University of Baghdad
College of Engineering
JE
JOURNAL OF ENGINEERING

Journal of Engineering

journal homepage: www.joe.uobaghdad.edu.iq

Volume 30 Number 1 January 2024

Investigate IPD Factors' Effect on Value Engineering for the Communication Sector in Iraq

Prween S. Majeed[1,*], Mervit R. ALTaie[2]

Department of Civil Engineering, College of Engineering, University of Baghdad, Baghdad, Iraq.
prween.sabeeh2101m@coeng.uobaghdad.edu.iq[1], meervat.r@coeng.uobaghdad.edu.iq[2]

ABSTRACT

Integrated project delivery is collaboratively applying the skills and knowledge of all participants to optimize the project's results, increase owner value, decrease waste, and maximize efficiency during the design, fabrication, and construction processes. This study aims to determine IPD criteria positively impacting value engineering. To do this, the study has considered 9 main criteria according to PMP classification that already covers all project phases and 183 sub-criteria obtained from theoretical study and expert interviews (fieldwork). In this study, the SPSS (V26) program was used to analyze the main criteria and sub-criteria priorities from top to bottom according to their values of the Relative Importance Index. The results of this study have clarified the **(**Project stockholders Management **)** as the most significant main criteria with RII (74%) and (Stakeholders, work team, customers, suppliers, and project managers' support improve the probability of project implementation on the ground) as the most significant sub-criteria with (RII) (91%)

Keywords: Integrated Project Delivery (IPD), Value Engineering (VE), Statistical Analysis, Project Performance

*Corresponding author
Peer review under the responsibility of University of Baghdad.
https://doi.org/10.31026/j.eng.2024.01.06

Article received: 09/04/2023
Article accepted: 04/08/2023
Article published: 01/01/2024

التحري في تأثير عوامل IPD على الهندسة القيمية لقطاع الاتصالات في العراق

بروين صبيح مجيد[1]،*، ميرفت رزاق الطائي[2]

قسم الهندسة المدنية، كلية الهندسة، جامعة بغداد، بغداد، العراق

الخلاصة

التسليم المتكامل للمشروع هو تطبيق تعاوني لمهارات ومعارف جميع المشاركين لتحسين نتائج المشروع ، وزيادة قيمة المالك ، وتقليل النفايات ، وزيادة الكفاءة أثناء عمليات التصميم والتصنيع والبناء. تهدف هذه الدراسة إلى تكامل IPD مع هندسة القيمة وتعريف معايير IPD ذات التأثير الإيجابي على هندسة القيمة للقيام بذلك ، فقد أخذت الدراسة في الاعتبار 9 معايير رئيسية وفقًا لتصنيف PMP الذي يغطي بالفعل جميع مراحل المشروع و 183 معيارًا فرعيًا تم الحصول عليها من الدراسة النظرية ومقابلات الخبراء (العمل الميداني). في هذه الدراسة ، تم استخدام برنامج SPSS (V26) لتحليل المعايير الرئيسية وترتيب المعايير الفرعية حسب الاولوية لقيم مؤشر الأهمية النسبية الخاصة بهم. أوضحت نتائج هذه الدراسة أهم المعايير الرئيسية (المساهمين في المشروع) مع نسبة مؤشر الاهمية النسبية (74٪) و (المساهمين ، فريق العمل ، العملاء ، الموردين ، ودعم مديري المشروع يحسن احتمالية تنفيذ المشروع على أرض الواقع.) أهم المعايير الفرعية مع نسبة مؤشر الاهمية النسبية (91٪)

الكلمات المفتاحية: طريقة تسليم المشروع المتكامل , الهندسة القيمية , التحليل الاحصائي , اداء المشروع

1. INTRODUCTION

Traditional construction projects use delivery methods like design-build, design-bid-build, and construction management. Despite the widespread use of the same techniques for decades, many experts remain unsatisfied with the results **(Hall and Scott, 2016; Giachino et al., 2016; Yu et al.,2017).** Owners are often dissatisfied with construction projects due to several factors, including low quality, delays, and cost overruns. **(Lichtig, 2006; Alves and Shah, 2018**; **Samarghandi et al.,2016).** IPD develops as an original delivery approach that improves project performance through a highly collaborative process, allowing it to have positive coemption between participants. This makes it better than traditional delivery methods **(El Asmar et al., 2012; Kahvandi et al., 2017).** The American Institute of Architects AIA defines it as "a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the skills and knowledge of all project participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency throughout all project phases **(AIA, 2007; Fischer et al., 2017; Li et al .,2015), Fig. 1** show the Contracts, processes, data/modeling, teams, and communications define a majority of IPD research, and their unique characteristics set them apart from more traditional approaches **(Pishdad, 2017; Brahmi and Sassi, 2022).**
According to **(Nigjeh and Amani, 2022; Park, 2017; Miles,2015)**, Value engineering is a powerful technique for problem-solving, cost reduction, and improving performance and

quality, which, by identifying and enhancing value measures and employing creativity, increases client satisfaction and profitability. VE is not a low-cost use. VE is a methodical approach to increasing the "value" of a product or service by analyzing how it is used. Eq. (1) shows value refers to the usefulness and expense ratio. Value, consequently, can be enhanced by either enhancing the purpose or cutting down on expenses (**Atabay and Galipogullari, 2013; Ibengwe and Onyango, 2023; Yihua and Tuo, 2011).**

$$\text{Value Engineering} = \frac{\text{Function}}{\text{cost}} \quad (1)$$

This study aims to identify the main and sub-criteria that need to be analyzed and considered for recommending the lPD factor's effect on value engineering in the communication sector in Iraq and the order of the relative importance of the various criteria and sub-criteria (RII).

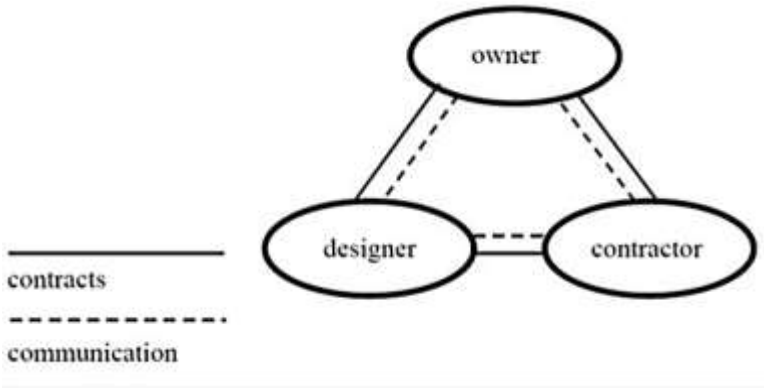

Figure 1. Contractual relationship in IPD **(AIA, 2007)**

2. METHODOLOGY

It is the systematic research process to gather, analyze, and interpret information. It provides a framework for r studies, ensuring the data collected is reliable, valid, and objective. Research methodology is crucial in all fields of study. In this study, three steps are included.

2.1 Design the Questionnaire

This study uses a quantitative method, interviewing professionals in the Iraqi telecommunication sector to complete the questionnaire. There are a variety of experience levels of expertise among owners, advisors, and contractors because of their unique perspectives and experiences. The various entities involved in the IPD process can evaluate the IPD sub-criteria that affect value engineering, as shown in **Table 1.**

Table 1. The details of Civil engineers Experts in Civil engineering specialists

Scientific Qualification	No. of Experience	Experience
Ph.D.	3	More than 30 years
MSc.	5	20years

The researcher established the framework for the questionnaire axes after a series of meetings, and an exchange of ideas and information on secondary criteria provided the basis according to by fundamentals of project management. The questionnaire was divided into three parts: the first contains the introduction and a simplified explanation of the subject of the study. The second involved personal questions and the third had technical questions organized along nine main axes with a Likert scale five-degree as shown in **Table 2.**

1- Project Scope Management.
2- Project Time Management.
3- Project Cost Management.
4- Project Quality Management.
5- Human Resources Management.
6- Project Communication Management.
7- Project Risk Management.
8- Project Procurement Management.
9- Project Stakeholder Management.

That already covers IPD delivery in all project phases (PMP GUIDE) Significant success factors that added value to project performance were identified through interviews with experts of Iraqi engineers (both public and private).

Table 2. Likert scale **(Salkind, 2010)**

Opinion	Weight
It has no impact.	1
An inadequate grade	2
average degree	3
high level	4
Very high level	5

2.2 Pilot Study

A pilot study is an initial, smaller-scale experiment performed on a subset of the total study population with characteristics indicative of the full population should have (30) participants at least This study selected 30 respondents, distributed the questionnaire, and collected, organized, and prepared the replies for statistical tests **(Abbas and Burhan, 2022; Victorson et al., 2020; Teijlingen and Hundley, 2002).**

2.3 Close Questionnaire

The questionnaire was passed on to a sample of 100 engineers who work in the communication sector, but 77 correct and completed questionnaire forms. The technical part of the questionnaire was divided into nine main axes based on the basics of project management. Each main axe consists of many sub-criteria and, as a result, generates 183 sub-criteria, as shown in Appendix A on a five-point scale. After explaining the purpose of the questionnaire, the researcher collected the voting results and analyzed the answers

using the SPSS program (V26) by extracting the arithmetic mean and standard deviation for all the criteria, in addition to the relative importance index.

3. QUESTIONNAIRE DATA ANALYSIS

Questionnaire data can be broadly categorized into two types: qualitative and quantitative data. Qualitative data include open-ended responses that provide descriptive and subjective information, while quantitative data consists of structured responses that can be quantified and statistically analyzed **(Field, 2013; Pershing, 2006; Gorter, 2015)**

3.1 Validity

To develop tests, standards, and honesty, it is necessary to present the scale's paragraphs to a panel of experts to assess their validity. This is the most accurate gauge of sincerity **(Majeed and Breesam, 2021; Taherdoost, 2016)**

3.2 Reliability

This test is used to evaluate the acceptability and reliability of the results. Cronbach's alpha is commonly used to measure accuracy, uniformity, homogeneity, unity, dimensionality, and harmony **(Abbas and Burhan, 2023; Taber, 2018; Elsayed, 2012; Roberts and Priest, 2006). Table 3.** shows the result of the Validity and reliability test for the main criteria and all values above the standard range (0.7)

Table 3. Validity and Reliability Statistical factors groups

No	Main Criteria	No. of item	Readability	Validity
1	Scope	20	0.74	0.75
2	Time	22	0.779	0.818
3	Cost	21	0.756	0.8
4	Quality	21	0.724	0.85
5	Recourse	20	0.72	0.9
6	Communication	21	0.707	0.809
7	Risk	20	0.73	0.85
8	Procurement	20	0.73	0.8
9	Stack	20	0.739	0.9

3.3 Mean

The means test was used to analyze response data. The average rating for each response factor or choice was determined using point scales. After calculating the average, the options were ranked from least to most important. The formula is used to determine each criterion's average rating **(Siegel and Castellan, 2008; de Carvalho, 2016; Lampert, 2010; Mohammad and Mahdi, 2014; Doos et al., 2016).**

3.4 The index of relative importance (RII)

The relative relevance index is a way to use statistics to rank various variables. A formula is used to rank the most important influences on VE based on how often the elements occur, which is decided by experts. The formula for the relative frequency index is given **(Majeed and Breesam, 2021; Noori and Rasheed, 2023),** as presented in **Table 4.**

$$\text{RII (criteria)} = \sum [\![W/(A * N)]\!] \quad (2)$$

where:
W is a cumulative weighting of each characteristic
A is top-ranked (used 5)
N is cumulative responses

Table 4. The rank of main criteria regarding RII, mean, and SD.

Descriptive Statistics			
Main Criteria	Mean	Std. Deviation	RII
Project stockholders Management	3.7318	0.26369	0.746
Human resources Management	3.6338	0.48064	0.727
Project Risk Management	3.6006	0.22992	0.72
Project cost Management	3.5494	0.47368	0.71
Project Quality Management	3.5461	0.39386	0.709
Project Time Management	3.5277	0.48421	0.706
Project procurement Management	3.5084	0.31689	0.702
Project Communication Management	3.5053	0.18152	0.701
Project Scope Management	3.5026	0.18405	0.701

For the subcriteria also analyzed with the SPSS program among the 183 sub-criteria, it was found that 67 sub-criteria have a Relatively important index(RII) to and greater than 0.7 To reach accurate and specific results to benefit from them in the future as much as possible, a second questionnaire was conducted, and the most influential criteria were investigated among the 67 criteria. According to the table below, the result was the selection of 23 sub-criteria, considered the most significant for value engineering, as shown in **Table 5**.

Table 5. IPD factors' effect on value engineering

Category	Sub-criteria	Mean	Std. Deviation	RII
scope	The skill of the work team in formulating the details of the project by covering all the details	4.5455	0.50119	0.9091
	Defining the details of the project based on the details of the work required, the method of implementation, the periods, and the required specifications	4.4935	0.50324	0.8987
	Transparency and clarity in describing the work required by the beneficiary	4.4286	0.49812	0.8857

Time	The work team's experience in preparing the schedule in a flexible manner for the project's activities	4.5065	0.50324	0.9013
	Manage relationships between project team members	4.4545	0.85140	0.8909
cost	Develop a budget for the required work by defining the cost of the work items in the project and the level of project performance	4.4805	0.50290	0.8961
	quality of work required	4.0130	0.80285	0.8026
	Prepare an emergency budget to face the dangers	3.8312	1.17432	0.7662
quality	Spreading the culture of quality, clarifying its importance to the survival and development of the institution, and showing its material and moral benefits	4.0779	0.77402	0.8156
	Continuous evaluation of services to ensure continuous improvement	3.8571	0.78997	0.7714
Human Resource	Organizing training and introductory workshops on the project	4.5714	0.52387	0.9143
	The skill of the work team in administrative methods: listening to the ideas of others, to dialogue with others about the goals of the group, helping individuals while showing respect for the other party and supporting his views, developing communication skills between the team and using various means of communication such as e-mail	4.5714	0.49812	0.9143
	Participation of the management team and exchange of ideas and suggestions	4.0909	0.78106	0.8182
	Managing the relations between the work team members on the one hand and the external relations on the other hand	4.0000	0.79472	0.8
Communication	Identify the project management stakeholders, the power of the individuals, and their positions.	4.5714	0.49812	0.9143
	Specify communication hours within the official working hours	3.4935	1.20986	0.6987
risk	Stakeholder culture of the need to study and analyze project risk	4.4935	0.50324	0.8987
	Showing the cost and benefit of applying Risk assessment.	4.0909	0.83006	0.8182
procurement	Managing and organizing contracts in a way that guarantees the rights of both	4.5584	0.49983	0.9117

	parties regarding the supply periods and the conformity of the required specifications			
	continuous effort to learn more about the best materials and manufacturing techniques	4.4286	0.49812	0.8857
Stakeholder	Determining the amount of communication with stakeholders to the extent that fits the terms of reference, such as investigating and questioning concepts or events to gain greater understanding, obtaining facts to confirm or define information	4.5584	0.49983	0.9117
	Identify and distinguish stakeholders	4.4805	0.50290	0.8961
	Team experience with similar projects	4.4286	0.49812	0.8857

4. RESULTS AND DISCUSSION

The results in **Table 4** that the first criterion is stakeholders with RII (0.746), and this is because each (Integrated project delivery IPD and the value engineering VE) depends on its success in managing humans through the enjoyment of experience, knowledge, creativity and innovation skills, project management, defining responsibilities, choosing those responsible carefully and professionally, and choosing flexible methodologies that are in the interest of the project's progress. As well as sequentially, the arrangement of the remaining criteria based on the opinion of the sample of engineers with expertise in communications. Also, the ratios of the effect of the rest of the criteria, where the researcher agreed with experts in communication projects. Choosing sub-criteria with impact rates of 0.7 and more, as shown in **Table 6. (Kassem et al., 2020)**

Table 6. Range values of RII

Category	Range
Little effect (LE)	0.1 ≤ LE ≤0.2
Some effect (SE)	0.2 <SE ≤ 0.4
Average effect (AE)	0.4 <AE≤ 0.6
High effect (HE)	0.6 <HE ≤ 0.8
Very high effect (VHE)	0.8 <VHE

5. CONCLUSIONS

Through the results that were reached and the status of some projects that were not implemented due to the lack of drafting of contracts well, this sector must adopt new techniques for dealing with tasks, new contracting methods, and improved knowledge to address many issues, including cost overruns, improvement of project functions, project completion on time, and quality of service. The study aimed to determine the success criteria for the integrated project delivery method that promotes value engineering because it is derived from the experiences of knowledgeable and skilled people. Both the project delivery

method and the value engineering technique are based on collective, collaborative work that enhances achieving the project's desired goals. It requires continuous training and updating, similar to the neighboring countries, and staying abreast of the most critical developments in the sectors of the telecommunications field. Finally, the study showed the possibility of applying integration due to common standards enhancing the project's value. These standards can only increase the value of the project once specialized systems and skilled personnel are developed. Technical systems and trained personnel are needed to use many indicators and increase project value effectively.

6. NOMENCLATURE

Symbol	Description
IPD	Integrated project delivery
PMP	Project Management Professional
RII	Relative important index
VE	value engineering
AIA	American Institute of Architects

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Appendix A

1- Project scope management	
No.	Sub Criteria
1	Transparency and clarity in describing the required works

2	Adequate support from stakeholders, work teams, customers, suppliers, and project managers
3	The origin of the required specifications
4	The skill of the work team in formulating the details of the project by covering all the details
5	Project type, size, and similar work experiences
6	Defining the details of the project based on the details of the work required and the method of implementation
7	Setting up the domain for purely profitable purposes
8	Make a list of the deliverables team members must create to meet the project goals.
9	The beneficiary of the project
10	Defining project boundaries from the start, it is also important to list what the project does not include.
11	General economic and political stability
12	Method of payment of financial dues
13	Define a list of all expected constraints so that you can seek ready-to-work solutions as they arise.
14	The type of project is an investment and service.
15	Adjust scope changes during the project life cycle and balance the project triangle.
16	Project function and purpose
17	Duration of work execution
18	Provide photographs and illustrations.
19	Table of quantities details
20	It organizes relations between stakeholders and achieves a set of principles such as justice, transparency, and equality.
2- Project Time Management	
No.	Sub Criteria
21	Project size
22	The work team has an accredited certificate in project time management.
23	Adopting methods and methodologies for other previous projects
24	The work team's experience in preparing the schedule in a flexible manner for the project's activities
25	Starting events that need approvals and long processing times
26	Multiple specializations of the work team
27	Determine working hours and times.
28	Continuous communication between stakeholders by various means to avoid delay and lack of clarity
29	Cash liquidity and financial support to avoid delays or stoppages in business
30	Determine the start and end dates for the required work.
31	Project management environment
32	Monitor and control the execution of the schedule.
33	Provide detailed plans for the required work.
34	Work according to the required specifications.

35	Manage relationships between project team members.
36	Delegate powers to the work team and define them by the team
37	Cooperation and team spirit at work
38	Reduce routine work
39	The presence of the time preparation team in the same work environment as the project
40	Understanding the competitive landscape in the labor market
41	Adopting traditional methods in preparing the schedule
42	Managing the risks that may face the work and affect the schedule
3- Project Cost Management	
No.	Sub Criteria
43	Set a budget for the required work
44	Satisfying the project financier
45	Calculating the estimated total cost of work activities
46	Exceeding the additional costs associated with the original approvals and laboratory tests
47	desired job site
48	Cost analysis through analysis of the function of the elements
49	Work environment and coordination of communication
50	Speed up work as quickly as possible to reduce costs.
51	Adapting to changes in the external environment
52	Project completion schedule
53	Taking into account the time period between cost estimation and implementation of the works
54	Reliance in estimating prices on practical experience
55	Avoid spare orders in executing works in anticipation of cost increases.
56	Adoption of raw materials and raw materials that support the environment
57	the required quality of work
58	Reliance on electronic programs to calculate quantities and prices
59	The success of your business in sales and marketing
60	Advantages and disadvantages of your company's products compared to those of your competitors
61	Reducing working hours
62	Prepare an emergency budget to cope notifications.
4-Project Quality Management	
No.	Sub Criteria
63	Planning for quality requirements early stages
64	Involvement and approval of the quality team on project details and steps
65	Satisfaction of the beneficiary and owners interest
66	Dispensing with quality checks and relying on the team's practical experience
67	Adopting modern methods of training, education and work
68	The speed of completing the required work
69	QA test
70	Origin of raw materials
71	QC test
72	Experimental tests of the service provided

73	The origin of the machines or materials, regardless of the skill of the labor force
74	Availability of features in addition to the original requirements without affecting the cost
75	Moral work climate
76	stakeholder culture
77	The number of members of the quality team
78	Spreading the culture of quality
79	Flexibility of the beneficiaries
80	Stages of project progress
81	Contemporary changes keep pace.
82	Continuous evaluation of services
5- Human Resources Management	
No.	Sub Criteria
83	Strategic planning for team management
84	Teamwork skills in administrative methods
85	Nature and type of project
86	The extent and diversity of the work team's specializations
87	Training of work cadres within the team development programs
88	Duration of completion of the required work
89	Incentives and annual profits
90	The annual evaluation of the work team
91	Business timings
92	management policy
93	Organizing training and introductory workshops on the project
94	Support distinguished staff and provide development opportunities.
95	The participation of the management team and the exchange of ideas and suggestions
96	Citizenship, loyalty, and sincerity in performing tasks
97	Managing relationships between members of the work team
98	Teamwork discipline
99	Organizational justice for the staff of the work team
100	Individual capabilities of the work team
101	The purpose and objective of the project
102	Legislation and rules governing occupational health and safety
6-Project Communication management	
No.	Sub Criteria
103	Stakeholder identification
104	Determine contact hours
105	Plan, manage, and control this communication.
106	The capacity of the information storage servers
107	Compatibility of the communication strategy with the objectives and requirements of stakeholders
108	Compatibility of the communication strategy with the objectives and requirements of stakeholders
109	Type of communication audiovisual official books

110	The beneficiary of the project
111	Transparency in sharing information
112	Excellent negotiation ability
113	Presentation skills and speaking skills
114	Diversity of communication methods
115	The scientific background of the team members
116	Exploiting public events and employing them in a way that increases the effectiveness of the required communication
117	working hours
118	The presence of the work team in one place
119	Create an atmosphere of openness by speaking.
120	Provide communication methods for the work team.
121	The amount of work to be performed
122	Effective listening to project managers
123	Setting priorities and adhering to the communication system
7-Project Risk Management	
No.	Sub Criteria
124	Stakeholder culture of the necessity of studying and analyzing project risk
125	Determine the risk response plan after a series of operations.
126	Years of experience for the risk management team
127	View plans and solutions for similar projects.
128	Preparing an emergency budget
129	Neglecting small risks or events
130	Resorting to the use of alternatives in case of unexpected danger
131	Not to exceed the estimated cost.
132	Predicting risk through indicators that occur in action
133	Project time management
134	Adopting risk management strategies
135	Type and details of work
136	Pay attention to the following factors (leadership, planning, communication, teamwork, and evaluation).
137	Accurately define responsibilities and tasks.
138	Work schedule
139	Demonstrate the cost and benefit of applying ERM.
140	Achieving the required quality standards
141	Provide a program to monitor the execution of tasks.
142	Make an assessment of the effectiveness of the ongoing activities.
143	Incentive system at all levels of the organization.
8-Project Procurement Management	
No.	Sub Criteria
144	Sobriety of the procurement party in completing the procurement of materials, devices, and equipment
145	Organizing the balance between the financial balance granted by the financial department and the required purchase priorities

146	Managing and organizing contracts in a way that guarantees the rights of both parties
147	Constantly striving to increase knowledge.
148	The time required for the project
149	Find alternative sources of supply.
150	Buying insurance at the best economical availability
151	Providing the required specifications regardless of costs
152	Ensure continued good relationships with suppliers.
153	Number of years of experience for the procurement team
154	Ensure the supply and storage of raw materials identical to what is required.
155	Reliance on the reputation of the processing party
156	Green purchasing policy
157	The nature of the materials or equipment
158	Ensure the quality of performance in the purchasing department operations.
159	Reliance on the credibility of suppliers
160	The discount offered by suppliers as a form of competition
161	Cost is the main criterion for processing.
162	The amount of material to be processed
163	Pledge to act with honesty and sincerity
164	Identifying and distinguishing stakeholders
165	Find out the influence and interests of stakeholders.
166	Develop a communication management plan.
167	Determine the method of dealing with stakeholders in a way that supports individuals and work to accomplish the required work.
168	The technical competencies of the work team
169	Project scope management
170	Transforming inflexible people into more flexible people with a positive impact on work performance by focusing on strengths and turning weaknesses into strengths
171	Project cost management
172	Work to avoid the risks resulting from stakeholders.
173	Adopting social relations with work regardless of the tasks of each individual
174	Determine the amount of communication with stakeholders.
175	Human Resource Management
176	Monitor the current strategy and try to improve it continuously
177	Determine the job site.
178	Teamwork experience for similar projects
179	Manage project communications through information planning.
180	Commitment to implementing the schedule
181	Project size
182	Focus on project goals.
183	Be honest and polite.