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Solutions to Overcome Integrated Project Delivery Implementation Barriers: A Meta-Synthesis Approach

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Abstract: Construction projects encounter myriad problems, some of which may be connected to the project delivery model. Integrated project delivery (IPD) is an approach that removes the gap between the planning and the construction stages of a project. Various barriers to implementation exist within the construction industry and these can be resolved by effective solutions. Identifying and classifying these solutions is considered essential for successful project delivery. In this context, this study aims to illustrate and classify the solutions that have been proposed since the introduction of IPD as a new approach for the implementation of construction projects. In this study, a meta-synthesis approach has been used as a qualitative method, and pattern and descriptive coding and analysis have been used to analyse the data. The solutions analysed in the meta-synthesis suggest that all stakeholders—including designers, construction engineers, construction team members and operation and maintenance team members—each have the same responsibility to improve IPD and meet the project goals. This study is significant because it suggests important resolutions to the barriers to IPD implementation and may help construction industry stakeholders better facilitate IPD and enhance clauses of their contracts.

Keywords: Integrated project delivery (IPD), Barriers, Meta-synthesis, Construction projects, Project management

INTRODUCTION

Construction projects are among the most important and costly projects in any country. They can both create jobs and impose high expenses on stakeholders. Construction projects often lead to societal economic growth and they also include maintenance of environmental and social sustainability. Projects should be completed to meet the needs of communities and improve quality of life without compromising the needs of the next generation; additionally, they must be effectively designed, built and maintained (Cheng, 2012). The steps needed to implement a construction project will be successful when a coherent group of stakeholders works together. Many available methods do not promote integration of project stakeholders. To improve project success, methods and systems for construction, operation and maintenance can integrate the design and planning phases from construction and maintenance phases, generating cost and time savings (Ghassemi and Becerik-Gerber, 2011). One of the most important project

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delivery methods is integrated project delivery (IPD). It can be acknowledged that "the concept of IPD is an effective integration for project owners to prevent problems in the delivery of construction projects".

IPD's initial instructions and guidelines were developed by the American Institute of Architects (AIA) in 2007 (AIA, 2007). The IPD method is a project delivery approach with the following features: (1) Risk/reward sharing, (2) Early participation of project stakeholders, (3) Replacing the tender stage with purchase stage, without traditional tender conditions, and (4) Postponement of profit payment until project completion. This delivery method attempts to bridge the gap between the planning and the construction phases of construction projects (Mihic, Sertic and Zavrski, 2014). Despite the benefits of IPD, some important obstacles have prevented it from being fully implemented. In some country contexts, obstacles can result in harm in the quality, time, cost and main goals of the project. Thus, resolving the primary obstacles has been a concern for IPD executives in recent years. Numerous case studies have been done in an attempt to overcome such issues (Kahvandi et al., 2018).

Numerous studies have discussed obstacles to IPD implementation (Kahvandi et al., 2018; Kahvandi et al., 2019b) and some case studies have presented project-specific solutions. However, so far, no research has been conducted to review all studies that identified solutions to IPD implementation. Thus, this study aims to illustrate and classify the solutions proposed in several studies conducted since the introduction of IPD as a new approach to construction project implementation. This broad view of potential solutions will help researchers and stakeholders in the construction industry to strengthen their solutions and utilise proven methods for IPD implementation. Therefore, this study seeks to answer "What are some of the solutions to resolve the obstacles to IPD implementation from industry owners and how will these solutions improve IPD implementation?" This study is significant in that it will help stakeholders of the construction industry develop and undertake IPD. Moreover, it will aid in removing obstacles to IPD implementation by providing information to develop contract improvement tools. Furthermore, the solutions outlined in this study will be organised into major categories of construction domains to facilitate their examination and in turn, will be organised as opportunities for IPD implementation by different stakeholders.

LITERATURE REVIEW

In this section, the definitions and principles related to IPD will be reviewed, as well as IPD barriers and the meta-synthesis approach.

INTEGRATED PROJECT DELIVERY

In the 1940s, different construction delivery systems were being developed for use and improvement of projects. At this time, the design-bid-build approach had already been widely used in the USA for decades (Pishdad-Bozorgi and Beliveau, 2017). Although this methodology was widely used, issues related to inefficiency, fragmentation and resource waste were causing client dissatisfaction with projects' final results (Viana et al., 2020). For a partial solution, a new method was implemented in the 1960s, namely the construction management approach. This method focuses on supervision and control of teams and information; however, it was still considered a partial solution because of frequent issues still occurring at the time (Hamzeh et al., 2019). In the 1990s, the design-build method was created, aiming to put an end to all previous issues by using a single contract to provide both designing and building services. Unfortunately, the quality criteria decreased drastically when compared with previous methods (Hamzeh et al., 2019; Kahvandi et al., 2020). As the construction sector is experiencing major transformations and improvements due to rapid development, such traditional delivery methods may be unable to succeed as a result of extended project durations, cost overrun, low quality, frequent safety incidents, disputes, goal inconsistency, change orders, rework, adversarial relationships, arbitrations and litigations (Durdyev et al., 2019; Jadidoleslami et al., 2019; Temel et al., 2019).

To finally overcome such issues, Viana et al. (2020) outlined how IPD has surged as a systematic and integrated construction process that improves the project through early involvement, multi or poly-party contracts, open communication, collaboration, goal setting, team alignment and building information modeling (BIM) technology. Additionally, projects implemented through IPD foster a shared risk and reward environment (Kahvandi et al., 2017; Jadidoleslami et al., 2019; Viana et al., 2020). El Asmar, Hanna and Loh (2013) defined the method as "a delivery system distinguished by a multiparty agreement and the very early involvement of key participants". Jadidoleslami et al. (2019) explained how the IPD method has focused on a win-win relationship and common interests between contractors. It is also important to mention that the AIA recommended that for a proper IPD implementation, some essential principles must be understood and applied through each of its phases: optimise the whole, not the parts; early and clear goal definition; collaboration; integration of people and systems; joint ownership; respect; trust; transparency; a safe environment; shared risk and reward; and up-to-date technology (Cheng, 2012). Table 1 illustrates the attributes of IPD characteristics and principles.

Table 1. The attributes of IPD (as adapted from Mohamed Salleh et al. [2019])

Attributes		
Main team early participation	1.	The main team participation at an early stage enhances improved and innovative ideas.
	2.	Team involvement allows immediate feedbacks for improvement.
	3.	Teamwork produces accurate costs and estimations.
Collaboration	1.	Enhance collaboration with iterative and immediate face-to-face communication.
	2.	Members of each department are put together in a big room concept.
	3.	Information exchange can illustrate unforeseen issues and increase trust.
Team ideas support	1.	The culture promotes innovation and creative thinking environment.
	2.	Motivated teamwork environment that allows overall project vision.
	3.	Team members with a collaborative mindset, creativity and adaptability.

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Table 1. (*Continued*)

Attributes	
Sharing	1. Key participants sharing the pain and the gain of the project performance. 2. Creates a competitive team environment for rewards by cost savings on the project.
Financial transparency	1. Transparency among the contracting parties in decision making and cost savings. 2. Cost assessment benefits by reducing the risk of cost uncertainty.
Joint decision making	1. The collaborative mindset to make any essential decision. 2. Creates innovation, especially in terms of progress and project coordination.
Trust and accountability	1. Trust enhances collaboration between parties and building accountability. 2. All information exchange process between contracting parties is easier to implement. 3. The concept of trust can prevent repetitive and redundant works.

Benefits of IPD include cost, time, quality and the ability to improve on unforeseen issues during project implementation (Collins and Parrish, 2014). Some of these benefits could be related to feasible estimations, fewer project changes, minimum waste, better communication, integration and common goals, as well as an increase in quality (Collins and Parrish, 2014; El Asmar, Hanna and Loh, 2015). Because of these benefits, Jadidoleslami et al. (2019) stated that the project goals and objectives can be achieved faster, cheaper and with less waste.

For instance, The Tønsberg Project was the first IPD project carried out in Norway, in the Norwegian healthcare sector. It consists of a 31,000 m^2 somatic building and a 12,000 m^2 psychiatry building, at a cost of approximately USD370 million. The Tønsberg Project embraced IPD and implemented all the theoretical IPD elements presented, namely technology, contract, processes and culture (Aslesen et al., 2018). Experiences from the project highlighted how IPD may facilitate a higher level of common understanding and collaboration between key project participants. Another case study highlighting the benefits of IPD is the Conference Centre Project, a building project that consists of a conference centre and a multimedia resource centre in Jerusalem. The conference centre is approximately 7,014 m^2. The project team was involved in different stages and worked individually as IPD functional groups. The use of IPD principles enabled integration at the project level. Additionally, IPD in this case was useful to enhance the performance of the construction supply by encouraging progression and coordination, and reducing corrective iterations (Mesa, Molenaar and Alarcón, 2020).

In addition, Durdyev et al. (2019) described how IPD could increase success in constructing greener buildings due to stakeholders' early involvement and trust, which are essential elements for delivering green building projects (Durdyev et al., 2019; Chen and MingMak, 2021). Furthermore, Kraatz, Sanchez and Hampson (2014) highlighted how all team members in a project bring knowledge, encouraging a culture of risk management and cost-efficient processes that impact the final project quality.

IPD Barriers

Despite all the aforementioned benefits, according to Kahvandi et al. (2019a), the number of construction companies utilising IPD is still relatively small (Durdyev et al., 2019). The current numbers could be attributed to potential negative barriers that exist in applying the IPD method, where a successful delivery relies on establishing several mechanisms, and a failure in any of those could create major barriers to overcome (Sun et al., 2015). These failures could include flawed mechanisms in risk-sharing and profit distribution, ineffective decision-making systems, procurement difficulties, lack of trust, inadequate training and disagreement on liability waivers, among others (Kent and Becerik-Gerber, 2010; Durdyev et al., 2019). When it comes to IPD implementation, developed countries possess some advantages due to access to more sophisticated technology. In developing countries, the situation is reversed and the current barriers are more impactful (Ghassemi and Becerik-Gerber, 2011; Cheng et al., 2018). Although the barriers are prevalent, a small number of studies exploring how to overcome such issues in developing countries have been conducted (Hamzeh et al., 2019). One example from Iran emphasises additional attention that must be taken when transitioning from traditional project methods to IPD, by aligning IPD regulations and the required infrastructure while also fostering collaboration culture (Noghli, Saghatforoush and Forghani, 2018). Another study in Malaysia corroborated the negative impacts in resisting to change from traditional methods to IPD (Osman et al., 2015).

Several studies conducted in developed countries and emerging markets describe barriers to IPD implementation (Durdyev et al., 2019). For an illustration of this literature, Durdyev et al. (2019) created a table providing a list and typology of barriers, which is divided into six categories, as shown in Table 2.

Table 2. IPD barriers (as adapted from Durdyev et al. [2019])

Category	Description	References
Commitment and involvement (CI)	1. Lack of commitment to quality throughout construction	CEC (Commission for Environmental Cooperation) (2015)
	2. Lack of commitment by government officials	CEC (2015) and Hamzeh et al. (2019)
	3. Lack of commitment by the owner to an integrated approach	AIA (2007) and Atkinson and Westall (2010)
	4. Contractor's late engagement in design	Ghassemi and Becerik-Gerber (2011)
	5. Reluctance to cross-disciplinary input in an early design stage	Ghassemi and Becerik-Gerber (2011)
	6. Lack of tradespeople's involvement	Azhar (2014)
	7. Lack of operator's involvement	Azhar (2014)

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Table 2. (*Continued*)

Category	Description	References
Communication and collaboration (CC)	1. Lack of well-conducted kick-off meetings	CEC (2015)
	2. Lack of communication between stakeholders	AIA (2007) and Atkinson and Westall (2010)
	3. A poor relationship between stakeholders	Atkinson and Westall (2010)
	4. Lack of spirit of collaboration in each team member	Mesa, Molenaar and Alarcón (2019)
	5. Activity delays due to disputes	Mesa, Molenaar and Alarcón (2016)
	6. Lack of utilisation of BIM	(CEC, 2015)
	7. Late and/or unclear decisions by the owner	Mesa, Molenaar and Alarcón (2019)
	8. Unclear expectations by owner	Azhar (2014)
Skills and experience (SE)	1. Lack of joint decision-making skills	AIA (2007) and Atkinson and Westall (2010)
	2. Lack of IPD experience of the contractor	Mesa, Molenaar and Alarcón (2019)
	3. Lack of expert consultants in IPD	CEC (2015)
Motivation and promotion (MP)	1. Lack of promotion to achieve the greenest buildings	AIA (2007) and Atkinson and Westall (2010)
	2. Lack of government incentive policies	Kent and Becerik-Gerber (2010) and Hamzeh et al. (2019)
	3. The unwillingness of the industry to varying from its traditional methods	Ghassemi and Becerik-Gerber (2011) and Hamzeh et al. (2019)
	4. Lack of sustainability goals set by the client	CEC (2015)
Knowledge and information (KI)	1. The steep learning curve in IPD projects	Kent and Becerik-Gerber (2010) and Hamzeh et al. (2019)
	2. Owner's lack of knowledge about alternative options for higher performance	CEC (2015) and Hamzeh et al. (2019)

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Table 2. (*Continued*)

Category	Description		References
	3.	Lack of input provided on constructability and installation processes	CEC (2015)
	4.	Lack of government regulations	Kent and Becerik-Gerber (2010) and Hamzeh et al. (2019)
Project execution (PE)	1.	High embedded risks (i.e., financial)	Hamzeh et al. (2019)
	2.	Long-term resiliency issues that put investment at risk	CEC (2015)
	3.	Selection of a contractor for lowest-cost bids	Mesa, Molenaar and Alarcón (2016)
	4.	High initial investment	Azhar (2014)
	5.	Project size	Mesa, Molenaar and Alarcón (2016)

The barriers identified in the study are classified into six categories, namely CI, CC, SE, MP, KI and PE (Durdyev et al., 2019). When it comes to CI, the lack of CI in decision makers directly impacts the CC category with inefficiency among practitioners regarding exchanging and implementing lessons learned. Barriers in SE are related to the assimilation of new skills and competencies to support IPD. KI barriers are related to the concept of respect as a necessary catalyst to usage. Finally, PE-related barriers include difficulty with successful execution and integration of principles into every stage of project procurement (Durdyev et al., 2019). Additionally, Kahvandi et al. (2019b) presented another list of IPD barriers, which is illustrated in Table 3.

Table 3. IPD barriers components (as adapted from Kahvandi et al. [2019b])

Components' Title	Factors' Title
Managerial	The challenge of selecting compensator for financial losses; Inconsistency in project management; Poor matrix structure in project-based organisations; Lack of sufficient knowledge of investors about new successful contractual systems all over the world; Lack of holding training courses for investors about defining and stating the advantages of new successful contractual systems all over the world; Poor information sharing among different phases of the project; Lack of proper definition of teamwork culture among project key stakeholders.

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Table 3. (*Continued*)

Components' Title	Factors' Title
Environmental	Lack of motivation for investors to use modern contracts, such as IPD approach; Lack of control and strong management of the employer; Lack of proper orientation for future and not paying attention to future development, particularly in the governmental projects; Lack of familiarity of contractors with IPD approach; Lack of conditions for the insurance to cover the entire project in the country, according to new contractual systems; Lack of conditions for the insurance to cover the responsibilities according to new contractual systems for the contractor; Non-participation of governmental agencies in construction, according to the governing rules in the governmental contracts.
Contractual	Lack of mutual trust among project key stakeholders regarding managerial and financial issues; Lack of appropriate policies and current construction contractual strategies; Lack of identical contracts among subcontractors, such as IPD approach; Tendency to use conventional contractual methods and resistance to new ideas; Lack of proper definition of responsibilities of each of parties of the contract.
Technical	Lack of integrated collaboration among key stakeholders, due to lack of the necessary technology; Lack of using BIM as an appropriate instrument to implement IPD approach; Lack of sufficient knowledge about design and construction and maintenance among employer agents.

In that study, a comprehensive list of barriers related to IPD implementation was developed through a questionnaire survey using a comprehensive IPD literature review. Stakeholders who responded to the survey include project managers, employers, consultants and contractors in the construction field. Using exploratory factor analysis, four categories or macro factors of barriers were identified: contractual, environmental, managerial and technical (Kahvandi et al., 2019b).

METHODOLOGY

The meta-synthesis approach, as Gu and Tang (2005) explained, is a "confident hypothesis, rigorous validation" – in other words, quantitative knowledge arises from qualitative understanding. For such an approach, the proposed hypothesis and quantitative validation focus on uniting a myriad of information, computer technology, disciplines, human experience and knowledge. According to Glass (1976), such an approach can be defined as a statistical method aiming to perform quantitative integration and analysis of the results from all the empirical studies relevant to a specific issue and agreeable to quantitative aggregation. The approach can be oriented to a synthesised work coming from multiple disciplines or domains and appear in strategic planning, project assessment and evaluation, or roughly, complex problem solving. Such a method can be classified into three different categories: (1) Qualitative meta-synthesis, (2) Qualitative/quantitative meta-synthesis and (3) Meta-synthesis from qualitative hypothesis to quantitative validation (Gu and Tang, 2005). The first category, qualitative meta-synthesis, is considered the production of assumptions or hypotheses regarding unstructured problems, such as exposed qualitative relations or structures of concerning issues.

The second category, qualitative/quantitative meta-synthesis, aims to conduct quantitative analysis based on qualitative assumptions acquired from the first category, where it is used in the systems analysts and engineering field. In the third and final category, meta-synthesis from the qualitative hypothesis focus on validating the results from the previous category, where if the validation is considered positive, solutions regarding the unstructured issue are acquired (Gu and Tang, 2005).

Using the meta-synthesis method, it is possible to achieve reliable results and ensure that the quality data is aligned. In addition, meta-synthesis uses the integration of several studies to produce complete findings. The meta-synthesis method qualitatively examines the data and findings of previous studies (Noblit and Hare, 1988). On the other hand, the meta-synthesis method is used for systematic search of resources and focuses on qualitative studies. This method is tested and establishes a clear relationship between the text of the initial studies and the conclusion by developing important rules for systematic review. Walsh and Downe (2005) enriched the qualitative research literature, emphasising the necessity to collect separate studies to provide complete and concise results. Some of the general goals of this method include summarising and theorising at high levels and developing the concept under study (Sandelowski and Barroso, 2006).

The articles collected by the meta-synthesis method in the current study have been analysed by QSR NVivo 8.0 software. This software plays a key role in the analysis of qualitative studies and allows for easy classification of data using a coding system. Thus, the meta-synthesis method was used to review and present existing solutions to resolve obstacles to IPD implementation in construction projects. The best data were extracted from the studies and categorised according to the research needs. Noblit and Hare (1988) provided a framework for the meta-synthesis approach to analyse and synthesise the qualitative studies applying seven steps, as shown in Figure 1.

Figure 1. Steps of meta-synthesis method

DATA ANALYSIS

Step One: State the Research Question

In the meta-synthesis method, the first step is to develop and state the research question. The research question should be based on the researcher's interest or on the previous studies (Noblit and Hare, 1988). To develop it, the researcher should follow four basic questions: "What research has been done?", "Who?", "When?" and "How does it use a method to collect research data?"

In this study, the research done includes identification and classification of IPD implementation obstacles, as well as suggestions and solutions for how to solve these problems. The "who" is the research population, which in this study are the relevant databases, scientific articles and journals, books and masters and doctoral dissertations. Research conducted from year 2007 to 2020 will be evaluated. A systematic search of library studies has been done.

Thus, the questions of this research are: "What are the existing solutions to resolve the obstacles to IPD implementation in different countries between 2007 and 2020?", "How can these solutions be categorised?" and "How will they improve IPD implementation?"

Step Two: Search for Studies Systematically

A systematic search for relevant studies using reliable databases in both English and Persian languages have been done. Studies published between 2007 and 2020 were included. The keywords used to search for relevant sources are listed in Table 4 while the results and databases used are illustrated in Table 5.

Table 4. Keywords used in the searches

Keywords
Integrated Project Delivery
Barriers of Implementation IPD
Project Management
Solutions Problems
Solutions Barriers
Solutions Obstacles
Overcome Problems
Overcome Barriers
Overcome Obstacles

Table 5. The name of English and Persian databases used throughout searches

Database
Wiley
ProQuest
Civilica
ASCE
ScienceDirect
AIA
SMPS Foundation
IEEE
Springer
Taylor & Francis
Dissertation

Step Three: Search and Select Appropriate Texts

In the third step of the meta-synthesis method, the selected texts are analysed and several criteria are used to remove the studies that are not relevant to the research question (Yahyapour, Shamizanjani and Mosakhani, 2015). The criteria of this study were: publication dates between 2007 and 2020, high quality of the research methods and findings and validity of the sources. After collecting potential texts using the keywords outlined in Table 4, the sources were examined. Next, the titles and abstracts were reviewed to remove irrelevant sources. Then the content of texts was reviewed. Lastly, the quality of the remaining articles was examined using the Critical Assessment Skills Program (CASP). This programme has 10 indices: (1) Research objectives, (2) Method logic, (3) Research plan, (4) Sampling method, (5) Data collection, (6) Reflection, (7) Moral considerations, (8) Data analysis and accuracy, (9) A clear statement of findings and (10) Research value (Campbell et al., 2003). Each source was given a score between 0 and 50, and based on these metrics, they were divided into groups by quality of "Very good" (41–50 points), "Good" (31–40 points), "Medium" (21–30 points), "Poor" (11–20 points) and "Very poor" (0–10 points) (Campbell et al., 2003; Weed, 2006). In this study, the cases with a score of less than 21 were removed from further analysis.

Thus, the criteria for accepting the studies into the meta-synthesis included: research language (English or Persian), publication date (2007 to 2020), texts and findings (qualitative, quantitative-qualitative and case studies) and type of studies (articles, books, theses, organisational and institutional studies, masters and doctoral dissertations). Figure 2 shows the process of searching for and selecting relevant articles.

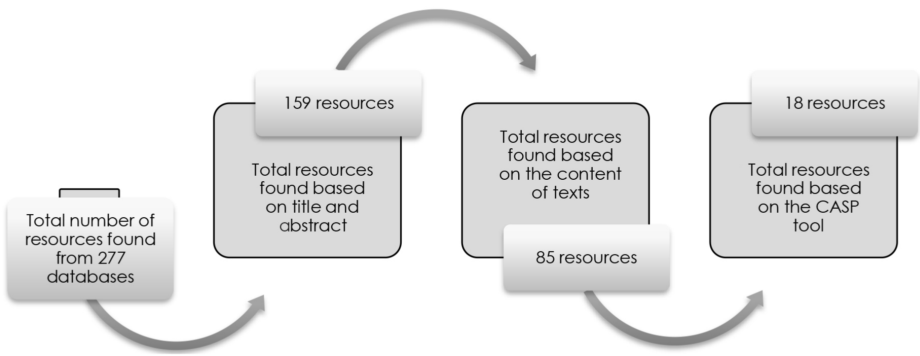

Figure 2. The process of searching for relevant articles

After using the CASP procedure to include only high-quality and relevant articles, 18 sources remained (Yahyapour, Shamizanjani and Mosakhani, 2015). Thus, the remaining cases have been used for final analysis and the response to the research question.

Step Four: Extracting Data from Texts

After culling relevant articles based on the research question, the 18 sources that remained from the previous step were analysed. Under the final selection process, the type of data of each study was specified. In the meta-synthesis method, a limited number of articles should be obtained. Researchers using the meta-synthesis method have found that reaching 18 sources is an acceptable result (Yahyapour, Shamizanjani and Mosakhani, 2015). It is important to mention that IPD is a new approach and it has been implemented in a limited number of projects. The data collected in this step were coded based on their type and then categorised. Finally, after performing the fifth step, the data were analysed and categorised and presented in Table 3 according to the assigned codes.

Step Five: Analysis and Combining the Qualitative Data

Using QSR NVivo 8.0, each text was examined thematically and a codebook was created. Some codes were determined by the researcher and others became relevant during the coding stage using the meta-synthesis method. Each data point was categorised using descriptive coding and analysis. Then similar codes were identified and placed into subgroups. Subgroups were categorised based on topic with the guidance of several experts in the construction industry.

Step Six: Quality Control of Findings

Using the meta-synthesis method, quality control is considered essential for a successful project delivery. In this study, the sources were selected from valid databases and the items that did not meet the required quality and validity were removed from the analysis. Then to ensure the quality of the studies, the steps were reviewed and the quality of them was evaluated using the CASP. In this step, it is possible to ensure the quality of the sources and the data mentioned in their content. The selected codes and the information classification method of the texts extracted from the databases were compatible with the codes considered by this method. Data coding and classification were reviewed several times to ensure the quality of data. Finally, the opinions of other experts were used to verify the accuracy of the final results of the meta-synthesis method.

Step Seven: Presenting Results and Findings

In this step, the research question was answered. The categorisation of solutions to resolve the obstacles to IPD implementation is presented in Table 6. Moreover, the naming and classification of this categorisation have been reviewed by several experts in the construction industry.

Table 6. The solutions to resolve the obstacles to IPD implementation

Pattern Coding	Descriptive Coding	Solutions	References
Technical and executive	Designers and construction engineers	Identifying the activities that lead to delays and planning, in order to eliminate them.	Ghassemi and Becerik-Gerber (2011)
		Designing based on integration processes.	Hamzeh et al. (2019)
		The design should be simplified and integrated with the construction phase.	Durdyev et al. (2019)
		Increased flexibility in designs.	Piroozfar et al. (2019)
		Developing a database in the design companies as the lessons learned from IPD.	Govender et al. (2018)
		Creating a new post in the design organisations as IPD expert.	Piroozfar et al. (2019)
		Presenting plans in accordance with the unique conditions of the project site.	Mohamed Salleh et al. (2019)
		Considering using prefabricated components in the conceptual design phase.	Roy, Malsane and Samanta (2018)
		The designers should play an interactive role in the field of construction.	Hall and Scott (2019)
		Identifying the possible changes and reviewing and presenting alternative solutions.	Zuber, Nawi and Nifa (2019)
		Specialised reviews using multidisciplinary experts, who have reviewed the design and provide feedback.	Hamzeh et al. (2019)
		Using computer models to evaluate design features and make essential changes, and identifying possible interactions and simulating different aspects of the project over time.	Roy, Malsane and Samanta (2018)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Using a design checklist to review key features and requirements that should be met before implementation.	Hamzeh et al. (2019)
		Designers and engineers should review technical specifications in order to reduce errors and conflicts before their final issuance.	Govender et al. (2018)
		Using an industrial design system for easier construction.	Zuber, Nawi and Nifa (2019)
		Presenting a constructible design and providing technical support for the construction team.	Bilbo et al. (2014)
		The designers should contact the construction experts to avoid conflicts and disagreements.	Nejati, Javidruzi and Mohebifar (2014)
	The construction and operation and maintenance teams	The outdated construction equipment and methods should be removed from plans.	Pishdad-Bozorgi (2017)
		Providing the necessary suggestions to remove the restrictions and obstacles by the contractor team improves the hierarchy of site operations.	Durdyev et al. (2019)
		The presence of construction contractors in the initial design phase with a focus on project cost and time assessment is important.	Ebrahimi and Dowlatabadi (2018)
		The role of the contractor in improving the IPD system involves the use of an experienced team in the field of construction.	Ghassemi and Becerik-Gerber (2011)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Providing effective suggestions to the selected contractor will lead to effective alternatives for design and construction which will result in cost-effective changes.	Mohamed Salleh et al. (2019)
		Experimental models are an important part of the suggested plan that enhance project capabilities.	Pishdad-Bozorgi (2017)
		Stakeholders' acceptance and understanding of the specific conditions of the IPD system at the end of the project.	Pishdad-Bozorgi (2017)
		Paying special attention to safety and insurance issues in the project implementation phase.	Roy, Malsane and Samanta (2018) and Mohamed Salleh et al. (2019)
		The presented plans should be reviewed by construction experts.	Mihic, Sertic and Zavrski (2014)
		The experience of construction phase staff can improve project design plans.	Durdyev et al. (2019)
		They should consult with the contractors about determining materials, during the planning phase.	Mihic, Sertic and Zavrski (2014)
Organisational and managerial	Rules and training	Learning from users' feedback.	Hall and Scott (2019)
		Developing and using maintenance checklists and standards and further training of personnel to deal with cultural problems.	Nejati, Javidruzi and Mohebifar (2014)
		Standardising materials, construction details, construction systems, etc., through repetitive processes reduces some costs.	Govender et al. (2018)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Support designers to provide prefabricated designs and optimal plans.	Nejati, Javidruzi and Mohebifar (2014)
		Taking advantage from design software and applications and project control, then teaching them to the staff.	Paik et al. (2017)
		Holding training meetings and seminars, by presenting a professional degree to improve IPD knowledge.	Piroozfar et al. (2019)
		Integrating and sharing knowledge of design, construction and maintenance to develop technical standards and prevent future problems.	Zuber, Nawi and Nifa (2019)
		Developing standards in designs according to the uniqueness of projects and developing practical standards according to the experiences of the owners of the construction industry.	Hall and Scott (2019)
		Modifying employment methods by emphasising having good communication and teamwork skills.	Durdyev et al. (2019)
		Effective management of construction resources such as improving responsibilities and standards of labours and trainings.	Roy, Malsane and Samanta (2018)
		Paying attention to the improvement of the knowledge of construction and maintenance contractors and their presence in the early phases of design.	Nejati, Javidruzi and Mohebifar (2014)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Developing special insurance policies to fully protect the stakeholders in IPD projects.	Azhar, Kang and Ahmad (2014)
		Developing special IPD rules to support banks and providing credits.	Sommer, Dukovska-Popovska and Steger-Jensen (2014)
	Finance and contracts	Taking advantage from the experiences of the construction sector to perform the designs in contracts.	Mohamed Salleh et al. (2019)
		Preparing the contract documents for the presence of maintenance contractors in the early phases of design.	Ebrahimi and Dowlatabadi (2018)
		Developing a database of contractors with IPD implementation experience.	Azhar, Kang and Ahmad (2014)
		Considering more terms in contracts regarding site access and use, security and facilities.	Sommer, Dukovska-Popovska and Steger-Jensen (2014)
		The life cycle cost model selects the best implementation system.	Paik et al. (2017)
		The use of investment and contractual capabilities of the private finance initiative (PFI).	Zuber, Nawi and Nifa (2019)
		Presenting and receiving investment plans that improve risk-taking.	Ahmad, Azhar and Chowdhury (2019)
		Providing field visits by designers of running projects for control and monitoring.	Hall and Scott (2019)
		The use of investment and contractual capabilities as public private partnership (PPP).	Azhar, Kang and Ahmad (2014)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Using the life cycle cost at different stages of the decision-making process because it calculates future costs, disruptions in the building operations, taxes, and energy; and predicts the life of building components and analyses failure.	Ahmad, Azhar and Chowdhury (2019)
		Considering a detailed schedule in contracts for all phases of the project life cycle.	Nejati, Javidruzi and Mohebifar (2014)
		Providing formal commitment to use the IPD system and then convincing owners and contractors to take advantage of it.	Sommer, Dukovska-Popovska and Steger-Jensen (2014)
	The employer, project manager and planning team	Selecting a designated subconsultant and a construction consultant who will specifically assist in the IPD implementation and project planning.	Ahmad, Azhar and Chowdhury (2019)
		Investigating the obstacles that may interrupt the construction phase during the planning phase.	Paik et al. (2017)
		Using facility management (FM) in the early phases of the project.	Piroozfar et al. (2019)
		Communicating with design and construction teams to select the appropriate options in the project life cycle.	Paik et al. (2017)
		Using methods and technologies that minimise the risks of climate change.	Durdyev et al. (2019)
		Using the contractor's experience in identifying materials.	Ebrahimi and Dowlatabadi (2018)

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Table 6. (*Continued*)

Pattern Coding	**Descriptive Coding**	**Solutions**	**References**
		Focusing on project optimisation rather than design and planning optimisation.	Hall and Scott (2019)
		Welcome to creativity and new ideas for IPD promotion.	Ebrahimi and Dowlatabadi (2018)
		Accurate definition of project objectives to make detailed decisions in the project.	Zuber, Nawi and Nifa (2019)
		The full support of the employer for the IPD system improves the quality of the group working.	Durdyev et al. (2019)
		The employer's support for new design and construction methods.	Hamzeh et al. (2019)
		The use of IPD as a basis for competition in construction companies.	Hamzeh et al. (2019)
		Creating a centralised system of powerful support programme to exchange design, technical, management and monitoring information.	Sommer, Dukovska-Popovska and Steger-Jensen (2014)
		Holding periodic brainstorming sessions at all stages.	Azhar (2014) and Hall and Scott (2019)
		Regular reporting of IPD system benefits.	Zuber, Nawi and Nifa (2019)
		Developing this attitude that IPD should be considered as an investment opportunity that reduces risks.	Bilbo et al. (2014)
		Using external experts to take advantage of their experiences about IPD implementation in person and virtually.	Azhar (2014)

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Table 6. (*Continued*)

Pattern Coding	Descriptive Coding	Solutions	References
		Focusing on teamwork to meet the goals of the group rather than personal goals using BIM.	Durdyev et al. (2019)
		The use of experienced contractors regarding maintenance to attend in the initial phases of the project.	Azhar (2014)

Using the data presented in Table 6, Figure 3 shows a framework for descriptive and pattern analysis of solutions to resolve the obstacles to IPD implementation.

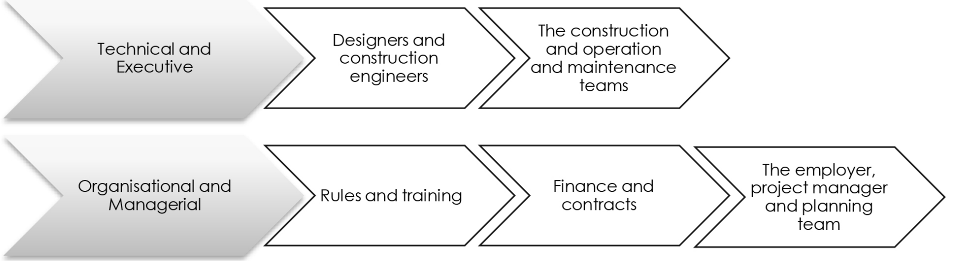

Figure 3. The framework of solutions to resolve the obstacles to IPD implementation

In recent years, several efforts have been made to resolve IPD obstacles. Given the current complexities, industry owners are trying to resolve conflicts to improve project quality. Due to advances in the methodology, IPD has been successfully implemented in numerous projects and as expected, it has had the ability to resolve many of the problems present in traditional systems (Kahvandi et al., 2019a). In this study, the authors attempt to examine and classify experiences and implementation solutions in a comprehensive and purposeful way. In the next section, we will discuss the results of this research.

DISCUSSION

Due to differences between countries' project conditions, obstacles in implementation of IPD have affected factors such as contracts and tenders in both the private and public sectors (Collins and Parrish, 2014). In this sense, the current study sought to investigate and provide solutions to resolve such obstacles to IPD implementation. The solutions provided in this study are categorised into two major sections and five subsections. After reviewing the studies selected by the meta-synthesis method, different solutions were analysed. In technical and executive areas, all stakeholders—including designers, construction engineers, construction teams and operation and maintenance teams—each have the same responsibility to improve IPD and meet the project's goals. For example, design based on integration processes should be done exactly according to IPD criteria. Designers should act in coordination with construction engineers, causing a significant cost reduction.

For example, in the Denver Hospital project in Colorado, USA, worth USD160 million and scheduled to be completed within 24 months, the IPD method was successfully implemented. Because of this success, the costs decreased 26% (Mesa, Molenaar and Alarcón, 2016). To improve IPD knowledge and achieve results such as this, solutions such as training sessions and seminars could be considered as options in the management of a project. This has already been implemented, for example, during construction of the Cardinal Glennon Children's Hospital project in Missouri, USA. Stakeholders participated in training courses and they used an integrated contract to solve inflexibility problems present in traditional contracts. New methods in design and new construction technologies also allowed for the project's success. One additional project that could be used as an example is the San Francisco Medical Center project, which is also in USA. For this project, the employer's consent to implement IPD saved roughly USD1 million in electrical equipment and USD5 million in mechanical equipment. Additionally, with the initial maintenance contractor consultation, more appropriate and updated equipment was provided for the project (Kahvandi et al., 2019b). Finally, in the Sutter Health Fairfield Medical Center project in California, the initial budget was estimated to be USD22 million but it was able to be reduced to USD19 million due to IPD method application (AIA California Council, 2010).

When it comes to protection of stakeholders in IPD projects, special insurance rules and provision of special credit to the contractors need to be put in place for the project's success. However, IPD insurance contracts are still in development. The Autodesk One Market project, a commercial building in USA was completed in nine months with a budget of about USD10 million. The project team used conventional insurance contracts with the agreement that claims would not be made amongst stakeholders, except in cases of fraud and misconduct, in order to share the risks and rewards (Ghassemi and Becerik-Gerber, 2011). In this regard, the employer's full support of IPD can improve teamwork quality, as defined by mutual cooperation at the beginning of the project. Terminal 5 of London's Heathrow Airport is another complex project that used IPD principles and was completed with a GBP4.3 billion budget (Basu, Little and Millard, 2009). The success of this project depended on three areas: the procurement system, teamwork culture and mutual trust, such that all stakeholders' main goals were able to be met (Caldwell, Roehrich and Davies, 2009; Brady and Davies, 2010).

Examples of IPD implementation in developing countries include a wastewater treatment plant project in Vietnam, which was built to improve urban infrastructure for drainage and sewage systems. IPD is a new project implementation system in Vietnam and this project's success has inspired the possibility of further IPD application in the construction industry, particularly in the early involvement of key participants, risk and reward management and contracts. The Iran Mall project was the first project in Iran to use both BIM technology and IPD principles, and it is one of the largest commercial complexes in the Middle East. Its area is about 1,700,000 m^2 and it is located west of Tehran. This complex includes a commercial section, two office towers, parking, two five-star hotels and catering halls. In this project, various contractors were employed with different types of contracts, some of which followed IPD methodology. However, due to existing challenges, IPD was not completely implemented (Kahvandi et al., 2018).

It should be noted that the presented solutions do not resolve all obstacles but the many benefits of IPD will allow construction industry's owners in different countries to find solutions to resolve issues that may arise. Overall, IPD implementation aims to optimise the project's final cost, time and quality.

CONCLUSION

Selecting appropriate project delivery methods could enable a construction project's success and the IPD approach can support stakeholders in this regard. This study has collected research published between 2007 and 2020 to carefully examine solutions to resolve IPD obstacles, in an attempt to add an organised collection of IPD solutions to existing knowledge. The solutions presented in this study are only some of the first steps to improve the use of IPD in the future.

Using macro categorisation and pattern coding, the solutions found in the analysis were coded into four categories: organisational, managerial, technical and executive; which cover most issues related to the construction field. In addition, the current study sought to provide a more comprehensive framework for solutions to resolve IPD obstacles. These solutions can also facilitate the presence of maintenance contractors in the early design and implementation phases of projects, which is an important step in improving the quality of complex projects. On the other hand, the findings illustrate that IPD can facilitate BIM absorption.

Limitations in this study include the resources used, the low use of IPD contracts and the scarcity of referable resources. For future research in developing countries, the study opens new horizons for promoting the adoption of IPD in the architecture, engineering and construction (AEC) industry. The study's primary added value to the existing body of knowledge is to go beyond the conceptual stage of existing studies by initiating real-life applications of IPD through exploring and classifying case projects.

For further study, we suggest exploring how the construction industry can incorporate the servitisation strategy to integrate construction and improve the relationship between AEC firms and the client specialised in the project during development.

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