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817

Integrated project delivery enablers to enhance conventional project delivery toward improving design documentation quality

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Abstract

Purpose – The purpose of this study was to identify specific enablers intrinsic to integrated project delivery (IPD) that can be adapted into the conventional project delivery (CPD) approach to enhance the quality of design documentation produced under the CPD within the Ghanaian construction industry.

Design/methodology/approach – The study employed questionnaires and semi-structured interviews for data collection. The sample size was 235 responses for questionnaires while 15 participants were interviewed. The survey instrument was piloted with industry professionals to ensure validity. IBM SPSS was used to analyze quantitative data by determining frequencies, percentages, correlation and regression, while content analysis was used on qualitative data with the aid of QSR Nvivo software.

Findings – Key findings include the need to adapt the early involvement of key participants for collaborative design input, tie individual success to overall project success with incentives and establish shared accountability for design errors and encourage open communication.

Practical implications – Adapting IPD enablers into the CPD approach would ensure higher-quality design documentation and more efficient project delivery. This has the potential to improve project outcomes, reduce errors, and foster better collaboration among stakeholders.

Originality/value – This study is the first of its kind to identify specific enablers inherent in IPD that can be adapted into the CPD approach to improve the quality of design documentation within the Ghanaian construction industry.

Keywords IPD, Enablers, Conventional project delivery (CPD), Design documentation

Paper type Research paper

1. Introduction

The success of a project depends significantly on the chosen project delivery method, which influences the duration, cost, quality, risks and sustainability (Zhang *et al.*, 2021; Shoar and Payan, 2021; Hamzeh *et al.*, 2019). The quality of design documentation also plays a crucial role in this success (Ajayi and Oyedele, 2018). Despite its importance, the conventional project delivery (CPD) approach, also known as the traditional method, remains the dominant practice in global construction (Agbaxode *et al.*, 2021b; Harper *et al.*, 2016; Mesa *et al.*, 2016). In CPD, a primary contractor handles construction, and consultants manage design and supervision (Rowlinson and McDermott, 2005).

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However, CPD has faced criticism for its lack of integration and collaboration during design documentation production, resulting in subpar quality (Agbaxode *et al.*, 2021b; Durdyev *et al.*, 2019; Ma *et al.*, 2018; Harper *et al.*, 2016). This deficiency is a significant concern within the industry (Akampurira and Windapo, 2019; Tuhacek and Svoboda, 2019), prompting the need for transformative initiatives, emphasizing enhanced collaboration and early stakeholder engagement (Ling *et al.*, 2020; Agbaxode *et al.*, 2020; Ma *et al.*, 2018). Some developed countries are addressing this by advancing integration and technology.

Integrated project delivery (IPD) emerges as a potential solution, emphasizing project success, collaboration and stakeholder integration (Mesa *et al.*, 2016). Despite its benefits, barriers hinder global adoption (Ashcraft, 2022; Roy *et al.*, 2018), including financial, organizational and environmental factors (Kahvandi *et al.*, 2019). Research suggests CPD may persist due to the industry's reluctance to embrace new technologies (Addy *et al.*, 2018).

Literature reveals the subpar quality of design documentation produced under the CPD approach (Agbaxode *et al.*, 2023a, 2024; 2021a, b; Akampurira and Windapo, 2019; Tuhacek and Svoboda, 2019; Ma *et al.*, 2018). There is also substantial literature on IPD and its benefits in ensuring early stakeholder involvement and collaboration, thereby enhancing design documentation quality (Ashcraft, 2022; Walker and Rowlinson, 2020; Hamzeh *et al.*, 2019; Kahvandi *et al.*, 2019).

However, research emphasizes the need to explore and integrate IPD enablers into CPD to enhance design documentation quality (Addy *et al.*, 2018), given CPD's global dominance (Aldossari *et al.*, 2021; Salla, 2020). Therefore, this study aims to identify specific IPD enablers that are adaptable to CPD, focusing on improving the design documentation quality since there is a dearth of research on this. Moreover, as CPD is the predominant method in Ghana (Agbaxode *et al.*, 2023b, 2024; Addy *et al.*, 2018), the study seeks IPD enablers for enhancing design documentation quality within the Ghanaian construction sector. The significance lies in the potential to drive industry-wide improvements in design documentation quality, leading to project success and stakeholder collaboration.

2. Literature review

2.1 Conventional project delivery (CPD)

The CPD approach involves contracting a primary builder exclusively for construction, with a team of consultants responsible for design and supervision (Rowlinson and McDermott, 2005). This approach prevails in Ghana and globally (Agbaxode *et al.*, 2021b; Salla, 2020; Harper *et al.*, 2016), with approximately 60% of global construction projects adopting CPD (Aldossari *et al.*, 2021; CMAA, 2012). Nonetheless, it faces persistent criticism, primarily focused on the quality of design documentation (Agbaxode *et al.*, 2023a; Shoar and Payan, 2021; Zaneldin, 2020). A common theme is the perceived lack of integration during the design phase (Ma *et al.*, 2018; Harper *et al.*, 2016), resulting in subpar documentation (Akampurira and Windapo, 2019; Tuhacek and Svoboda, 2019). This leads to reduced productivity, increased costs, delays and lower quality (Agbaxode *et al.*, 2023a; Shoar and Payan, 2021; Tuhacek and Svoboda, 2019; Zhang *et al.*, 2018), as well as conflicts, rework, waste and hindered communication (Rowlinson and McDermott, 2005; Nawi *et al.*, 2014).

In contrast, IPD emerged as a promising solution to these limitations (Hamzeh *et al.*, 2019; Mesa *et al.*, 2016). Although the adoption of IPD has been relatively gradual within the industry, it has garnered increasing attention, particularly in developed nations, due to its potential to address the deficiencies in CPD (Walker and Rowlinson, 2020; Mesa *et al.*, 2016). However, researchers and industry practitioners emphasize the need to improve the design documentation quality produced under CPD (Agbaxode *et al.*, 2021b, 2023a; Abdallah *et al.*, 2018). This call stems from CPD's likely enduring dominance, especially in developing nations (Addy *et al.*, 2018). Therefore, this study aims to identify specific IPD enablers that are adaptable to CPD, with a focus on improving the design documentation quality.

2.2 Integrated project delivery (IPD)

IPD is a comprehensive approach that harmonizes participants, systems, business structures and practices with the goal of optimizing project outcomes, increasing efficiency and minimizing waste through collaborative efforts (AIA and AIACC, 2007). IPD underscores integration among key participants, bringing together owners, architect-engineer teams and contractors into a unified entity that cultivates a more inclusive and cooperative project environment, distinguishing it from CPD (Walker and Rowlinson, 2020). IPD ensures the early involvement of key participants in decision-making, advocates a risk and reward-sharing model and enhances collaboration and communication among stakeholders (Walker and Rowlinson, 2020; CMAA, 2012). It improves cost and time efficiency through more precise documentation, ensuring superior quality cost estimates and minimizing change orders (Agbaxode *et al.*, 2020; Nawi *et al.*, 2014; Jayasena and Senevirathna, 2012).

At an early design stage, IPD unites all project stakeholders, fostering an open process that encourages continuous knowledge sharing and collaboration (Walker and Rowlinson, 2020). While the CPD approach faces inefficiencies due to segregated responsibilities (Walker and Rowlinson, 2020), IPD facilitates a behavioral transformation (AIA and AIACC, 2007). Attaining a pure IPD contract necessitates a multiparty agreement (CMAA, 2012), often involving co-location in a "Big Room" to facilitate integration and collaboration (Walker and Rowlinson, 2020). IPD enhances project delivery by boosting efficiency through collaboration and integrated approaches (Dosumu and Aigbavboa, 2018). Its early involvement of key stakeholders, transparent process and collaborative strategies contribute to efficient project execution and a heightened level of client satisfaction (Abdirad and Dossick, 2019).

Recent years have witnessed a surge in IPD adoption, especially in Europe, driven by technological advancements (Walker and Rowlinson, 2020; Akampurira and Windapo, 2019). However, the adoption landscape varies significantly in many developed and developing countries, where IPD has yet to gain traction (Addy *et al.*, 2018; Ahmed, 2018).

IPD thrives on various tools such as building information modeling (BIM). BIM offers a digital representation of the project, enhances collaboration through a common data environment for all stakeholders and facilitates decision-making throughout the project lifecycle (Dosumu and Aigbavboa, 2018; Abdallah *et al.*, 2018). IPD also leverages other tools like lean construction principles, which focus on waste reduction and efficiency optimization. It embraces virtual design and construction (VDC) and cloud-based collaboration platforms that utilize 3D modeling and simulation, ensuring real-time collaboration and data sharing among project team members (Abdallah *et al.*, 2018; Pärn *et al.*, 2018).

BIM plays a crucial role in IPD during the design stage by facilitating early design visualization, clash detection and the data integration of various key participants. This integration enhances collaboration among stakeholders at the early stages of the project, resulting in improved design and documentation quality (Abdirad and Dossick, 2019). Consequently, some software vendors and industry practitioners have advocated for the use of BIM as a cure-all for design-related errors (Abdallah *et al.*, 2018; Love *et al.*, 2011). However, Pärn *et al.* (2018), in a study on BIM usage, and Love *et al.* (2011), on effective BIM usage, argue that BIM alone is not a panacea for poor design documentation quality.

3. Conceptual framework

McGeorge (1988) defined design quality as effectiveness and constructability, emphasizing optimal economy and safety. Other scholars such as Agbaxode *et al.* (2023a) and Laryea

(2011) focused on clarity, adequacy, precision and effectiveness in defining the design documentation quality. Thus, this study assesses design documentation quality based on its clarity and effectiveness in fulfilling its purpose. It serves as a focal point to reflect the efficacy and comprehensiveness of a project's design documents, influenced by the chosen project delivery method (Ajayi and Oyedele, 2018). This study considered two major project delivery methods: CPD and IPD. The CPD approach is widely used but has been criticized for its limited integration during the design phase, leading to suboptimal design documentation quality (Ma *et al.*, 2018; Harper *et al.*, 2016).

In contrast, IPD unites all project stakeholders early in their design phase, fostering collaboration and continuous knowledge sharing (Walker and Rowlinson, 2020). It addresses CPD limitations, emphasizing collaboration, trust, shared project outcomes among participants and flexibility (Walker and Rowlinson, 2020; Hamzeh *et al.*, 2019). Despite IPD's benefits, barriers hinder its global adoption (Ashcraft, 2022; Roy *et al.*, 2018), including financial, organizational and technological factors (Kahvandi *et al.*, 2019). This leads to continued CPD usage due to industry reluctance (Addy *et al.*, 2018). However, adapting IPD enablers into CPD could enhance design documentation quality (Addy *et al.*, 2018), which is the aim of this study.

The study identified three enabler categories: contractual principles (CPs), behavioral principles (BP) and early involvement and collaboration of key participants (EICKP).

CP encompasses agreements and responsibilities among project stakeholders. It emphasizes early participant involvement and timely contribution of knowledge and experience (Walker and Rowlinson, 2020; Agbaxode *et al.*, 2020). Other key enablers include equal participation, shared risk and reward, fiscal transparency and joint accountability (Agbaxode *et al.*, 2020; Jayasena and Senevirathna, 2012).

On the behavioral front, IPD fosters positive relationships based on mutual respect and trust (Agbaxode *et al.*, 2020; Thomsen *et al.*, 2010). It relies on collaboration, open communication, information sharing and transparency (Agbaxode *et al.*, 2020; Jayasena and Senevirathna, 2012). It promotes a collaborative culture that may positively impact the quality of design documentation (Agbaxode *et al.*, 2020). EICKP ensures early involvement, fostering collaboration and knowledge sharing (Walker and Rowlinson, 2020). These principles drive IPD, enhancing decision-making (Thomsen *et al.*, 2010).

IPD advocates for early collaboration, aiming to prevent design flaws (Walker and Rowlinson, 2020). The collaborative approach enhances design efficiency and project quality (Agbaxode *et al.*, 2020; Thomsen *et al.*, 2010). These principles drive IPD, positioning it as a potential global standard that enhances decision-making (Thomsen *et al.*, 2010; Jayasena and Senevirathna, 2012). These principles in IPD enhance design efficiency and project quality (Agbaxode *et al.*, 2020; Thomsen *et al.*, 2010).

The study proposes integrating IPD enablers into the prevailing CPD approach to enhance design documentation quality, supported by prior research (Ling *et al.*, 2020; Addy *et al.*, 2018). This forms the basis for the primary hypothesis – H1: adapting IPD enablers into CPD will improve the quality of design documentation. By establishing this framework as presented in Figure 1, the study aims to identify specific IPD enablers that can elevate design documentation quality within CPD, contributing to improving construction project outcomes.

In Ghana, where the study occurs, adapting IPD enablers into CPD needs to align with the existing project delivery standards, such as those by the Public Procurement Authority (PPA) and the International Federation of Consulting Engineers (FIDIC) suite of contracts (Dagba and Dagba, 2019; Asiedu and Alfen, 2015). Despite these regulatory frameworks, customization through special conditions of contract is common.

The construction industry's resistance to adopting new project delivery approaches (Ashcraft, 2022; Kahvandi *et al.*, 2019; Roy *et al.*, 2018) underscores the importance of leveraging IPD's inherent enablers to improve design documentation quality within CPD

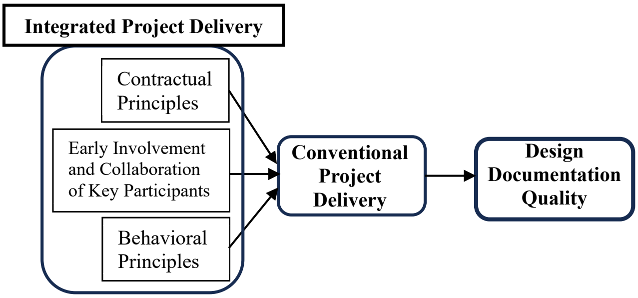

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Figure 1.
Conceptual framework

(Addy *et al.*, 2018). Previous studies by Ling *et al.* (2020) and Agbaxode *et al.* (2023b) support this, suggesting CPD often integrates IPD-related practices to enhance project performance. While IPD shows promise for improving design documentation quality at pre-design and design stages (Ling *et al.*, 2020), it is crucial to identify and adapt IPD enablers specifically to enhance design documentation quality within the CPD approach. Thus, this study aims to identify and adapt enablers that are inherent in IPD to improve design documentation quality within CPD.

4. Methodology

The study adopted a mixed-method approach, incorporating both survey and semi-structured interviews to ensure a comprehensive data collection process within the Ghanaian construction industry. The study used a mixed sequential approach, where the questionnaire survey data were collected and analyzed followed by interview data collection and analysis to gain a well-rounded perspective on the aim. This methodology helped gather practical insights from professionals in the Ghanaian construction industry and maintained the highest standards of rigor (Saunders *et al.*, 2019; Creswell and Creswell, 2017; Tashakkori and Teddlie, 2010). Interviews were undertaken after the questionnaire survey to delve deeper into the study, enriching its comprehensiveness and nuance. This approach aimed to bolster the validity of the findings while also unveiling unforeseen insights that might elude detection during the questionnaire survey. This back-and-forth method allowed for qualitative discoveries that aligned with the quantitative results to be incorporated, excluding any newly discovered insights that stood on their own.

In order to provide a structured framework for gathering rich data through the interviews, predetermined questions were formulated based on the outcome of the questionnaire survey. This was followed by a purposeful selection of professionals to gather relevant qualitative data, which resulted in 15 participants who are quantity surveyors, architects and project managers. QSR Nvivo 12 Pro software was used to analyze interview transcripts, categorizing themes based on descriptions and wordings.

4.1 Data collection and sample size determination

To ensure reliability and consistency, the questionnaire survey was crafted through review of existing literature. The identified enablers in IPD that have the potential to improve design documentation quality were presented, and respondents were asked to rate them on a five-point scale. A score of 1 indicated strong disagreement, while 5 indicated strong agreement. The use of the five-point Likert scale enhanced respondents' understanding and interpretation of the scale, ensuring a balanced approach to gathering viewpoints and facilitating straightforward data analysis (Saunders *et al.*, 2019; Creswell and Creswell, 2017). The survey was administered online using Google Forms, which facilitated respondents' outreach. Respondents were identified via LinkedIn profiles and use of WhatsApp platforms for various professional bodies. Semi-structured interviews were conducted via phone and in-person meetings at interviewees' convenience. Participant selection method combined simple random and purposive sampling. Simple random sampling was employed for the survey to ensure that every professional had an equal chance of participating and to minimize bias, thus enhancing the simplicity and transparency of the process (Saunders *et al.*, 2019). For the selection of interviewees, purposive sampling was utilized to ensure that only specific professionals with a minimum of five years' working experience in the field were chosen. Initially, participants were chosen based on their profession: architects, quantity surveyors, project managers, engineers, supervisors and clients. Subsequently, their industry experience was considered, with a five-year minimum to ensure an in-depth understanding of the subject matter.

To determine the actual sample size for the survey questionnaire, it was ensured that the minimum sample size and the estimated response rate for this study do not fall short of earlier studies done in the same geographical area. This was achieved by using the following formula by Saunders *et al.* (2016).

$$n^a = \frac{n\,x\,100}{re\%}\ \text{therefore,}\ n^a = \frac{229\,x\,100}{53} = 432$$

Where, n^{a} is the actual sample size required, n is the minimum size and $re\%$ is the estimated response rate. To determine these values, two studies by Agbaxode *et al.* (2021a, 2020), conducted in a similar location as this study, were consulted. They provide a minimum sample of 229 with a 53% response rate. Thus, this study's actual sample size was calculated as 432. However, 235 responses were received, yielding a 54% response rate. Interview data collection continued until it became evident that no new information was being gathered, resulting in data saturation and yielding 15 participants (Saunders *et al.*, 2019).

4.2 Data analysis

IBM SPSS Version 27.0 aided in analyzing quantitative data, using frequencies, percentages, correlations and regressions to assess relationships (George and Mallery, 2019; Aldrich, 2018). Spearman's correlation gauged enabler associations, particularly within the Likert-type survey responses (George and Mallery, 2019; Morgan *et al.*, 2019; Aldrich, 2018). Multiple regression was used due to its suitability with the aim of the study to determine the relationship of the dependent variable's value to its predictors (George and Mallery, 2019; Morgan *et al.*, 2019). Qualitative data underwent content analysis using QSR Nvivo 12 Pro.

4.3 Validity, reliability, and generalizability

Ensuring research validity, reliability and generalizability is vital (Saunders *et al.*, 2019; Dudwick *et al.*, 2006). In achieving this, the study employed triangulation, combining quantitative and qualitative methods (Denzin, 2012; Denzin and Lincoln, 2011). The survey design, which was based on existing literature, was pilot tested with construction industry professionals. The content of the questionnaire was reviewed for clarity, relevance and comprehensiveness by these professionals, and all review comments were implemented. This was done to ensure that the questions cover all relevant aspects of the research aim. Additionally, Cronbach's alpha (α) values were computed for the Likert-scale questions (Bonett and Wright, 2015; Tavakol and Dennick, 2011) to enhance data trustworthiness (Mohajan, 2017).

5. Results and analysis

5.1 Quantitative data

The quantitative data comprised of 235 questionnaire responses, underpinning the study's main question: *what are the enablers in IPD that can enhance the CPD approach toward improving design documentation quality?*

5.1.1 Respondents' background. The survey respondents are construction industry professionals, comprising 27% project managers, 22% quantity surveyors, 15% engineers and foremen each, 13% architects, 5% managing directors and 3% clients. Experience-wise, 45% have 11–20 years, 38% have 6–10 years, 11% have 1–5 years and 6% have 21–30 years. In terms of education, 55% have first degrees, 22% hold master's degrees, 19.5% have higher national diplomas, 2% are Ph.D. holders, 1% are technicians and 0.5% hold diplomas. On their sector of work, 49.79% are in the private sector, 50.21% in the public sector, with 65% working for consultants and 35% for contractors, reflecting a balanced private-public perspective.

5.1.2 Categories of data. This study classifies data into three categories: CP, BP and EICKP (Agbaxode *et al.*, 2020; Jayasena and Senevirathna, 2012). A total of 25 enablers: 12 for CP, 6 for BP and 7 for EICKP was used as presented in Table 1.

5.1.3 Validity, reliability and generalizability of study data. To ensure data validity, reliability and generalizability, Cronbach's alpha (α) values were used. IBM SPSS software was used for the test, and the following values are interpreted according to Tavakol and Dennick (2011), $\alpha \geq 0.9$ (Excellent); $0.9 > \alpha \geq 0.8$ (Good); $0.8 > \alpha \geq 0.7$ (Acceptable); $0.7 > \alpha \geq 0.6$ (Questionable); $0.6 > \alpha \geq 0.5$ (Poor) and $0.5 > \alpha$ (Unacceptable). Higher values (>0.7) indicate higher correlation of the items.

The actual Cronbach's alpha values for the three data categories are as follows: 0.986 for CP, 0.975 for BP and 0.972 for EICKP. However, the least actual Cronbach's alpha value from the three data categories is 0.972, greater than 0.9 (i.e. $\alpha > 0.9$), indicating an *excellent* level of internal consistency. Therefore, the complete data from the three categories are highly reliable and valid.

5.1.4 Spearman's rank-order correlation analysis. A nonparametric correlation analysis was conducted to assess the degree of correlation, significance level and test correlation coefficient hypotheses, with a total of 235 cases as presented in Table 1. The mean and standard deviation values presented in Table 1 are relatively high, indicating a statistical significance, with the lowest at 0.533 and the highest at 0.842. The enabler codes in Table 1 represent enablers across other tables. The least Spearman's correlation coefficients (r_s) from the three categories of data are +0.747, +0.695 and +0.700.

The highest values are +0.997, +0.952 and +0.975. Both the least and the highest values are very close to +1, indicating strong, positive correlations within the data groups. All ρ – values (0.000) are well below the 0.01 level, demonstrating a statistically significant association. The null hypothesis is rejected, and the alternative hypothesis accepted that the relationship between the enablers is statistically significant because all the ρ – values are less than 0.01 but not equal to zero, H_1: ρ (rho) $\neq 0$. Therefore, the correlation coefficients (r_s) of +0.747, +0.695 and +0.700 are statistically significant ($\rho = 0.000$).

Therefore, the Spearman's rank-order correlation analysis confirms a strong, positive correlation among the 25 enablers within IPD, deemed statistically significant ($r_s(12) = +0.747, p = 0.000$); ($r_s(6) = +0.695, p = 0.000$) and ($r_s(7) = +0.700, p = 0.000$).

5.1.5 Multiple regression analysis. The regression presents the summary, Analysis of Variance (ANOVA) and coefficients of regression with a sample size (N) of 235. Table 2 presents the *model summary analysis* involving the coefficients, the R-square, the adjusted R-square and the standard error of the estimate for the three data categories.

From Table 2, the *R* values for the three data categories are 0.914, 0.861 and 0.877, while the adjusted R^2 values are 0.827, 0.735 and 0.762. This means that 82.7, 73.5 and 76.2% of the variance in the categories of enablers can be predicted combining all the enablers.

Categories	Code	Enablers	Mean	Std. Deviation
Contractual principles	CP1	Involve Key participants early in the project	4.46	0.541
	CP2	Early contributions of knowledge and expertise by key participants	4.40	0.540
	CP3	Making collaborative value-based decisions by all participants	4.49	0.565
	CP4	Key participants bound together as equals	4.39	0.576
	CP5	Jointly and early developed project target criteria	4.38	0.651
	CP6	Tye the success of key participants to the success of the project	4.45	0.593
	CP7	Key participants jointly accountable for any errors in design	4.40	0.533
	CP8	Key Participants receive financial compensation based on project outcome	4.45	0.607
	CP9	Sharing financial risk among key participants	4.34	0.649
	CP10	Using new technologies and approaches during design	4.29	0.769
	CP11	Waiving liabilities between key participants	4.29	0.842
	CP12	Encourage fiscal transparency between key participants	4.41	0.803
Behavioral principles	BP1	Key participants having mutual respect	4.50	0.587
	BP2	Key participants having mutual trust for each other	4.41	0.565
	BP3	Willingness to collaborate as key participants	4.43	0.584
	BP4	Open communication among key participants	4.45	0.621
	BP5	Open information sharing among key participants	4.50	0.682
	BP6	Ensuring transparent processes throughout the project	4.59	0.644
Early involvement and collaboration of key participants	EI1	Better understanding of the owner's anticipated outcome	4.39	0.555
	EI2	Participants' collaborating effectively improves documentation quality	4.33	0.547
	EI3	More timely and informed understanding of the design	4.49	0.557
	EI4	Opportunity for adequate pre-design, design, and documentation planning	4.40	0.571
	EI5	Provides an opportunity for strong pre-construction planning	4.43	0.590
	EI6	Early visualization of construction sequencing prior to commencing project	4.28	0.788
	EI7	Higher effort from key participants during design documentation leads to improved documentation quality	4.39	0.806

Source(s): Authors' own work

Table 1.
Descriptive statistics of data ($N = 235$)

With reference to *ANOVA* presented in Table 2, the F-ratio values, which tests whether the overall regression is a good fit for the data, are 94.426, 108.978 and 108.111 for the three data categories. All values are greater than 1, indicating efficiency and acceptability. A 95% confidence level that represents a 5% (0.05) level of significance was set; therefore, a sig. value of 0.001 for all the three data categories in this case less than 0.05 is acceptable. The ANOVA results is an indication that the independent variables statistically and significantly predict

	Categories		R	R square	Adjusted R square	Std. Error of the estimate
Summary	CP	1	0.914	0.836	0.827	11.779
	BP	1	0.861	0.741	0.735	14.601
	EICKP	1	0.877	0.769	0.762	13.824

	Categories		Sum of Squares	df	Mean Square	F	Sig
ANOVA	Contractual principles	Regression	157201.018	12	13100.085	94.426	<0.001
		Residual	30798.982	222	138.734		
		Total	*188000.000*	*234*			
	Behavioral principles	Regression	139394.081	6	23232.347	108.978	<0.001
		Residual	48605.919	228	213.184		
		Total	*188000.000*	*234*			
	Early involvement and collaboration of key participants	Regression	144620.205	7	20660.029	108.111	<0.001
		Residual	43379.795	227	191.100		
		Total	*188000.000*	*234*			

Source(s): Authors' own work

Table 2.
Regression analysis Summary and ANOVA

the dependent variable $F(12, 222) = 138.734$, $p < 0.05$; $F(6, 228) = 213.184$, $p < 0.05$ and $F(7, 227) = 191.100$, $p < 0.05$. Therefore, the regression is a good fit for the data. However, the F-values are 94.426, 108.978 and 108.111, which are all statistically significant and indicate that the predictors significantly combine to predict enablers inherent in IPD.

The *regression analysis coefficients* for each enabler is presented in Table 3. A sig. value below 0.05 indicates statistical significance at a 95% confidence level, as per this study's criteria. Hence, enablers with $p < 0.05$ significantly differ from zero. From the sig. values of CP, six enablers significantly adds to the prediction when the other predictors are considered, all with $p < 0.05$, and include *key participants involved early in the project, tying their success to project success, joint accountable for any errors in design, sharing financial risk among key participants, utilization of new technologies during design and encourage fiscal transparency between key participants.*

There are three enablers from the BP that significantly adds to the prediction with $p < 0.05$ and include *key participants having mutual respect for each other, having mutual trust for each other and ensuring transparent processes throughout the project.* On EICKP, three enablers significantly add to the prediction with $p < 0.05$ and include *better understanding of the owner's anticipated outcome, effective collaboration by all participants improves design documentation quality and a timely and informed understanding of the design.*

Summary of results: The multiple regression analysis aided in determining enablers inherent in IPD to improve the quality of design documentation. The combination of the enablers based on the three data categories is statistically significant, i.e. $F(12, 222) = 138.734$, $p < 0.05$; $F(6, 228) = 213.184$, $p < 0.05$ and $F(7, 227) = 191.100$, $p < 0.05$. The results indicate that when the 25 enablers are included, it is only 12 enablers in IPD that can be adapted into the CPD approach. This includes six CP, namely *involving key participants early in the project, tying their success to project success, key participants jointly accountable for any errors in design, sharing financial risk among them, utilization of new technologies during design and encourage fiscal transparency between key participants.* There are three BP, namely *key participants having mutual respect for each other, having mutual trust for each other and ensuring transparent processes throughout the project.* There are also three enablers on EICKP, namely *better understanding of the owner's anticipated outcome, effective collaboration by all participants and there is a timely and informed understanding of*

Categories		Enablers	Unstandardized coefficients B	Std. Error	Standardized coefficients Beta	*t*	Sig
Contractual principles	1	(Constant)	−168.344	7.725		−21.792	<0.001
		CP1	66.844	12.140	1.275	5.506	<0.001
		CP2	−3.190	6.018	−0.061	−0.530	0.597
		CP3	8.409	6.408	0.168	1.312	0.191
		CP4	−6.380	11.123	−0.130	−0.574	0.567
		CP5	−9.403	5.331	−0.216	−1.764	0.079
		CP6	−60.792	10.847	−1.271	−5.605	<0.001
		CP7	37.981	12.255	0.714	3.099	0.002
		CP8	−4.020	6.811	−0.086	−0.590	0.556
		CP9	16.374	5.440	0.375	3.010	0.003
		CP10	−16.360	6.197	−0.444	−2.640	0.009
		CP11	8.351	5.113	0.248	1.633	0.104
		CP12	13.632	3.618	0.386	3.767	<0.001
Behavioral principles	1	(Constant)	−142.526	8.320		−17.130	<0.001
		BP1	15.876	5.022	0.329	3.161	0.002
		BP2	34.839	5.581	0.695	6.242	<0.001
		BP3	−8.825	6.369	−0.182	−1.386	0.167
		BP4	−0.782	5.446	−0.017	−0.144	0.886
		BP5	−8.016	4.737	−0.193	−1.692	0.092
		BP6	12.259	3.632	0.278	3.376	<0.001
Early involvement and collaboration of key participants	1	(Constant)	−137.243	8.194		−16.750	<0.001
		EI1	22.021	8.163	0.431	2.698	0.008
		EI2	9.734	3.945	0.188	2.467	0.014
		EI3	17.042	5.820	0.335	2.928	0.004
		EI4	−12.389	7.932	−0.250	−1.562	0.120
		EI5	−1.250	5.099	−0.026	−0.245	0.807
		EI6	4.155	4.552	0.116	0.913	0.362
		EI7	5.510	4.457	0.157	1.236	0.218

Source(s): Authors' own work

Table 3.
Regression analysis coefficients

the design. However, the adjusted R-square values for the three categories are 0.827, 0.735 and 0.762. This indicates that 82.7, 73.5 and 76.2% of the variance in the enablers on the three categories are significant.

5.2 Interview data analysis

Interviewee anonymity and confidentiality was achieved by assigning pseudonyms (P1-P15), as presented in Table 4.

5.2.1 Participants background information. There were 15 participants from 3 main professions: quantity surveyors, architects and project managers, with 5 professionals in each group. Around 11 participants (73%) hold master's degrees, while 4 (27%) have bachelor's degrees. Their collective experience in the construction industry is extensive, ranging from a minimum of 8 years to a maximum of 21 years, with an average of 14 years. They have worked in both public and private sectors, including roles in contractors' and consultants' organizations. In terms of sector distribution, eight participants (53%) are in the public sector, while seven (47%) work in the private sector. Ten participants (67%) are affiliated with consultants' outfits, while five (33%) are associated with contractors' outfits. This diverse representation ensures a comprehensive perspective from both the private and public sectors, as well as from consultants and contractors.

Table 4.
Enablers inherent in IPD for improving design documentation quality

Enablers	Participants responses P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	Frequency	Ranking
CP2		√	√	√	√	√	√		√		√	√	√	√	√	*12*	*1*
BP4		√		√	√	√	√		√		√	√	√		√	*10*	*2*
CP5	√	√		√	√		√				√	√		√	√	*9*	*3*
CP1	√	√	√	√			√		√					√	√	*8*	*4*
CP6				√	√	√	√				√	√	√	√		*8*	*5*
BP2		√			√	√	√					√	√			*6*	*6*
BP1			√		√	√						√	√			*5*	*7*
BP3						√	√		√				√		√	*5*	*8*
CP4						√	√						√	√		*4*	*9*
CP3	√					√		√								*3*	*10*
EI3					√		√					√				*3*	*11*
CP7		√					√									*2*	*12*
CP8					√	√										*2*	*13*
EI5										√			√			*2*	*14*
EI1							√									*1*	*15*
EI2		√														*1*	*16*
EI4							√									*1*	*17*

Source(s): Authors' own work

5.2.2 Enablers in IPD that can be adapted into the CPD. Interview transcripts were auto coded using QSR Nvivo 12 Pro to classify and categorize data for analysis. This process included selecting content, defining units and categories and coding based on descriptions. It identified 17 enablers as presented in Table 4, with 8 enablers for CP, 4 for BP and 5 for EICKP.

Table 4 presents the significance of enablers, gauged by their frequency. Around 12 participants emphasized early involvement of key participants in the project; 10 stressed the importance of collaborative willingness among key participants; 9 highlighted early contributions of knowledge by key participants and 8 advocated for collaborative value-based decision-making and joint accountability for design errors. Further examination of the findings revealed that the interview results largely corroborate the survey findings. This culminates in a total of 12 key findings categorized as CP, BP and EICKP, as presented in the next section.

6. Results and discussion

The study identified 12 IPD-based enablers organized into 3 key categories aimed at enhancing CPD and improving the quality of design documentation. These enablers consist of six findings from CP, three from BP and three from EICKP. The findings reveal that many principles underlying IPD are applicable within CPD. This perspective aligns with research by Ling *et al.* (2020), highlighting the significant potential for CPD to adopt IPD-related practices to enhance project performance. The findings also reveal that enhanced collaboration among team members, coupled with their shared commitment to achieving project objectives, ensures improved project outcomes.

This notwithstanding, the study identified some operational principles that contribute to enhancing CPD and improving the quality of design documentation, which Walker and Rowlinson (2020) refer to as the foundational elements of the IPD framework. These operational principles are interconnected with both contractual and BPs, as presented in Table 1. Specifically, they include the willingness of key participants to collaborate and tie their success to the project's success, ensuring alignment of values among stakeholders. Additionally, the study emphasizes sharing financial risk among key participants through an integrated risk mitigation strategy. Moreover, it underscores the importance of utilizing new technologies and approaches, such as BIM and the Last Planner System, during the design phase to enhance efficiency and productivity. Lastly, open information sharing among key participants is highlighted as crucial for fostering transparency and facilitating effective communication. These operational principles play a pivotal role within both contractual and BPs toward fostering collaboration and minimizing risks within CPD projects, ultimately contributing to improved project outcomes. The key findings and discussions are presented in the subsequent subsections.

6.1 IPD contractual principles

CPs form the foundation of IPD and play a crucial role in enhancing the quality of design documentation. Kahvandi *et al.* (2018) emphasize that clear contractual agreements are essential for establishing collaborative frameworks. However, the study identified six findings on CPs, namely engaging key participants early in the project, tying their success to project success, holding key participants jointly accountable for any errors in design, sharing financial risk, utilization of new technologies during design and encouraging fiscal transparency. By incorporating contractual provisions that prioritize early engagement of participants, particularly during the design phase, IPD create an environment conducive to the development of high-quality design documentation (Maskil-Leitan and Reychav, 2018).

Early engagement of participants, as stipulated in IPD, contributes significantly to the improvement of design documentation quality. By involving owners, consultants and contractors from project inception, IPD facilitates the exchange of knowledge and expertise necessary for informed design decisions (Viana *et al.*, 2020). This early involvement ensures that diverse perspectives are considered during the design process, leading to more comprehensive and well-informed design documentation (Jadidoleslami *et al.*, 2019).

IPD promotes shared responsibility among project participants, which positively impacts the quality of design documentation. Participants view project success as a collective endeavor and are motivated to uphold high standards of quality in all project deliverables, including design documentation (Viana *et al.*, 2020). This shared commitment to project success, as mandated by IPD, fosters a culture of collaboration and accountability, driving participants to invest time and effort in producing accurate and detailed design documentation (Maskil-Leitan and Reychav, 2018).

Collaborative accountability, a key principle embedded in IPD, contributes to the improvement of design documentation quality by promoting transparency and proactive problem-solving. Participants are jointly accountable for design outcomes and are incentivized to identify and address potential errors or inconsistencies in design documentation (Agbaxode *et al.*, 2020). This collaborative approach to accountability reduces the likelihood of design-related issues going unnoticed or unaddressed, thereby enhancing the overall quality and reliability of design documentation (Elghaish *et al.*, 2020).

IPD often encourages the integration of innovative technologies to support the creation and management of design documentation. Ling *et al.* (2020) highlight the role of digital tools and platforms in facilitating collaboration, version control and documentation management among project participants. Additionally, the emphasis on fiscal transparency in IPD promotes accountability and ensures that adequate resources are allocated to support the production of high-quality design documentation (Ling *et al.*, 2020).

6.2 IPD behavioral principles

IPD emphasizes collaborative approaches and behavioral factors that significantly influence project success (Agbaxode *et al.*, 2020), as well as improving the quality of design documentation. IPD stresses the careful selection of project participants based on their skills and their willingness to foster positive relationships (Ling *et al.*, 2020). This means assembling a team of individuals who not only excel in their respective roles but also understand the importance of effective communication and collaboration. Such a team is more likely to contribute to thorough and cohesive design documentation. This notwithstanding, the study findings present three BPs namely key participants having mutual respect, having mutual trust and ensuring transparent processes throughout the project.

Mutual trust, respect and integrity among key participants are fundamental to IPD (Durdyev *et al.*, 2019). A foundation of trust enables team members to openly share ideas, provide constructive feedback and collectively work toward the project's goals. This environment encourages thorough documentation review and refinement, ultimately enhancing its quality.

IPD mandates transparent processes throughout the project lifecycle, with key participants expected to share information openly (Ma *et al.*, 2018). This ensures that all participants have access to relevant information, fostering a shared understanding of project requirements and objectives. Clear communication channels facilitate the exchange of feedback and revisions, leading to more comprehensive and accurate documentation.

IPD emphasizes regular meetings and discussions to facilitate communication among project participants (Ma *et al.*, 2018). This ensures that all team members are aligned regarding project progress, changes and priorities. It allows for timely updates to documentation and enables swift resolution of any discrepancies or issues that may arise.

6.3 Early involvement and collaboration of key participants

The study identified three findings on the EICKP, namely better understanding of the owner's anticipated outcome, key participants' collaboration improves design documentation quality and early and better understanding of the design. The EICKP in IPD plays a crucial role in enhancing the quality of design documentation. According to Jadidoleslami *et al.* (2019), key participants must be engaged early in the project, especially during the design phase (Maskil-Leitan and Reychav, 2018). This early involvement fosters collaboration, leading to various project benefits (Viana *et al.*, 2020). One significant benefit is the increase in early knowledge sharing, which contributes to developing a more effective, feasible and constructible design (Elghaish *et al.*, 2020). Moreover, it helps in reducing potential rework during the construction stage (Viana *et al.*, 2020; Kahvandi *et al.*, 2016).

Early involvement of key participants also improves pre-design, design and documentation planning. It also enhances critical decision-making. It provides stakeholders with a better understanding of the design and the owner's anticipated outcomes (Agbaxode *et al.*, 2020). Additionally, it elevates the quality of design documentation, leading to better project delivery (Ling *et al.*, 2020; Jadidoleslami *et al.*, 2019). Owners' early involvement in the project is particularly crucial as it enhances critical decision-making processes (Adamtey, 2021; Ling *et al.*, 2020), consequently reducing claims and minimizing changes (Kahvandi *et al.*, 2016).

The level of collaboration during the design stage of IPD projects is notably deeper compared to other stages of the project lifecycle. This deeper collaboration enhances participants' understanding of the project and ensures a thorough review of the design before construction commences (Ling *et al.*, 2020; Ma *et al.*, 2018). The findings suggest that IPD projects produce better-quality design documentation, underscoring the importance of EICKP (Jadidoleslami *et al.*, 2019; Maskil-Leitan and Reychav, 2018).

7. Conclusion

This study used a mixed sequential approach to identify intrinsic enablers within IPD that could enhance the quality of design documentation under the CPD approach in the Ghanaian construction industry. It focused on activities during the pre-design and design stages of construction projects. A total of 12 key IPD enablers were identified and expected to significantly improve design documentation quality and overall project delivery under the CPD approach. The findings underscore the importance of involving key participants early in the process, incentivizing individual success tied to project success, establishing shared accountability for design errors, promoting open communication, distributing financial risk through a shared contingency fund, adopting new technologies, maintaining fiscal transparency and documenting decisions transparently. The study's findings offer valuable insights for implementing specific IPD enablers to enhance design documentation quality in CPD scenarios, signaling a shift toward efficiency, accountability and quality in design documentation within the broader construction industry landscape.

The study contributes to theoretical understanding of construction project delivery by identifying key IPD enablers and shedding light on how IPD can enhance design documentation quality and project outcomes within CPD. It lays groundwork for future research to examine the effectiveness of specific IPD practices across different contexts. In practical terms, stakeholders in the architectural, engineering and construction (AEC) industry, including project managers and clients, stand to benefit significantly. Implementing these IPD enablers can lead to enhanced collaboration, fewer design documentation errors, and improved project outcomes. By promoting transparency, accountability and the adoption of technology, these findings provide a practical guide for integrating IPD principles into project management strategies, thereby fostering innovation and excellence in design documentation and project execution.

8. Limitations and recommendations for future research

Notwithstanding the significant contribution of this study, it is limited by its aim of identifying specific enablers that are inherent in IPD that can be adapted into the CPD approach, particularly during the production of design documentation to improve quality. Future studies should consider establishing an implementation framework within the CPD approach using the identified enablers. However, this study shares common methodology, study respondents and participants, with more research being carried out to develop a framework to enhance the quality of design documentation.

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