Supplier / Partnership Selection System Analysis Based on Analytic Hierarchy Method Process in Oil and Gas Drilling Project
(Case Study: PT. KMI)

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Abstract:- Analytic Hierarchy Process is a method used to make decisions from Multi Criteria to solve complex problems in selecting partners. This research aims to use this approach to build a partner selection system using utilizing competitive priorities values from administrative, quality, delivery, financial, technical and price criteria. The researchers used questionnaires distributed for functional managers and auction committees. This research concluded that the price is the most important criterion among competitive priorities criteria for selecting as it got a percentage of 0.506 of the general sum, followed by technical criteria with a value of 0.197 and the criteria for quality with a value of 0.142, financial criteria with a value of 0.057 and delivery criteria with a value of 0.057. This research concluded that partner B chose as best supplier due to got highest priority had the highest value with a value of 0.292 followed by other partners, namely work partner A scored 0.261, work partner D scored 0.224 and work partner C scored 0.223. In the light of what the research has concluded, the researcher recommends using the Analityc Hierarchy Process method in making decisions to choose suppliers / partners, especially in the selection of partners for the Integrated Management Project (IPM), namely the drilling project at the KMI company which consists of 19 supporting services. Because this approach has several advantages and the precise features used for complex decisions.

Keywords:- Supplier Partners, Selection, Criteria, Alternatives, AHP

I. INTRODUCTION

PT. Indonesian Oil and Gas Contractors - (PT. KMI) which was established in 2008, is part of the subsidiary PT Pertamina (Persero) which is one of the largest Oil and Gas (Oil and Gas) Drilling Services Companies in Indonesia which is engaged in drilling and workover services. wells (Drilling and Workover Services) for exploration and exploitation drilling, workover, oil and gas and geothermal, as well as integrated drilling solutions (Integrated Project Management - IPM).

KMI currently has 41 rig units (including one rig unit dedicated as a training center rig), with a horse power of 150 HP to 2000 HP, 27 top drive units with a capacity of 250 tons and 500 tons, 7 units of H2S monitoring, and Other non-rig services such as coring services, fishing services, water pumps, Aerated Drilling, Directional Drilling and electrical services, as well as developing new products / services to provide integrated solutions for drilling and workover activities.

Integrated Project Management (IPM) is a project management system that coordinates and integrates all elements in the drilling service process, which includes rig supply services (KMI's core business) and other drilling support services, into one unit in the management of oil and gas and geothermal drilling projects, drilling support services include: Rig Services, Top Drive Services, Drilling Fluid Services (drilling mud) Directional Drilling Services, Cementing Services, Mud Logging Unit Services, H2S Monitoring Services, General Services and other services. Through these strategies, it is hoped that KMI can support the oil and gas industry in Indonesia and achieve the company's targets.

KMI develops IPM services which consist of rig provisioning services and several other drilling support services in one project management to generate value-added revenue in order to achieve the company's target with business cooperation and complete national programs to develop and explore new oil and gas reserves by collaboration with several potential business partners with the type of business cooperation:

A. Main-contractor / Sub-contractor, Main Contractor, namely the use of one main contractor who carries out a construction project, 2008. Multi Contarktor is the use of more than one main contractor who carries out and works on a construction project work, 2008

B. Consortium, an association of two or more Companies that join forces to complete a project within a certain time limit where a contract with the Project Owner is made directly on behalf of each member company

C. Joint Operation, an association of two or more entities that join forces to complete a project within a certain time limit where the contract with the employer or Project Owner is signed on behalf of JO

In the process of determining business cooperation with prospective partners, there are a number of requirements and mechanisms that are passed in order to find suppliers / partnership according to the expectations of the company, in order to get the desired results and bring the good name of the company and the achievement of company targets.

➤ *Cases Identification*

Based on the background, phenomena and theories of previous researchers on multi-criteria variables in the supplier / partnership selection process, the researchers describe some problem identification as follows:

1. Limited time in the process of selecting partners to find the best partner according to existing regulations to support the drilling project more objectively.
2. Selection of partners who have Multi Criteria Decision Making (MCDM) in accordance with the company's work standards to get the best partners and bring image of the company with customers to be more objective.
3. Who is the best supplier / partnership if assessed using the Analytical Hierarchy Process (AHP) using the expert choice 11 application?

II.   THEORITICAL REVIEW

Supply chain is a network of companies that work together to create and deliver a product / service to the end user (customer). Companies usually consist of a series of suppliers, factories, distributors, shops or retailers, as well as supporting companies such as logistics service companies.

In a supply chain, there are 3 types of flows that must be managed from upstream (upstream, which is the side where the goods are still in the form of raw material) to downstream (downstream, which is the side where the goods are in the form of final products or end items that are ready to be consumed by the customer. namely the flow of material, information, and money (Pujawan, 2017).

According to (Stock, 2001), there are eight core businesses in supply chain management which include:
A. Customer relationship management. Identifying potential customers who are considered to be of benefit to the company.
B. Customer service management. Timely information for customers, to facilitate the delivery of goods.
C. Demand management. Balancing customer demand with the company's ability to meet these demands.
D. Order fulfillment. Fulfilling consumer needs at the right time, place, and quantity.
E. Manufacturing flow management. Actions to match demands from customers with production capabilities that the company can fulfill.
F. Procurement. Actions from the purchasing function by developing communication mechanisms in order to reduce time and provide savings in purchase transactions.
G. Product development and commercialization. The act of involving suppliers and consumers in the process of developing a company's product that consumers want.
H. Return. Is an action to manage feedback from customers on products in order to improve performance for the company

The supplier selection process goes through three basic stages, namely:
A. The first stage, pre-selection, where the procurement management in each organization looks for potential suppliers / suppliers who can meet the needs of the organization
B. The second stage is the evaluation of each supplier / supplier to find a professional supplier / supplier with special abilities and narrow the list and limit it to a certain number of suppliers.
C. The third stage is the negotiation stage, after the decision maker in the purchasing department and other departments concerned determiwho the supplier / supplier is based on the previous evaluation and selection process.

Table 1:- Pairwise Comparation scale

Intensitas	Kepentingan Keterangan
1	Kedua elemen sama pentingnya.
3	Elemen yang satu sedikit lebih penting daripada elemen yang lainnya.
5	Elemean yang satu lebih penting dari elemen yang lainnya.
7	Satu elemen jelas lebih mutlak penting daripada elemen yang lainnya.
9	Satu elemen mutlak penting daripada elemen lainnya.
2,4,6,8	Nilai – nilai antara dua nilai pertimbangan yang berdekatan.
Kebalikan	Jika aktifitas i mendapat satu angka dibandingkan dengan aktivitas j, maka j memiliki nilai kebalikannya dibandingkan dengan i.

After the criteria are set and several supplier candidates / supplier partners are obtained, the company must make an election. The company may choose one or several of the alternatives.
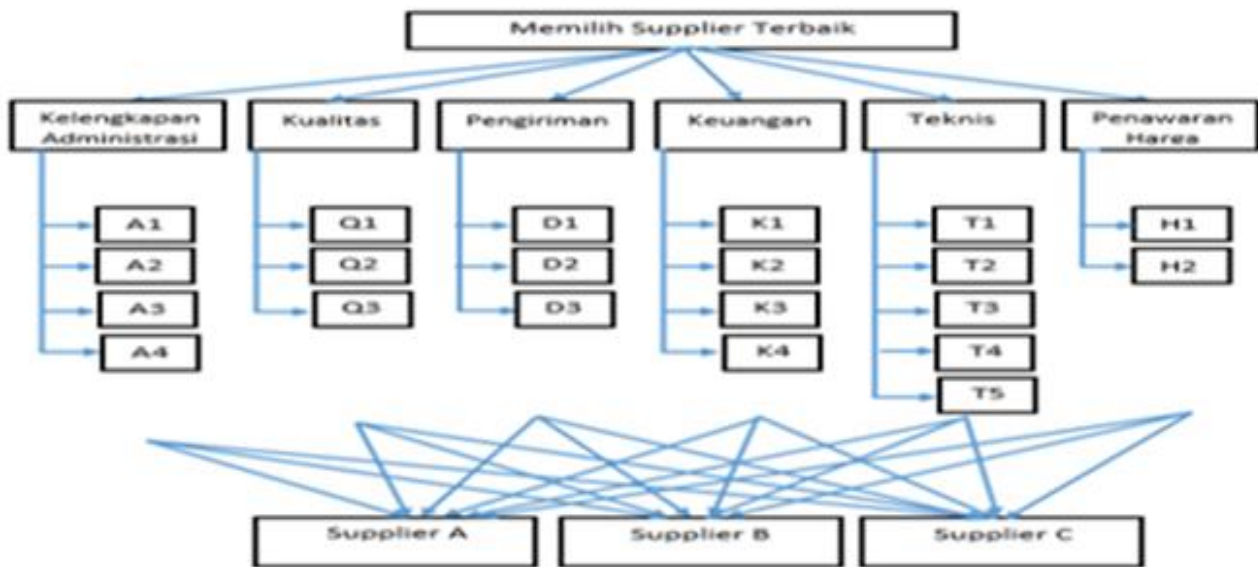
Gambar 2 Struktur Hirarki masalah

Pict 1:- Framework Hierarchy structure

III. METHODOLOGY

The Analytic Hierarchy Process (AHP) method is a basic approach in making decisions in selecting suppliers / partners with a hierarchical system. AHP is designed to overcome between rational and intuitive in choosing the best from a number of alternatives that have been evaluated by taking into account several criteria. In this process the decision maker makes an assessment.

By using paired comparisons which are then used to rank the overall priority alternatives. AHP allows inconsistencies in assessment and provides opportunities to improve consistency (Saaty, 2012).

Basically, AHP is a method used to solve complex and unstructured problems into groups, by arranging the groups into a hierarchy, then entering numerical values as a substitute for human perception in making relative comparisons. With a synthesis it will be able to determine which element has the highest priority.

➢ *Basic Principles of AHP*
In solving problems with AHP, there are several principles that must be understood, including (Kusrini, 2007)
a. Complex systems can be understood by breaking them down into supporting elements, arranging elements hierarchically and combining them or synthesizing them. The hierarchy of problems is structured to assist the decision-making process by paying attention to all decision elements involved in the system
b. Assessment of criteria and alternatives Furthermore, the criteria and alternatives are carried out by means of a pairwise comparison process.
c. Synthesis of Priority, For each criterion and alternative it is necessary to do a pairwise comparison. The relative comparison values of all alternative criteria can be adjusted with the predetermined judgment to produce percentages and priorities
d. Logical Consistency (Logical Consistency), consistency has two meanings. The first meaning is that similar objects can be grouped according to uniformity and relevance. And the second meaning concerns the level of relationship between objects based on certain criteria

➢ *Data analysis technique*
The data analysis used in this research is the Analytical Hierarchy Process (AHP) method. The calculation is carried out using Expert Choice 11 software. Expert Choice is one type of software that is widely used in analyzing the results of AHP percentageing.

IV. RESEARCH RESULTS

In this study, the researcher tried to use the Analysis Hierarchy Process Method in the process of selecting partners to support and support the KMI marketing team, to get a project in the KKKS.

Table 2:- List of Services for Integrated Project Management (IPM)

Sumu		Jasa Pekerjan / Materil		Supporting	
	1	IPM MANAGEMENT		Ownership	
	2	Drilling Rig Services min 1500HP Complete With Top Drive		Ownership	
	3	Drilling Fluid & Completion Services		Partnership	
	4	Directional Drilling, MWD and LWD Services		Partnership/Ownership	
	5	Cementing Unit and Well Stimulation Services		Partnership	
	6	Mud Logging Unit Services		Partnership	
	7	H2S Monitoring Unit Services		Ownership	
	8	Electric Wireline Logging Unit & TCP Services		Partnership	
	9	DST, Surface Well Testing & Slickline Unit Services		Partnership	
	10	Tubular Inspection		Partnership	
	11	OCTG - Material		Partnership	
	12	Drilling Bit - Material		Partnership	
	13	Casing Accessories - Material		Partnership	
	14	Waste Management & Water Treament Plan		Partnership	
	15	Fishing Tool		Partnership	
	16	Liner Hanger Services		Partnership	
	17	Casing Running Services & CDS		Partnership	
	18	Geomechanic Services		Partnership	
	19	RTO		Partnership	

Integrated Management Project (IPM) is a Drilling project organized by PT KMI for drilling oil wells in the East Java region which consists of 19 supporting services.

From each of these services, 3-5 prospective partners / suppliers will be invited to follow the auction process. Of all the auction participants, only one Work Partner will be taken with the highest assessment percentage. The percentage of the assessment is obtained from respondents' answers to the questionnaire which are processed and input using the Analysis Hierarchy Process (AHP) method with the help of Expert Choice 11 software.

➢ *Hierarchy Arrangement*
After the problems have been parsed and defined, the next step is to break down the problem as a whole into its elements according to stages. The elements are also broken down to get accurate results. In the AHP method.

There are 4 alternative candidates or that's will be processed, including supplier A, supplier B, supplier C and supplier D, then they will be selected based on the AHP method which begins with the preparation of hierarchy in selecting the best work partner.

In this study, researchers took sampling on one of the Integrated Management Project (IPM) support services,
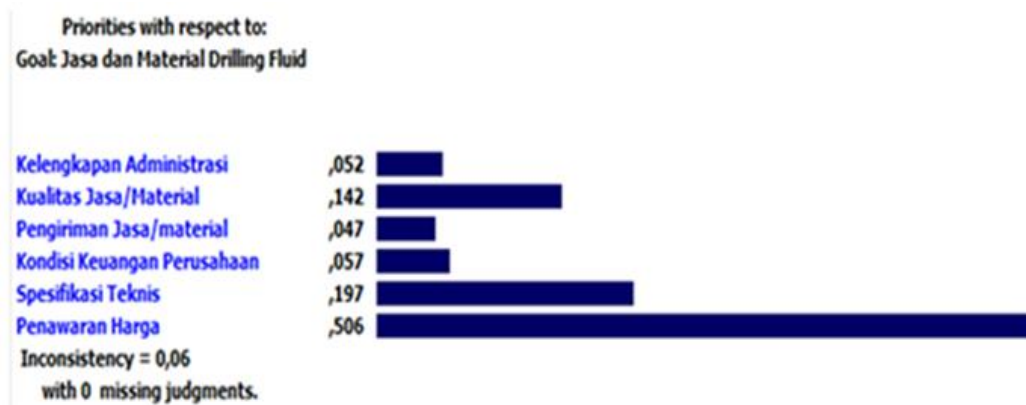
namely Drilling Fluid & Completion Services at PT. KMI and organized into three hierarchical levels. Level 0 is the goal / goal, namely choosing the best work partner, the first level is the criteria for selecting clone partners, level 2 is the sub-criteria which is the elaboration of the first level (criteria), while level 3 is the alternative which partners should be chosen.

➢ *Pairwise Comparison Matrix*
Create a pairwise comparison matrix that describes the relative contribution of the influence of each element to each of the criteria objectives that are a level above it. Pairwise comparison matrices were created to compare criteria and criteria, sub-criteria with sub-criteria and to compare alternatives with alternatives using expert choice 11 software.

➢ *Calculation of the percentage of each variable level 1 (Criteria)*
Data for measuring the priority interests of the criteria in the selection of suppliers / partners were obtained through a questionnaire distributed to 5 respondents, namely users and the auction committee who were directly in charge of the selection process. After the assessment of 5 respondents was obtained.

Priorities with respect to:
Goal: Jasa dan Material Drilling Fluid

Kelengkapan Administrasi	,052
Kualitas Jasa/Material	,142
Pengiriman Jasa/material	,047
Kondisi Keuangan Perusahaan	,057
Spesifikasi Teknis	,197
Penawaran Harga	,506

Inconsistency = 0,06
    with 0 missing judgments.

Pict 2:- Assessment Criteria by using Expert Choise 11

From the calculation of pairwise comparisons between variables in selecting suppliers / partners, the percentages for all level 1 criteria are shown in the figure

➢ *Calculation of the percentage of Each Variable Level 3 (Alternative)*

The results of the pairwise comparison calculation between the alternatives in the sub-criteria are carried out comprehensively, starting from the administrative completeness sub-criteria to the sub-criteria for offering prices with each alternative that is one example in the Sub criteria (H2) picture of the price bid letter:

Recapitulation of percentage can be seen in the table below.

Table 3:- Seconder Data Criteria and Sub Criteria as the basis for selecting Partners

No	KRITERIA	SUBKRITERIA
1	Kelengkapan Administrasi	Surat Izin Usaha
2		Susunan Pengurus Perusahaan
3		Tanda Daftar Perusahaan
4		Standarisasi HSE
5	Kualitas	Produk jasa/material pengalaman ke seluruh Anak perusahaan Pertamina
6		Produk jasa/material pengalaman ke kontraktor MIGAS
7	Pengiriman	Lead time
8		Ketepatan waktu pengiriman
9		Waktu yang dibutuhkan untuk pengiriman jasa / material
10	Kondisi Keuangan	Laporan Keuangan 2 tahun terakhir audited
11		NPWP Perusahaan dan telah melunasi kewajiban pajak akhir tahun
12		Surat Referensi Bank
13		Rekening Koran Perusahaan selama 3 bulan terakhir
14	Teknis	Peralatan Kerja
15		Pengalaman Kerja
16		Tenaga Kerja
17		Methodologi dan Teknologi Pelaksanaan Pekerjaan
18		Kualitas mutu
19	Penawaran Harga	Surat Jaminan Bank / Bid Bond
20		Surat Penawaran Harga

➢ *Consistency Test*

The use of the AHP method in the analysis process uses human perception as input, therefore inconsistency is very likely to occur because humans have limitations in expressing their perceptions consistently, especially if they have to compare many criteria. Based on this condition, humans can state their perceptions will be consistent later or not.
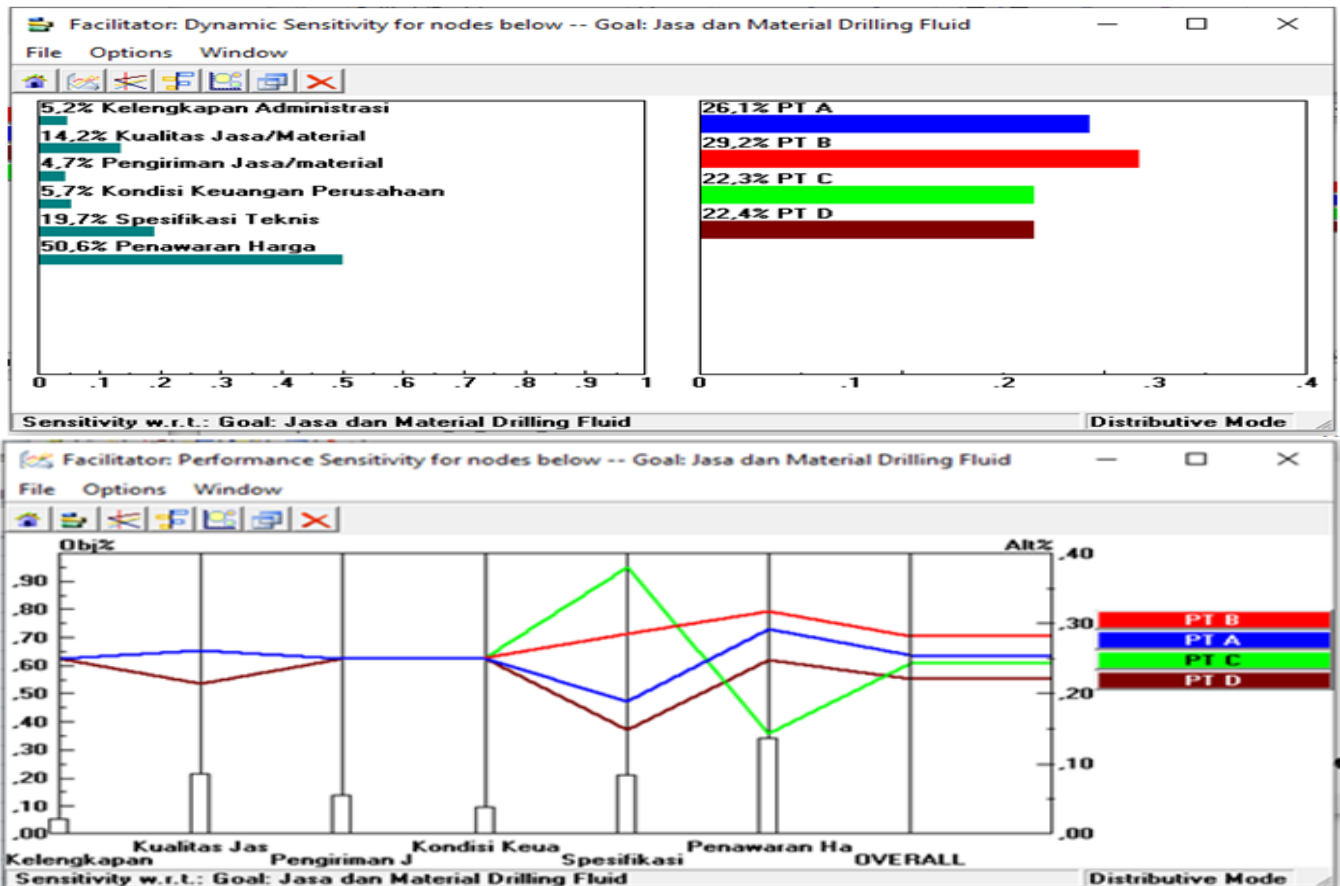
Pict 3:- The results of data processing with Expert Choice Performance Sensitivity

This consistency measurement is intended to see the inconsistency of the responses given by respondents. If CR <0.1, the pairwise comparison value on the given criteria matrix is consistent. If CR> 0.1, the pairwise comparison value on the given criteria matrix is inconsistent. So that if it is not consistent, then the filling of the values in the paired matrix on the criteria and alternative elements must be repeated.

➢ *Global Priority*
After each criterion, sub-criteria and alternatives have been obtained, then the next step is synthesis to obtain the overall alternative percentage from the existing criteria. Previously, the local priority had to be searched for the global value (global priority) first.

From the data that has been calculated above, it shows that overall, Partner B with a percentage value of 29.2% is the first priority to be selected as a supplier / Partner by PT. Indonesian Oil and Gas Contractors. The second priority is Partner A with a percentages value of 26.1%, the third priority is Partners D with a percentage value of 22.4% while the last priority is Partner C with a percentage value of 22.3%.

Table 4:- Global Priority based on AHP - Expert Choice calculations

level0	level1 (kriteria)	level2 (subkriteria)	Alternatif	Bobot Global
a	Kelengkapan Administrasi 0,052	Surat Izin Usaha 0,200	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Susunan Pengurus Perusahaan 0,200	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Tanda Daftar Perusahaan 0,200	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Standarisai HSE 0,400	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
b	Kualiatas Jasa / Materaial 0,142	Jasa/material Pengalaman Di APH 0,667	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Jasa/Material Pengalaman DI KKS Migas 0,333	MITRA A	0,286
			MITRA B	0,286
			MITRA C	0,286
			MITRA D	0,143
c	Pengiriman Jasa/material 0,47	Lead Time 0,14	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Ketepatan Waktu Pengiriman 0,528	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Waktu yang dibutuhkan 0,333	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25

level0	level1 (kriteria)	level2 (subkriteria)	Alternatif	Bobot Global
d	Kondisi Keuangan Perusahaan 0,057	Laporan Keuangan 2 tahun terakhir Audited 0,464	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		NPWP Perusahaan 0,207	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Referensi Bank 0,161	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Rekening korang 3 Bulan terakhir 0,168	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
e	Spesifikasi Teknis 0,197	Peralatan Kerja 0,110	MITRA A	0,122
			MITRA B	0,444
			MITRA C	0,312
			MITRA D	0,122
		Pengalaman Kerja 0,172	MITRA A	0,122
			MITRA B	0,255
			MITRA C	0,49
			MITRA D	0,132
		Tenaga Kerja 0,70	MITRA A	0,131
			MITRA B	0,354
			MITRA C	0,354
			MITRA D	0,161
		Metodelogi dan Teknologi 0,367	MITRA A	0,213
			MITRA B	0,274
			MITRA C	0,376
			MITRA D	0,137
		Kualitas Mutu 0,281	MITRA A	0,237
			MITRA B	0,237
			MITRA C	0,347
			MITRA D	0,18
f	Penawaran Harga 0,506	Surat Jaminan Bank 0,333	MITRA A	0,25
			MITRA B	0,25
			MITRA C	0,25
			MITRA D	0,25
		Penawaran Harga 0,667	MITRA A	0,312
			MITRA B	0,351
			MITRA C	0,09
			MITRA D	0,247

Alternatif	Bobot Global	Prioritas/Rank	Presentasi
MITRA A	0,261	II	26,1
MITRA B	0,292	I	29,2
MITRA C	0,223	IV	22,3
MITRA D	0,224	III	22,4

V. CONCLUSION

Based on the research objectives and research results above, it can be concluded the following:

1. The process of selecting suppliers / partners is getting faster and easier with the AHP method which is used to be able to participate in the auction or direct award process at the customer and is more objective.

2. With the existing criteria used as requirements in selecting suppliers / partners for one of the supporting services for drilling services in the East Java region, including the criteria for completeness of administration, quality, delivery, financial, technical and price quotations. These criteria have a percentage according to the results of the study, the criteria for administrative completeness have a percentage of 0.052, the quality criteria have a percentage of 0.142, the delivery criteria have a percentage of 0.047, the financial criteria have a percentage of 0.057, the technical criteria have a percentage of 0.197 and the criteria for bidding have a percentage of 0.506. From the results of the percentage assessment, the most prioritized criterion is the price bid criterion because it has the greatest percentage to win the tender competition without neglecting other, no less important aspects.

3. Objectively calculating the overall global percentage of each partner, which gets the highest percentage is Work Partner B. Followed by work partner A, work partner D and the last is work partner C. of each alternative percentage calculation - for each alternative, the result shows that work partner A gets a percentage of 0.261, work partner B gets a percentage of 0.292, work partner C gets a percentage of 0.223 and work partner D gets a percentage of 0.224 With this percentages rating, the alternative that is most prioritized is Work Partner B because it gets a percentages rating the highest in total and in several aspects.

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