The Next Era of IPD Research: A Systematic Literature Review of The IPD Research Trends 2017-2020

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Abstract. Questions around integration, innovation, and collaboration within project teams have been the focus of increasing research in recent years. This is in response to the notorious fragmentation and the inherent performance issues that face the construction industry. Among the solutions identified, new contractual approaches, namely, integrated project delivery (IPD), have been investigated to understand how they can help overcome the industry's issues. This paper aims to contribute to the previous efforts that studied the research trends of the IPD from 2001 to 2016 by synthesizing the last four years from 2017 to 2020. This period accounts for more than 70% of research on IPD compared to the previous 16 years combined. A systematic literature review was conducted to understand the trends in IPD research over the last four years. The results allowed the research team to understand better where such research was being conducted, what type of projects were being studied, and most importantly, the topics being covered within this research and its results. This paper proposes an initial review that will be further developed in a full-length journal paper.

1. Introduction
The past two decades have seen the emergence of integrated project delivery (IPD) as an alternative to traditional project delivery approaches. IPD relies on bringing the key participants of a project into a multiparty contract where risks and rewards are shared, and the project is managed in a way that enables collaborative decision-making. This approach has emerged as highly effective instead of other, more traditional project delivery systems. It has demonstrated distinct advantages in directing the attention of project parties toward meeting a project's objectives.

Many studies have been conducted on this innovative and collaborative approach to enrich the collective understanding of the principles and promises of IPD while investigating the factors that affect its adoption since its emergence at the beginning of the 2000's. Researchers have conducted some reviews to synthesize this knowledge, namely Kahvandi et al. [4], who investigated research between 2001 and 2016. As IPD grows in popularity, its investigation through research also intensifies. This paper summarizes findings from a systematic literature review that builds on Kahvandi et al.'s [4] work to investigate research conducted between 2017 and 2020. The aim is to identify and discuss the research trends of the past four years concerning IPD. A full-length follow-up paper will present the results of this investigation in depth.

2. Literature review
The construction industry has been described as a broken industry by many. Indeed, it has failed to take full advantage of the technological advances in many areas that serve the construction process such as, material science, building technology, and equipment, to name but a few. Low productivity levels were among the prominent leading indicators of this missed opportunity to maximize the value generated. The construction industry has systematically experienced a decline in productivity levels in stark contrast to other Non-farm industries [1].

It is widely believed that fragmentation between project parties is one of the main reasons for this situation [2]. This deprives project parties of getting the most out of their respective and collective capabilities. These missed opportunities include early involvement of critical knowledge and experience early in the design phase, ensuring alignment to project goals across the project team, and incentivizing collaboration throughout
the project's lifecycle [3]. Therefore, a call for change in the way projects are managed, contracts are developed, and teams are formed has been heard around the globe.

IPD has been hailed as a solution to many of the industry's current issues. The beginning of research on IPD can be traced back to 2001, with its roots being tied to relational contracting strategies and approaches developed in the 1980s and 1990s. Since then, IPD has rapidly grown in popularity and has been the subject of much research. For instance, the authors of [4] investigated the developments of IPD over 15 years and displayed the research trends of IPD from 2001 to 2016. The results of their research can be summarized as follows:

- The USA leads in IPD from 2001 to 2016, taking advantage of the fact that most of the initiating studies on IPD were conducted there; however, IPD studies were conducted in many countries, including many developing countries.
- The most significant percentage of the studies in the period in question used some sort of conceptual data of IPD more than quantitative and qualitative data.
- Two different periods can be noticed; in the first, the most significant percentage of IPD research addressed the principles of IPD, while in the second, it investigated the challenges and barriers of IPD adoption. However, many studies that looked through other aspects of this promising delivery system, such as the integration between IPD and BIM, the implementation of IPD, and solutions to the barriers, were conducted.
- In terms of the application domain, most IPD research has studied the application of IPD on infrastructure projects in that period.

3. Methodology

In the last four years, research on IPD has continued to grow. Researchers from different countries around the world have scrutinized the different aspects of this promising approach. This study builds on the previous efforts in [4] that studied the research trends of IPD from 2001 to 2016 by covering the period from 2017 to 2020. It synthesizes the research done on IPD to form and understand the current research trends and the gaps that still need more contribution. Moreover, this study tried to enhance some aspects of the previous study by following a rigorous review process and providing the details of the review process, including the inclusion and exclusion criteria, and reform some used categories and classifications to represent the research trends better.

This study applied a systematic literature review methodology to discover the research trends around IPD from 2017 to 2020. The intent behind choosing this methodology is to provide more reliable results through a rigorous process containing predetermined inclusion and exclusion criteria. In addition, to provide the full path of the review process [5], where the systematic literature review "is designed to reduce the effect of the reviewers' own bias, and a full protocol should be written to define and guide the process" [6]. Lastly, the extracted data from the systematic review were combined or compared in many places with the data from [4] to understand the evolution of IPD research trends over the last two decades.

3.1. Review process

The process started by searching specific academic databases such as (ASCE, EI Compendex, Inspec, Knovel, IEEE, Science Direct, Springer Link, Wiley online library, Emerald, and ASME), for articles that contain any of the two terms, integrated project delivery and IPD, in any part of the article. The inclusion criteria were set to include all papers about IPD within the construction industry, published between 01-01-2017 and 31-12-2020, published in peer-reviewed journals or conferences. The exclusion criteria were established to exclude all papers that fall under other types of documents, addressing industries other than Construction, Studies that we could not get access to its full paper., and papers in languages other than English.

The first round of the review process resulted in collecting 1044 papers carried forward to the next step of the research. Then, those papers were first sorted and filtered to remove all duplicated papers. This process left a total of 615 papers, which were then scanned by title and abstract to remove irrelevant papers. Next, papers that do not have open access and those in a language other than English were excluded. As a result, the final number of publications considered in this review was 112 articles, as shown in Figure 1.
3.2. Validation

The review process and results were validated through two different stages; the first stage was to validate the review protocol and the review process, which was done through two specialist librarians at the École de technologies supérieure's library. The review protocol and a detailed research process were submitted to them for review. A meeting was held with them where the details of the process were discussed. As a result of this step, a revised version of the research protocol has been generated.

![Flowchart of the review process](image)

**Figure 1.** Flowchart of the review process

The second stage was used to validate the review results, which were done with the help of an external validator. This external validation process first explained the review protocol, review process, and the pool of papers to the researcher validating the approach. The person randomly selected 15% of the papers, extracted the required information, and classified the papers. The results from this round of validation process were compared with the researcher’s results. The comparison revealed an 85% match of the data extracted. Next, the researcher added his explanation to the points of differences with the validator, and the sheet was sent back again to the validator for the second round of validation. Again, the validator responded to the researcher's arguments, and the percent of the match after this round reached 98%. Eventually, the logic concluded from this exercise on 15% of the articles was applied to all the other articles. In addition, the classification categories were reviewed by the validator, and a new application domain category was suggested that ensure better classification for the project types under each domain.

4. Data analysis and discussion

As illustrated in the previous section, the search process resulted in 112 papers, of which 78 were journaled papers and 34 were conference papers. These selected papers were read, and information on the publishing year, country of publishing, type of data used, the domain of application, and the subject area were extracted to form and understand the research trends around IPD research.

4.1. Publishing year

The first indicator developed was the year of publication. The year of publication was determined as the year the paper was made available, not the year of submission or approval. The results show that the last four years from 2017 to 2020 represent a continuation of the growing trend in IPD research, where the amount of the published research in the last four years equals more than 70% of the total published research in the period from 2001 to 2016. In particular, the year 2019 saw the highest number of IPD publications between the last four years with 32 papers, while both 2017 and 2018 have witnessed 30 and 29 publications respectively, while only 21 papers were published in 2020.
4.2. Country of publishing

Another aspect that was considered is the global reach of IPD research by identifying the country of publishing. In the cases where multiple authors with different affiliations were indicated, the first author's affiliation was used to determine the country of publication. The reviewed papers show that in the period from 2017-2020, 28 different countries have contributed to the efforts of investigating the different aspects of IPD. As shown in Figure 2, the USA, China, and Norway are leading in terms of the number of IPD research published in the period in question. The USA alone contributed to the diffusion of 31 research, while China diffused 22 research and Norway put in 9 research. Next in the list, UK and Canada arose with 5 and 4 research on IPD, respectively. It is interesting to note that Asia as a continent diffused 45 IPD research produced by 12 different countries. North America came next with 35 publications, then Europe with 26 research by ten different countries. In contrast, only two countries in Africa and one country in South America and Oceania have shown up on the list.

By looking back to the period from 2001 to 2016, remarkably, the result in [4] did not provide the total number of countries that diffused IPD research; instead, they mentioned that 13 countries and the European group have contributed to IPD research. Therefore, to be able to compare with that period, the 28 countries that diffused IPD research from 2017 to 2020 can be sorted in the same logic to 18 countries and the European group, and that is indicating the notable increase in the number of countries that are participating in the IPD research efforts.

Figure 2. Distribution map of IPD research from 2017-2020

4.3. Type of research conducted

As indicated by the data collected and used to analyze and interpret the results, the type of research constitutes another avenue for evaluation. Throughout the papers reviewed in this study, and as shown in Figure 3, most of the papers employed qualitative methods to understand IPD. Indeed, almost 57% of the studies were qualitative. Conversely, studies using quantitative data amounted to 27%, while only 12% of the studies used the mixed method where both qualitative and quantitative data were collected. In addition, a small fraction that did not exceed 4% was for studies that used some sort of conceptual data.

4.4. Application domains

Many studies attempted to investigate IPD using a case study approach. That being said, this approach was not utilized homogenously across the sample. Indeed, case studies were rarely used in many countries where IPD is still in the early stages of adoption. Thus, finding cases to study that utilized IPD as a project delivery system was a barrier to this research approach. Therefore, only 46% of the selected research were case studies investigating an IPD or collecting data from persons directly involved in the IPD project. Those papers were
classified into six categories based on the application domain, as shown in Figure 4. Institutional (i.e., federal building, hospital, university), which is the most represented domain with 37% of the cases, Infrastructure (i.e., bridges, highways, dams), which the second most represented domain with 20% of the cases. Next, the Residential and commercial (i.e., office buildings, housing, commercial centers) and the Industrial (i.e., factories, oil, and gas plants) appeared in 12% and 4% of the cases, respectively.

Lastly, two more categorizations are provided to serve the studies that do not fall under the categories mentioned above. Miscellaneous research studied project types not included in the previous categories, e.g., renovation projects, and Multiple for research that studied projects from more than one domain.

![Figure 3. Research publication per data type.](image)

![Figure 4. Research publication per application domain.](image)

4.5. Subject area
Finally, and potentially most importantly, the research trends on IPD were investigated to identify the topics and the addressed subjects, which can help frame the needs and gaps, which would shape future trends in IPD research. The selected studies were categorized into five different groups, as shown in Table 1. Nonetheless, it is worth mentioning that the same study could be classified under more than one category in many cases. There is no clear dividing line between those categories, resulting in some research under two or even three categories. However, in this study, to simplify and clarify the research trends around IPD, the researcher meant to classify each study under one category based on the most addressed topic in the study.

As illustrated in Table 1, most of the research reviewed in this study can be classified under two subject areas, principles of IPD with 37 articles (33%) and implementation of IPD with 33 articles (30%). The next subject area that made up a considerable share of the research topics is the integration between IPD and building information modeling (BIM), which were addressed in 21 different studies representing 19% of the total reviewed studies. The next in line are the barriers and challenges; this topic was addressed in 12 research representing 11% of the total studies. Moreover, lastly, the subject that brought the least attention is solving the barriers of IPD adoption, which were addressed in 9 studies that speak for only 8% of the total reviewed studies.

5. Conclusions
This study aims to discover the research trends of IPD over the last four years from 2017 to 2020, driven by the increase in the popularity of this innovated and promising approach and the rise in the number of studies that addressed IPD in recent years, which make it paramount to understand what has been accomplished and identify the current trends on IPD research. Therefore, determine the needs and gaps that should be addressed in future research while the IPD is gaining more popularity and is expected to spread in more regions around the world due to the general dissatisfaction with the construction industry's performance.

| Subject area   | Description                                                                 | Number of articles |
|----------------|-----------------------------------------------------------------------------|--------------------|
| Principles     | Papers around the principles of IPD, an introduction to IPD, the need for IPD. | 37                 |
Implementation
Papers investigated the circumstances of IPD implementation through a case study or the implementation attempts within a specific region or country.

33

Barriers and challenges
Papers around the barriers and challenges of IPD adoption and implementation.

12

Solving barriers
Papers that are dedicated to understand and propose solutions to the barriers of IPD adoption.

9

IPD and BIM
Papers that looked into integrating the IPD and BIM or addresses IPD and BIM together as innovative tools and approaches to the construction industry.

21

The last four years from 2017 to 2020 represent a continuation of the growing trend in IPD research, where 112 papers were published in the form of journal or conference articles. This trend still can grow, as more and more projects are starting to adopt IPD and more successful stories of projects that employed IPD is spreading. This deployment would drive both researchers to reveal any vague understanding of IPD and industry parties who will be more willing to take steps toward adapting IPD.

Although 28 different countries have contributed to the efforts of IPD research in the last four years, more local research and case studies are needed to promote the adoption of IPD in more construction markets. The concepts of IPD still unknown in many construction markets around the world. There is a need for pioneers who could act as early adopters of IPD hand by hand with conducting local research on IPD to promote this innovative and collaborative delivery system.

The principles and the implementation of IPD were the most two addressed topics in the last four years, 2017 to 2020; however, as more new construction markets in different countries would enter and practice the IPD system, the need for studies that address the challenges and the barriers and ways to solve that barrier in the new markets are paramount. In addition, most case studies in the published researches are around institutional and infrastructure projects, which usually involve a high level of complexity. However, the problems of the construction industry are not limited to those project types only. Therefore, there is a need for more (low-medium) complexity-level case studies to test the effectiveness of IPD in managing different projects sizes.

Eventually, it should be noted that this paper proposes an initial review that will be further developed in a follow-up full-length journal paper where the results of this investigation will be presented in more depth.

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