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The impact of successful communication between stakeholders at the design phase, using Integrated Project Delivery (IPD) method, on construction industry

أثر التواصل الناجح بين المعنين بالمشروع في مرحلة التصميم باستخدام أسلوب تسليم المشاريع المتكاملة على صناعة البناء"

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ABSTRACT:

The construction industry has become more complex and specialized in recent years, and clients' satisfaction can be achieved by delivering quality products and services that provide the best value for money. Successful communication between stakeholders is crucial for the success of a project in today's construction industry. This paper aims to explore the impact of successful communication between stakeholders at the design phase. This could be achieved through a proper understanding of their requirements, fulfilling their needs, integrating them into the design decision-making process and delivering the project within the specified time and most cost-effective manner (Ahmed and Kangari, 1995; Hudson, 1999). This research aims to explore the impact of successful communication between stakeholders using the Integrated Project Delivery (IPD) method in construction projects. The research will involve a thorough literature review, and qualitative data collection through case studies. The results of this research will be valuable for construction industry professionals.

Keywords: project delivery system, integrated project delivery, building information Modeling, time schedule, stakeholders.

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الملخص :

أصبحت صناعة البناء والتشييد أكثر تعقيدًا وتخصصًا في السنوات الأخيرة، ويمكن تحقيق رضا العملاء من خلال تقديم منتجات وخدمات عالية الجودة توفر أفضل قيمة مقابل المال. يعد التواصل الناجح بين أصحاب المصلحة أمرًا بالغ الأهمية لنجاح المشروع في صناعة البناء والتشييد اليوم . تهدف هذه الورقة إلى استكشاف تأثير التواصل الناجح بين أصحاب المصلحة في مرحلة التصميم. ويمكن تحقيق ذلك من خلال الفهم الصحيح لمتطلباتهم، وتلبية احتياجاتهم، ودمجهم في عملية صنع القرار التصميمي وتسليم المشروع في الوقت المحدد و الطريقة الأكثر فعالية من حيث التكلفة (أحمد وكانجاري، 1995؛ هدسون، 1999). يهدف هذا البحث إلى استكشاف أثر التواصل الناجح بين أصحاب المصلحة باستخدام طريقة تسليم المشاريع المتكاملة (IPD) في مشاريع البناء. وسيتضمن البحث مراجعة شاملة للأدبيات، وجمع البيانات النوعية من خلال دراسات الحالة.

وستكون نتائج هذا البحث ذات قيمة لمحترفي صناعة البناء والتشييد.

الكلمات المفتاحية: انظمة تسليم المشروع، تسليم المشروع المتكامل، نمذجة معلومات البناء، الجدول الزمني، المعنيين بالمشروع.

1. INTRODUCTION:

Traditional delivery techniques used in the construction industry include design-build, design-bid-build, and construction management. Despite their long history of use, many professionals are unhappy with the results (Hall and Scott, 2016; Perlberg, 2009; Lichtig, 2006; Alves and Shah, 2018). Since the projects frequently have poor quality, schedule and cost overruns, among other problems, these issues might be resolved (Lichtig, 2006; Alves and Shah, 2018). In this regard, the complexity of construction is now rising quickly, and according to Hamzeh et al. (2019), the delivery methods currently in use are deemed inadequate since they are unable to keep up with contemporary trends, directly contributing to the aforementioned dissatisfactions. In this regard, the appropriate

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delivery strategy is now seen as new construction approach that increases the project performance through a highly collaborative process (El Asmar et al., 2013; DeBernard, 2008).

Integrated Project Delivery (IPD) has become a popular project delivery system to address the construction industry's challenges, such as delivering projects with high quality, cost-effectiveness, and within a specific timeline. In some countries, such as the United States, IPD has been widely implemented in construction projects, improving project delivery quality, cost, and time constraints. IPD success depends on the participation of key project participants and the usage of Building Information Modelling (BIM). IPD highly values stakeholder communication, data-driven decision-making, and an all-encompassing strategy throughout the project lifecycle. By emphasizing stakeholder contact throughout the design process, evaluating the literature, and contrasting different cases, This study focuses on the design stage since it is one of the stages that affect a project's outcome and intends to investigate the effects of effective stakeholder communication using the Integrated Project Delivery (IPD).

Fig. 1: IPD communication

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2. Literature review

2.1. Project Delivery Method

According to Arroyo (2014), El Asmar et al. (2013), Korkmaz et al. (2013), Moazzami, Ruwanpura, & Jergeas (2013), and Rolstadas, Hetland, Jergeas, & Westney (2011) b, the Construction sector uses a variety of project delivery methodologies (PDM). According to several studies (El Asmar et al., 2013; Korkmaz et al., 2013; Moazzami, Dehghan, F Jergeas, & Ruwanpura, 2015; Moazzami et al., 2013; Rolstadas et al., 2011b), three common approaches are Design-Bid-Build (DBB), Design-Build (DB), and Construction Management (CM). The two essential elements of the definition of project delivery technique provided by El Asmar et al. (2013) are "relationships between different project stakeholders" and "timing of their engagement," and these approaches clearly differ in both respects.

Many people have examined the effectiveness of various project delivery techniques, such as DBB, DB, and CM. An illustration. Bennett et al. (1996) evaluated the performance of DBB and DB in terms of quality, schedule, and cost, concluding that DB was superior to DBB. In a comparison between DBB and DB, Ibbs et al. (2003) discovered that the latter is superior in terms of schedule, but not in terms of cost and labor productivity. According to the Economist (2000), inefficiencies, delays, and mistakes account for more than 30% of yearly expenditure on construction in the U.S. A study conducted by Forbes and Ahmed (2011) shows a loss of 17 to 36 billion dollars per year due to dysfunctional communication between two key stakeholder groups: designers and constructors. The results of these studies indicate the need for fundamental change in the way projects are structured executed, and organized in the construction industry. Lack

of effective communication, information sharing, and collaboration among various groups of stakeholders who operate in their silos have been identified as key reasons for the continued poor performance of conventional delivery methods in the AEC industry (AIA. 2007; CURT, 2007; Hanna, 2016). Relational contracting and collaborative arrangements for project delivery have been presented as solutions (Ashcraft, 2014; Fischer et al., 2017, Hanna, 2016: Lahdenperä, 2012).

2.2. Communication

The United States Army Corps of Engineers (USACE) defines Communication as "A voluntary organized process by which multiple stakeholders having shared interests perform as a team to achieve mutually beneficial goals. It is based on establishing these goals early in the project lifecycle, building trusting relationships, and engaging in collaborative relationships It requires empowering team members to solve problems at the lowest organizational level possible" (USACE 2010), 78 business professionals were polled by Chan, Chan, and Ho regarding the advantages of collaboration on building projects in 2003. The top five advantages were stronger relationships between project participants, greater communication among participants, being ability to react quickly to emergencies or changing project or business requirements, fewer disputes, and more productivity. In conclusion, effective stakeholder communication throughout the design process has a big impact on project results. It guarantees that needs are understood clearly, facilitates effective decision-making, lowers mistake and rework, harmonizes expectations, boosts teamwork, and increases stakeholder satisfaction. As a result, it is vital to give

effective communication methods top priority and funding during any project's design phase.

2.3. Integrated Project Delivery

The design-bid-build technique, which was for a long time the most popular in the United States (Kent and Becerik-Gerber, 2010; Miller et al., 2000; Pishdad-Bozorgi and Srivastava, 2018), marked the beginning of the history of delivery methods. In accordance with Hamzeh et al. (2019) or Kent and Becerik-Gerber (2010). The design-bid-build technique resulted in a segregated process where the project was nurtured from the beginning to the end phase directly through one contractor, owner, and architect. Multiple cultures were nevertheless produced as a result of this approach, leading to problems including inefficiency, fragmentation, and resource waste (Gallaher et al., 2004). When the new delivery method was introduced in the 1960s, these problems were only partially resolved (El-adaway et al., 2018; Hamzeh et al., 2019). Since then, the construction management technique has employed a methodology that oversees and regulates the project teams and information. 30 years later, in 1990, a brand-new approach called the design-build technique was developed with the goal of eradicating the reaming concerns as well as enhancing the cost, schedule, and quality, according to Kent and Becerik- Gerber (2010). Although the method has shown a wide variety of improvements, the project's quality fell noticeably when compared to the design-bid–build and construction management approaches used in the past. Project partnering, also known as IPD, has become a popular delivery method to replace the main traditional ones, such as design-bid-build, design-build, and construction management, in order to address the new issues (ATA, 2007; Fischer et al., 2017; Mesa et al., 2016; Gallaher et al., 2004; Kent and Becerik-Gerber,

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2010). Time, cost, and quality are the three main project characteristics that IPD is focused on improving (Azhar et al., 2014; Harrison et al., 2016).

Traditional Project Delivery		Integrated Project Delivery
Teams are created by a hierarchical system. Mangement is top-down and teams work as individual entities.	**Teams**	Teams are integrated for collaboration. IPD partners are bound as equals and work for a common goal.
Design and construction phases are planned separately. Design deliverables are not considered while planning the execution.	**Planning**	Planning takes place into early stages of the project. Design and construction deliverables are tied to the project goals.
Design and construction processes are worked separately. Information is shared as required and teams do not communicate constantly.	**Process**	Design and construction processes are integrated and relay on the early involvement of the key stakeholders.
Projects are mostly 2D based and 3D models are not used for coordination and construction. Information is not standardized.	**Technology**	Projects are BIM based and 3D models are used for coordination and construction. Information is standardized through a CDE.
Unilateral decision-making. Risk is transferred between each team.	**Agreements**	Multi-lateral decision making. Risk is shared between partners.

table.1: the main differences between traditional project delivery and IPD approach.

2.3.1. Principles of integrated project delivery

The American Institute of Archi tests & AIA California Council (2007) and Beleric-Ger beer and Kent (2010) are adopted the nine principles of IPD as below:

- Mutual Respect and trust.
- Shared Risk and Rewards.
- Collaborative Innovation and Decision Making.
- Early Involvement of Key Participants.
- Early Goal Definition.
- Intensified Planning.

- Open Communication.
- Organization and Leadership.
- Multi-party Agreement.
- Good Technology.

2.3.2. IPD Benefits

According to Collins and Parrish (2014) and Glick and Guggemos (2009), the IPD technique has the potential to increase quality, reduce unanticipated difficulties, and control costs in a project. The alignment of the stakeholders since the conception phase might result in these advantages. Early partnerships have led to estimates that are thought to be more realistic and achievable than those produced by standard approaches (Fischer et al., 2017; Lee et al., 2013). As a consequence of fewer adjustments and sound forecasting, the in question estimations greatly enhance the cost and time criteria (Azhar et al., 2014; Kahvandi et al., 2017). Additionally, IPD focuses on project improvement, where achieving efficiency in every area is important. According to Fischer et al. (2017), Lichtig (2006), Lee et al. (2013), several qualities for such improvement

might be handled as results through integration agreement, communication, technology, and minimal material waste. As an example, communication technology is seen to be more important than other findings (Fischer et al., 2017). Due to a higher application, the stakeholders are aligned in all communication-related aspects, from daily operations to the end result, giving all parties the right information for decision-making later

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on (Kelly and Ilozor, 2013; Fischer et al., 2017; Perdomo and Cavallin, 2014).

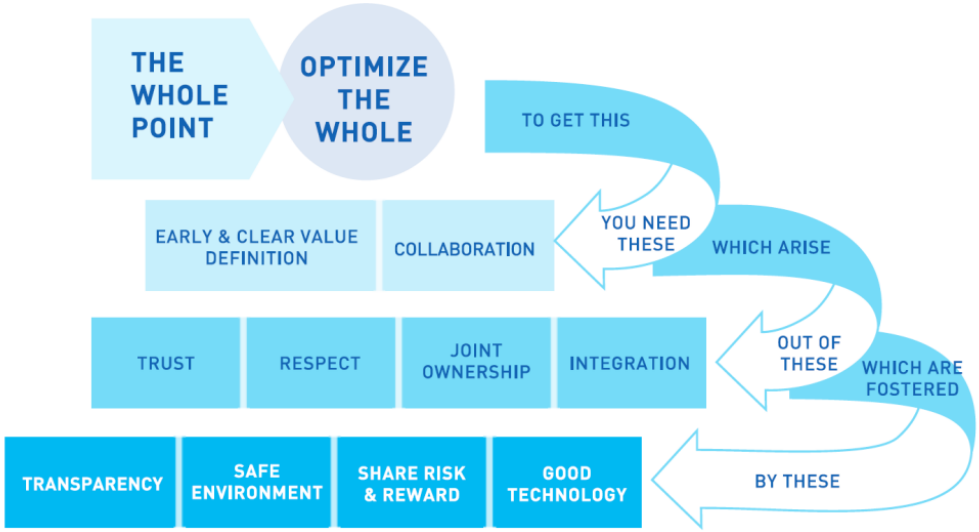

Fig. 2: IPD communication
Source: AIACA V3

2.3.3. IPD Challenges:

All project stages and parties involved can benefit from IPD, but there are obstacles that must be solved for the approach to be effective (Ebrahimi and Dowlatabadi, 2018; Ghassemi and Becerik-Gerber, 2011). The four key problems in this delivery system are cultural, technological, legal, and financial, according to Ghassemi and Becerik-Gerber (2011). Construction companies may be hesitant to use a different strategy because the industry has largely adopted the traditional delivery system, previously referred to as Design-Bid-Building (Fischer et al., 2017; Roy et al., 2018; Lichtig, 2006; Ilozor and Kelly, 2011). This is due to cultural reasons. According to Fischer et al. (2017), one approach to overcoming this difficulty may be a team-wide training programme aimed at demystifying the method (Ilozor

and Kelly, 2011). Ghassemi and Becerik-Gerber (2011) performed a survey to show that the intense training system appeared to aid the transition from the conventional technique to IPD, demonstrating the effectiveness of such a solution. In order to overcome cultural difficulties, rigorous learning and personal behavioural modifications may be used (Ghassemi and Becerik-Gerber, 2011; Lozor and Kelly, 2011; Fischer et al., 2017; Lichtig, 2006).

2.3.4. Building information modeling (BIM)

Building information modelling (BIM) is a technique based on intelligent 3D models that is more effective and efficient used by experts in the fields of architecture, engineering, and construction for the efficient planning, designing, building, and managing of buildings (Arunkumar et al. 2018). BIM is viewed as a management and communication tool for all project stakeholders since it encompasses all digital information required for the project from the outset through construction and operations, allowing BIM to establish a hub for project-related information. Collaboration models may enhance the quality of design and construction, communication, and cooperation amongst stakeholders (Mahjoob and Abed 2017). In order to provide the participants with the advantages of this technology, BIM actually demands participation. The advantages of using this technique are apparent and clear (Glick and Guggemos 2009). Additionally, BIM model simulations that may be done for many elements including prices, energy consumption, traffic, traffic lights, and traffic direction aid with planning constructability, operations, and maintenance. Despite the many advantages BIM provides for the construction sector, if

it is not suitable for adoption, it poses certain difficulties for the business (Abbasianjahromi et al. 2018).

2.3.5. BIM AND IPD

Despite the fact that IPD may be employed without BIM technology, BIM's enabling advantages are substantial. BIM and IPD must be used because of the needs of the industry's owners. The globalization of supply chain goods in the construction industry, the need to boost efficiency in construction, and the ensuing low profit margins are some of the factors driving the increased usage of BIM and IPD. The BIM tool and IPD approach complement one another in addition to the need for higher sustainability, a reduction in the environmental effects of construction, and an increase in the complexity of the building process (Wright, 2011).

BIM supports information integration and offers a single platform for data storage and retrieval, whereas IPD offers a framework for integrating the shared goals and values of project participants.IPD does assist in removing barriers to enhance early participation of key contributors, cooperation, and boost the degree of trust among key participants, hence assisting in the removal of barriers to BIM implementation (Piroozfar et al. 2019).

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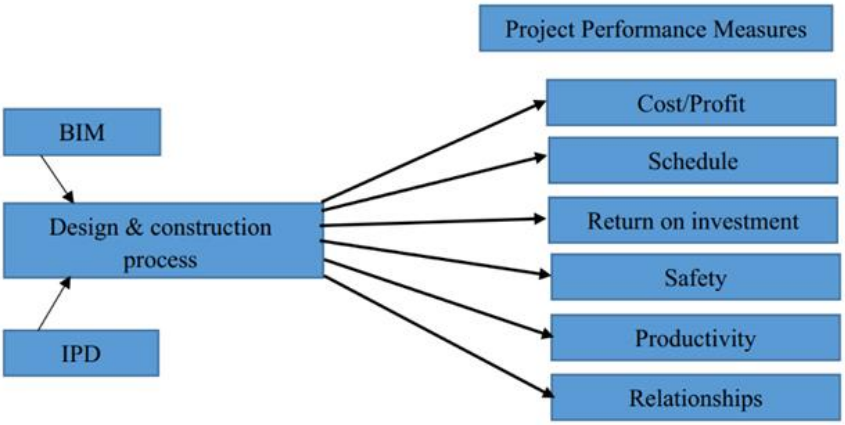

Fig. 3, which shows the integration model of BIM/IPD,the influence of BIM/IPD on several areas of the construction process is shown

2.4. DESIGN PHASE AND IPD

CONCEPTUALIZATION Conceptualization begins to determine WHAT is to be built.

All key stakeholders are involved in the programming process; input is obtained from as many participants as possible.

CRITERIA DESIGN During Criteria Design the project is defined and the targets and metrics by which the success of the project will be measured are agreed upon.

DETAILED DESIGN The Detailed Design phase concludes the WHAT phase of the project. Note that the Detailed Design phase is longer and more intense than traditional Design Development because more is accomplished. The team will decide the level of detail required. During this phase, all design decisions necessary to ensure that changes during construction will not be necessary are finalized, and the design is fully and unambiguously defined.

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2.5. PATH TO CONTRACT

The process typically starts with owner alignment, moves on to team selection, a team alignment/contract workshop, and then activities that must be completed after the workshop. The phases in the procedure might occasionally overlap or be carried out concurrently with validation work. As an IPD leader, you will need to invest a lot of effort in setting up team and project management, financial organization and maintenance procedures, and effective management procedures utilizing lean tools from the outset of the project. Maintain the team culture, project finances, and project management procedures once this foundation has been laid. Team management discusses how to create a solid team culture that gives team members a sense of psychological safety and mutual trust. This is essential for guaranteeing team collaboration and encouraging open communication about the needs of the team and the project from conception to completion. A team's organizational structure, which identifies leaders and decision-makers, as well as its decision-making procedures, are all part of team management. Each project and owner will have a unique setting and set of difficulties. As a result, the procedure should be modified to suit your unique needs. The broad outline provided below can be used as a starting point for a more specialized procedure and is suitable for a variety of tasks.

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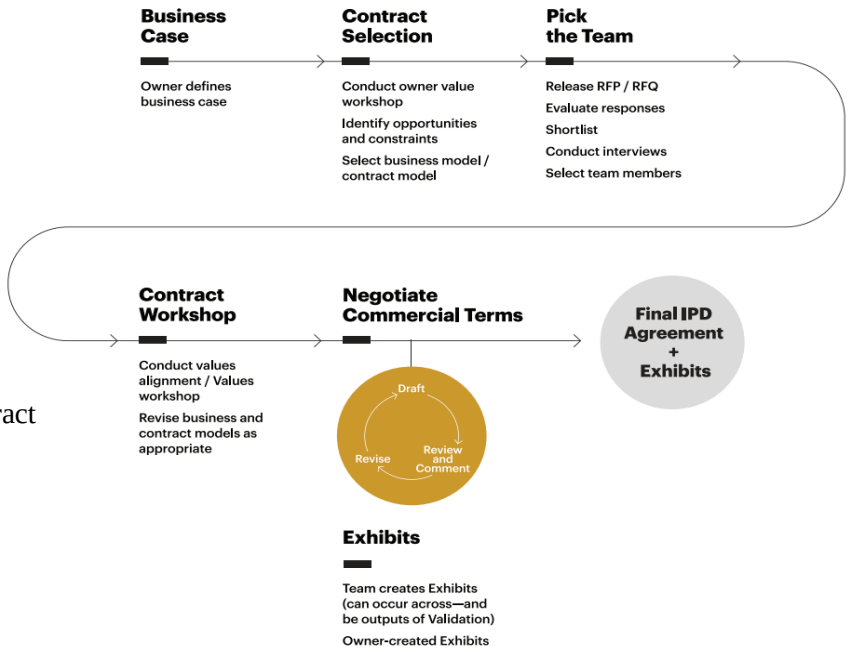

Fig. 4 Path to Contract
Source: Aiaca V3

3. STATEMENT OF THE PROBLEM:

Different project delivery methods, including design-bid-build (DBB), construction management at risk (CMR), and design-build (DB), have historically been utilized in the building construction sector. Owners choose these delivery strategies in part to guarantee performance in terms of time, money, and quality. Many construction projects fall short of the owner's performance objectives despite this array of possibilities (Lichtig 2006; Egan 1998). Lack of integration in various delivery techniques, both vertically and horizontally in the interactions between the owner, the designer, and the constructor, is frequently noted as a cause of subpar project performance. According to the authors, the building design and construction industry has to move towards greater participant coordination and more collaborative techniques in order to address these issues (Egan 1998; Mitropoulos and Tatum 2000; Kim and Dossick 2011). Traditional project delivery methods often have poor quality, schedule, and cost overruns, and

poor communication among other issues, (Lichtig, 2006; Alves and Shah, 2018). Because traditional methods of project delivery lack communication during the design phase and have negative impacts on the entire project and thus schedule, cost, and quality, it was necessary to find a solution and find more collaborative delivery methods.

4. RESEARCH METHODOLOGY

5. 3.1 Research strategy/methodology The research attempts to find innovative solutions for communication during the design phase of construction projects and implement IPD in Egypt. Data collection is a principal activity in the research process. Data were collected from different sources, using different methods to achieve certain objectives. Data collection was based on literature review and case studies. Firstly, the literature review used textbooks, academic and peer-reviewed journals, conference and seminar proceedings, dissertations and theses, organizations and government publications, internet and related websites to examine the nature of the construction industry in Egypt, value in construction, traditional procurement approaches, IPD and challenges of implementing IPD in the design phase. Secondly, three case studies collected

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were analyzed to investigate the value delivered to the client or missed due to the use of IPD in the design phase and traditional procurement approaches.

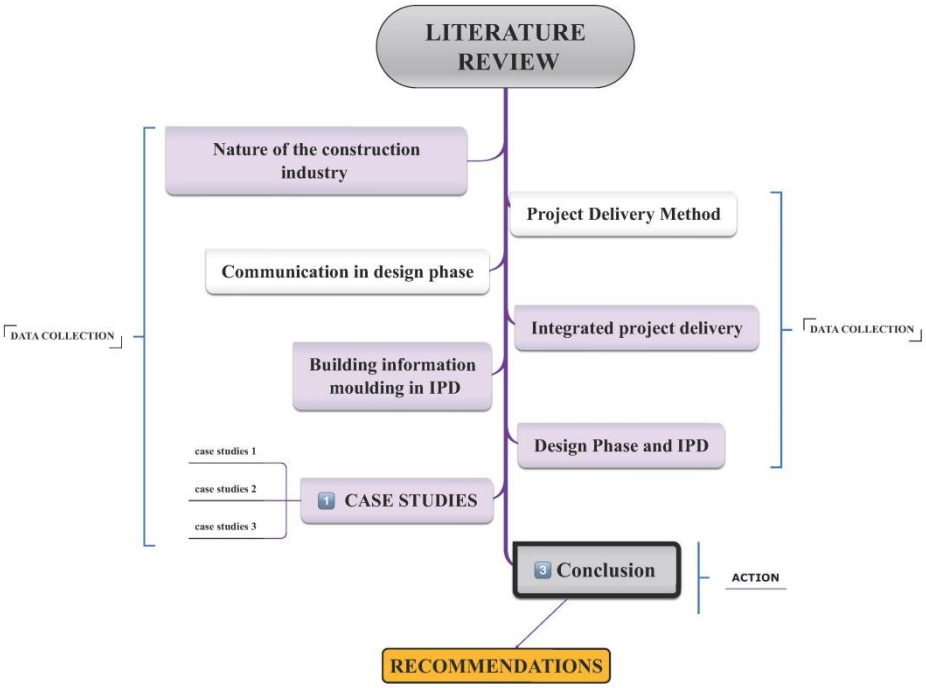

Fig. 5 RESEARCH METHODOLOGY

6. CASE STUDIES:

Sturman said in order to explain and examine a specific subject, phenomenon, event, or project, case studies are a research approach that is employed (Sturman, 1997). Their objectives range from determining the factors, structures, forms, and interactions amongst the people in the situation to evaluating work performance or development progress. Within this research, three case studies were selected (two cases with the traditional method and one case with IPD method). These projects were studied and analyzed during the design phase, because they affect the results of the project completely until its completion, to know the impact of good communication in the design stage of the project on the success of the project in terms of time, cost and quality (IPD CASE studies,AIA, 2020).

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CASE STUDIE 1: USCF MISSION BAY MEDICAL CENTER

Project Description			
Project Location	**USA,San Francisco,CA**		
Project Contract	**Multiple Independent Contracts, IPD**		
Project Type	**(Hospital)**		
Project cost	**1.5 billion $**		
Project Start	**January 2007**	**Completion**	**August 2014**

Several subs, including MEP, drywall and concrete contractors, provided design assistance services during the construction design phase. The team co-located on-site and collaboratively developed and coordinated the construction documents. As the team expanded. It remained co-located onsite for the duration of construction. In late fall of 2006, UCSF began their search for an architect. Stantec (at that time known as Anshen+ Allen) was contracted in early 2007 to design the large hospital complex (IPD CASE studies, AIA, 2020).

The project began by following a traditional design process, even as concurrently the UCSF Director of Design and Construction was working to pursue an integrated and collaborative delivery model, UC was able to adopt a collaborative delivery process however contracts and contractual relationships remained fairly traditional DPR was. At the time UCSF was initiating the project, there was tremendous competition with several other large hospital projects underway in the region. It was difficult for UCSF, a public organization that typically does hard-bid projects, to attract firms capable of doing a job of this size and complexity. In the end, UCSF was successful in creating a project team

interested in creating a project with IPD characteristics. they have performed as expected and the owner feels they are getting good value from the IPD process. Although the contract structure was not integrated, the collaborative experience proved very valuable to the contractor and architect and they are marketing their experience to win additional work.

COST PREDICTABILITY : of the project was a major factor in choosing the IPD delivery model. The Director of Design and Construction, who had experience with the alliance-building program, believed that the integrated model would provide the most predictable cost. The contractor was confident that this model would offer more control (IPD CASE studies,AIA, 2020)., based on previous experience with the Target Value Design process. The team was able to price the project before the design was completed, enabling them to optimize the design according to the client's budget.

SCHEDULE PREDICTABILITY Perceived Benefit: The team believes there are positive schedule predictability benefits however the contractor attributes benefits primarily to the Last Planner System, a Lean process tool. Overall, compared to 2007 projections the project duration was extended by two months, however, most of the schedule changes occurred during the design phase where additional effort reduced the construction duration by 2 months. The owner noted this equalled substantial savings (IPD CASE studies, AIA, 2020).

REDUCED RISK Risk management was a major driver in selecting IPD. The project was very large and complex with high risks. The project director felt the project would have been at far greater risk if it had been a hard-bid job. Perceived Benefit: The team felt there were significantly lower risks due to the transparency and high-functioning team provided by the integrated delivery.

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There was a significant net savings of time and cost to the owner. This sometimes e would have been very difficult to achieve without IPD because it required accelerated coordination (IPD CASE studies, AIA, 2020).

CASE STUDIE 2: Dr. Prabhu Halakatti Hospital

Project Description			
Project Location	**India,Dr. Prabhu Halakatti Hospital, Belagavi**		
Project Contract	**traditional project delivery**		
Project Type	**hospital**		
Project cost	**Unknown**		
Project Start	**Unknown**	**Completion**	**Unknown**

The second case study examines an Indian hospital project that was executed using a conventional procurement strategy. This approach was selected to enable the project's specifications and expected costs to be clearly defined before contractors were engaged. However, the project team identified various issues during the design phase that persisted during the construction phase. These problems included poor communication between the client, architect, contractor, and management team, as well as project delays and cost overruns resulting from customer modifications during construction and a lack of involvement in the design process. The case study's findings demonstrated that traditional procurement may not be a viable option going forward due to its inadequate outcomes and unexpected results. Consequently, the hospital client was discouraged from using this method in future projects and began exploring alternative approaches, such as the integrated approach, through further research and study (Ayman Othman, 2020).

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CASE STUDIE 3: Public Faculty Building, Egypt

Project Description			
Project Location	**EGYPT**		
Project Contract	**traditional project delivery**		
Project Type	**University**		
Project cost	**2.25Million $**		
Project Start	**Unknown**	**Completion**	**Unknown**

This third project is a faculty building in one of the public universities in Egypt. The building consists of five floors with an area of 7,200 square meters and estimated budget of EGP 33 million. The building adopted the Design Bid Build approach. Within this approach, the contractor and other construction professionals are not included in the design process. This prevented providing the design team with feedback to improve the project design. Accordingly, a number of issues appeared during the construction process which resulted in reducing the value delivered to the client. Examples of these issues include adding new windows to increase the natural lighting to corridors and reduce the use of artificial light. In addition, changing the roof insulation type to a more advanced and better-performing one which will help reducing the air conditioning capacity and operation cost. Moreover, changing the traditional structural system of one of the floors from beam system to a flat slab system to suit the function of the floor. These modifications resulted in extra cost of Architecture design firms EGP 550,397 and 75 days' delay. These issues could be avoided through adopting a more integrated approach where all project participants communicate during the design process and collaborate towards developing better design (Ahmed et al., 2016).

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7. Conclusion and discussion

A literature analysis was conducted to gain a general understanding of the current status of BIM (Building Information Modeling) and IPD (Integrated Project Delivery) and a wide range of sub-topics addressed in research within these fields, especially in the initial design phase of a project. The literature is highly positive regarding the potential benefits of increased collaboration during the design phase, particularly between BIM and IPD. Numerous studies have documented the synergies between these technologies in the design phase and their overall project-enhancing benefits. Case studies have demonstrated clear differences between the use of collaborative methods in the design phase and individual, non-collaborative methods in the overall success of the project. The importance of trust between contracting parties has been identified as crucial for the success of IPD in the design phase. There are conflicting results regarding the excessive increase in collaboration and its overall impact on project success, highlighting the need for further study on these issues and related topics. Therefore, further research is recommended, including the need to improve understanding of the adoption of the right relationship between stakeholders and its positive impact on project scheduling, safety, quality, etc.

Furthermore, it was found that when implementing IPD in conjunction with BIM technology, five key requirements were emphasized: early involvement of all key participants, collaboration throughout all project phases, open communication between parties, effective coordination, and appropriate technology. Additionally, it was noted that the benefits of BIM technology align with the benefits of the IPD system.

Case studies of IPD projects may be helpful also in future research to compare its performance with the performance of traditional projects. Therefore, further research is recommended, including the need to improve understanding of the adoption of the right relationship between stakeholders and its positive impact on project scheduling, safety, quality, etc.

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