are presented as context-specific representations of relationships among variables or concepts. The research design literature, in contrast, primarily focuses on methodological decisions such as paradigm selection, sampling, data collection, and analysis. Across these bodies of literature, limited attention is given to the mechanisms through which theoretical and conceptual frameworks influence methodological choices.

This fragmentation creates a methodological gap in which researchers often understand the purpose of frameworks but lack guidance on how to translate them into coherent research designs. Consequently, studies frequently exhibit weak alignment between theoretical assumptions, conceptual representations, methodological choices, and analytical procedures.

4.1.2. Recurring Challenges Identified in the Literature

The synthesis further revealed four recurring methodological challenges.

Challenge 1. Symbolic Use of Frameworks

Many studies treat theoretical and conceptual frameworks as symbolic components included primarily to satisfy academic conventions. Frameworks are often presented in literature review sections but play little role in shaping subsequent methodological decisions.

Challenge 2. Weak Conceptual Translation

Researchers frequently struggle to translate abstract theoretical constructs into contextually relevant variables and measurable indicators. As a result, conceptual frameworks often become simplified reproductions of existing theories rather than context-specific analytical tools.

Challenge 3. Methodological Misalignment

The literature reveals numerous examples where methodological choices are insufficiently justified by theoretical assumptions. Common manifestations include the selection of research designs, data collection methods, and analytical techniques that are inconsistent with the theoretical foundations of the study.

Challenge 4. Disconnection Between Analysis and Theory

A further challenge concerns the interpretation of findings. Many studies employ analytical procedures without explicitly linking the results back to the theoretical framework, thereby limiting theoretical contribution and cumulative knowledge development.

These recurring challenges collectively suggest the need for a structured mechanism capable of integrating theoretical foundations with methodological execution.

4.1.3. Gap in Existing Research Design Models

A comparative analysis of established methodological frameworks revealed important limitations.

Research design models such as the Research Onion provide valuable guidance regarding methodological decision-making but do not explicitly explain how theoretical and conceptual frameworks should shape those decisions. Similarly, theory-building frameworks focus primarily on theory generation and refinement rather than methodological translation. Conceptual framework development approaches explain how frameworks may be constructed but provide limited guidance regarding the operationalization within research design.

Consequently, no existing model was found to explicitly formalize the pathway linking, theoretical foundations, conceptual framework development, research design selection, methodological implementation, and analytical interpretation.

The absence of such a model constituted the principal methodological gap addressed by this study.

4.2. Development of the Framework-Design Integration Model (FDIM)

4.2.1. Emergence of the FDIM

The FDIM emerged from the integration of concepts identified through the methodological synthesis process. Rather than creating entirely new methodological constructs, the model reorganizes and formalizes existing concepts into a coherent structure that explains how frameworks inform methodological decisions.

The model was developed through a theory-adaptation strategy, whereby recurring methodological concepts were extracted, compared, refined, and integrated into a unified framework.

Five interdependent components emerged from this process:

i. Theoretical anchoring.
ii. Conceptual translation.
iii. Design alignment.
iv. Methodological mapping.
v. Analytical coherence.

These components represent distinct but interconnected stages through which theoretical and conceptual frameworks influence research design.

4.2.2. Conceptual Architecture of the FDIM

The FDIM proposes a matrix between, theoretical anchoring → conceptual translation → design alignment → methodological mapping → analytical coherence.

The flow reflects a rather multiple movement. The first is a forward progression, where theory informs design decisions. The second is a backward integration, where empirical findings are interpreted in relation to the original theoretical framework, thereby contributing to theory validation, refinement, or extension. Additional connections show relationships between the different components of the FDIM. The cyclical logic distinguishes the FDIM from static models and positions it as a dynamic tool for conducting and evaluating research. The model is particularly suited to interdisciplinary contexts, such as construction management and engineering, where the translation of social science theories into technical applications requires both conceptual adaptation and methodological precision.

The FDIM is grounded in the premise that rigorous research design requires alignment across five interdependent layers: (1) theoretical anchoring, (2) conceptual translation, (3) design alignment, (4) methodological mapping, and (5) analytical coherence. These

layers represent a progression from abstraction to empiricism [30]; however, they are not strictly linear. The model incorporates feedback mechanisms that facilitate refinement and recalibration at each stage. The proposed FDIM is presented in Figure 1.

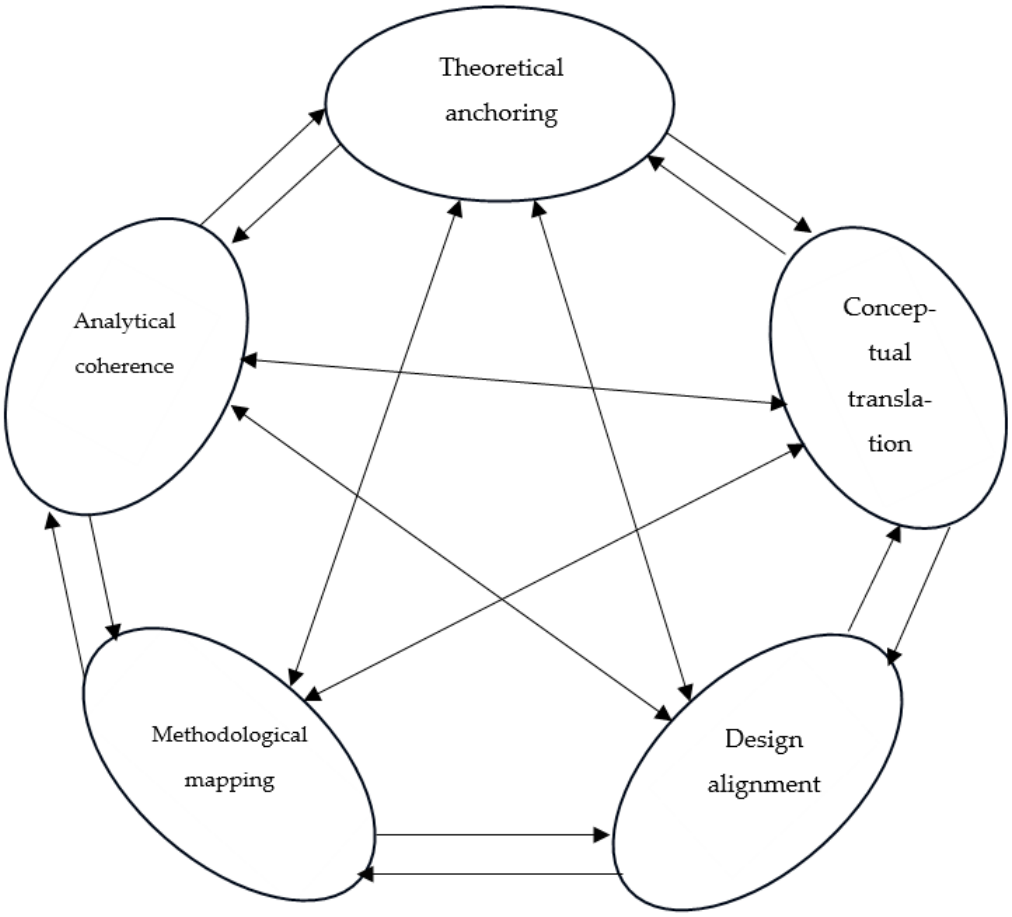

Figure 1. Framework-Design Integration Model.

The model proposes that methodological coherence is achieved when each stage of research design can be explicitly traced back to the theoretical assumptions underpinning the study. Unlike traditional research design models that focus primarily on methodological decisions, the FDIM places theoretical and conceptual frameworks at the center of the design process.

The model is iterative rather than linear, allowing feedback between stages and recognizing the dynamic nature of research development.

4.2.3. Definition and Boundaries of FDIM Components

To reduce conceptual overlap and enhance operational clarity, each component was assigned a distinct role, addressing a specific primary question in the research.

Theoretical Anchoring

Theoretical anchoring refers to the identification and justification of the theory or theories used to explain the phenomenon under investigation.

Primary Question: Why does the phenomenon occur?
Output: Theoretical framework.
Boundary: Focused exclusively on explanatory foundations.

The first component of the FDIM involves the identification and justification of an appropriate theoretical framework. This stage establishes the intellectual foundation [55] of the study and determines the explanatory lens [16] through which the research problem is investigated. Theoretical anchoring requires more than the selection of a widely cited model, it demands a critical evaluation of the theory's relevance, assumptions, and scope in relation to the research context. For instance, adopting the UTAUT in a study on construction technology adoption necessitates careful consideration of the underlying assumptions about individual behavior, organizational context, and technological environments. Researchers must explicitly justify why the theory is suitable and identify any limitations that may require adaptation of the model. Theoretical anchoring also involves delineating key constructs and hypothesized relationships, which serve as the building blocks for subsequent conceptualization. Importantly, theoretical anchoring sets the epistemological and ontological tone of the study [56], thereby influencing the selection of an appropriate research paradigm in later stages.

Conceptual Translation

Conceptual translation refers to the adaptation of theoretical constructs into a context-specific representation of the phenomenon.

Primary Question: How should theory be represented within the research context?
Output: Conceptual framework.
Boundary: Focused on contextualization and construct adaptation.

Conceptual translation represents the transformation of abstract theoretical constructs into a context-specific conceptual framework [11]. This stage is critical for bridging the gap between general theory and the particularities of the research setting.

Conceptual translation involves:

- Adapting theoretical constructs to reflect contextual realities;
- Introducing additional variables where necessary;
- Refining relationships between constructs;
- Defining the scope and boundaries of the study.

For example, while UTAUT provides a general structure for understanding technology acceptance, a conceptual framework for 3D concrete printing technology acceptance in the South African construction sector may incorporate additional factors such as regulatory constraints, infrastructure readiness, and industry fragmentation [32]. The contextual variables are not deviations from theory, but extensions that enhance the explanatory power within the specific domain. This stage also requires the explicit articulation of assumptions and the development of a visual or schematic representation of the conceptual framework [36]. The representation serves as a blueprint for the research design, ensuring that all subsequent methodological decisions are grounded in a clearly defined structure.

Design Alignment

Design alignment concerns the selection of research paradigms and research designs that are consistent with the theoretical and conceptual foundations of the study.

Primary Question: What research strategy best addresses the conceptual framework?
Output: Research design.
Boundary: Focused on strategic methodological decisions rather than operational procedures.

Design alignment focuses on the selection of appropriate research design that is consistent with the theoretical and conceptual frameworks. This stage involves aligning the study with a suitable research paradigm, strategy, and overall approach. The choice of research paradigm is directly influenced by the assumptions embedded in the theoretical

framework [32,35]. For example, theories that posit measurable relationships between variables typically align with positivist or post-positivist paradigms [51], while theories emphasizing subjective meaning may require interpretivist approaches [57]. In many cases, particularly in interdisciplinary research, a pragmatist paradigm [2,22,28] may be adopted to accommodate methodological diversity.

Design alignment also includes the selection of a research strategy, such as survey research, case study, experimental design, and mixed-methods approaches. The decision must be justified in relation to the conceptual framework. For instance, a study examining both the determinants and contextual barriers of technology adoption [32] may require a mixed-methods design to capture both quantitative relationships and qualitative insights. The design alignment ensures that the research design is not chosen arbitrarily but emerges logically from the theoretical and conceptual foundations. Design alignment establishes coherence between what is being studied and how it will be studied.

Methodological Mapping

Methodological mapping refers to the translation of conceptual constructs into measurable or observable elements.

Primary Question: How will concepts be investigated empirically?
Output: Sampling strategies, instruments, and data collection procedures.
Boundary: Focused on operationalization and implementation.

Methodological mapping operationalizes the research design by specifying the procedures for data collection and measurement [56]. This stage translates the conceptual framework into actionable methodological steps, ensuring that each construct and relationship is adequately captured.

Methodological mapping encompasses several key elements, including the following:

- Sampling strategy: Determining the target population and sampling technique based on the constructs and relationships defined in the conceptual framework.
- Data collection methods: Selecting appropriate instruments, such as surveys, interviews, and observational tools, that align with the nature of the variables.
- Instrument design: Developing or adapting measurement tools to ensure construct validity and reliability.
- Measurement scales: Defining how variables will be quantified or categorized.

For example, constructs derived from UTAUT may be operationalized through validated survey items measured on Likert scales, while additional context-specific variables may require newly developed indicators [32]. In qualitative components, interview guides must be designed to explore the dimensions identified in the conceptual framework. Methodological mapping also involves documenting the rationale for each decision [58], thereby enhancing transparency and reproducibility. This stage is particularly important for avoiding the common pitfall of methodological incoherence [38], where methods are selected independently of theoretical considerations.

Analytical Coherence

Analytical coherence concerns the alignment between theoretical assumptions, analytical techniques, and interpretation of findings.

Primary Question: How will evidence be analyzed and interpreted?
Output: Analytical strategy and theoretical interpretation.
Boundary: Focused on evidence evaluation and theory-informed interpretation.

This stage completes the forward progression of the FDIM and initiates the backward integration process, where findings are interpreted in relation to the original theoretical

framework. This enables the study to contribute to theory validation, refinement, or extension. Analytical coherence focuses on ensuring that data analysis techniques are aligned with the methodological design and the underlying frameworks. The chosen analytical techniques must be capable of addressing the research questions and testing the relationships specified in the conceptual framework [38]. In quantitative research, this may involve the use of statistical techniques such as regression analysis [26] or structural equation modelling [59] to examine relationships between variables. The selection of the techniques must be justified in relation to the theoretical framework, ensuring that the analytical techniques are appropriate for testing the hypothesized relationships. In qualitative research, analytical approaches such as thematic analysis and content analysis [41] must be designed to capture the meanings and patterns associated with the constructs. Theoretical frameworks may guide the coding process [11], while conceptual frameworks ensure that analysis remains focused on the relevant variables [19]. In mixed-methods research, analytical coherence involves integrating findings from different data sources in a manner that reflects the conceptual framework [32]. This may include triangulation, complementarity, or sequential analysis, depending on the research design.

The boundaries of the different components of the FDIM are summarized and presented on Table 2.

Table 2. Boundaries of the FDIM components.

Component	Boundary
Theoretical anchoring	Why the phenomenon occurs
Conceptual translation	Context-specific representation
Design alignment	Research strategy and paradigm
Methodological mapping	Data collection and measurement
Analytical coherence	Data interpretation and testing

4.3. Operationalization of the FDIM

To demonstrate how the model translates into practical methodological decisions, Table 3 presents the FDIM operationalization matrix.

Table 3. FDIM operationalization matrix.

FDIM Components	Key Decisions	Primary Outputs	Quality Criteria	Common Errors
Theoretical anchoring	Theory selection	Theoretical framework	Explanatory fit	Theory dumping
Conceptual translation	Variable adaptation	Conceptual framework	Contextual relevance	Direct theory replication
Design alignment	Paradigm and design selection	Research strategy	Methodological consistency	Design-theory mismatch
Methodological mapping	Sampling and measurement	Data collection plan	Construct validity	Weak operationalization
Analytical coherence	Analysis and interpretation	Findings and implications	Interpretive alignment	Disconnected analysis

The matrix demonstrates that methodological coherence can be assessed through explicit relationships between framework components and methodological outputs.

4.4. Iteration and Feedback Mechanisms

A distinguishing feature of the FDIM is the emphasis on iteration and feedback. Research design is rarely a linear process. Insights gained at later stages often necessitate revisions to earlier components. For example, challenges encountered during data collection may reveal gaps in the conceptual framework, prompting refinement of constructs or relationships. Similarly, unexpected analytical findings may lead to reconsideration of theoretical assumptions. The FDIM accommodates this reality by incorporating feedback loops between all components. The iterative structure enhances the flexibility of the model while maintaining overall coherence. It also reflects the dynamic nature of research, particularly in complex and evolving fields such as construction engineering and digital innovation.

4.5. Illustrations

To demonstrate the applicability and analytical robustness of the Framework-Design Integration Model, illustrative examples are drawn from research within the construction and engineering domains. The illustrations are not intended as full case studies, but as analytically structured examples that trace how theoretical and conceptual frameworks inform specific methodological decisions. By mapping each scenario onto the components of the FDIM, the study illustrates how the model facilitates coherence between theory, design, and empirical execution.

Two demonstration scenarios are considered: (1) 3D concrete printing technology acceptance, (2) sustainable construction materials development. The examples reflect the diversity of research contexts in the built environment and engineering.

4.5.1. Scenario 1: 3D Concrete Printing Technology Acceptance

The first illustration draws on research investigating the adoption of 3D concrete printing technology within the construction sector. This domain is particularly suited to framework-driven inquiry due to the intersection of technological innovation, organizational behavior, and industry-level constraints.

Theoretical Anchoring

The illustration is anchored in the UTAUT model, which provides a structured explanation of technology adoption behavior. The theory identifies key determinants, including performance expectancy, effort expectancy, social influence, and facilitating conditions, and posits their influence on behavioral intention and usage. The selection of UTAUT is justified by the strong empirical validation and the relevance to understanding adoption decisions among professionals. However, the original formulation assumes relatively stable organizational environments, necessitating contextual adaptation for the construction sector.

Conceptual Translation

The conceptual framework extends UTAUT by incorporating construction-specific variables such as regulatory clarity, policy maturity, and infrastructure readiness.

The additions reflect the fragmented and project-based nature of the construction industry, where adoption decisions are influenced not only by individual perceptions but also by institutional and systemic factors. The resulting conceptual framework retains the core structure of the UTAUT, while enhancing the contextual relevance.

Design Alignment

Given the explanatory nature of the theoretical framework and the need to test relationships between variables, the study adopts a positivist research paradigm with a quantitative survey design. This alignment ensures consistency between the assumptions of the theory

and the methodological approach. However, recognizing the contextual complexity of 3DCP adoption, the design incorporated a supplementary qualitative component, resulting in a sequential explanatory mixed-methods approach. This facilitates the quantitative testing of relationships followed by qualitative exploration of underlying mechanisms.

Methodological Mapping

- Sampling: A stratified sampling approach ensured representation across different stakeholder groups since the target population included construction professionals, engineers, and policymakers involved in digital construction technologies.
- Data Collection: Structured questionnaires were developed using Likert-scale items derived from validated UTAUT instruments, with additional items reflecting the added context-specific variables.
- Operationalization: Constructs such as performance expectancy are measured through indicators related to productivity gains and project efficiency, while facilitating conditions are operationalized through access to infrastructure and training.

Analytical Coherence

Data analysis employed structural equation modelling to test the relationships between constructs. This technique aligns with the theoretical framework by enabling the examination of latent variables and their interdependencies. Qualitative data was analyzed thematically to provide explanatory depth.

FDIM Insights

This example demonstrates a relatively strong alignment across all components of the FDIM. The FDIM demonstrated value by providing a structured pathway from technology adoption theory to methodological execution. Rather than selecting survey instruments and analytical techniques independently, each methodological decision was explicitly linked to theoretical constructs and conceptual relationships.

The model improved traceability, construct operationalization, and analytical justification compared with conventional methodological planning approaches.

4.5.2. Scenario 2: Sustainability and Geopolymer Materials Research

The second illustration considers research on the development and application of sustainable construction materials, particularly tailings-based geopolymers. Unlike the previous example, this domain often lacks explicit engagement with theoretical or conceptual frameworks.

Theoretical Anchoring

In many studies within this domain, theoretical anchoring is minimal or implicit, with research primarily driven by engineering principles and experimental objectives. While this approach is valid for certain types of investigation, it often limits the integration of broader conceptual considerations, such as sustainability, lifecycle performance, and socio-economic impact.

Conceptual Translation

Where conceptual frameworks are present, they tend to focus on material properties and performance indicators, such as compressive strength, durability, and environmental impact. However, these frameworks are rarely linked to broader theoretical constructs, resulting in a narrow scope of analysis.

Design Alignment

Research designs are typically experimental, involving laboratory testing and performance evaluation. While methodologically rigorous in technical terms, these designs often lack explicit alignment with conceptual or theoretical frameworks.

Methodological Mapping and Analysis

Methodological decisions are driven by engineering standards and testing protocols rather than by a structured conceptual framework. Data analysis focuses on statistical comparison of material properties, with limited engagement with theoretical interpretations.

FDIM Insights

This example illustrates a contrasting scenario in which the absence of explicit framework integration leads to a form of methodological isolation. While the research may achieve technical validity, it may lack broader explanatory power or interdisciplinary relevance. The FDIM highlights the potential for enhancing such studies by incorporating conceptual frameworks that link material performance to sustainability theories, policy considerations, or adoption dynamics. The analysis revealed that many technical studies focus heavily on laboratory procedures and performance testing while giving limited attention to explicit theoretical foundations.

The FDIM highlighted opportunities for integrating sustainability theories, circular economy perspectives, and socio-technical considerations into experimental research.

This suggests that the model may enhance explanatory depth in domains traditionally dominated by technical performance evaluation.

4.5.3. Cross-Illustration Synthesis

A comparative analysis of the demonstration scenarios reveals several important insights. The degree of integration between theoretical and conceptual frameworks varies significantly across research domains. Studies on technology adoption tend to exhibit stronger alignment, while technically oriented research often lack explicit framework integration. The value of the model increases as disciplinary complexity increased. The role of the conceptual framework is particularly critical in interdisciplinary contexts [56]. It serves as the useful mechanism for adapting and extending theory [25], ensuring relevance to specific research settings. According to Rashid and Rasheed [38], where conceptual translation is weak or absent, methodological coherence is compromised. The Framework-Design Integration Model demonstrates flexibility across different research paradigms and methodological approaches. Whether applied in quantitative, qualitative, or mixed-methods studies, the model provides a consistent structure for linking theory to design. The cross-illustration synthesis is summarized and presented on Table 4.

Table 4. Cross-illustration summary.

Feature	3DCP	Geopolymers
Paradigm	Pragmatism	Experimental
Theory dependence	High	Low
Framework adaptation	Moderate	Minimal
FDIM benefit	Alignment	Framework insertion

4.6. Practical Guide for Researchers

While the previous sections established the conceptual and analytical foundations of the FDIM, the ultimate value lies in the applicability to real-world research practice. The practical guide is structured around three interrelated components: (1) a step-by-step

procedure for integrating frameworks into research design, (2) a decision-making tool to support methodological alignment, and (3) a diagnostic checklist for evaluating the internal coherence of a study. Taken together, these tools operationalize the FDIM, enabling researchers to move from abstract methodological principles to better design decisions. Although applicable across disciplines, the proposed guide is particularly relevant to interdisciplinary fields such as construction management and engineering, where the integration of theoretical and empirical elements is often challenging.

4.6.1. Step-by-Step Guide to Framework Integration with Research Design

The FDIM can be implemented through a systematic sequence of steps, each corresponding to a core component of the model. The steps are iterative, and refinement is expected. However, the steps provide a structured pathway that ensures alignment between theoretical grounding and methodological execution.

Identify and Justify the Theoretical Framework

The process begins with the selection of an appropriate theoretical framework that explains the phenomenon under investigation [60]. It is necessary to clearly articulate the theoretical framework with defined constructs and relationships. The step requires critical engagement with the theory assumptions, scope, and relevance. The researcher should:

- Identify theories from the literature;
- Evaluate the explanatory power in relation to the research problem;
- Justify the selection based on contextual relevance and prior empirical support.

For example, studies on technology adoption in construction may draw on the Unified Theory of Acceptance and Use of Technology but must explicitly justify the applicability to the specific technological and institutional context.

Develop the Conceptual Framework

Once the theoretical foundation is established, the next step involves translating it into a conceptual framework tailored to the research context [45]. A contextualized conceptual framework with clearly defined variables and relationships is developed. This requires adapting theoretical constructs and, where necessary, introducing additional variables that reflect contextual realities. The task includes:

- Mapping theoretical constructs to context-specific variables;
- Identify any gaps in the theory and incorporate relevant extensions;
- Defining relationships between variables;
- Developing a visual representation of the conceptual framework.

This step is critical for ensuring that the study is both theoretically grounded and empirically relevant.

Align Choices with Appropriate Research Paradigm

The choice of research paradigm should follow logically from the assumptions embedded in the theoretical and conceptual frameworks [61]. An explicitly stated research paradigm aligns with theoretical assumptions. Researchers must explicitly articulate their ontological and epistemological positions and demonstrate how these inform the methodological approach. The researchers should:

- Determine whether the study aligns with positivist, interpretivist, or pragmatist traditions;
- Justify the choice of paradigm in relation to the nature of the research problem;
- Ensure consistency between the paradigm and the types of data to be collected.

Select and Justify the Research Design

At this stage, the overall research strategy [51] is defined. A coherent research design aligns with the framework and research questions. The design must be capable of addressing the research questions and testing the relationships specified in the conceptual framework. The task includes:

- Choosing an appropriate design (e.g., survey, case study, experiment, mixed methods);
- Justifying the choice in relation to the conceptual framework;
- Defining the scope and structure of the study.

For instance, explanatory models derived from theory often require quantitative designs, while exploratory extensions may necessitate qualitative or mixed-methods approaches.

Map the Methodological Components

This step involves the detailed specification of methods for data collection and measurement [3]. It is important to fully specify the methodological plan of the research with clear linkage to the framework constructs. Each methodological decision must be traceable to the conceptual framework. The tasks include:

- Defining the target population and sampling strategy;
- Developing or adapting data collection instruments;
- Operationalizing variables into measurable indicators;
- Ensuring the validity and reliability of measurement tools.

The emphasis here is on transparency and alignment, ensuring that all methodological choices are theoretically and conceptually justified.

Ensure Analytical Alignment

The final step involves selecting data analysis techniques that are consistent with the research design and capable of addressing the research questions [54]. The selected analytical strategy should align with the data and the theoretical assumptions. The researcher should:

- Choose appropriate analytical methods (e.g., regression, structural equation modelling, thematic analysis);
- Justify the methods in relation to the conceptual framework;
- Plan for integration of findings, particularly in mixed-methods studies.

Iterate and Refine

The FDIM emphasizes iteration. The researcher should revisit earlier steps as required, to ensure that the research design is refined and coherent, particularly when challenges arise during data collection or analysis.

4.6.2. Decision-Making Framework for Methodological Alignment

To complement the step-by-step guide, a decision-making framework that assists researchers to systematically align each stage of the study is presented in Table 5. The framework is structured around key questions that must be addressed at each stage of the research process, including assessment scale and overall maturity score.

Table 5. Decision-making framework.

FDIM Component	Key Question	Key Decisions	Primary Outputs	Quality Criteria	Assessment Scale		Overall Maturity Score		Common Errors
Theoretical anchoring	What explains the phenomenon?	Theory selection	Theoretical framework	Explanatory fit	Absent	0	Missing	0	Theory dumping
					Weak	1	Poor alignment	1–5	
					Adequate	2	Moderate alignment	6–10	
					Strong	3	Strong alignment	11–15	
Conceptual translation	How is the theory adapted to context?	Variable adaptation	Conceptual framework	Contextual relevance	Absent	0	Missing	0	Direct theory replication
					Weak	1	Poor alignment	1–5	
					Adequate	2	Moderate alignment	6–10	
					Strong	3	Strong alignment	11–15	
Design alignment	What approach best captures the relationships?	Paradigm and Design selection	Research strategy	Methodological consistency	Absent	0	Missing	0	Design-theory mismatch
					Weak	1	Poor alignment	1–5	
					Adequate	2	Moderate alignment	6–10	
					Strong	3	Strong alignment	11–15	
Methodological mapping	How will constructs be measured?	Sampling and measurement	Data collection plan	Construct validity	Absent	0	Missing	0	Weak operationalization
					Weak	1	Poor alignment	1–5	
					Adequate	2	Moderate alignment	6–10	
					Strong	3	Strong alignment	11–15	
Analytical coherence	How will relationships be tested or interpreted?	Analysis and interpretation	Findings and implications	Interpretive alignment	Absent	0	Missing	0	Disconnected analysis
					Weak	1	Poor alignment	1–5	
					Adequate	2	Moderate alignment	6–10	
					Strong	3	Strong alignment	11–15	

The structured approach ensures that each decision is logically connected to the preceding section, thereby reducing the risk of methodological inconsistency [36]. It also provides a transparent audit trail that enhances the credibility and reproducibility [58] of the study.

4.6.3. Diagnostic Checklist for Research Coherence

In addition to guiding the research design process, the FDIM could be used as an evaluative tool to assess the coherence of a completed or ongoing study. The following checklist provides a set of criteria against which researchers could examine their work.

Theoretical and Conceptual Clarity

- Is the theoretical framework clearly defined and justified?
- Are key constructs explicitly identified?
- Is the conceptual framework logically derived from the theoretical framework?
- Are context-specific variables clearly explained and justified?

Alignment with Research Design

- Are the research questions consistent with the theoretical framework?
- Is the chosen research paradigm explicitly stated and justified?
- Does the research design logically follow from the conceptual framework?

Methodological Consistency

- Is the sampling strategy appropriate for the constructs being studied?
- Are data collection methods aligned with the nature of the variables?
- Are measurement instruments valid and reliable?
- Is there a clear link between variables and their operationalization?

Analytical Rigor

- Are data analysis techniques appropriate for the research design?
- Do analytical methods align with the theoretical assumptions?
- Are findings interpreted in relation to the conceptual and theoretical frameworks?

Overall Coherence

- Is there a clear and traceable link from theory to analysis?
- Are all methodological decisions explicitly justified?
- Does the study demonstrate internal consistency across all stages?

4.6.4. Integrative Value of the Practical Guide

The tools presented in the study collectively transform the FDIM from a conceptual model into a practical instrument for research design and evaluation. By providing a structured pathway, a decision-support mechanism, and a diagnostic framework, the guide addresses the key limitations identified in existing approaches, particularly the lack of theoretical clarity and methodological integration [36–38,40,43]. The guide does not prescribe a rigid methodology. Instead, it offers a flexible yet structured approach that can be adapted to different research paradigms, disciplines, and contexts. The emphasis on alignment and transparency ensures that researchers can justify the choices made, while maintaining coherence between theoretical foundations and empirical execution [11]. The practical application of the FDIM offers a means of enhancing both the rigor and relevance of a good study.

5. Discussion

5.1. Reframing the Relationship Between Frameworks and Research Design

A central argument emerging from this study is that theoretical and conceptual frameworks should no longer be viewed as peripheral components of research design. The findings suggest that many methodological challenges reported across disciplines stem from the treatment of frameworks as descriptive sections rather than as functional mechanisms that actively shape methodological decisions. Existing methodological practices often position theoretical and conceptual frameworks within literature review sections [7,29,62,63], with limited attention given to how they influence subsequent choices relating to research design, sampling, data collection, measurement, and analysis.

The Framework-Design Integration Model (FDIM) addresses this limitation by repositioning frameworks at the center of the research process. Rather than treating theory as a preliminary requirement and methodology as a separate technical exercise, the model conceptualizes research design as a process of progressive translation from theoretical explanation to empirical investigation. This perspective extends prevailing understandings of methodological rigor [38,64] by arguing that coherence emerges not simply from the application of appropriate methods but from the explicit alignment of theoretical assumptions, conceptual representations, methodological procedures, and analytical strategies.

This reconceptualization is particularly important in contemporary research environments characterized by increasing interdisciplinarity. As researchers draw theories from multiple disciplines and apply them to complex practical problems, the need for systematic mechanisms that preserve coherence across research stages becomes increasingly critical. The FDIM therefore contributes to a broader shift toward integrative methodological thinking in which theory and method are viewed as mutually constitutive rather than sequentially independent components.

5.2. Positioning the FDIM Within Existing Methodological Scholarship

An important contribution of this study lies in clarifying how the FDIM differs from existing methodological frameworks. Although the five components of the model, theoretical anchoring, conceptual translation, design alignment, methodological mapping, and analytical coherence, draw upon concepts that are already familiar within the methodological literature, the novelty of the FDIM does not reside in the individual components themselves. Rather, it resides in the formalization of the relationships between the components and the explicit articulation of the pathways through which frameworks inform methodological decisions.

Existing research design models provide valuable guidance regarding methodological choices but often stop short of explaining how theoretical foundations should influence those choices [51,56,65,66]. For example, widely used research design frameworks describe paradigms, strategies, methods, and analytical procedures but rarely specify how researchers should move from theoretical assumptions to concrete methodological decisions. Similarly, the literature on conceptual framework development focuses on constructing conceptual representations of phenomena but provides limited guidance on how those representations should shape research design.

The FDIM addresses this gap by introducing an explicit integration logic. It specifies how theoretical frameworks are translated into conceptual frameworks, how conceptual frameworks guide research design, how designs inform methodological implementation, and how analytical procedures should remain connected to theoretical assumptions. In doing so, the model transforms what has traditionally been an implicit process into an explicit methodological architecture.

Furthermore, the FDIM extends beyond existing models by incorporating a traceability principle. Every major methodological decision should be traceable to a corresponding theoretical or conceptual justification. This principle strengthens transparency, enhances methodological defensibility, and provides a clear audit trail linking theoretical assumptions to empirical procedures.

5.3. Theoretical Contributions of the FDIM

The FDIM contributes to methodological scholarship in several important ways.

Firstly, the model advances understanding of the relationship between theoretical and conceptual frameworks. The existing literature frequently discusses these concepts independently [11], leading to persistent confusion regarding their respective roles. By positioning conceptual frameworks as translation mechanisms between theory and methodology, the FDIM provides a more precise explanation of how these constructs interact during research design.

Secondly, the study contributes to emerging discussions regarding methodological coherence. While coherence is often recognized as a desirable characteristic of high-quality research [67], it is rarely conceptualized as a structured process. The FDIM advances the notion that coherence is not an outcome that emerges automatically but a condition that must be intentionally constructed through alignment across multiple research stages.

Thirdly, the model introduces the concept of framework-driven methodological alignment. This perspective challenges conventional approaches in which methodological choices are frequently justified based on disciplinary norms or researcher preference rather than theoretical requirements. By emphasizing framework-driven decision-making, the FDIM encourages researchers to justify methodological choices based on conceptual necessity rather than methodological convenience.

Fourthly, the model contributes to theory adaptation and contextualization. The conceptual translation stage recognizes that theories rarely transfer directly across contexts without modification [25]. This is particularly important in applied fields where imported theories often require adaptation to accommodate local, organizational, technological, or cultural conditions. The FDIM therefore supports a more dynamic understanding of theory application in which theories are refined and contextualized rather than merely adopted.

Finally, the model contributes to discussions concerning cumulative knowledge development. By ensuring that analytical interpretation remains connected to theoretical foundations, the FDIM facilitates the refinement and extension of theory based on empirical evidence. This feature addresses a common weakness in empirical studies where findings are reported descriptively but are not systematically integrated into broader theoretical debates.

5.4. Implications for Interdisciplinary Research

The illustrations demonstrate that the value of the FDIM becomes particularly evident in interdisciplinary research contexts. Interdisciplinary studies frequently involve the integration of theories, concepts, methods, and analytical traditions originating from different disciplines [56]. While such integration can generate innovative insights, it also introduces substantial risks of methodological fragmentation.

The technology adoption illustration demonstrates how the model could facilitate integration across social, organizational, and technological dimensions. In this context, researchers must often reconcile competing theoretical perspectives while simultaneously selecting methods capable of capturing complex relationships. The FDIM provides a structured mechanism for navigating these challenges by maintaining explicit connections between theoretical assumptions and methodological choices.

The geopolymer and sustainability illustration highlights a different contribution. Technical and engineering research often prioritizes experimental procedures and performance evaluation, sometimes at the expense of broader conceptual and theoretical engagement. The FDIM demonstrates how explicit framework integration can extend the explanatory scope of technical studies by incorporating sustainability theories, socio-technical perspectives, and policy-related considerations. As a result, research can move beyond determining whether a technology works toward understanding why it matters and how it may be adopted, governed, and scaled.

The capacity of the model to operate across different disciplinary traditions suggests that it may provide a useful foundation for addressing increasingly complex societal challenges that require collaboration among engineering, social science, management, and policy researchers.

5.5. Evaluating the Practical Utility of the FDIM

A distinguishing feature of the FDIM is the emphasis on practical applicability. Many methodological frameworks provide conceptual guidance but offer limited support for implementation. The present study sought to address this limitation through the development of complementary tools, including a step-by-step implementation guide, a decision-making framework, an operationalization matrix, and a diagnostic checklist.

Collectively, these tools transform the model from a conceptual proposition into a practical methodological instrument. Researchers can use the model not only to design studies but also to evaluate the coherence [67] of existing research projects. Supervisors may employ the framework when guiding postgraduate students, while reviewers may use it as a lens for assessing methodological rigor.

The operationalization matrix is particularly significant because it translates abstract methodological principles into observable decisions, outputs, quality criteria, and common errors. This feature increases the practical utility of the model by providing researchers with a structured mechanism for identifying weaknesses and improving research quality by including the assessment scale and overall maturity score. The higher these scores, the more coherent the research design.

The introduction of diagnostic criteria and assessment tools also creates opportunities for future empirical evaluation. Researchers may use these tools to examine whether stronger framework-method alignment is associated with improvements in research quality, theoretical contribution, or methodological transparency.

5.6. Reflection on the Scope and Boundaries of the Model

Although the FDIM offers a structured approach to framework integration, it should not be interpreted as a universal solution to all methodological challenges. Research design remains an inherently complex and context-dependent process, and no single model can fully capture the diversity of research practices across disciplines and paradigms.

One potential concern is that the structured nature of the model may be perceived as overly linear. However, the FDIM is intended to be iterative rather than prescriptive. The model recognizes that research often involves movement between stages, particularly during conceptual refinement, instrument development, and analytical interpretation [24]. The inclusion of feedback loops is therefore critical to preserving flexibility while maintaining coherence.

Another consideration relates to paradigm diversity. Although the model was designed to be paradigm-neutral, the emphasis on explicit alignment may be more naturally suited to positivist and mixed-methods traditions than to highly emergent forms of qualita-

tive inquiry. Further investigation is therefore required to determine how the model can be adapted for interpretive and constructivist research contexts.

Finally, the model should be understood as a framework for enhancing methodological coherence rather than a substitute for methodological expertise. Effective application still requires researchers to exercise critical judgement, disciplinary knowledge, and contextual awareness. The FDIM provides a structure for decision-making, but the quality of those decisions ultimately depends on the competence and reflexivity of the researcher.

Taken together, these considerations suggest that the greatest value of the FDIM lies not in prescribing a rigid sequence of research activities but in providing a transparent mechanism through which researchers can systematically connect theory, conceptualization, methodology, and analysis. By doing so, the model advances methodological scholarship while offering a practical pathway for improving the rigor, transparency, and impact of academic research.

6. Conclusions

The study set out to address a critical, yet often overlooked, issue in research methodology. The lack of systematic integration between theoretical and conceptual frameworks and research design. A major weakness in contemporary research practice lies in the insufficient integration of theoretical and conceptual frameworks into research design. The study argue that these frameworks must be repositioned as active, functional drivers rather than passive descriptive elements. The study introduces the Framework-Design Integration Model as a structured, iterative approach linking theoretical anchoring, conceptual translation, design alignment, methodological mapping, and analytical coherence, thereby shifting the field from conceptual clarification to methodological operationalization. The core contribution of the FDIM is the provision of a clear, systematic pathway that could enhance alignment across all stages of research, potentially improve rigor and validity, and possibly transforms theory into a practical instrument for guiding research decisions. In terms of implications for research and practice, the model could promote a move away from fragmented approaches toward integrated, coherent designs that strengthen both theoretical relevance and real-world applicability. For academia, it advances methodological clarity by resolving ambiguities between theoretical and conceptual frameworks, enhances internal consistency in research design, supports theory development through iterative feedback, and improves transparency and reproducibility. Within the built environment and engineering research, the FDIM offers a valuable structure for addressing complex, interdisciplinary challenges by enabling robust investigations into areas such as digital technology adoption, sustainability practices, and organizational dynamics, while also enhancing the policy relevance and industry applicability of findings. For early-career researchers and research training, the model serves as a practical and pedagogical tool that simplifies the translation of theory into method, improves the quality of postgraduate research, and fosters a more critical and reflective approach to research design. However, the study is limited by the conceptual nature of the FDIM, the lack of large-scale empirical validation, potential complexity and resource demands, and varying applicability across research paradigms., In addition, built-environment illustrations may restrict generalizability, there is potential over-simplification of the iterative process, and applicability across quantitative, qualitative, mixed-methods, and experimental designs remains untested. Consequently, future research should focus on empirically testing the model across disciplines, refining and adapting the model for different contexts, extending the application to qualitative and interpretive research as well as experimental studies, exploring the role in interdisciplinary problem-solving, and developing digital tools to enhance the accessibility and practical implementation.

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Abbreviations

The following abbreviations are used in this manuscript:

UTAUT	Unified Theory of Acceptance and Use of Technology
FDIM	Framework-Design Integration Model
3DCP	3-Dimensional Concrete Printing
SEM	Structural Equation Modelling

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