A Readiness Model for Integrated Project Delivery

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Abstract

As the construction industry continues to embrace Integrated Project Delivery (IPD) for its widely recognized benefits and efficiency improvements, the number of projects utilizing this approach is growing. Despite this trend, IPD represents a significant departure from the traditional, less collaborative, and integrated methods that have long dominated the industry. Consequently, practical experience with IPD remains in development. Therefore, a readiness model to evaluate project readiness to implement IPD becomes essential in order to target and develop the necessary capabilities. To address this gap, this paper introduces and validates a project-level IPD readiness model and assessment tool that provides a detailed picture of readiness across IPD capabilities and helps set clear expectations for project stakeholders. The model supports early-stage IPD implementation decisions by offering a structured approach to assessing and improving readiness, ensuring that teams, resources, and plans are aligned with the collaborative and integrative demands of IPD. Guided by Design Science Research (DSR) principles, the methodology integrates a thorough understanding of existing gaps, leverages prior knowledge, and then develops and refines the readiness assessment tool, complemented by an application and validation step through two case studies. The Readiness Model includes three main components: an IPD Capability Framework, a Readiness Framework, and an Assessment Tool that classifies project readiness into five levels; Emergent, Low, Moderate, High, and

Optimal, providing a structured path for assessing and advancing IPD project preparedness. This model lays the foundation for more standardized and consistent IPD implementation, ultimately contributing to its optimization as a collaborative approach within the construction industry.

PRACTICAL APPLICATIONS:

This research introduces a new IPD Readiness Model to evaluate the preparedness of construction projects to implement Integrated Project Delivery (IPD). The model offers a structured approach for assessing readiness at the project initiation phase and comprises two key components: a readiness framework and a self-assessment tool. The framework organizes essential IPD capabilities and associated readiness indicators into actionable focus areas, providing a comprehensive structure to guide project planning and alignment. The assessment tool operationalizes this framework into a practical format, enabling project teams, organizations, and owners to evaluate readiness across critical IPD dimensions. It supports users in identifying strengths, uncovering gaps, and prioritizing improvements before project launch. The tool is particularly valuable for those aiming to align project conditions with the collaborative demands of IPD and ensure that teams, resources, and plans are adequately prepared for implementation.

Keywords: Integrated Project Delivery (IPD), IPD Readiness Model, IPD Capability, Readiness Assessment

1. Introduction:

Integrated Project Delivery (IPD) is an innovative project delivery approach that emphasizes the collaboration and integration of stakeholders, systems, and practices throughout the project's different phases (Fischer et al., 2017). Since its inception, this approach has gained in popularity, reflecting the industry's increasing recognition of the importance of integration, collaboration and its need to find more

collaborative approaches to the delivery of capital projects (Viana et al., 2020). Despite the growing interest in IPD, many projects continue to struggle during the early stages of implementation due to insufficient preparation for its collaborative, contractual, and organizational demands (Rashidian et al., 2022; Arar et al., 2024). Therefore, the full potential of IPD remains constrained by the need for more refined frameworks, mechanisms, and tools to optimize its application and ensure a wider adoption across the industry.

This research builds upon a foundational study that developed a capability maturity model for IPD. The capability maturity model established a structured framework and tool to enable post-project evaluation of IPD practices, allowing projects to benchmark their practices against industry best practices and capture lessons learned to promote ongoing improvement (Arar et al., 2025).

However, the IPD maturity models and similar post-project evaluation frameworks do not adequately support early, project-specific decision-making regarding whether a project is sufficiently prepared to embark on IPD (Arar et al., 2025). As a result, owners and project teams often rely on informal judgment or partial indicators when deciding to pursue IPD, creating avoidable uncertainty at a critical decision point (Durdyev et al., 2019). This gap highlights the need for a structured, project-level readiness assessment that can systematically evaluate preparedness prior to IPD implementation and guide targeted preparatory actions (Weiner, 2020). Addressing this gap is particularly urgent as IPD adoption expands beyond early adopters to organizations with limited prior experience, where the consequences of insufficient readiness are more pronounced (Allison et al., 2018; Kent & Becerik-Gerber, 2010).

To this end, this study develops and validates a project-level IPD readiness model and assessment tool to support early-stage IPD implementation decisions. The study adopts a Design Science Research (DSR) approach, focusing on the development and validation of a practical artifact to address this identified problem. This contribution addresses a critical gap in existing IPD research by enabling systematic, project-specific readiness evaluation prior to IPD implementation. The readiness assessment

tool is intended for project representatives responsible for early-stage IPD implementation decisions and is designed to reflect project-level readiness, whether administered by a single designated representative or collectively by multiple IPD contract signatories involved in project leadership.

2. Background:

This background section provides the theoretical foundation for the proposed IPD readiness model. It reviews general readiness concepts, examines readiness in the context of IPD, and explains how prior work on IPD maturity informs the development of a project-level readiness model.

2.1 Readiness Models

Readiness assessments across many disciplines are key in strategic planning and implementing new methodologies or technologies effectively. It involves carefully assessing technological, organizational, or psychological preconditions that need to be met before implementing innovations or changes (Dalton & Gottlieb, 2003). Ensuring the project readiness at the initiation phase is critical for aligning strategic objectives with operational readiness. Integrating readiness assessment into project planning helps manage risks associated with unpreparedness and has been shown to be an effective strategy in project management. This importance for readiness becomes particularly relevant in the context of innovative and relatively new delivery systems such as IPD, which contrasts with most traditional construction practices and necessitates a thorough evaluation of readiness to ensure successful implementation.

Although this study focuses on readiness for implementing IPD at the project level, it draws on existing theories of organizational readiness for change. These theories articulate multi-dimensional and multi-level aspects of readiness and offer a robust foundation for understanding the complexities involved in preparing projects to adopt a new approach that departs from common industry practices Holt et al., 2007; Weiner, 2020). This transition involves four key dimensions: the process of change, the content of

what is changing, the context in which the change occurs, and the actors involved in or affected by the change. Proper consideration and alignment of these dimensions are crucial for successfully executing change initiatives Holt et al., 2007).

The readiness concept can be traced at various levels, which in turn include organizational, project-specific, and individual capabilities that together allow the successful adaptation of new processes or implementation of innovation (Lehman et al., 2002; Holt et al., 2007; Schumacher et al., 2016; Weiner, 2020). Organizational readiness generally covers broad assessments of an entity's preparedness for adopting innovations or changes. This will consider the strategic alignment of organizations, processes, and cultures with new methodologies to verify whether the whole entity is ready to address the proposed changes (Hanafi et al., 2016; Weiner, 2020; Magalhães et al., 2023) . Project-specific readiness, on the other hand, focuses on conditions that should be in place to enable specific projects or initiatives to succeed. It ensures that the critical elements needed to execute the project successfully, like resources, stakeholder alignment, and project goals, are all in a favorable position to proceed with the project and support its successful implementation (Liao et al., 2020; Britel & Cherkaoui, 2021). Individual readiness concerns individual prepossessions and attitudes toward innovations or changes. It concerns aspects like optimism, innovativeness, and insecurities in individual attributes that can relate to the likelihood of embracing innovations or changes (Parasuraman, 2000; Holt et al., 2007; Liu et al., 2019). This broad application of readiness emphasizes the importance of ensuring favorable conditions and a complete setup to implement new solutions.

Within organizational contexts, readiness for change is also underlined through a dual-component model that outlines the psychological and social aspects of organizational adaptation, namely the change commitment and change efficacy. Commitment to change refers to the collective concern and determination of the members within an organization in the pursuit and support of change. This shows the psychological preoccupation with the process of change. On the other hand, change efficacy relates

to the collective belief in their ability to effectuate change successfully; this includes skill sets and resources within the organization. These components are essential for fostering an environment conducive to change by ensuring that all members are willing and capable of contributing to the transformation efforts (Weiner, 2020).

Additionally, some studies in the literature have adopted an approach that classifies readiness into distinct stages to simplify the identification of readiness evaluation outcomes and the necessary interventions to enhance it. For instance, readiness has been categorized into stages such as pre-contemplation, contemplation, and preparation, which reflect different levels of organizational willingness and capacity for change (Vax et al.,2021). Similarly, NOAA's R&D readiness levels provide a structured framework that categorizes readiness in terms of technology and operational capability into nine levels (NOAA 2022). This stage-based approach helps in pinpointing the appropriate interventions tailored to specific readiness levels to promote successful implementation initiatives (Vax et al.,2021).

These perspectives inform the development of the IPD readiness model by supporting a multi-level view of readiness, framing willingness and capacity through change commitment and efficacy, and providing precedent for stage-based assessment of preparedness across IPD capabilities.

2.2 Readiness in the Context of IPD

The readiness assessment for implementing IPD reveals a critical, yet underexplored, area in the literature. Existing studies on IPD readiness are scarce and tends to focus either on organizational readiness to adopt IPD or on assessing how well projects align with IPD principles, rather than on the specific conditions, resources, plans, and alignment needed from the onset for successful implementation.

One notable effort involved developing a model focusing on IPD and Information and Communication Technology (ICT) readiness. This model primarily assessed how well projects aligned with IPD principles by evaluating ICT integration and identifying areas for improvement. This model served to

determine the level of a project's alignment with IPD principles rather than evaluating the foundational conditions necessary for initiating IPD (Azhar, 2014). Another effort was made to address IPD readiness, through at the organizational level, within Malaysia's Industrialised Building System (IBS) sector, aiming to understand organizations' willingness to adopt collaborative project delivery methods. This research established a framework to gauge organizational alignment with IPD, providing insights into organization-level preparedness (Osman et al., 2015; Osman et al., 2017).

These studies, while valuable, focus on organizational readiness or the project's degree of alignment with IPD principles, leaving a gap in project-specific readiness assessments that consider the unique capabilities required for successful IPD implementation from the outset. Consequently, this research seeks to fill this gap by providing a theoretical framework and practical tools for **assessing the readiness for implementing IPD at the project level** regarding a wide array of IPD capabilities. Therefore, **this study defines readiness within the context of IPD as a critical early-stage assessment that determines a project's preparedness to undertake IPD by focusing on the essential capabilities, plans, resources, and alignment necessary for starting a new IPD project effectively**.

Building on this understanding, it is clear that while readiness assessment at the initiation phase of projects is crucial, the focus in current research, despite its scarcity, tends to be predominantly on organizational readiness or alignment with IPD principles. This leaves a notable gap for a readiness model specifically tailored to IPD at the project level, which would thoroughly address the detailed preparation of capabilities, resources, and alignments essential from the project's inception. This study aims to fill this gap by developing a readiness model that assesses and ensures all essential components are aligned to support successful IPD implementation. To support this effort, the next section outlines how the IPD capability maturity model developed in prior research provides the foundational components for constructing a project-level readiness model.

2.3 IPD from Maturity to Readiness

IPD represents a relatively novel and transformative approach within the construction industry, challenging long-established contractual, organizational, and operational norms (Kent & Becerik-Gerber, 2010). While its benefits are increasingly recognized, the practical mechanisms needed to support consistent and standardized IPD implementation and enable continuous improvement remain underdeveloped (Rashidian et al., 2022; Arar et al., 2024). In particular, there is a lack of structured tools and frameworks that allow project teams to systematically assess their preparedness for IPD and to evaluate implementation performance over time.

While Arar et al. (2025) introduced an IPD capability maturity model for post-project evaluation, a complementary project-level readiness framework is still needed to assess preparedness prior to implementation and support more consistent IPD initiation.

Readiness and maturity are related but distinct concepts that address different stages of capability development. Readiness refers to the ability of an organization or project team to mobilize people, processes, and tools to achieve a specific objective effectively (Helfat & Peteraf, 2003), and is concerned with whether the necessary conditions are in place prior to implementation. Maturity, in contrast, reflects the extent to which processes are defined, institutionalized, and continuously improved to achieve consistent and repeatable performance over time (Paulk et al., 1991).

In the context of IPD, readiness addresses whether a project team is prepared to initiate IPD, while maturity evaluates how well IPD practices are executed after implementation. This distinction positions readiness as a pre-implementation construct that complements maturity-based assessments and provides the conceptual foundation for the IPD capability maturity model described in the following section.

The capability maturity model consists of several key components: the (1) Capability Framework constructed upon a cross-framework analysis of established IPD frameworks and represents a broad set of capabilities required for successful IPD implementation, (2) Capability Indicators were determined using

empirical data from three IPD case studies. These indicators are evident in the practical elements of IPD such as behaviors, norms, policies, activities, tools, and practices that demonstrate the presence of IPD capabilities, the (3) Maturity Matrix that represents an evaluation framework for IPD maturity on a scale of five levels; Initial, defined, managed, Proficient, and advanced, and the (4) Maturity Assessment Tool that enables a structure evaluation for IPD implementation practices and determines its maturity. Collectively, these elements provide the mechanism for assessing the degree to which IPD practices have been implemented effectively, providing a methodological approach to capture and evaluate their maturity and facilitate their continuous improvement in (Helfat & Peteraf, 2003).

For readiness purposes, this study adopted and built on the IPD capability framework presented in Arar et al. (2025) with its two key components: the IPD capabilities and capability indicators, shown in Figure 1, to create a structured readiness model that guides project teams during the critical initial phases, ensuring all capabilities are aligned to successfully execute an IPD project. The IPD capability framework is constructed upon a detailed list of skills, processes, and tools required for successful IPD implementation, along with their corresponding indicators.

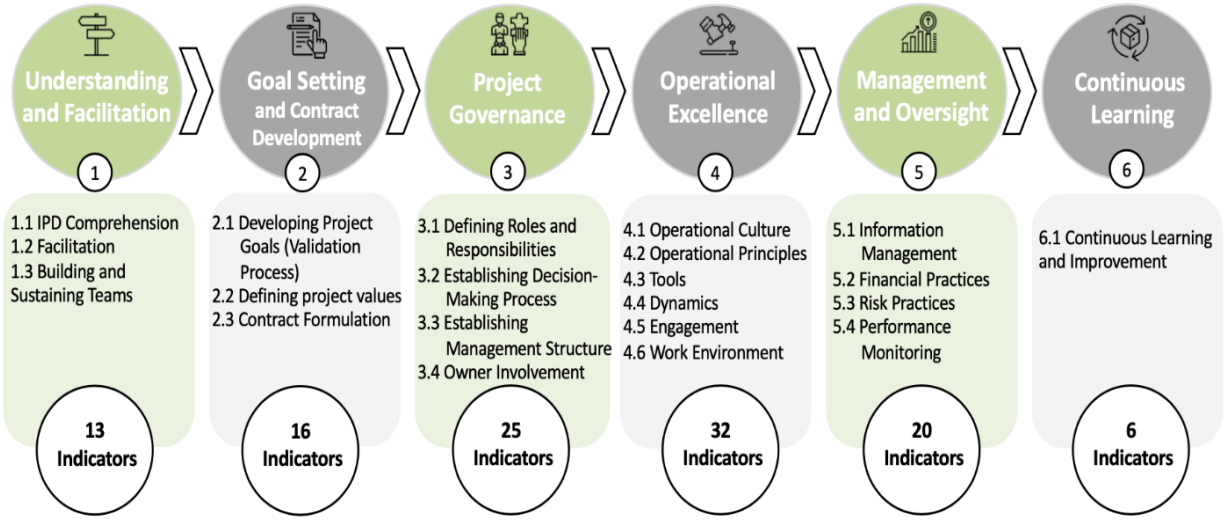

Figure 1. IPD Capability Framework (Arar et al., 2025).

3. Methodology:

This study aims to develop an IPD-specific readiness model to enhance the project initiation phase by guiding all parties through the critical focus areas required for successful IPD implementation, setting clear expectations, and aligning project efforts towards creating a conducive project environment. The methodology of this study followed a pragmatic approach, designed to prioritize the achievement of specific outcomes. The methodology employed in this research was guided by Design Science Research (DSR) principles that emphasize creating innovative and practical solutions -artifacts- namely, a readiness assessment tool to facilitate informed evaluation of project readiness to implement IPD. This approach was implemented through a staged process of problem identification, conceptual model development, and the iterative refinement of their operational tools through validation in multiple case studies (Venable et al., 2012; vom Brocke et al., 2020).

Therefore, aligning with the DSR approach, the methodology involved the following four steps, as illustrated in Figure 2: (1) Adapting the IPD Capability Framework for Readiness Purposes, (2) Developing the Readiness Framework, (3) Developing the Readiness Assessment Tool, and (4) Validation through Case Studies.

3.1 Adapting the IPD Capability Framework for Readiness Purposes:

Consistent with the DSR's focus on utilizing existing knowledge to create new and useful artifacts, a closer examination of the IPD capability framework and its indicators was performed to determine their suitability for developing the IPD readiness model. The adaptation of capability maturity indicators into readiness indicators followed a structured step-by-step procedure.

First, the full set of IPD capability indicators developed in Arar et al. (2025) was used as the initial input. **Second**, each indicator was screened against predefined criteria to determine whether it represented a

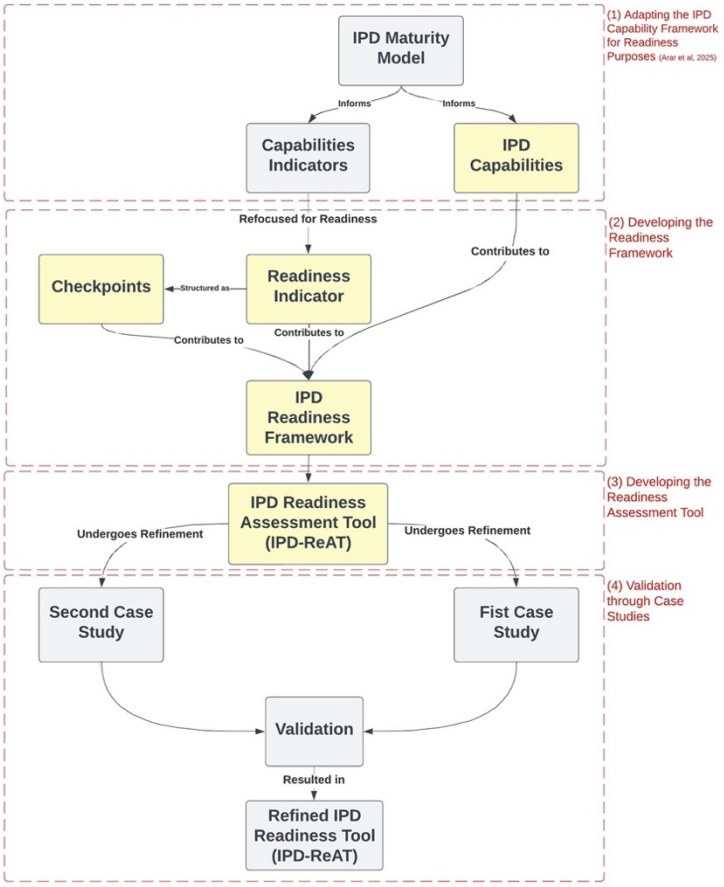

Figure 2. IPD Readiness Model Development Process

precondition for IPD implementation or a post-implementation outcome. This evaluation was based on criteria focused on each indicator's relevance and predictive quality for signaling readiness in IPD contexts, including:

- Relevance: Each indicator was assessed for its direct relevance to the key dimensions of readiness in IPD, considering all IPD capabilities.
- Predictive Quality: Indicators were classified based on their ability to predict future project performance (leading), reflect past outcomes (lagging), or monitor ongoing project conditions (continuous) (Anderson & McAdam, 2004).

The indicator classification process was conducted collaboratively within the research team. The initial screening and classification of capability indicators were conducted by the first author, who assessed each indicator's relevance and predictive quality for readiness. This initial classification was then subjected to

a detailed review by a second author, focusing on conceptual consistency and alignment with readiness assessment objectives. A final high-level review was conducted by the remaining author to ensure coherence across capabilities and consistency with the intended use of the model. Discrepancies identified during these review stages were discussed and resolved through consensus. This iterative process ensured consistent interpretation and alignment of indicators with the readiness model's role as an early-stage assessment tool.

Third, after classifying indicators as leading, lagging, or continuous, only leading indicators suitable for signaling preparedness prior to IPD implementation were retained for readiness purposes. Indicators were retained if they described conditions or arrangements that must exist prior to IPD implementation, such as the presence of defined processes, governance mechanisms, or resource commitments. Indicators were excluded if they required evidence of completed actions, achieved outcomes, or post-project performance. For example, indicators referring to the systematic use of lessons learned to improve performance were excluded, whereas indicators assessing whether a structured process exists to capture and analyze lessons learned were retained for readiness purposes.

Fourth, retained indicators were reformulated, where necessary, to emphasize the presence of plans, mechanisms, roles, resources, or commitments rather than evidence of achieved performance. Accordingly, indicators were reworded to assess preparedness (e.g., the existence of agreed roles, decision protocols, or planned governance structures) rather than the effective execution of these elements.

Finally, the resulting readiness indicators were mapped to their corresponding IPD capabilities to ensure conceptual consistency and served as inputs to the framework synthesis process described in Section 3.2.

Although no standalone content validity study was conducted, the readiness indicators are grounded in an empirically established IPD capability maturity model. The indicators were derived from capability elements previously validated through multiple IPD case studies (Arar et al., 2025) and were

systematically screened and reformulated to represent preconditions for IPD implementation at the project initiation stage.

3.2 Developing the Readiness Framework:

In the next step, a framework synthesis process was employed to integrate and structure the outputs of the previous step into a coherent readiness framework. Following synthesis principles outlined by (Brunton et al., 2020), the process focused on organizing IPD capabilities, readiness indicators, and readiness checkpoints into a structured matrix that clarifies their interrelationships.

The overall structure of the framework was informed by prior readiness and maturity modeling approaches that use hierarchical capability structures and indicator-based decomposition (Jayanetti et al., 2022; Schumacher et al., 2016b). Building on these approaches, this study adapts the structure specifically for a project-level readiness context by translating indicators into actionable readiness checkpoints that can be assessed prior to IPD implementation.

Finally, guidance from recent readiness framework applications (Chen et al., 2023) informed how the framework was operationalized to support practical assessment and interpretation. The resulting IPD Readiness Framework maps each capability to specific readiness indicators and checkpoints, providing a structured representation of the critical conditions required for successful IPD implementation.

3.3 Development of the Readiness Assessment Tool:

This step involves transforming the structured readiness framework into a practical self-assessment tool; the IPD Readiness Assessment Tool (IPD-ReAT). The tool is designed to act as a diagnostic and guidance tool that guides project teams in preparing for IPD implementation. In its current form, the tool is intended for use at the project initiation stage by project representatives responsible for evaluating whether and how IPD should be pursued.

The development of this tool draws from established practices in the literature, such as in Vax et al. (2021), which delineates organizational readiness into stages like pre-contemplation, contemplation, and preparation, and in NOAA (2022), which segments the readiness of R&D projects into nine levels. For this study, five readiness levels were defined for IPD projects: Emergent, Low, Moderate, High, and Optimal readiness. The criteria for each level, along with their respective scoring ranges, is detailed in section 4.

To simplify the assessment process, the tool is organized as a series of binary Yes/No questions. This binary structure was adopted to ensure that questions capture the presence or absence of concrete preparatory conditions, thereby reducing subjectivity and interpretive ambiguity and supporting consistent use at the project initiation stage. A number of readiness indicators represent each capability, and each indicator is covered by one or more questions that enable the assessment of IPD capability readiness. The questions in this tool are specifically formulated to gauge the presence and efficacy of readiness indicators within the preliminary plans of a project.

Scoring and aggregation followed a predefined procedure aligned with the binary structure of the assessment. Each question was scored as Yes = 1 and No = 0, while "I don't know" responses were treated as missing and excluded from score calculations. For each readiness indicator, scores across its associated questions were averaged to compute an indicator-level score. Indicator scores were then averaged to compute a capability-level readiness score.

All readiness indicators and capabilities were equally weighted, reflecting the premise that IPD implementation requires balanced preparedness across multiple interdependent capability areas rather than prioritization of a single dimension.

The resulting capability-level score represents the proportion of readiness conditions satisfied for that capability at the project initiation stage. Readiness levels are therefore interpreted as proportional completeness of preparatory conditions rather than as precise continuous measurements. Capability

scores were then mapped to the five readiness levels (Emergent, Low, Moderate, High, and Optimal) using the scoring ranges defined in Section 4.

3.4 Validation through Case Studies:

Aligning with the DSR principles, this study adopts a naturalistic, ex post validation approach. This implies employing real-world IPD case studies (naturalistic) to assess the developed readiness tool (ex post) (Venable et al., 2012). To facilitate this validation, two public bodies organizations that are in the early stages of implementing IPD were engaged. The two case study projects were purposefully selected to validate the readiness assessment tool under conditions aligned with its intended use. Both cases were at the project initiation stage, where key decisions regarding whether and how to implement IPD had not yet been finalized, making them suitable for assessing early-stage readiness. The cases differ in project context and scope and include an educational building project in Quebec, Canada, and a commercial building systems upgrade under consideration in downtown Montreal. This selection allowed the tool to be tested across different project types and early-stage IPD decision scenarios prior to formal implementation.

The application of the tool in these projects aims to explore the tool's external validity, which is crucial for assessing its potential generalizability across different contexts (Egami & Hartman, 2023). In addition, the process established construct validity by gathering feedback from key representatives of the two case studies to confirm that the tool measures what it is intended to measure (Wolming & Wikström, 2010).

A consistent validation procedure was applied across both case studies.:

I. **Tool Introduction**: Each organization was first introduced to the IPD readiness model and the assessment tool, including its structure, indicators, and interpretation of readiness levels.

II. **Assessment Execution**: The assessment was completed using a self-assessment approach by designated owner representatives based on project information available at the project initiation stage.

III. **Results Calculation and Reporting:** Assessment responses were aggregated to calculate capability-level readiness scores and generate a readiness profile for each project.

IV. **Follow-up Interviews and Feedback**: Follow-up interviews were conducted with key project representatives to review the results, clarify responses, and gather feedback on the clarity, relevance, and practical utility of the tool. In total, three interviews involving six participants were conducted across the two case studies.

It is important to note that, as the readiness assessment relies on self-reported responses, the results are subject to potential biases, including overestimation of readiness, selective disclosure, or strategic responses at early decision stages. To mitigate these risks, the assessment was complemented by follow-up discussions with project representatives to clarify responses, validate interpretations, and contextualize results. In addition, alternative administration approaches were discussed, including an audit-based approach led by an external evaluator or collecting responses from a broader group involving multiple IPD signatories, to reduce individual bias and improve reliability.

4. The IPD Readiness Model

The outcomes of this study led to the development of the IPD Readiness Model, which consists of two interrelated components designed to evaluate and guide the preparedness for IPD implementation. The components are: (1) the IPD Readiness Framework, which organizes essential IPD capabilities and related readiness indicators into actionable focus areas, offering a comprehensive structure to guide project planning and alignment; and (2) the IPD Readiness Assessment Tool (IPD-ReAT), designed to evaluate a project's readiness to begin implementing IPD. The development of these two components

was complemented by application and validation steps that ensure the practical applicability and relevance of the readiness framework and assessment tool in real-world scenarios.

4.1 IPD Capabilities and Readiness Indicators:

The IPD readiness model presented in this study is based on the IPD maturity model developed in (Arar et al., 2025). In particular, it builds on the two main components of the maturity model: the IPD capabilities and their corresponding indicators. These indicators have been repurposed in this study to assess readiness at the initial stages of a project.

The review was performed according to the criteria provided in the methodology section (see Section 3.1) and involved a detailed classification of each indicator as leading, lagging, or continuous, based on their potential impact on the project. As shown in Table 1, a significant portion of the indicators (83) were classified as leading, indicating their critical role in the early detection of readiness and their applicability across all project phases, including the initial stage. Conversely, 18 indicators were deemed continuous, and 11 lagging, suggesting their suitability for ongoing assessments or outcome evaluation in later phases.

Table 1. IPD Capability Indicators Classification

Set	Capability	Capability Indicators Classified (Leading, Lagging, Continuous)
Understanding and Facilitation	**IPD Comprehension**	**(1)** Understanding of IPD Principles and Processes **(Leading), (2)** Recognition of the Relevance of IPD to Project Success **(Leading)**, **(3)** Integration of IPD in Execution **(Leading)**, **(4)** Adaptation of IPD Practices Based on Project Needs **(Continuous)**.
	Facilitation	**(1)** Assessment of Gaps in Understanding of IPD Practices **(Leading)**, **(2)** Training of on IPD Tools **(Leading)**, **(3)** Effectiveness of Facilitation in Enhancing IPD Understanding **(Lagging)**, **(4)** Contribution of Facilitation to Culture Establishment **(Leading)**.
	Building and Sustaining Teams	**(1)** Establishment of Team Culture **(Leading)**, **(2)** Implementation of Flat Hierarchy **(Leading)**, **(3)** Open Communication **(Leading)**, **(4)** Encouragement of Participation **(Leading)**, **(5)** Continuous Improvement of Team-Building Methods **(Continuous)**.
Goal Setting and Contract Development	**Developing Project Goals (Validation Process)**	**(1)** Validation Process **(Leading)**, **(2**) Collaboration in Validation **(Leading)**, **(3)** Participation in Validation **(Leading)**, **(4)** Impact of validation on team culture **(Leading)**, **(5)** Defining Project Goals **(Leading)**, **(6)** Clarity and Comprehensiveness of Validation Report **(Leading)**, **(7)** Introduction of New Methods in Validation **(Continuous)**.
	Defining project values	**(1)** Defining Core Values **(Leading)**, **(2)** Communication of Values **(Leading)**, **(3)** Reference to Values in Decision-making **(Leading)**, **(4)** Revisitation of Values **(Continuous)**, **(5)** Strengthening of Values Through New Methods **(Continuous)**.

	Contract Formulation	**(1)** Participation in Contract Formulation **(Leading)**, **(2)** Integration of All IPD Principles **(Leading)**, **(3)** Utilization of Facilitation Means **(Leading)**, **(4)** Contract Optimization **(Leading)**.
Project Governance	**Defining Roles and Responsibilities**	**(1)** Definition of roles and responsibilities **(Leading)**, **(2)** Overlaps and conflicts **(Leading)**, **(3)** Discussion of Roles and Responsibilities **(Leading)**, **(4)** Communication of Roles and Responsibilities **(Leading)**, **(5)** Understanding of Roles and Accountability **(Leading)**, **(6)** Adaptation of Roles **(Continuous)**.
	Establishing Decision-Making Process	**(1)** Inclusion in Decision-Making **(Leading)**, **(2)** Transparency in Decision-Making **(Leading)**, **(3)** Guidance by Project Goals **(Leading)**, **(4)** Use of Decision Tools **(Leading)**, **(5)** Decision Outcomes **(Lagging)**, **(6)** Documentation of decisions **(Leading)**, **(7)** Adaptability and Agility in Decision-Making **(Continuous)**.
	Establishing Management Structure	**(1)** Management Structure **(Leading)**, **(2)** Coordination of Activities Across Management Levels **(Leading)**, **(3)** Coordination of Decisions **(Leading)**, **(4)** Adaptability of management strategies **(Continuous)**, **(5)** Integration of New Management Strategies **(Continuous)**.
	Owner involvement	**(1)** Involvement in Decision-Making **(Leading)**, **(2)** Involvement in Day-to-Day Operations **(Leading)**, **(3)** Role in Project Governance **(Leading)**, **(4)** Support for the IPD Model **(Leading)**, **(5)** Contribution to Collaborative Environment **(Leading)**, **(6)** Contribution to Team Culture **(Leading)**, **(7)** Leadership **(Leading)**.
Operational Excellence	**Operational Culture**	**(1)** Promotion of Lean Practices **(Leading)**, **(2)** Support for a Collaborative Work Environment **(Leading)**, **(3)** Adoption of a No-Blame Culture **(Leading)**, **(4)** Assessment and Implementation of Practices Enhancing Lean Culture **(Continuous)**, **(5)** Encouragement of New Methods to Enhance Collaborative Culture **(Continuous)**.
	Operational Principles	**(1)** Streamlining of Workflows **(Leading)**, **(2)** Emphasis on Waste Reduction **(Leading)**, **(3)** Emphasis on Value Maximization **(Leading)**, **(4)** Emphasis on Continuous Improvement **(Leading)**, **(5)** Integration of Lean and IPD Principles **(Lagging)**, **(6)** Role of Operational Principles in Advancing Project Management Practices **(Continuous)**.
	Tools	**(1)** Use of BIM **(Leading)**, **(2)** Enhancement of Collaboration and Communication through BIM **(Leading)**, **(3)** BIM as Information Source **(Leading)**, **(4)** BIM's Role in Information Quality **(Lagging)**, **(5)** Use of Lean Tools **(Leading)**, **(6)** Integration of Lean Tools and Techniques into Operational Practices **(Leading)**.
	Dynamics	**(1)** Structuring of Multidisciplinary Teams **(Leading)**, **(2)** Flexibility of Team Formations **(Leading)**, **(3)** Definition of Responsibilities Within Teams **(Leading)**, **(4)** Decision-Making Authority Within Teams **(Leading)**, **(5)** Cross-Disciplinary Collaboration **(Lagging)**.
	Engagement	**(1)** Use of Formal Communication **(Leading)**, **(2)** Direct and Informal Engagement **(Leading)**, **(3)** Communication and Engagement Strategies **(Leading)**, **(4)** Continuous Improvement of Engagement Techniques and Strategies **(Continuous)**.
	Work Environment	**(1)** Frequency of Big Room Meetings **(Leading)**, **(2)** Big Room Setup **(Leading)**, **(3)** Impact of Big Room Sessions on Engagement **(Lagging)**, **(4)** Impact of Big Room Sessions on Team Unity **(Lagging)**, **(5)** Impact of Big Room Sessions on Collaboration **(Lagging)**, **(6)** Incorporation of Advanced Tools and Techniques in Big Room Settings **(Leading)**.
Management and Oversight	**Information Management**	**(1)** Information Structure **(Leading)**, **(2)** Information Sharing **(Leading)**, **(3)** Access to Data **(Leading)**, **(4)** Use of Advanced Technologies to Enhance Data Utilization and Support Decision-Making **(Leading)**.
	Financial Practices	**(1))** Integrating Team members in Financial Discussions **(Leading)**, **(2)** Financial Transparency **(Leading)**, **(3)** Financial Responsibility **(Leading)**, **(4)** Use of Incentive Mechanisms **(Leading)**, **(5)** Role of Incentive Mechanisms in Collaboration and Performance Enhancement **(Lagging)**, **(6)** Financial Decision-Making Tools **(Leading)**.
	Risk Practices	**(1)** Risk Management Practices Inclusivity **(Leading)**, **(2)** Frequency of Risk Management Practices **(Leading)**, **(3)** Use of Collaborative Tools **(Leading)**, **(4)** Risk Ownership **(Lagging)**, **(5)** Improvement of Risk Management Practices **(Continuous)**.
	Performance Monitoring	**(1)** Use of Dashboards **(Leading)**, **(2)** Data Collection and Analysis **(Leading)**, **(3)** Adaptation of Metrics **(Continuous)**, **(4)** Metrics' Role in Decision-Making **(Lagging)**, **(5)** Data and Metrics updates **(Continuous)**.

Continuous Learning	**Continuous Learning and Improvement**	**(1)** Capture of Lessons Learned **(Leading)**, **(2)** Analysis of IPD Practices Feedback **(Leading)**, **(3)** Analysis of Stakeholder Feedback **(Leading)**, **(4)** Assessment of Client Satisfaction **(Leading)**, **(5)** Feedback Integration **(Continuous)**, **(6)** Continuous Improvement in Feedback Capturing and Utilization **(Continuous)**.

4.2 IPD Readiness Framework:

The IPD Readiness Framework was developed by incorporating IPD capabilities and previously identified readiness indicators into detailed checkpoints, which are specific markers derived from these indicators through a synthesis process (see Section 3.2). These checkpoints operationalize the indicators into assessable readiness conditions. This integration forms a structured approach to evaluate and guide project readiness for IPD implementation. The synthesis of these elements provides a clear pathway to assess readiness, identify gaps, and plan developmental measures, ensuring projects are well-prepared to begin implementing IPD. This mapping, as shown in Table 2, serves as a theoretical framework upon which a practical tool for assessing readiness is developed in the next step.

Table 2. IPD Readiness Framework

Capability Sets	Capabilities	#	Readiness Indicator	Checkpoints
Understanding and Facilitation	IPD Comprehension	1.1.1	Understanding of IPD Principles and Processes	Ensure sufficient understanding of the IPD framework, principles, phases, and practices.
		1.1.2	Recognition of the Relevance of IPD to Project Success	Establish clarity on how IPD contributes to project success, highlighting its advantages over traditional delivery methods.
		1.1.3	Integration of IPD in Execution	Strategically plan to incorporate the principles of IPD into project execution plans.
	Facilitation	1.2.1	Assessment of Gaps in Understanding of IPD Practices	Conduct a detailed assessment of gaps in knowledge related to IPD practices.
		1.2.2	Training of on IPD Tools	Provide consistent training on IPD tools and techniques for all new members of the project.
		1.2.3	Contribution of Facilitation to Culture Establishment	Emphasize building a supportive IPD culture during facilitation practices.
	Building and Sustaining Teams	1.3.1	Establishment of Team Culture	Focus on fostering a unified and cohesive team culture, invest time and resources there, and recognize it as a key driver for success.
		1.3.2	Implementation of Flat Hierarchy	Implement flat hierarchy structures that reflect the joint management of the project.
		1.3.3	Open Communication	Encourage open and direct communication among team members.
		1.3.4	Encouragement of Participation	Encourage active participation from all team members, ensuring everyone's input is valued.

Goal Setting and Contract Development	Developing Project Goals (Validation Process)	2.1.1	Validation Process	Establish a structured validation process to effectively guide the development of project goals.
		2.1.2	Collaboration in Validation	Encourage collaboration, emphasizing the need to incorporate diverse perspectives effectively during the validation process.
		2.1.3	Participation in Validation	Emphasize inclusivity and active participation of all project team members during the validation process.
		2.1.4	Impact of validation on team culture	Use the validation process as an opportunity to enhance team culture, promoting unity and a shared commitment to the project goals.
		2.1.5	Defining Project Goals	Ensure that project goals are clearly defined and understood by all team members as a result of the validation process.
		2.1.6	Clarity and Comprehensiveness of Validation Report	Focus on the clarity and comprehensiveness of the validation report to provide a solid foundation for subsequent contract development and project execution.
	Defining project values	2.2.1	Defining Core Values	Ensure that the project's core values are well-defined and align with the overarching goals of the IPD project.
		2.2.2	Communication of Values	Ensure that core values are clearly communicated and understood by all project members.
		2.2.3	Reference to Values in Decision-making	Regularly reference the project's core values during the decision-making process to ensure that all decisions align with them.
	Contract Formulation	2.3.1	Participation in Contract Formulation	Ensure collaborative participation in contract formulation, involving all IPD project members actively.
		2.3.2	Integration of All IPD Principles	Integrate all IPD principles within the contract.
		2.3.3	Utilization of Facilitation Means	Employ various facilitation methods, such as workshops and expert consultations, to aid in the contract development process.
		2.3.4	Contract Optimization	Optimize the contract to ensure it adapts to specific project conditions and fosters collaboration throughout the project.
Project Governance	Defining Roles and Responsibilities	3.1.1	Definition of roles and responsibilities	Ensure roles and responsibilities are clearly defined among the team.
		3.1.2	Overlaps and conflicts	Even with the project being jointly managed, work to minimize overlaps and conflicts within team roles.
		3.1.3	Discussion of Roles and Responsibilities	Facilitate comprehensive discussions involving all parties to agree on their roles and responsibilities within the project.
		3.1.4	Communication of Roles and Responsibilities	Ensure roles and responsibilities are communicated to all team members so they are informed and aligned.
		3.1.5	Understanding of Roles and Accountability	Ensure a deep understanding of the accountability structure, and each team member knows their responsibilities and the expectations placed upon them.
	Establishing Decision-Making Process	3.2.1	Inclusion in Decision-Making	Include all relevant IPD members in decision-making processes to foster inclusivity and collective responsibility.
		3.2.2	Transparency in Decision-Making	Conduct decision-making transparently to build trust and keep all team members informed and involved.
		3.2.3	Guidance by Project Goals	Guide all decisions by the overarching project goals to maintain consistency and focus throughout project execution.
		3.2.4	Use of Decision Tools	Employ decision-support tools effectively to assist in evaluating alternatives and making well-informed decisions.
		3.2.5	Documentation of decisions	Document all decisions comprehensively, providing clear context and rationale to support understanding and future reference.

	Establishing Management Structure	3.3.1	Management Structure	Establish a clear management structure with distinct roles and responsibilities across different levels (SMT, PMT, PIT).
		3.3.2	Coordination of Activities Across Management Levels	Promote effective coordination of activities across various management levels to provide clarity and effective governance.
		3.3.3	Coordination of Decisions	Ensure decisions are consistently aligned and effectively communicated across all management levels.
	Owner involvement	3.4.1	Involvement in Decision-Making	The owner should be actively involved in project decision-making.
		3.4.2	Involvement in Day-to-Day Operations	The owner should be directly involved and engaged in day-to-day project operations.
		3.4.3	Role in Project Governance	The owner should play a central role in project governance.
		3.4.4	Support for the IPD Model	The owner should fully embrace and advance the IPD model to facilitate successful adoption and implementation.
		3.4.5	Contribution to Collaborative Environment	The owner should actively contribute to fostering a collaborative environment.
		3.4.6	Contribution to Team Culture	The owner should actively contribute to creating a favorable team culture.
		3.4.7	Leadership	The owner should serve as a role model through leadership and commitment to the IPD approach.
Operational Excellence	Operational Culture	4.1.1	Promotion of Lean Practices	Promote the adoption and implementation of Lean practices throughout the project course.
		4.1.2	Support for a Collaborative Work Environment	Foster a work environment that encourages teamwork and collective problem-solving.
		4.1.3	Adoption of a No-Blame Culture	Promote a no-blame culture that supports learning from mistakes.
	Operational Principles	4.2.1	Streamlining of Workflows	Promote streamlined workflows to enhance efficiency, positioned as a fundamental operational principle.
		4.2.2	Emphasis on Waste Reduction	Focus on minimizing waste across all project phases as a core operational principle.
		4.2.3	Emphasis on Value Maximization	Ensure value maximization is a key consideration in all project decisions, promoting its role as a key operational principal.
		4.2.4	Emphasis on Continuous Improvement	Commit to continuous improvement by regularly evaluating and enhancing project practices.
	Tools	4.3.1	Use of BIM	Utilize BIM effectively across various applications to support and enhance project processes.
		4.3.2	Enhancement of Collaboration and Communication through BIM	Leverage BIM to enhance collaboration and communication, positioning it as a pivotal element in project management.
		4.3.3	BIM as Information Source	Employ BIM as a reliable and comprehensive source of project information, ensuring data integrity and accessibility.
		4.3.4	Use of Lean Tools	Frequently use various Lean tools to streamline workflows and maximize project value.
		4.3.5	Integration of Lean Tools and Techniques Into Operational Practices.	Leverage the use of Lean tools and techniques as the core of the project's operational practices.
	Dynamics	4.4.1	Structuring of Multidisciplinary Teams	Structure teams (PITs) inclusively to integrate a broad range of disciplines effectively.
		4.4.2	Flexibility of Team Formations	Maintain flexible team formations that can adapt to changing project needs and dynamics.
		4.4.3	Definition of Responsibilities Within Teams	Clearly define responsibilities within teams to ensure clarity and accountability in task management.
		4.4.4	Decision-Making Authority Within Teams	Empower teams with the authority to make decisions relevant to their tasks.
	Engagement	4.5.1	Use of Formal Communication	Limit communication through formal channels to essential and legal correspondences only.

		4.5.2	Direct and Informal Engagement	Encourage direct and informal engagement among team members through various channels, including digital platforms and informal meetings.
		4.5.3	Communication and Engagement Strategies	Develop and implement inclusive communication and engagement strategies that keep all team members, including on-site personnel, well-informed and aligned with project objectives.
	Work Environment	4.6.1	Frequency of Big Room Meetings	Ensure Big Room meetings are held frequently (physical or virtual) to enhance team unity and maintain collaborative momentum.
		4.6.2	Big Room Setup	Design the Big Room setup to promote inclusivity and collaboration, featuring equal seating arrangements and no-title zones.
		4.6.3	Incorporation of Advanced Tools and Techniques in Big Room Settings	Utlize advanced tools and techniques in Big Room settings to enhance the effectiveness of sessions and facilitate collaboration.
Management and Oversight	Information Management	5.1.1	Information Structure	Organize information within the project in a structured manner that ensures clarity and easy accessibility.
		5.1.2	Information Sharing	Facilitate the sharing of information using digital platforms to ensure efficient dissemination.
		5.1.3	Access to Data	Ensure real-time access to data for project members to facilitate timely decisions and responsiveness to project dynamics.
		5.1.4	Use of Advanced Technologies	Explore the opportunities to implement advanced technologies such as AI, digital twins, and VR to enhance data utilization and support decision-making processes.
	Financial Practices	5.2.1	Financial Discussions	Integrating all team members in financial discussions to foster a culture of shared financial responsibility.
		5.2.2	Financial Transparency	Employ open-book accounting to ensure transparency in financial activities.
		5.2.3	Financial Responsibility	Establish policies or practices to follow up on shared and individual financial responsibility to promote a mature culture of shared financial responsibility and solid individual accountability.
		5.2.4	Use of Incentive Mechanisms	Employ incentive mechanisms that enhance team performance and sustain collaboration throughout the project and in different scenarios.
		5.2.5	Financial Decision-Making Tools	Utilize advanced financial decision-making tools to support financial planning and execution.
	Risk Practices	5.3.1	Risk Management Practices	Engage all IPD members in risk management activities to ensure a uniform understanding and collective approach to risk mitigation.
		5.3.2	Frequency of Risk Management Practices	Implement regular risk assessments to address new and evolving risks.
		5.3.3	Use of Collaborative Tools	Regularly utilize collaborative tools, such as risk registers, to identify, assess, and manage risks effectively and facilitate decision-making.
	Performance Monitoring	5.4.1	Use of Dashboards	Implement dashboards to visualize a broad range of performance metrics such as budget, schedule, safety, culture, and more to enable broad oversight and quicker response.
		5.4.2	Data Collection and Analysis	Standardize data collection across all project disciplines and members to enhance the accuracy and reliability of performance analysis.
Continuous Learning	Continuous Learning and Improvement	6.1.1	Capture of Lessons Learned	Systematically capture and document lessons learned throughout the project duration.
		6.1.2	Analysis of IPD Practices Feedback	Regularly gather and analyze feedback on IPD practices to identify areas for improvement and reinforce successful strategies.
		6.1.3	Analysis of Stakeholder Feedback	Consistently collect and analyze stakeholder feedback to ensure project alignment with all participant expectations and needs.

	6.1.4	**Assessment of Client Satisfaction**	**Continuously assess and address client satisfaction to respond to client needs effectively.**

Readiness for Understanding and Facilitation: The readiness for this set ensures that project teams are thoroughly prepared with foundational IPD knowledge and skills essential for successful implementation. IPD Comprehension readiness confirms the team's understanding of the IPD framework, principles, phases, and practices and how IPD contributes to project success. Facilitation readiness involves conducting assessments of gaps in understanding IPD practices, providing training on IPD tools, and emphasizing the contribution of facilitation practices to establishing a supportive culture. Lastly, Building and Sustaining Teams readiness ensures the establishment of a unified team culture, implements flat hierarchy structures to reflect joint management, and promotes open and direct communication, along with encouraging active participation from all team members, thereby fostering an environment where everyone's input is valued.

Readiness for Goal Setting and Contract Development: This set prepares teams for critical early-phase project planning and contractual agreements. Readiness in Developing Project Goals is centered around establishing a structured validation process that guides a clear definition of project objectives. This process ensures readiness by fostering collaboration to incorporate diverse perspectives and enhancing team culture—key elements that promote unity and a shared commitment to project goals. Readiness in Defining Project Values ensures that the project's core values will be well-defined, well-communicated, and regularly referenced during decision-making processes, ensuring all decisions align with overarching project values. Readiness in Contract Formulation ensures an active and collaborative participation in contract development. This includes stress on integrating all IPD principles into the contract and employing various facilitation methods, such as workshops and expert consultations, to aid the development process. Moreover, this readiness area emphasizes optimizing contracts to adapt to specific project conditions and to foster ongoing collaboration throughout the project lifecycle.

Readiness for Project Governance: This set's readiness focuses on preparing teams to implement the governance aspects of IPD by ensuring that roles are structured to facilitate effective project management. Defining Roles and Responsibilities readiness focuses on the existence of plans to ensure roles and responsibilities are clearly defined, communicated, and understood across the team. This includes fostering team discussions to ensure mutual agreement on roles, enhancing team alignment, and promoting a deep understanding of individual accountability. Establishing Decision-Making Processes readiness aims to ensure an inclusive and transparent environment where decision-making involves all relevant team members in decision processes, taking benefits of collaborative decision-support tools, and is consistently guided by overarching project goals. Establishing a management structure readiness ensures proper coordination at different levels of management, so that decisions and activities are aligned and duly communicated. And last, in this set, Owner Involvement readiness indicates active and continuous project owner involvement both at the decision-making level and at the level of everyday operations, encouraging a leadership role in governance and fostering a collaborative environment. This includes the owner's support for the IPD model and contributing to establishing a favorable team culture. This includes the owner's support for the IPD model and contributing to establishing a favorable team culture.

Readiness for Operational Excellence: This set concerns the team's preparedness to foster a cohesive and efficient operational framework. Operational Culture readiness confirms that the team is prepared to adopt Lean practices, maintain a collaborative work environment, and cultivate a no-blame culture conducive to learning. Operational Principles readiness ensures that the principles of streamlining workflows, minimizing waste, value maximization, and continuous improvement are the guiding principles of the project. Tools readiness verifies that the project can effectively utilize BIM for various applications, positioning it as a pivotal tool in project management. It also confirms that Lean tools will be employed consistently as part of the project's core operational strategy. Dynamics readiness emphasizes

establishing flexible, multidisciplinary team structures that are ready to adapt to changing project needs. This readiness includes ensuring that team responsibilities are clearly defined and that teams are empowered with appropriate decision-making authority. Engagement readiness ensures that the project has developed comprehensive engagement strategies encouraging open and informal communication channels to keep all team members informed and aligned. As the final component to ensure operational framework excellence, the Work Environment readiness stresses the importance of conducting frequent Big Room meetings to promote inclusivity and sustained collaboration.

Readiness for Management and Oversight: This set prepares the project to implement management protocols that support effective execution and oversight. Information Management readiness verifies that the project is equipped to organize information in a structured and accessible manner, ensuring that information sharing is transparent and efficiently disseminated via digital platforms. Financial Practices readiness ensures that all team members are integrated into financial discussions, promoting a culture of shared financial responsibility. This includes the readiness to maintain financial transparency through open-book accounting and employ incentive mechanisms that enhance performance and sustain collaboration. Risk Practices readiness prepares the project to engage all members in risk management activities, ensuring a collective approach to identifying, assessing, and mitigating risks. In addition, it stresses utilizing collaborative tools like risk registers in the process. Performance Monitoring readiness confirms that the project can implement dashboards for the visualization of a broad range of performance metrics. The criticality of standardized data collection across all disciplines to enhance the accuracy and reliability of performance analysis is highlighted.

Readiness for Continuous Learning: The set ensures the project is prepared to adapt to evolving standards and stakeholder expectations through proactive learning and feedback mechanisms. This involves systematic capture and documentation of lessons learned, regular analysis of feedback about IPD

practices, and continuous assessment of client satisfaction. This would foster a culture that embraces continuous improvement and responsiveness to feedback.

4.3 IPD Readiness Assessment Tool (IPD-ReAT):

At this stage, the Readiness Framework was transformed into a practical assessment tool called the IPD Readiness Assessment Tool (IPD-ReAT). Structured as a self-assessment tool in a questionnaire style, the IPD-RAT uses a binary (Yes/No) response format to simplify the evaluation process and capture the presence or absence of concrete preparatory conditions, supplemented by an 'I don't know' option to acknowledge uncertainties. Each readiness indicator developed in the previous steps is transformed into one or more questions, allowing for a direct assessment of readiness across various aspects of IPD.

The questions are designed to measure the extent to which project-specific readiness factors—outlined as readiness checkpoints—are present and actionable within the project plans. Each capability-level readiness score reflects the proportion of readiness conditions satisfied and is categorized into five readiness levels to support interpretation and decision-making. The readiness levels are defined as follows:

- **Emergent** (0–20%): Indicates that few or no readiness conditions are in place and that the project lacks essential preparatory arrangements.
- **Low** (>20–40%): Indicates that initial readiness conditions are present, but substantial gaps remain across key areas.
- **Moderate** (>40–60%): Indicates that several readiness conditions are in place, although important elements still require development prior to IPD implementation.
- **High** (>60–80%): Indicates that most readiness conditions are in place, with only limited preparatory gaps remaining.

- **Optimal** (>80–100%): Indicates that readiness conditions are largely complete and that the project is well positioned to begin IPD implementation.

The readiness levels are calculated by aggregating the scores from each question, providing a quantifiable measure of readiness that can be analyzed at both the capability and overall project level. This enables a better understanding of which areas may require additional focus or more resources to enhance project readiness. This design ensures that the tool can serve as both a diagnostic and guidance tool that guides project teams toward targeted improvements in their readiness for IPD implementation.

Readiness results are intended to be interpreted holistically at the capability-profile level rather than as precise numerical thresholds. Small differences in readiness scores should not be interpreted as materially distinct readiness states, but rather as indicative of relative completeness of preparatory conditions across capabilities. Accordingly, the readiness categories serve as heuristic groupings to support sense-making, discussion, and prioritization at the project initiation stage, rather than deterministic classifications.

In a final step, this tool involved an application and validation step through two case studies, as outlined in the next section, to ensure its effectiveness in assessing readiness for IPD projects.

4.4 Application and Validation:

To validate and apply the developed readiness assessment tool, two case studies were conducted. Both case study projects were led by public-sector owners and assessed at the project initiation stage, prior to formal IPD contract execution. The first case involved a large-scale educational building project representing a major university expansion in Montreal, with anticipated participation from owners, designers, and construction partners in an integrated delivery setting.

The second case focused on a commercial building mechanical systems upgrade under consideration by a public institutional owner in Quebec as a candidate for IPD adoption. Although on a smaller scale, IPD was being evaluated to enhance coordination and governance.

Together, the two cases reflect different project scales and scopes while sharing comparable early-stage IPD implementation conditions, making them suitable for validating the readiness assessment tool under its intended use.

The tool is designed to be used at the project level to evaluate the collective readiness of the entire project to implement IPD. For validation purposes at this stage, the owner representatives responded to the assessment on behalf of their teams. In follow-up meetings, we discussed how the tool should ideally be administered in practice to ensure it accurately captures the readiness of the full project team. It is intended to assess the collective capability of the project and the team as a whole, rather than evaluating readiness at the level of individual roles or subgroups. The focus is on how the project, in its integrated form, is positioned to implement IPD.

Table 3 summarizes the readiness levels across key capabilities for both case studies, based on self-assessments completed by the owner representatives involved in each project. This comparison highlights the tool's ability to deliver a precise and detailed picture of readiness for each project, pinpointing readiness strengths and weaknesses to facilitate targeted interventions. The readiness assessment for Case Study 1 showed mixed results across different capabilities. The project demonstrated strong readiness in areas like Facilitation, Owner Involvement, Continuous Learning and Improvement, Building and Sustaining Teams, Developing Project Goals, Operational Culture, and Work Environment. However, it faced significant challenges, with low readiness observed in IPD Comprehension, Contract Formulation, Defining Roles and Responsibilities, Establishing Management Structure, Tools, Dynamics, Information Management, Performance Monitoring, and Engagement, indicating a need for stronger efforts and interventions to fully prepare the project to embark on these areas.

Table 3. Readiness Assessment Comparison – Two Case Studies

Capability Sets	#	Capabilities	Readiness Level	
			Case Study 1	Case Study 2
Understanding and Facilitation	1.1	IPD Comprehension	Low	Optimal
	1.2	Facilitation	Optimal	High
	1.3	Building and Sustaining Teams	High	Moderate
Goal Setting and Contract Development	2.1	Developing Project Goals (Validation Process)	High	High
	2.2	Defining project values	Moderate	High
	2.3	Contract Formulation	Low	Low
Project Governance	3.1	Defining Roles and Responsibilities	Low	Emergent
	3.2	Establishing Decision-Making Process	Moderate	Emergent
	3.3	Establishing Management Structure	Low	Moderate
	3.4	Owner involvement	High	Optimal
Operational Excellence	4.1	Operational Culture	High	High
	4.2	Operational Principles	Moderate	Moderate
	4.3	Tools	Low	Moderate
	4.4	Dynamics	Low	Low
	4.5	Engagement	Emergent	Low
	4.6	Work Environment	High	High
Management and Oversight	5.1	Information Management	Low	Low
	5.2	Financial Practices	Optimal	Low
	5.3	Risk Practices	Optimal	Low
	5.4	Performance Monitoring	Low	Emergent
Continuous Learning	6.1	Continuous Learning and Improvement	High	Moderate

In Case Study 2, the project demonstrated optimal readiness in IPD Comprehension and Owner Involvement, while high readiness was observed in Facilitation, Developing Project Goals, Defining Project Values, Operational Culture, and Work Environment. However, necessary attention to the readiness of the governance and monitoring aspects was highlighted by the emergent scores in readiness for Defining

Roles and Responsibilities, Establishing Decision-Making Processes, and Performance Monitoring scoring emergent.

Following the assessment and the report preparation, follow-up sessions with six representatives from the two case studies were conducted in three meetings to further validate the assessment outcomes. These sessions involved semi-structured interviews and open discussions to gather feedback on the accuracy, clarity, and practical utility of the tool. Participants included owner-side project management team members responsible for initiating or coordinating the IPD implementation process. The feedback underscored the tool's practical utility and accuracy. As one participant remarked, “It was pretty effective… it really reflected what we were experiencing right now.” Another added, “This really shows where we stand.” Such feedback affirmed the tool’s capability to reflect the projects’ readiness status.

The sessions also led to critical refinements in the tool’s design. Developed in both English and French, the tool benefited from improvements to its wording and question formats, ensuring clarity and precision in both versions. For example, terms such as "flat hierarchy" were clarified, questions were refined to distinguish between owner-defined objectives and team-developed IPD goals, and items related to stakeholder inclusion and validation processes were reworded to better reflect project-level conditions. The French version was provided to reduce language barriers and ensure consistent understanding during administration in the Quebec context, rather than to examine language- or culture-related differences in readiness interpretation.

Additionally, the validation discussions highlighted the importance of clearly defining how the readiness assessment tool can be administered in practice. Two complementary administration approaches were identified.

The first is an audit-based approach, which is suitable when an experienced facilitator or evaluator is available. In this approach, the evaluator administers the tool by reviewing project documentation,

meeting with key stakeholders, and consolidating available information to provide informed responses, thereby reducing individual bias and increasing assessment credibility.

The second approach involves gathering responses from a broader group of participants, typically the IPD project's leadership from all contract signatories. This collective approach is particularly appropriate when no single evaluator has comprehensive project knowledge and helps minimize subjectivity by capturing multiple perspectives. In this case, aggregation is performed at the capability level. Each respondent's answers are first used to compute a capability-level readiness score based on the associated questions, after which capability scores are averaged across respondents to derive a project-level readiness profile.

A significant refinement involved the scoring system. Initially, "I don't know" responses were treated as equivalent to "No," which negatively impacted readiness scores. Discussions clarified that "I don't know" should instead be excluded from the scoring process. For example, if one respondent answered "Yes" and another "I don't know," the "Yes" response would suffice as evidence of readiness. This adjustment ensures that readiness levels better reflect reality and avoid penalizing projects for lack of specific knowledge among individual respondents.

This validation and application process demonstrated the readiness tool's relevance, applicability, and usefulness. The refinements made during this process enhance its usability and accuracy, setting the stage for its broader application across diverse IPD projects.

5. Discussion:

Previous research efforts in IPD readiness, such as the models developed by Azhar (2014) focusing on IPD and Information and Communication Technology (ICT) readiness and the organizational readiness studies within Malaysia's Industrialized Building System (IBS) by Osman et al. 2015, provide valuable insights into alignment and preparedness conditions for IPD adoption. However, these models primarily assess readiness at an organizational or technological level or examine general alignment with IPD

principles, offering limited support for project-specific decision-making at the initiation stage. As a result, they do not explicitly address whether a given project is sufficiently prepared to commence IPD implementation.

Building on and extending these prior efforts, the readiness model presented in this study advances the state of practice by introducing a project-level, decision-oriented readiness framework and assessment tool. Unlike existing models that emphasize technology integration or organizational adoption, the proposed model operationalizes readiness across technological, human, and structural dimensions that directly influence early IPD implementation. It evaluates human readiness elements such as IPD comprehension, training and facilitation, team building, and engagement, alongside structural readiness aspects including governance arrangements, role definition, decision-making processes, and owner involvement. In addition, it incorporates technological and operational readiness through the assessment of BIM integration and Lean tools and practices. By translating readiness into actionable checkpoints across these dimensions, the model enables practitioners to systematically assess project preparedness, identify targeted preparatory actions, and support informed early-stage decisions to initiate IPD, thereby addressing practical needs not explicitly supported by previous readiness models.

From a different angle, the readiness model draws on organizational readiness for change principles, which emphasize readiness as a multilevel construct encompassing both willingness to adopt change and the capacity to implement it effectively (Holt et al., 2007; Weiner, 2020). This distinction is illustrated in the second case study, where strong commitment to IPD principles coexisted with gaps in governance-related capabilities, such as role definition and decision-making, limiting implementation effectiveness. This positioning is achieved by incorporating these theoretical constructs in practical readiness indicators and checkpoints that reflect the technological, psychological, and structural arrangements required to initiate collaborative and integrated practices.

Although the model focuses on project-level readiness, its structure underscores the multilevel nature of readiness, as emphasized in organizational change theories (Holt et al., 2007; Juan et al., 2017; Britel & Cherkaoui, 2021), where readiness for different capabilities requires alignment at the organizational, project, and individual levels. Project-level readiness, in the context of IPD, is inherently multi-organizational, requiring coordination and alignment across all IPD signatory organizations. The model addresses this by evaluating the collective readiness of both the integrated project and its team, with readiness indicators designed to reflect shared responsibilities, joint planning, and interdependent capabilities that span organizational boundaries. For instance, capabilities such as "IPD Comprehension" and "Building and Sustaining Teams" directly address the knowledge, attitudes, and behaviors critical for fostering individual readiness within the broader project framework. Similarly, the readiness model incorporates organizational aspects by embedding elements that touch on organizational readiness and alignment. For example, capabilities like "Owner Involvement" and "Establishing Management Structures" highlight how organizational frameworks and leadership influence readiness. That being said, the model does not explicitly address organizational-level readiness for IPD adoption. Organizational readiness involves strategic alignment, cultural transformation, governance structures, and overarching strategic goals that extend beyond the scope of project-specific readiness (Magalhães et al., 2023).

In this context, IPD readiness is inherently interdependent and extends beyond the internal conditions of a single organization. The readiness of a project to implement IPD is influenced by the preparedness, commitment, and capabilities of all key IPD signatories, including owners, designers, and contractors. While the readiness assessment tool may be completed by a single organization or a limited number of organizations at early project stages, the indicators are defined at the project level and reflect conditions that require alignment and participation across all IPD signatories. As such, readiness results should be interpreted as conditional on external stakeholder readiness, highlighting areas where inter-organizational coordination, engagement, or alignment is required prior to IPD implementation.

Building on this theoretical foundation, the model's validation through case studies provides further practical insights into its utility and implications. The results demonstrated that the readiness model effectively identifies strengths and areas for improvement within projects, providing detailed readiness profiles. For instance, while the results highlighted high to optimal readiness in facilitation and owner involvement in Case Study 1, they also indicated challenges in governance and operational readiness, such as in defining roles and responsibilities and engagement.

While the readiness assessment identifies specific gaps across governance, operational, and monitoring-related capabilities, the results also suggest underlying factors that help explain why these gaps emerge. In both case studies, lower readiness scores were predominantly observed in capabilities related to formal governance structures, contractual arrangements, and performance monitoring. These gaps reflect a common mismatch between early commitment to IPD principles and the formalization of the structures, processes, and mechanisms required to operationalize them. Although project teams demonstrated strong alignment and willingness to implement IPD, key enabling systems had not yet been fully established. This indicates that readiness gaps do not necessarily signal resistance or lack of intent, but rather highlight areas where deliberate preparatory actions are required prior to IPD implementation.

Beyond its diagnostic function, the structure of the readiness framework enables it to guide targeted preparatory actions. Each readiness gap is linked to specific readiness indicators and checkpoints, which point to concrete areas requiring attention prior to IPD implementation. Low-scoring capabilities highlight the need for focused preparatory efforts such as additional training, facilitation, governance clarification, contractual alignment, or engagement strategies, depending on the capability involved. In this way, the readiness model supports informed planning and prioritization of improvement actions without prescribing a fixed set of interventions.

From a practical perspective, the readiness assessment is intended to be applied at the project level and interpreted collectively by the IPD project team rather than by individual organizations. While

the tool produces a single project-level readiness profile, different IPD signatories may interpret the results through their respective roles and responsibilities. For example, owners may focus on governance, decision-making structures, and leadership commitment required to support IPD initiation, while designers and contractors may emphasize readiness related to collaboration processes, role clarity, and operational coordination. These role-specific interpretations do not represent separate readiness assessments, but rather complementary perspectives on the same project-level conditions.

6. Conclusion:

The readiness model developed in this study addresses a notable gap in IPD adoption and implementation by providing a structured framework and assessment tool to evaluate and guide project readiness at early stages. By operationalizing readiness through specific, actionable readiness checkpoints, the model supports more consistent and systematic preparation for IPD implementation. The primary contribution of this study is the development and validation of a project-level IPD readiness model and assessment tool that supports early-stage IPD implementation decisions, while the adaptation of an existing IPD capability maturity model into a readiness-oriented framework constitutes a secondary, enabling contribution.

By grounding the IPD Readiness Model in both the IPD capability framework, which is established upon empirical data from real IPD projects, and in principles of organizational readiness for change while tailoring its application to project-specific readiness, this study bridges practical and theoretical insights with actionable tools, setting the stage for more structured and consistent implementation of IPD.

The readiness model presented in this study and the previously developed IPD maturity model are intended to function as complementary assessments applied at different stages of the IPD lifecycle. While the readiness model supports pre-implementation evaluation of whether the necessary conditions for IPD are in place, the maturity model evaluates how IPD practices are enacted and institutionalized after implementation. Considered together, these models conceptually support a learning cycle in which

insights from post-project maturity evaluation can inform readiness considerations for future projects, enabling more informed preparation and capability development over time. Although this combined use is not empirically examined in this study, it represents a promising direction for future research on continuous improvement in IPD.

On the other hand, the study approach encountered a few limitations. For instance, the basis of validation was done with only two projects that were in the early stages of implementation where the project teams had not yet been fully assembled. As a result, the IPD readiness tool was primarily used by the owner teams dedicated to IPD rather than the entire IPD project team members. Ideally, the tool would be applied to a whole assembled IPD team to yield a complete perspective on the state of the project's preparedness to start implementing IPD collaboratively. Future studies should overcome these limitations by validating the model and the tool on a larger number of projects from diverse domains and by embedding a broader validation process engaging the participation of entire IPD teams at the inception of their collaboration. Future research may also explore alternative scoring and aggregation approaches, such as fuzzy logic–based extensions, to further capture degrees of readiness while preserving the practical intent of the tool. Additionally, future research may extend the proposed readiness assessment by empirically examining alternative aggregation and weighting strategies across capabilities to further refine the interpretive precision of readiness scores. Furthermore, future research may further strengthen the readiness model by conducting formal content validity assessments, such as expert-based evaluations, to independently examine the completeness and representativeness of the readiness indicators.

DATA AVAILABILITY STATEMENT:

Some or all data, models, or codes that support the findings of this study are available from the corresponding author upon reasonable request.

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References:

Allison, M., Ashcraft, H., Cheng, R., Klawens, S., & Pease, J. (2018). *Integrated Project Delivery: An Action Guide for Leaders*. http://conservancy.umn.edu/handle/11299/201404

Anderson, K., & McAdam, R. (2004). A critique of benchmarking and performance measurement. *Benchmarking: An International Journal*, *11*(5), 465–483. https://doi.org/10.1108/14635770410557708

Arar, A. J., Poirier, E., & Staub-French, S. (2024). A research and development framework for integrated project delivery. *Construction Management and Economics*. https://www.tandfonline.com/doi/abs/10.1080/01446193.2024.2390529

Arar, A. J., Poirier, E., & Staub-French, S. (2025). A Capability Maturity Model for Integrated Project Delivery. *Buildings*, *15*(10), 1733.

Azhar, N. (2014). *Integrated construction project delivery system in the US public sector: An information modeling framework*. https://digitalcommons.fiu.edu/cgi/viewcontent.cgi?article=2616&context=etd

Britel, Z., & Cherkaoui, A. (2021). Change Readiness Assessment for the Implementation of Building Information Modeling within a Construction Project Management Company. *Proceedings of the 2020 International Conference on Big Data in Management*, 136–140. https://doi.org/10.1145/3437075.3437094

Brunton, G., Oliver, S., & Thomas, J. (2020). Innovations in framework synthesis as a systematic review method. *Research Synthesis Methods*, *11*(3), 316–330. https://doi.org/10.1002/jrsm.1399

Chen, X., Chang-Richards, A., Ling, F. Y. Y., Yiu, T. W., Pelosi, A., & Yang, N. (2023). Developing a readiness model and a self-assessment tool for adopting digital technologies in construction organizations. *Building Research & Information*, *51*(3), 241–256. https://doi.org/10.1080/09613218.2022.2136130

Dalton, C. C., & Gottlieb, L. N. (2003). The concept of readiness to change. *Journal of Advanced Nursing*, *42*(2), 108–117. https://doi.org/10.1046/j.1365-2648.2003.02593.x

Durdyev, S., Hosseini, M. R., Martek, I., Ismail, S., & Arashpour, M. (2019). Barriers to the use of integrated project delivery (IPD): A quantified model for Malaysia. *Engineering, Construction and Architectural Management*, *27*(1), 186–204. https://doi.org/10.1108/ECAM-12-2018-0535

Egami, N., & Hartman, E. (2023). Elements of External Validity: Framework, Design, and Analysis. *American Political Science Review*, *117*(3), 1070–1088. https://doi.org/10.1017/S0003055422000880

Fischer, M., Ashcraft, H. W., Reed, D., & Khanzode, A. (2017). *Integrating project delivery*. John Wiley & Sons. https://books.google.ca/books?hl=en&lr=lang_en|lang_fr&id=_RojDgAAQBAJ&oi=fnd&pg=PR11&dq=Integrated+Project+Delivery++IPD&ots=Fbf79thfHt&sig=izIWaOoL3tStZOFp44KPvKq6NF4

Hanafi, M. H., Sing, G. G., Abdullah, S., & Ismail, R. (2016). ORGANISATIONAL READINESS OF BUILDING INFORMATION MODELLING IMPLEMENTATION: ARCHITECTURAL PRACTICES. *Jurnal Teknologi (Sciences & Engineering)*, *78*(5), Article 5. https://doi.org/10.11113/jt.v78.8265

Helfat, C. E., & Peteraf, M. A. (2003). *The dynamic resource-based view: Capability lifecycles. Strategic Management Journal24 (10): 997-1010*.

Holt, D. T., Armenakis, A. A., Feild, H. S., & Harris, S. G. (2007). Readiness for Organizational Change: The Systematic Development of a Scale. *The Journal of Applied Behavioral Science*, *43*(2), 232–255. https://doi.org/10.1177/0021886306295295

Jayanetti, J., Perera, B., & Waidyasekara, K. (2022). Defining a 'maturity model'in the construction context: A systematic review. *Proceedings of the 10th World Construction Symposium*, 298–312. https://www.researchgate.net/profile/Jkddt-

Jayanetti/publication/371599328_Defining_a_'maturity_model'_in_the_construction_context_A_systematic_review_DEFINING_A_'MATURITY_MODEL'_IN_THE_CONSTRUCTION_CONTEXT_A_SYSTEMATIC_REVIEW/links/648bfa8bb9ed6874a5b1a218/Defining-a-maturity-model-in-the-construction-context-A-systematic-review-DEFINING-A-MATURITY-MODEL-IN-THE-CONSTRUCTION-CONTEXT-A-SYSTEMATIC-REVIEW.pdf

Kent, D. C., & Becerik-Gerber, B. (2010). Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery. *Journal of Construction Engineering and Management*, *136*(8), 815–825. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000188

Lehman, W. E. K., Greener, J. M., & Simpson, D. D. (2002). Assessing organizational readiness for change. *Journal of Substance Abuse Treatment*, *22*(4), 197–209. https://doi.org/10.1016/S0740-5472(02)00233-7

Liao, L., Teo Ai Lin, E., & Low, S. P. (2020). Assessing building information modeling implementation readiness in building projects in Singapore. *Engineering, Construction and Architectural Management*, *27*(3), 700–724. https://doi.org/10.1108/ECAM-01-2019-0028

Liu, N., Ruan, L., Jin, R., Chen, Y., Deng, X., & Yang, T. (2019). Investigation of individual perceptions towards BIM implementation-a Chongqing case study. *Engineering, Construction and Architectural Management*, *26*(7), 1455–1475. https://doi.org/10.1108/ECAM-08-2018-0342

Magalhães, R. M., Mello, L. C. B. de B., & Hippert, M. A. S. (2023). Organizational readiness for building information modeling. *Frontiers in Engineering and Built Environment*, *3*(2), 137–152. https://doi.org/10.1108/FEBE-07-2022-0028

NOAA. (2022). *Readiness Levels – Office of Research Transition and Application*. https://orta.research.noaa.gov/support/readiness-levels/

Osman, W. N., Nawi, M. N. M., Anuar, H. S., Radzuan, K., & Osman, N. N. (2015). Readiness assessment for implementation of integrated project delivery (IPD) in industrialised building system (IBS) projects. *Jurnal Teknologi*, *77*(4). https://journals.utm.my/jurnalteknologi/article/view/6046

Osman, W. N., Nawi, M. N. M., Shafiei, M., & Aswad, F. (2017). An integrated procurement system: A study of construction firm readiness towards implementing of integrated project delivery (IPD). *International Journal of Supply Chain Management*, *6*(3), 360–366.

Parasuraman, A. (2000). Technology Readiness Index (Tri): A Multiple-Item Scale to Measure Readiness to Embrace New Technologies. *Journal of Service Research*, *2*(4), 307–320. https://doi.org/10.1177/109467050024001

Paulk, M. C., Curtis, B., & Chrissis, M. B. (1991). *Capability maturity model for software*. https://apps.dtic.mil/sti/html/tr/ADA240603/

Rashidian, S., Drogemuller, R., & Omrani, S. (2022). The compatibility of existing BIM maturity models with lean construction and integrated project delivery. *Journal of Information Technology in Construction*, *27*, 496–511.

Schumacher, A., Erol, S., & Sihn, W. (2016a). A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises. *Procedia CIRP*, *52*, 161–166. https://doi.org/10.1016/j.procir.2016.07.040

Schumacher, A., Erol, S., & Sihn, W. (2016b). A maturity model for assessing Industry 4.0 readiness and maturity of manufacturing enterprises. *Procedia Cirp*, *52*, 161–166.

Vax, S., Farkas, M., Russinova, Z., Mueser, K. T., & Drainoni, M.-L. (2021). Enhancing organizational readiness for implementation: Constructing a typology of readiness-development strategies using a modified Delphi process. *Implementation Science*, *16*(1), 61. https://doi.org/10.1186/s13012-021-01132-0

Venable, J., Pries-Heje, J., & Baskerville, R. (2012). A Comprehensive Framework for Evaluation in Design Science Research. In K. Peffers, M. Rothenberger, & B. Kuechler (Eds), *Design Science Research*

in Information Systems. Advances in Theory and Practice (pp. 423–438). Springer. https://doi.org/10.1007/978-3-642-29863-9_31

Viana, M. L., Hadikusumo, B. H., Mohammad, M. Z., & Kahvandi, Z. (2020). Integrated Project Delivery (IPD): An Updated Review and Analysis Case Study. *Journal of Engineering, Project & Production Management*, *10*(2). https://www.researchgate.net/profile/Marina-Viana-3/publication/339944244_Integrated_Project_Delivery_IPD_An_Updated_Review_and_Analysis_Case_Study/links/5e6ea96e92851c6ba7065555/Integrated-Project-Delivery-IPD-An-Updated-Review-and-Analysis-Case-Study.pdf

vom Brocke, J., Hevner, A., & Maedche, A. (2020). Introduction to Design Science Research. In J. vom Brocke, A. Hevner, & A. Maedche (Eds), *Design Science Research. Cases* (pp. 1–13). Springer International Publishing. https://doi.org/10.1007/978-3-030-46781-4_1

Weiner, B. J. (2020). *Chapter 8: A theory of organizational readiness for change*. https://www.elgaronline.com/edcollchap/edcoll/9781788975988/9781788975988.00015.xml

Wolming, S., & Wikström, C. (2010). The concept of validity in theory and practice. *Assessment in Education: Principles, Policy & Practice*, *17*(2), 117–132. https://doi.org/10.1080/09695941003693856

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