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Tools and Techniques for Improving Maturity Partnering in Indonesian Construction Projects

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Abstract: The construction industry is naturally complex and constantly changing, with various factors impacting project results. Among the different methods developed to navigate this complexity, partnering is believed to increase project value and performance. Therefore, this research aimed at analyzing and formulating elements as well as indicators at each phase of a partnership-based project life cycle, serving as tools and techniques for measuring the depth of partnering in construction projects. The methodology used included both qualitative and quantitative methods (mixed method). In the qualitative method, the literature from relevant journals, books, and previous research was reviewed. This process was followed by an expert assessment through a Focus Group Discussion (FGD) to define elements and indicators for measuring the depth of partnering in construction projects. Meanwhile, the quantitative method comprised analyzing secondary project data to compare projects with in-depth partnering in order to deliver better value. The result of this research was the development of Key Performance Indicators (KPIs) to measure maturity partnering in partnership-based projects. Typically, the tools were adjusted to different phases of the project life cycle, starting from project initiation, comprising all stakeholders. Consequently, the outcome of this research could be used by organizations in the construction industry to develop partnering in partnership projects in Indonesia.

Keywords: project performance; partnering; partnership project; project life cycle; tool and techniques

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1. Introduction

The construction industry is faced with several problems, including low productivity [1] and high waste [2]. According to Koskela (2000) and Chan et al. (1997) [3,4], chronic issues in the construction sector include low productivity, safety concerns, poor working conditions, unsatisfactory quality, a fragmented industry, a lack of coordination among participants, and excessive trading. In addition, there are issues related to production such as work quality, design changes, and material quality and availability, as well as utilization.

In a study conducted by Valverde (2011) [5], several factors contributing to low productivity on construction projects in various countries including Indonesia are (1) poor workmanship, (2) the unavailability of materials, (3) a lack of project information, (4) equipment availability, and (5) faulty work [5]. Other reasons for low productivity include labor expertise and experience, the availability of materials at the construction site, poor site management, political and safety situations, ineffective supervision, a lack of labor skills, bad weather, and unclear instructions. It is crucial to be aware that these factors have an impact on the cost performance of construction projects [6].

Alwi (2002) [2] stated six main factors causing waste in the construction industry in Indonesia, which include design changes, slow decision making, a lack of skilled workers, inadequate construction methods, and poor coordination among professional management. Therefore, waste management requires attention and action from all included parties. When managing and reducing waste, contractors are advised to (1) build long-term relationships with producers and suppliers in order to develop shipping methods that avoid excess supplies and delays; (2) consider the use of local materials and natural resources as much as possible; (3) conduct regular training programs for supervisors and workers to help in understanding the concept of waste; (4) conduct the construction process transparently to ensure everyone concerned can identify problems during the project; and (5) establish cooperation and regular meetings between project participants and construction personnel at various levels, thereby strengthening mutual trust and cooperation as partners.

Many efforts have been made to improve the performance of construction projects, and one effective approach is through partnering. This philosophy is believed to provide value and improve project performance in terms of cost, quality, time, safety, and the environment [7–10]. Research by Sari [11–13] proved that partnering established from the beginning of the project increases performance and provides added value for all stakeholders. Moreover, project management problems are experienced by owners, contractors, and subcontractors, based on the background of each stakeholder. A typical solution to achieve the objectives of stakeholders is trust and partnering [7,14]. Specifically, partnering can increase project performance, reduce costs, and improve quality.

Previous research has not fully discussed the ways in which partnering can be applied in construction projects to produce value for each stakeholder. Meanwhile, previous findings only focused on partnering factors [15,16], levels [12,13,17–20], interactions [13,21], challenges [13], waste reduction, and financial risk reduction [22–25]. Therefore, this research aims to improve our understanding of the way partnering is implemented in projects, considering depth as an indicator of success. It is important to acknowledge that this exploration will build on previous findings to strengthen our understanding of partnering.

1.1. Partnering

Partnering is practiced in private and government projects where there is collaboration between government and business entities. This type of partnering represents a positive collaboration between the groups, with two main models which are solicited and unsolicited.

Pinto Nunez et al. (2018) [24] stated that partnering needs to be measured in order to assess program performance, determine benefits and costs, help in decision making, and the future planning of partner programs [24]. In addition, the process assists in identifying areas that need improvement, thereby increasing partnering processes in the future [24,26]. Tools and techniques for partnering can support the aims of all project participants, creating a more cooperative and effective team [27,28]. However, implementing partnering can be complex and challenging, implying that a clear understanding of effective practices and project characteristics is necessary to ensure success [27,28]. Partnering guidance showed a positive result, including cost saving, qualitative optimization, and increased communication and trust between clients and contractors [29]. Challenges often arise from defining partnering as a coherent and universal strategy and from changes in attitudes and behavior [22,30]. Therefore, effective partnering implementation requires considering factors that strengthen certain work, appropriate tools and techniques, as well as a strong commitment from top management [31].

Hosseini et al. (2016) [29] showed that one obstacle to implementing partnering in the construction industry is a lack of understanding of effective practices. The successful implementation of partnering requires understanding the practices and characteristics of the project [13,24,30]. Furthermore, measuring partnering performance includes continuous evaluation throughout the project, which includes assessing specific targets, correct milestones, and available resources [31]. This measurement helps project managers to track when the project is progressing as intended or otherwise [31]. Therefore, evaluating the depth of partnering requires tools and techniques to measure every indicator at each stage in the life cycle of the project.

1.2. Maturity Partnering Technique

Thompson (1998) [17] stated that maturity partnering can be measured, and its characteristics are identifiable in project activities [20,30]. A higher level of maturity partnering in an organization leads to several achievements which include the following [18,20]:

(1) The development of a comprehensive and joint measurement system;
(2) Collaborations in performing work from start to finish;
(3) Cultural integration in work management;
(4) Transparency in cooperation;
(5) Trust is very high, and risk sharing occurs.

Pinto [24] also signified the importance of major elements in partnering, such as commitment, trust, respect, communication, and fairness. According to Sari (2022), [13] achieving mature partnering and TARIF values (Trust, Accountability, Responsiveness, Independence, and Fairness) requires good governance in an organization. Furthermore, the process of measuring maturity partnering helps to effectively track progress and provide early warnings in the establishment [18]. This is a system used to identify and correct progress when necessary [18]. Detecting problems early offers decision makers more options for resolving issues, which tends to reduce project costs and strengthen partnering relationships among stakeholders [18]. Pinto [24] further explained that maturity partnering is divided into four levels, each requiring metric guidance for deeper measurements.

Figure 1 shows the four stages of measuring maturity partnering in a project, which include the no partnering level (no program), simple, defined, managed, and institutionalized [24]. At the institutionalized partnering level, partnering has become an institutionalized value. Furthermore, partnering is joined into the strategy of organization with structured partnership documentation [24]. Partnering is validated as a long-term system associated with business objectives, leading to improved innovation performance over time [24]. Figure 2 shows that there is an increase in the level of maturity partnering and desire in an organization, with respect to the level of trust, commitment, communication, and respect [17,27].

1.3. Partnering in Project Life Cycles

Partnering is most effective when implemented according to the phases of a project life cycle [13]. There are different objectives at every phase of a project; therefore, partnering is present throughout. Sari (2023) [13] stated that the depth of partnering can be increased in each project delivery system at any stage of the project life cycle. Pinto (2018) [24] also stated that partnering deepens activities at each stage of the project. In the initiation phase, clear objectives are crucial to improve early collaboration, achieved through strengthening training and leadership. During project design and implementation, Asmar (2015) [9] proved, with maturity partnering, that even at the initiation phase, before 0% project design, stakeholders can determine the scope together, known as Integrated Project Delivery (IPD). Therefore, partnering is essential in every project life cycle to measure and evaluate the effectiveness of each strategy.

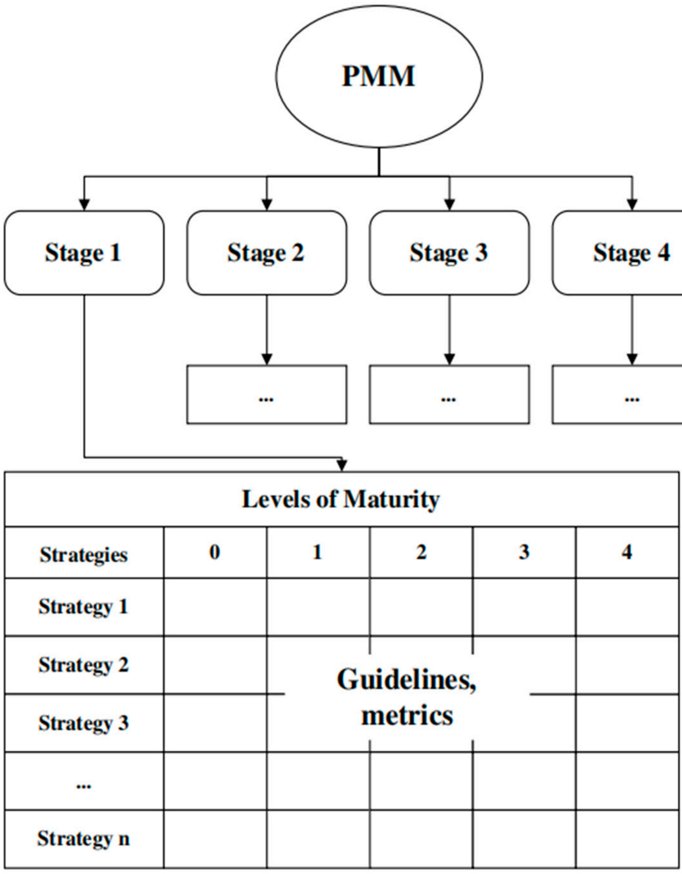

Figure 1. Maturity partnering schematic [24].

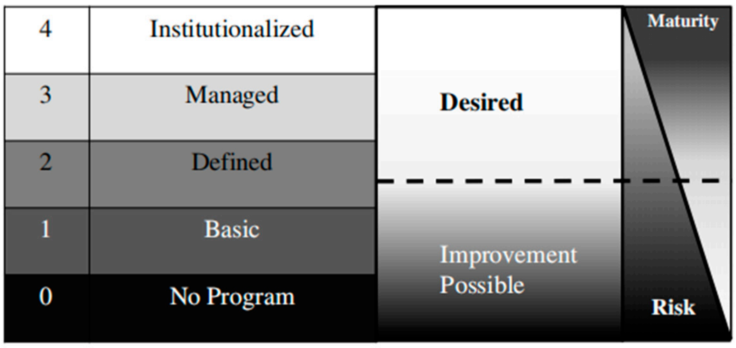

Figure 2. Maturity partnering map [24].

1.4. Delphi Method

The Delphi method includes selecting qualified experts, creating relevant questions as well as analyzing the answers of professionals [32,33], and selecting high-quality experts is crucial in this method [34,35]. Typically, research using the Delphi method includes 5–20 experts [34–36], and at least two rounds are conducted to make a decision. These experts are professionals with diverse knowledge [37], who are concerned with decision making in the respective companies of the professionals and have at least five years of experience.

Another important aspect in every Delphi research is ensuring that the results are based on consensus among the participants in each round. According to Hallowell and Gambatese (2010) [37], consensus is determined by the absolute deviation from the responses of the experts, showing a deviation of 5% from the median. Using absolute deviation and the median instead of standard deviation and means helps avoid biases.

2. Materials and Methods

The methodology used in this research was a mixed method consisting of qualitative and quantitative exploration methods, as shown in Figure 3.

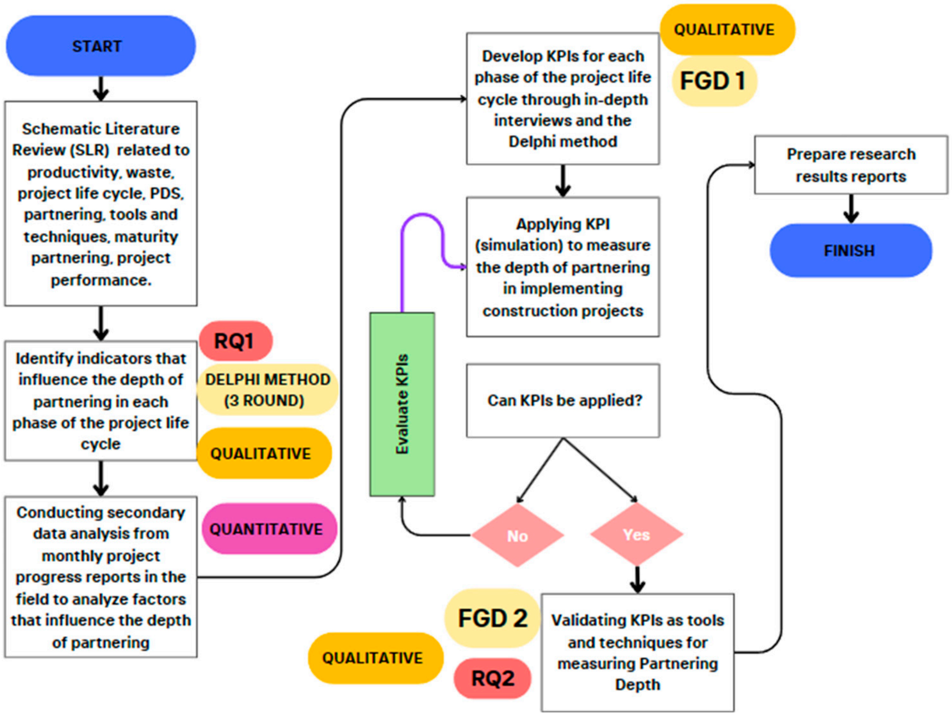

Figure 3. Steps of this research.

The research steps shown in Figure 3 consisted of the following:

Step 1: Conducting a Schematic Literature Review (SLR) to determine research gaps and novelty, analyses related to productivity, waste, project life cycles, project delivery systems, partnering, tools and techniques, maturity partnering, as well as project performance.
Step 2: Identifying indicators that influence the depth of partnering in each phase of the project life cycle. In this stage, identification was conducted through literature and previous research. Furthermore, the Delphi method was performed in 3 rounds to draw consensus from experts who have tacit knowledge of the field.
Step 3: Conducting secondary data analyses from the monthly progress report of the project to determine the depth of partnering in the DB project.
Step 4: Preparing KPIs for each phase in the project life cycle, accompanied by in-depth interviews with actors in the field. Following this, an FGD was performed to finalize the prepared KPIs.
Step 5: Applying KPIs in the project comprised generating a field report and measuring the depth of partnering using prepared KPIs. After the application of KPIs, the finalization process was initiated.
Step 6: Validating KPIs that have been confirmed in an expert FGD to finalize tools and techniques for measuring the depth of partnering in DB projects.
Step 7: Preparing the research report.

The schematic from the research methodology in this exploration was delivered through Research Questions (RQs) from the aims of this finding. There were two indicators to be achieved in this research that are described in Table 1.

Table 1. Research question strategy.

RQ	Problem	Input	Process	Output
RQ1	How do the indicators that are developed in every project life cycle phase to prepare tools and techniques deepen partnering for both private and government projects?	Variables from literature review	Literature research and validation from experts.	Indicator mapping of project life cycle on DB and DBB projects.
RQ2	How does building KPIs determine maturity partnering in every project life cycle phase and project performance?	Variables from literature review and output of RQ1.	Delphi method and in-depth interviews.	KPIs mapping to determine maturity partnering.

Table 1 shows two questions that were answered in the research conducted through the literature review and the Delphi method. To execute the Delphi method, the following were included:

1. Nine experts who were heterogeneously competent in construction management. The criteria for each expert were given limitations, including that the project managers were selected with experience as a manager of at least 5 (five) years in large category projects, namely a minimum of over IDR 100 billion. Similarly, senior designers were also limited to a minimum of 10 years of experience.
2. The Delphi method was conducted in three rounds to reach consensus to state the factors and variables that affect the depth of partnering in a DB project.

Below are the profiles of the experts included in the Delphi method.

Table 2 shows a list of the profiles of the participants in the Delphi method, which was conducted in three rounds.

Table 2. Profile of participants for FGD.

Actor	Resp.	Position/Role
Owner	1	Chief Executive Officer
	2	Chief Executive Officer
Designer	3	Senior Designer
	4	Senior Designer
Contractor	5	Chief Executive Officer
	6	Project Manager
	7	Operational Director
Academic	8	Professor of Construction Management
	9	Professor of Construction Management

3. Results

3.1. Schematic Literature Review

The schematic literature review focused on the factors and variables that influenced the level of maturity partnering in construction projects. These factors were divided into each phase of the project life cycle, which included initiation, design, construction work, and completion. Crane (1999) [18] concluded that the indicators for measuring partnering maturity consisted of five indicators.

The next step was separating the factors in Table 3 in every project life cycle phase by combining literature reviews from other members. The schematic literature review used for each life cycle phase of the project can be seen in Table 4.

Table 3. The indicators in measuring maturity partnering.

Cost	Schedule	Safety	Quality	Litigation
• Cost performance index • Project in cash flow plan • Billable ratio (engineering) • Engineering work hour/unit of product • Third-party work sampling to determine contractor effectiveness • Value engineering savings • Engineering as a percentage of total installed cost • Duplication of effort • Cost growth • Overhead as a percentage of total installed cost	• Schedule performance index • Milestones met • Immediate notification of delays • Preassembly of equipment (percentage of total) • Timely issue of engineering documents and equipment • Availability of spare parts/change parts • Cycle time (product to market) • Time to process change orders, purchase orders, requests for information, etc.	• Lost time and non-lost time incidents • Occupational Safety and Health Administration • Recordable incidents • Drug testing results • Safety training performed on time • Same-day correction of safety problems	• Conformance to specifications • Achievement of operating objectives • Percent of rework • Plant output • Participation in design by construction/manufacturing personnel • Start-up performance • Number of engineering changes • Customer feedback • Audit deviations • Errors and omissions • First-pass yield	• Outstanding claims • Number of conflicts elevated to each level

Table 4. Schematic literature review.

No.	Affecting Factor	References
Initiation		
1	Cost performance index	[38–40]
2	Project in cash flow plan	[38–40]
3	Third-party work sampling to determine contractor effectiveness	[38–40]
4	Cost growth	[38–40]
5	Project value on environmental awareness and environmentally friendly	[41]
6	There was stakeholder participation since before the project started	[21,42]
Design		
1	Value engineering savings	[43,44]
2	Engineering as a percentage of total installed cost	[43,44]
3	Conformance to specifications	[4,45]
4	Waste management by considering material optimization and transportation	[41,46–49]
5	Supplier/subcontractor participation in design process	[13,19,21]
Construction		
1	Billable ratio (engineering)	[50]
2	Engineering work hour/unit of product	[51]
3	Engineering as a percentage of total installed cost	[10]
4	Duplication of effort	[52–54]
5	Overhead as a percentage of total installed cost	[55–60]
6	Schedule performance index	[55–60]
7	Milestones met	[55–60]
8	Immediate notification of delays	[55–60]

Table 4. *Cont.*

No.	Affecting Factor	References
Construction		
9	Preassembly of equipment (percentage of total)	[55–60]
10	Timely issue of engineering documents and	[55–60]
11	equipment	[55–60]
12	Availability of spare parts/change parts	[55–60]
13	Cycle time (product to market)	[55–60]
14	Time to process change orders, purchase orders, requests for information, etc.	[55–60]
15	Lost-time and non-lost-time incidents	[55–60]
16	Occupational Safety and Health Administration	[55–60]
17	recordable incidents	[55–60]
18	Drug testing results	[55–60]
19	Safety training performed on time	[55–60]
20	Same-day correction of safety problems	[55–60]
21	Conformance to specifications	[55–60]
22	Achievement of operating objectives	[55–60]
23	Percentage of rework	[55–60]
24	Plant output	[55–60]
25	Participation in design by construction/manufacturing personnel	[55–60]
26	Start-up performance	[55–60]
27	Number of engineering changes	[55–60]
Closing		
1	Customer feedback	[18]
2	Audit deviations	[18]
3	Errors and omissions	[18]
4	First-pass yield	[18]
5	Outstanding claims	[18]
6	Number of conflicts elevated to each level	[18]
7	Time limit on building handover, maximum 5% penalty from contract	President decree no 54, point 93
8	Project maintenance cost	[61]
9	Green SOP in managing environmentally friendly building	[61]
10	Certificate of functional fitness published by local government before handover to owner	[61]

3.2. Delphi Method Round 1: Affecting Factors of Maturity Partnering

Round 1 of the Delphi method consisted of interviewing experts in order to provide opinions on the factors influencing the quality of maturity partnering in a project. During this phase, experts had five days to identify five influencing factors to prepare tools and techniques for measuring the level of partnering maturity. In addition, literature review mapping was also provided for the reference of the experts, without limiting previous experience in the field. The results of Delphi Round 1 are shown in Table 5, consisting of 26 factors.

Table 5. Delphi Round 1 results.

No.	Factors Affecting the Development of KPIs
1	Objectives and benefits of partnering
2	Object aim/project delivery system
3	Identified type of interaction
4	Activity goals in PDCA
5	Identified performance indicators
6	Underlying requirements and values
7	There was stakeholder participation before the project started
8	Project value regarding environmental awareness and environmentally friendliness
9	Cost performance index
10	Cost growth
11	Effectiveness in partnering
12	Savings due to value
13	Successful engineering compared to the total cost used
14	Conformity to specifications
15	Waste management during design
16	Repetitive work
17	Performance index schedule
18	Time needed for extra work
19	Conformity to specifications
20	Percentage of cost overruns
21	Suitable milestone schedule
22	Openness
23	Responsibility
24	Avoided conflicts of interest
25	Effectiveness in partnering
26	Loss due to project accidents that affected KPIs in formulating the tools and techniques in partnering projects

3.3. Delphi Method Round 2: Refining Affecting Factors

Round 2 comprised conducting FGD to discuss all the determined factors and importance. Subsequently, questions were asked to validate the importance level of each factor by selecting "Very Important", "Important", and "Not Important" for each phase of the project life cycle. The results of Delphi Round 2 are provided in Table 6.

Table 6. Delphi Round 2 results.

No.	Factors	Very Important	Important	Not Important
1	Aims and benefits of partnering	70%	30%	
2	Object goals/project delivery system	60%	40%	
3	Identified type of interaction	30%	70%	
4	Activity goals in PDCA	40%	60%	
5	Identified performance indicators	50%	50%	
6	Underlying requirements and values	40%	30%	30%

Table 6. *Cont.*

No.	Factors	Very Important	Important	Not Important
7	There was stakeholder participation since before the project started	50%	40%	10%
8	Project value on environmental awareness and environmentally friendly	50%	50%	
9	Cost performance index	20%	80%	
10	Cost growth	10%	70%	20%
11	Effectiveness in partnering	60%	40%	
12	Savings due to value	50%	50%	
13	Successful engineering compared to the total cost used	60%	40%	
14	Conformity to specifications	40%	60%	
15	Waste management during design	10%	90%	
16	Repetitive work	20%	70%	10%
17	Performance index schedule	40%	80%	
18	Time needed for extra work	40%	40%	20%
19	Conformity to specifications	50%	50%	
20	Percentage of cost overruns	40%	60%	
21	Suitable milestone schedule	60%	40%	
22	Openness	40%	60%	
23	Responsibility	50%	50%	
24	Avoided conflicts of interest	60%	40%	
25	Effectiveness in partnering	60%	40%	
26	Loss due to project accident	30%	50%	20%

From Table 6, each factor had an importance level above 50%. Therefore, all 26 factors were used to prepare tools and techniques to measure maturity partnering.

3.4. Delphi Method Round 3: Utility and Validation Affecting Factors

Utility and validation were conducted on the affecting factors identified in Delphi Round 2. In Round 3, experts were asked to assess utility on a scale from 1 to 5, with 0.1 showing "**Low Suitable**" and 5 showing "**High Suitable**". Furthermore, factors scoring below the average of 2.5 were not used as KPIs in developing tools and techniques for measuring maturity partnering. Table 7 shows the results of the utility and validation of the influencing factors.

Table 7. Delphi Round 3 results.

No.	Factors	Utility 1–5 Degree
1	Aims and benefits of partnering	5
2	Object goals/project delivery system	4
3	Identified type of interaction	4
4	Activity goals in PDCA	3
5	Identified performance indicators	4
6	Underlying requirements and values	4

Table 7. *Cont.*

No.	Factors	Utility 1–5 Degree
7	There was stakeholder participation since before the project started	4
8	Project value on environmental awareness and environmentally friendly	3
9	Cost performance index	3
10	Cost growth	2
11	Effectiveness in partnering	4
12	Savings due to value	3
13	Successful engineering compared to the total cost used	3
14	Conformity to specifications	3
15	Waste management during design	3
16	Repetitive work	3
17	Performance index schedule	4
18	Time needed for extra work	4
19	Conformity to specifications	4
20	Percentage of cost overruns	3
21	Suitable milestone schedule	4
22	Openness	4
23	Responsibility	4
24	Avoided conflicts of interest	5
25	Effectiveness in partnering	4
26	Loss due to project accident	2

According to Table 7, a consensus was obtained from experts that two factors were not used, namely no. 10 and no. 26.

4. Discussion

Validation was conducted on the factors and variables affecting the preparation of tools and techniques for maturity partnering in construction projects. The next step was to prepare an assessment of each factor using a Pinto-based metric, categorized as non-programmed, basic, defined, managed, and institutionalized. The scoring system ranged from 0 to 5, with detailed explanations provided as follows (Table 8).

Through in-depth interviews conducted at six project locations with varying project performances in DB projects, conclusions were based on the empirical field and the result of the in-depth interview. In the data analysis of field projects, it was found that project performance was lower when partnering levels were lower and partnering had not been implemented institutionally. Furthermore, the lack of intensive cooperation between owners and contractors as project stakeholders led to design changes during project implementation. Differences in understanding project documents led to the project lacking partnering from the beginning.

4.1. Project Data Progress Mapping

Mapping was created on six DB project locations that were located in Indonesia. The project value was more than IDR 100 billion, which is approximately USD 6.25 million, and the detailed data are shown in Table 9.

Table 8. Maturity partnering scoring [24].

Level	Description
Level 0	No partnering and no practice or partnering principle in the project.
Level 1	Partnering was conducted informally. It was not visible in the strategy prepared, and there was no team appointed as PIC for communication between stakeholders. Very limited partnering practices were used based on previous experience. Minimal efforts in reducing risks or taking risks for short-term benefits were employed. Ad hoc strategies were implemented by people who have partnering skills, and the process was not well controlled.
Level 2	There was a written plan for the partnership policy and strategy. There was a kick-off process and a meeting to discuss partnering in-depth, including previous plans and the appointment of a PIC to lead the partnering program being performed. Performance metrics were developed in partnering to achieve set project objectives, evaluating in-depth performance achievements, and there was feedback on problems solved by partnering.
Level 3	Organization-wide standards and strategies were applied to many projects. The partnering process occurred from the project initiation phase to establish shared aims and was managed using performance metrics. Achievement of organizational performance was visible, and productivity followed the objectives set. There was comprehensive documentation of meetings and coordination regarding the partnering conducted.
Level 4	Have and use strategies, documentation, and partnering were associated, integrated, as well as structured. A validated continuous improvement system to achieve project objectives and each phase innovates to increase value. The focus was on continuously improving performance through change management (e.g., incremental and innovative changes).

Table 9. List of projects.

No.	Title	Value (USD Million)	Location
1	DB "A"	12.5	DKI Jakarta
2	DB "B"	10.0	DKI Jakarta
3	DB "C"	16.5	Bukittinggi, West Sumatera
4	DB "D"	18.3	DKI Jakarta
5	DB "E"	9.0	DKI Jakarta
6	DB "F"	16.5	East Kalimantan

Project data were obtained in six locations spread nationally in Indonesia. The statistical results are shown in Table 10, in line with the list in Table 9.

Table 10. Statistical scoring.

Criteria	DB "A"	DB "B"	DB "C"	DB "D"	DB "E"	DB "F"
MEAN	0.268%	1.217%	7.544%	5.849%	9.399%	6.537%
MEDIAN	0.534%	3.137%	5.487%	6.092%	7.98%	4.719%
%MEAN and MEDIAN	49.811%	61.207%	37.475%	3.989%	17.815%	38.525%
STD	0.9%	1.5%	2.1%	3.2%	3.8%	3.4%
Deviation of MEAN	−0.7%	−0.3%	5.5%	2.6%	5.6%	3.1%

The data on DB "A" and DB "B", in the standard deviation graphics, show that the value deviated from the mean.

Figure 4 shows that the project performance was in accordance with the mean, median, and standard deviation. In this context, the DB "A" and DB "B" values were away from the mean. A similar value was also reflected in the in-depth interview results, where no partnering in a project caused poor project performance.

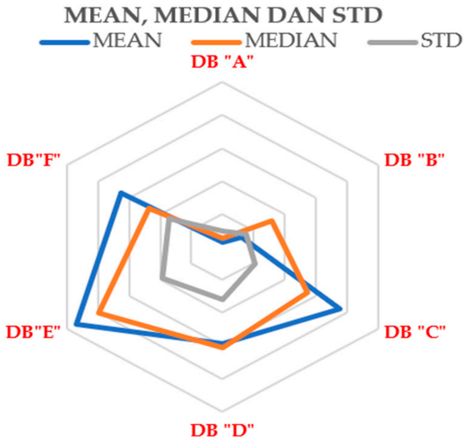

Figure 4. Statistical data of projects.

4.2. Maturity Partnering Simulation

Mapping and in-depth interviews were conducted on six projects to determine the position and scoring of each project. DB "A" had characteristics at the basic partnering level. Typically, partnering was not visible in the strategy prepared, and there was no team appointed as PIC for communication between stakeholders. Consequently, very limited partnership practices were used based on previous experience. Moreover, ad hoc strategies were implemented by people who have partnering skills, and the process was not well controlled, and some steps were not thoroughly communicated to achieve deep partnering. The positions of the owner and general contractor were still "competitive", and they supervised each other in achieving project performance. Additionally, project performance was behind schedule according to the planned project schedule, and project overhead had also increased. The same increment was conducted on five other projects to determine the maturity level of partnering for each project. Based on the results of the in-depth interviews and project data mapping, a conclusion was made from the six simulated projects as follows:

In Figure 5, it is shown that the DB "C" and DB "E" projects had an institutionalized level of implementation, where strategies and partnering mapping were in place from the start of the project. Subcontractors were required to prepare offers and implement the best value-for-money strategy in the offers. Additionally, in DB "D" and DB "F", partnering work occurred at a managed level, where the standardization of it had been established but had not yet fully become a culture in the organization. Partnering was still at the basic level, where there was still competition between the included parties in the DB "A" and DB "B" projects.

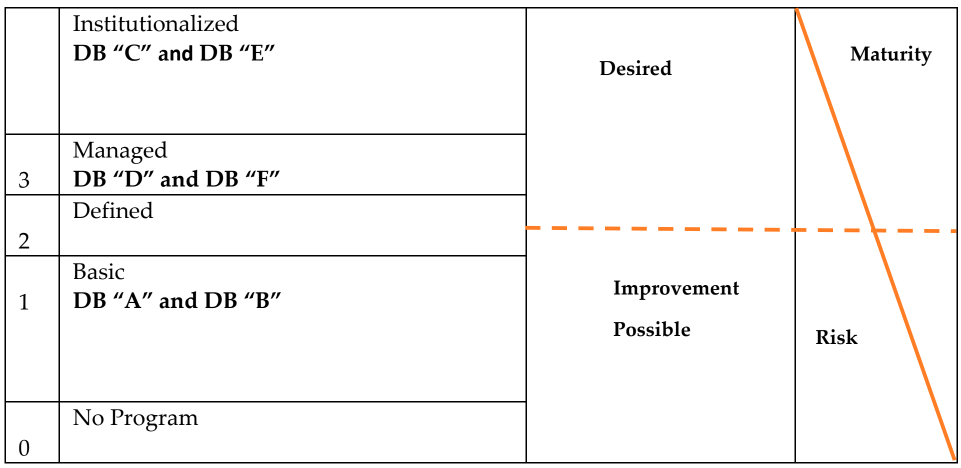

Figure 5. Simulation of partnering.

5. Conclusions

In conclusion, several inferences can be made from the prior discussion, which include the following:

1. Maturity partnering in a project improved service delivery and provided better value. This process led to better performance and faster completion times on projects. Although partnering could be a strategy to achieve better project performance, projects with deep partnering achieved better performance based on the trust placed in each stakeholder before project implementation.
2. The depth of the partnering was measured, and its maturity increased by examining the initial point of the existing partnering. This initial step allowed for the partnering to be expanded gradually, moving towards a deeper and more institutionalized direction. Partnering that was implemented institutionally became part of the organizational culture and achieved more specific organizational aims.
3. The indicators developed in measuring the depth of partnering were considered to be influencing factors in increasing the depth of it in DB projects.
4. KPIs were arranged as scoring in measuring maturity partnering using tiered levels, whereby project positioning on maturity partnering was measured. In addition, KPIs were a clear measure for determining the depth of a project based on standards that had been established together.
5. Project organizations that were aware of the maturity partnering position increased the level of it to improve quality and strengthen the culture in the project organization. The level of partnering depth was measured continuously to transform the partnering into an organizational culture useful for improving construction project performance.
6. The limitation of this research was that KPIs were structured to be implemented in Design and Build projects, but it was possible to modify developments for other delivery projects such as Design Bid Build and Integrated Project Delivery.

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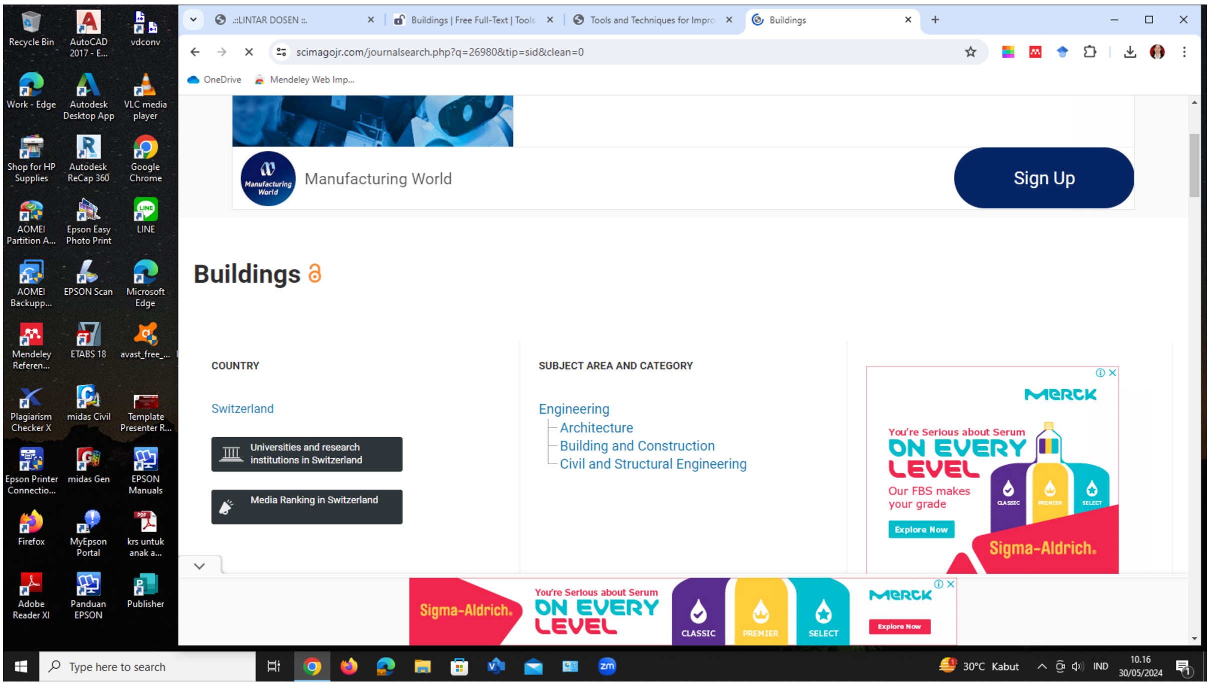
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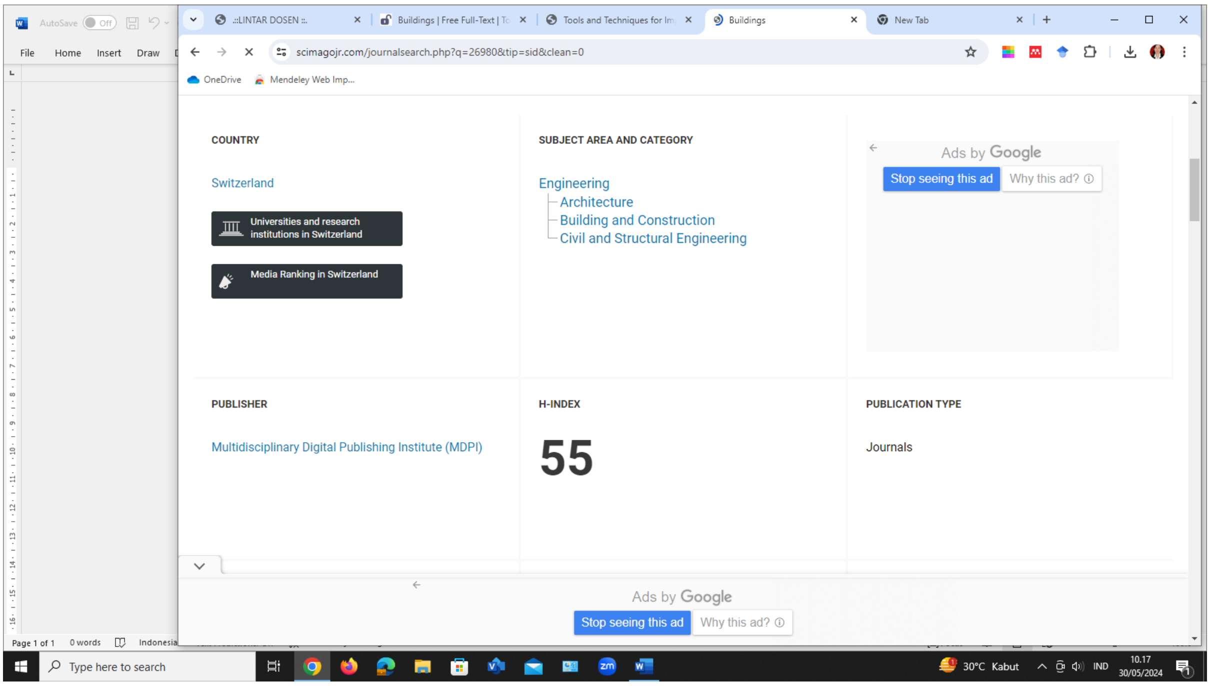
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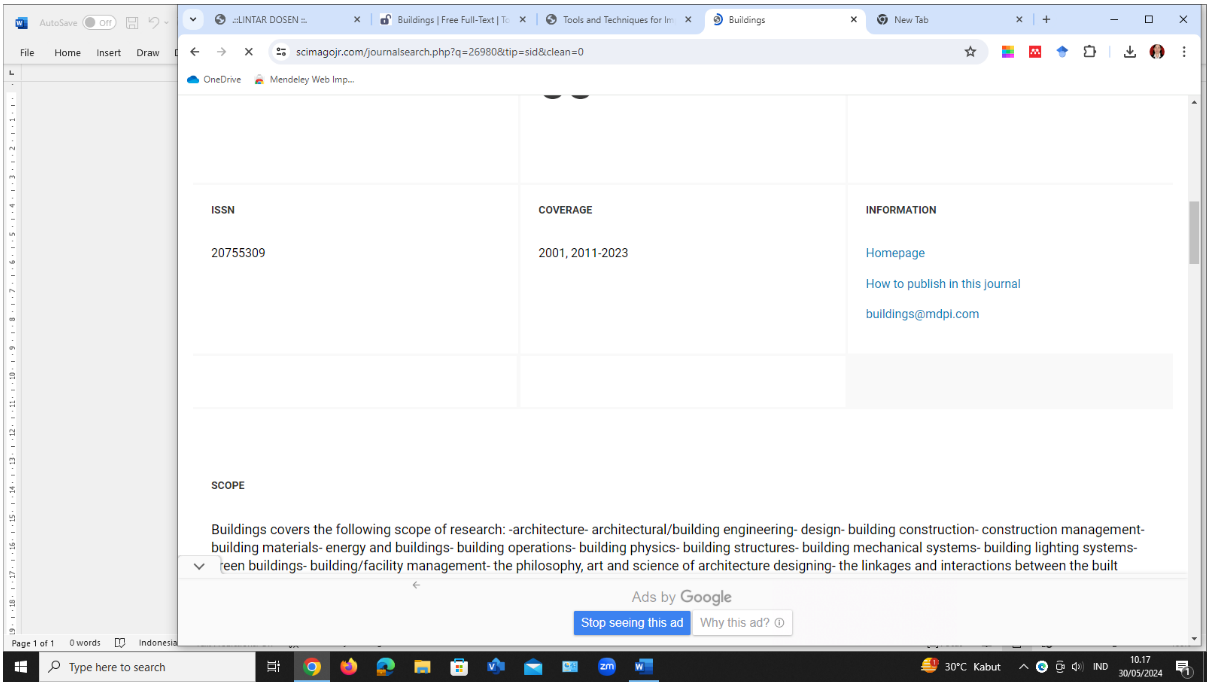
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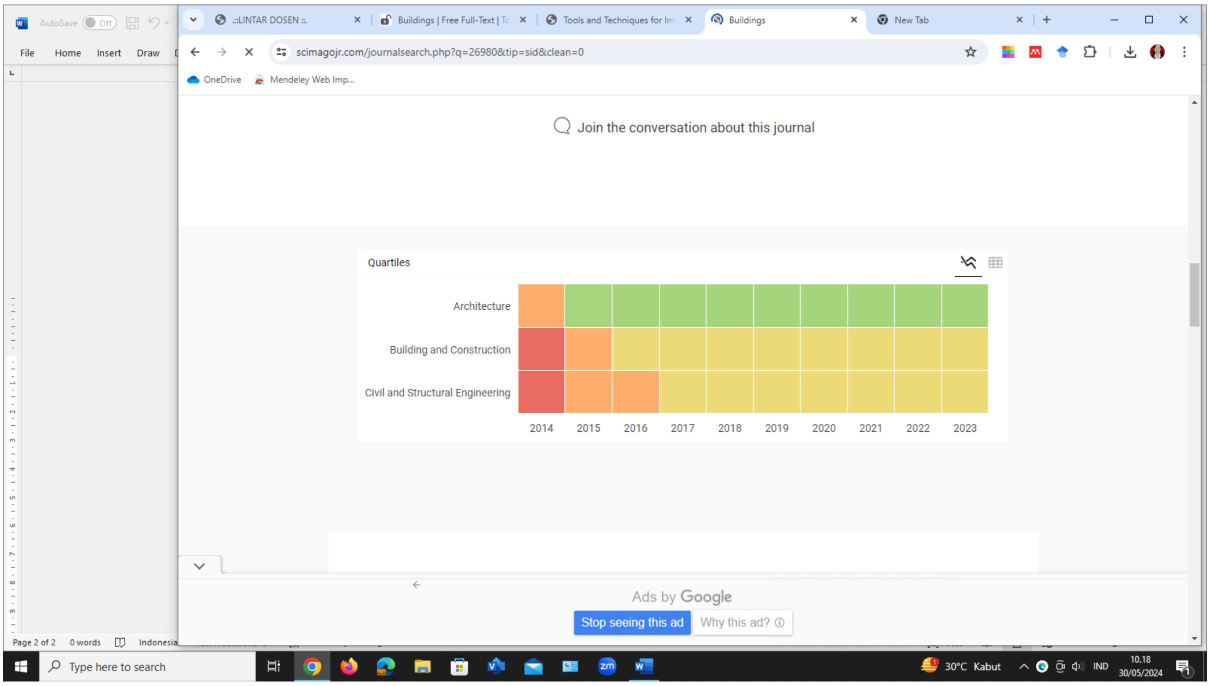
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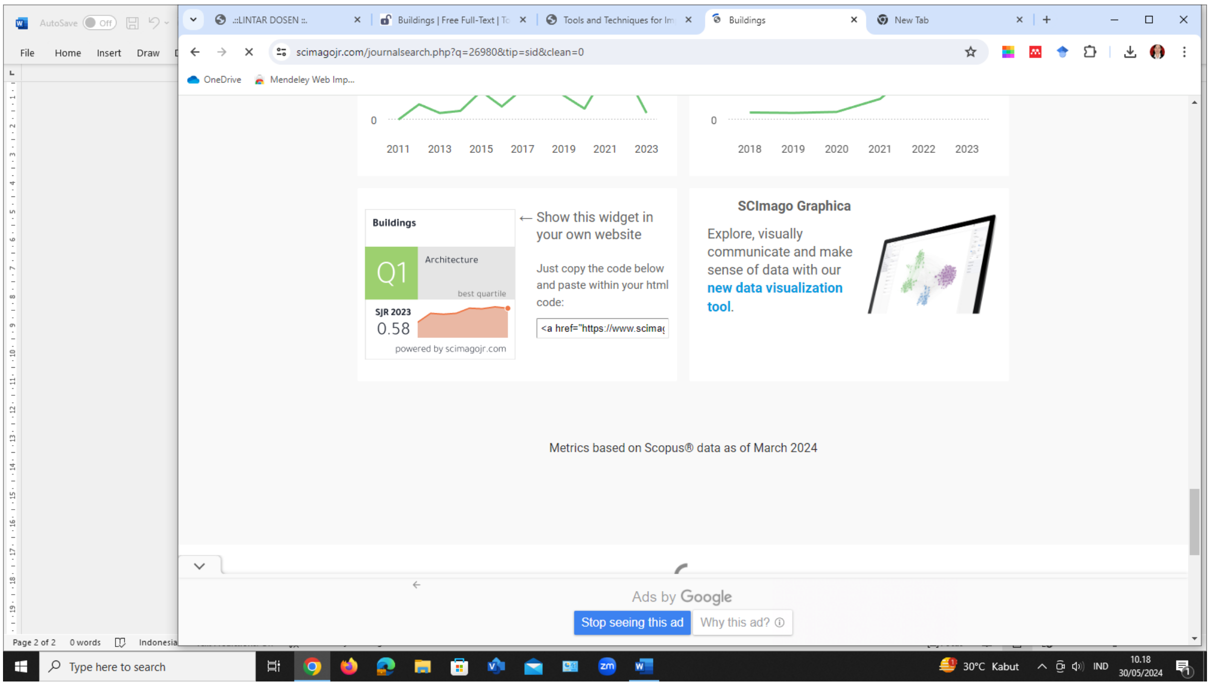
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