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Decision Support System for Developer Selection of The Project in TBIG Using The Fuzzy Ahp Method

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ABSTRACT

The selection of the right developer is a determining factor in the success of a project. This study uses quantitative data, using the fuzzy ahp model. The selection of criteria in this new decision-making system is carried out using FGD (Forum Group Discussion) by involving decision-makers within the IT department, to get the right criteria, and also using data from developer performance reports. so that the main criteria are right. The results obtained from the selection of developers using the Fuzzy AHP model show that criteria such as workload, speed, knowledge, and skills are the main criteria in selecting the right developer. The results of this study are developer alternatives that have been ranked based on the new method so that decision-makers can use the data as a basis for selecting developers to work on projects. Fuzzy AHP in the consistency level assessment is carried out at the hierarchical structure level and can accommodate inconsistencies in the assessment.

Ke ywords: Analysis Hierarchy Process, Fuzzy, Triangular Fuzzy Number, Developer, Selection.

1. INTRODUCTION

[1]The release of the Fitch report on May 20, 2019 states that tower companies in Indonesia tend to show faster economic growth this year. This is due to a significant increase in data traffic which further encourages providers to expand and strengthen their networks. For information, until the end of March 2019, the average income of the country's three largest providers has increased by 25% on an annual basis. The three providers are PT Telekomunikasi Indonesia Tbk (TLKM), PT XL Axiata Tbk (EXCL), PT IndosatTbk (ISAT). If the three companies are increasingly aggressive in expanding their networks, of course, this condition will also develop the telecommunication tower business. There are at least eight companies listed on the Indonesia Stock Exchange (IDX) in the telecommunications tower sector. One of the eight companies, PT Tower Bersama Infrastructure Tbk (TBIG), is the number two leader in the telecommunications tower industry in Indonesia[2] with a market capitalization of IDR 14.09 trillion.

Figure 1Telecommunication Issuer Market Capitalization (Trillion IDR)

Launching the Fitch report, TBIG's market share is around 16%. Fitch estimates that TBIG's revenue this year will grow by around 7-9% on an annual basis. This estimate is supported by the fact that the telecommunication company's capital expenditure budget for this year remains high, including for leasing towers and fiber network services. TBIG will benefit from Indosat's planned capital expenditure budget (Capex) of Rp 10 trillion. This shows that the opportunities for the telecommunication tower industry are very large.

To support the company in providing tower services with prime quality, in its operational activities, TBIG uses applications that are designed and developed independently. In the application development process, both adding new features or improvements to an already running system, it was found that several projects were running not according to predetermined targets, in this case, the project was completed, but did not meet the specified target time, and after the breakdown was based on stages SDLC (System Development Life Cycle) found that what causes the project to run not on target is the development phase of the other phases. This face development is the phase where a project whose requirements are complete, will be accepted by the System Development Head, wherein the System Development Head will assign the developer to work on the project. The current condition of the method used for assigning a project to a developer is only based on the workload or workload of the developer, and the current condition by using one criterion in the assignment of a

developer, obtained Key Performance Indicator (KPI)% Fulfillment System IT, which is the percentage of completion it projects with a predetermined target, the more it is completed not on target. Therefore, we need a new method and other criteria that can be used for decision making in assignments to developers.

Related to the above problems, the researcher found a research gap, namely how to provide an appropriate method of making decisions to assign assignments to developers.

Several aspects that will be the focus of the evaluation include:

1. In terms of the method of decision making, it is how to provide an appropriate method of decision-making in assignments to developers, to assist superiors in making decisions in terms of assignments to developers.
2. In terms of determining criteria in decision making is how to determine other criteria that can be used as reinforcement in the decision-making process.

Based on the above problems, a fast and precise decision-making system is needed to support the assignment. Fuzzy AHP Model is a Multi-Criteria Decision Making (MCDM) model to handle decision-making problems that are influenced by several factors to choose the best among alternatives based on certain variables and have the ability to handle vague assessments. and be subjective in the pairwise comparison process to achieve greater accuracy and consistency in the judgment of decision-makers. [3] In this case study, the assignment will be matched with the variables that will later be used in decision making.

2. RELATED WORK

[4] in his research developed the fuzzy ahp method for selecting personnel in IT companies, where the variables used in decision making are basic technical requirements, individual skills, auxiliary skills and the results of this study are, decision support system with a fuzzy model. ahp is as a future worker of research in decision making. From this research, three alternatives of junior developers have been ranked.

[3] in their research developed the Fuzzy AHP method for the problem of university academic staff selection, while the variables used in decision making are: Academic Qualification, Research Experience, Individual Factor, while the results of this study are that Fuzzy AHP is proven to be a more useful tool for solving multi-criteria decision problems with uncertainty. The results show that the alternative with the highest normalized weight is the most suitable candidate to be selected

[5] proposes a decision-making system that chooses the most appropriate Cloud Computing service provider using the fuzzy ahp method with the criteria used are Acquisition and transaction costs, Availability, Storage capacity, CPU, Performance, Security. From this research, 5 alternative cloud computing provider options have been ranked

[6] proposed a decision-making system to assist in the selection of notebooks using the fuzzy ahp method, with the criteria used are weight, memory, processor, ram, price, and hard drive. From this research, there are 7 choices of alternative notebooks that have been ranked

[7] proposes a decision-making system to select the best employee candidates for the IT department using the fuzzy ahp method, the criteria used are individual qualification, technical specifications, and general features. To obtain five alternative IT personnel who have been ranked.

[8] proposes a decision-making system to choose the best environmentally friendly supplier among many alternatives, the method used is fuzzy ahp, and the results are, the uncertainty problem in decision making can be resolved and decisions are more effective. obtained 3 best supplier alternatives that have been ranked

[9] proposes a decision-making system using the AHP method combined with a fuzzy intuitionistic interval to select a suitable supplier in a group decision-making environment, the criteria used are: Demand, Flexibility, Delivery time, quality, and price. Produce five suppliers that have been ranked.

[10] proposes a decision-making system to identify the right material supplier in an engineering project in the construction industry using the fuzzy ahp method to prioritize material supplier selection criteria in engineering and construction companies in Vietnamese. This research resulted in the top 5 criteria for suppliers.

[11] proposes a decision-making system using a methodology based on Fuzzy AHP to prioritize indicators of sustainable supply chains to identify, prioritize, and evaluating indicators of sustainable supply chains. The results show that environmental and social criteria contribute more to the sustainability of the supply chain

[12] proposes a decision-making system in determining warehouse locations, the method used in this research is fuzzy ahp which is used to consider doubts in decision making and evaluation, while the criteria used are, Geographical location, cost, Transport, Transport connectivity; labor and stable government. From this research, 5 alternatives to the Humanitarian Logistics warehouse have been ranked

[13]The student portal is a platform that provides useful and important information for students. It is important to improve the quality of the portal because it is useful for students. Therefore, the purpose of this study is to evaluate the quality of the UiTM Student Portal using Fuzzy Analytical. The criteria used in this study are Service Quality, System Quality, Information Quality, and Attractiveness. The research is expected to provide a valuable reference for UiTM Student Portal developers to improve the performance portal, thus helping students use the portal effectively. The results obtained are that the service quality criteria are ranked first which indicates that users pay more attention to improving service quality which will affect their level of satisfaction.

[14]Security has become an important issue when developing web applications. Security risk factors play an important role when it comes to integrating security during software development. therefore, the authors have assessed

the security risks of the health care web application. This research uses the fuzzy ahp method, while the criteria used in this study are Confidentiality, Integrity, Availability, Effectiveness, Efficiency, Satisfaction. The results of this study concluded that user satisfaction is the most crucial factor among the six security risk factors. To get optimal health care web maintenance, the application developer must focus on user satisfaction.

Table 1 : Comparation literature review

No	Authors	Criteria or Variable	Method	the results of the evaluation of the model and its comparison model
1	[4]	This study aims to develop a fuzzy analytic hierarchy process method for personnel selection in IT companies	Fuzzy ahp	From this research, three alternatives of junior developers are already ranked
2	[3]	the criteria used in decision making are Academic Qualification, Research Experience, Individual Factor	fuzzy ahp	The results show that the alternative with the highest normalized weight is the most suitable candidate to be selected
3	[5]	. The criteria used are Acquisition and transaction costs, Availability, Storage capacity, CPU, Performance, Security	Fuzzy Ahp	From this research, five alternative cloud computing provider options have been ranked
4	[6]	The criteria used are weight, memory, processor, ram, price, and hard drive.	Fuzzy ahp	From this research, there are seven alternatives of notebooks that have been ranked and obtained the best five alternative IT personnel who have been ranked
5	[7]	The criteria used: individual qualification, technical specification, and general features.	Fuzzy ahp	From this research resulted in 7 alternative notebook choices that have been ranked, obtained 5 best alternative IT personnel that have been ranked
6	[8]	With the following criteria: quality, environmental performance assessment, green manufacturing, customer co-operation, green cost, green design, and green logistic design	Fuzzy ahp	obtained 3 best supplier alternatives that have been ranked
7	[9]	Criteria used: Demand, Flexibility, Delivery time, quality, and price. Produce five suppliers that have been ranked.	ahp combined with fuzzy intervals	obtained 5 best supplier alternatives that have been ranked

8	[10]	proposes a decision-making system to identify the appropriate material supplier of an engineering project in industry	Fuzzy ahp	This research resulted in the top 5 alternative suppliers.
9	[11]	Criteria used: economic, social, environmental	Fuzzy ahp	The results show that environmental and social criteria contribute more to the sustainability of the supply chain
10	[12]	Geographical location, cost, Transport, Transport connectivity; labor, stable government.	Fuzzy Ahp	From this research, 5 alternatives to the Humanitarian Logistics warehouse have been ranked
11	[13]	Service Quality, System Quality, Information Quality, Attractiveness	Fuzzy Ahp	service quality criteria are ranked first which indicates that users pay more attention
12	[14]	Confidentiality, Integrity, Availability, Effectiveness, Efficiency, Satisfaction.	Fuzzy Ahp	satisfaction is the most crucial factor among the six security risk factors. To get optimal health care web maintenance

The conclusions that can be drawn from previous studies are what distinguishes between previous research and research that is being made on the object and criteria, the research that is being made the object is a decision-making system to choose alternatives from developers who are in the assignment of a project, and The criteria used for selecting a developer are developer workload, developer speed, developer knowledge, developer skills. Meanwhile, the equation between previous research and the research that is being made is both using the fuzzy ahp method

3. RESEARCH FRAMEWORK

In determining assignments to developers for a project, currently, superiors only use data from the workload of each developer, then the supervisor will assign assignments to developers whose workload is small and the results of these assignments can all be realized, but from the target side the time is not suitable, the quality of the project is not good. It is indicated by a lot of bugs after the project goes up to the production system. To solve problems in assignment to developers, accurate data is needed to be processed in decision making. One way to determine assignments to developers is based on more than one criterion in assigning developers, namely developer workload, developer speed, developer expertise, and developer project knowledge. This method can be a determinant in choosing a suitable developer for a project. With the criteria as mentioned above and the objectives to be achieved, with the Fuzzy AHP method approach, these criteria are identified and then poured into a decision hierarchy for analysis of decision making according to the Fuzzy AHP procedure.

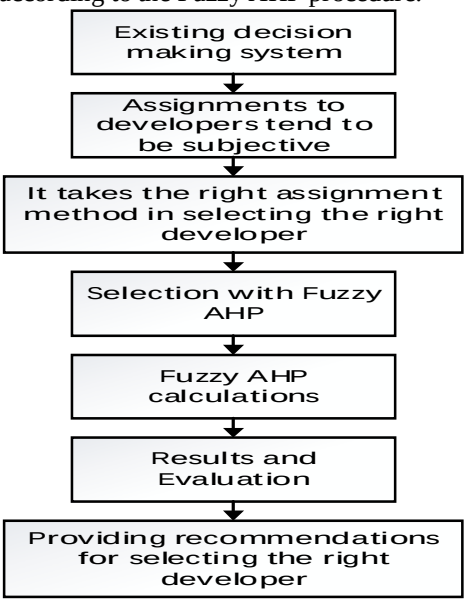

Figure 2: Research Framework

4. THEORY

4.1 Analytic Hierarchy Process (AHP)

The analytical hierarchy process or what is often called (AHP) was developed in 1980 by Saaty. AHP is a method for selecting the best alternative decision based on ranking when the decision-maker has several criteria. With AHP the decision-maker chooses an alternative according to the decision-making criteria based on the results of a given numerical score[3]. The weakness of this method is when the respondent gives a wrong assessment and is added by the absence of clear criteria for an expert. Most people ask

whether the perception of an expert can represent the interests of many people because, in reality, everyone has a different perception from other people[13]. AHP is a model for decision making that can help the human frame of mind. The main framework of this model is a functional hierarchy with the main input of human perception.[14]. AHP is used because of its ability to involve non-quantitative factors that are not financial numbers

AHP supports decision-makers to model complex problems that are structured into hierarchies that are easier to implement and evaluate.[15]. Whereas the weakness of this method is when the respondent gives a wrong assessment, plus there are no clear criteria for an expert. Most people ask whether the perception of an expert can represent the interests of many people because, in reality, everyone has a different perception from other people[13]. AHP is a model for decision making that can help the human frame of mind. The main framework of this model is a functional hierarchy with the main input of human perception. To test the feasibility, the inconsistency ratio is used. The AHP has been used widely, sometimes in combination with mathematical programs, in evaluating the performance of business and manufacturing systems.[14]. AHP is used because of its ability to involve non-quantitative factors that are not financial numbers. Comprehensive performance analysis should involve both qualitative and quantitative non-financial information which may not be included in the financial statements but which is essential to better assess the company's performance. AHP allows decision-makers to model complex problems that are translated into a hierarchical structure that is easier to understand and evaluate. The subjective evaluation will be converted into a numeric value and processed based on the ranking of alternatives on a numerical scale.[15]

4.2 Fuzzy Analytic Hierarchy Process

AHP fuzzy method is a sophisticated analysis method developed from conventional AHP. the vagueness that exists in decision making creates many problems and contributes to the inappropriate judgment of decision-makers in the conventional AHP approach[16] The conventional AHP method still cannot reflect the human thinking style. To avoid the risk of errors in interpreting one's thinking style on performance appraisal, the appropriate development method developed to solve problems that are still vague in the hierarchy is fuzzy AHP.[17] The AHP method used in determining decisions almost creates a relationship with a very unbalanced rating scale because the AHP method does not take into account the uncertainty of the relationship in its mapping.[18]. The level of analysis on fuzzy ahp depends on the degree of probability of each criterion, which depends on the response and respondent in answering questions, from the results of the questions, linguistic variables that have cryptic values can be used triangular fuzzy numbers or fuzzy triangles and at certain hierarchical levels, a matrix can be used. pairwise comparison

Table 2: Triangular Fuzzy Scales [19]

Saaty Scale	Definition	Fuzzy Triangular Scale
1	Equally Important	(1,1,1)
3	Weakly Important	(2,3,4)
5	Fairly Important	(4,5,6)
7	Strongly Important	(6,7,8)
9	Absolutely Important	(9,9,9)
2	The Intermittent values between two adjacent scales	(1,2,3)
4		(3,4,5)
6		(5,6,7)
8		(7,8,9)

5. PROPOSED MODELLING

The methodology used in this research is qualitative. It is a linguistic assessment which is developed into quantitative using a fuzzy analytic hierarchy process model. The model consists of problem analysis, data collection, evaluation, and results. For more details, it is illustrated in the diagram below.

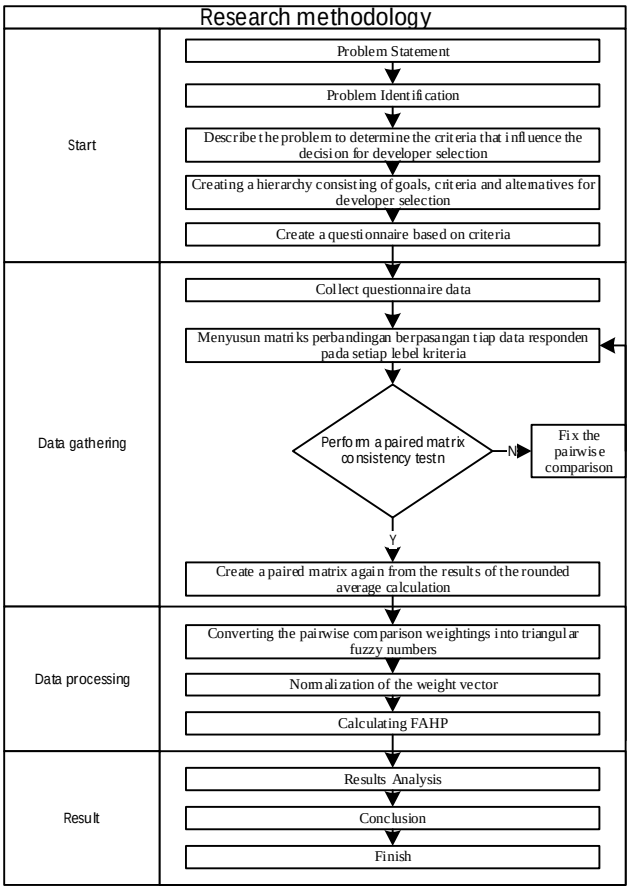

Figure 3: Propose Method

For more details, here are the steps in conducting this research:

1. Defining and describing the problem, namely the priority factors in making assignment decisions

2. Describe the problem to determine the criteria that affect decision making in the assignment.
   In this study consisted of 4 criteria, namely:
   1. The workload is the number of projects the developer is working on (C1)
   2. Speed is the speed at which a developer completes a project (C2)
   3. Knowledge, are the projects that the developer has working on (C3)
   4. Skill is the expertise of each developer, both hard skill and soft skill, which is tested every six months (C4)
3. Creating a hierarchy consisting of objectives, criteria and alternative solutions in making assignment decisions

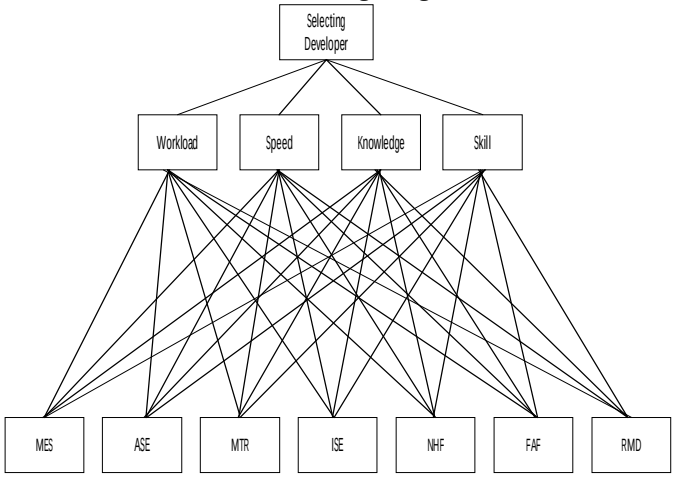

Figure 4:AHP Hierarchy Structure

4. Create a questionnaire based on criteria, Questionnaires were given to 13 respondents

Table 3: Respondents

Respondents		Population
Manager		3
Project Manager		6
Senior Development		4

5. Take developer data from each of the criteria

Table 4 : Data key performance indicator Developers

No	DeveloperName	Initial Name	Criteria	CriteriaValue
1	Muhamad EldiSudrajat	MES	Skill	75
2	Muhamad EldiSudrajat	MES	Speed	76.22
3	Muhamad EldiSudrajat	MES	Workload	2
4	Muhamad EldiSudrajat	MES	Knowledge	2
5	Azhar Setiawan	ASE	Skill	55
6	Azhar Setiawan	ASE	Speed	72.64
7	Azhar Setiawan	ASE	Workload	1
8	Azhar Setiawan	ASE	Knowledge	1
9	Mukhtarom	MTR	Skill	57
10	Mukhtarom	MTR	Speed	72
11	Mukhtarom	MTR	Workload	2
12	Mukhtarom	MTR	Knowledge	4
17	Ibnu Setiawan	ISE	Skill	57
18	Ibnu Setiawan	ISE	Speed	55.61
19	Ibnu Setiawan	ISE	Workload	2
20	Ibnu Setiawan	ISE	Knowledge	5
21	Nur Hazhifah	NHF	Skill	75
22	Nur Hazhifah	NHF	Speed	32.84
23	Nur Hazhifah	NHF	Workload	1
24	Nur Hazhifah	NHF	Knowledge	2
25	FarizAfifFauzan	FAF	Skill	46
26	FarizAfifFauzan	FAF	Speed	44.13
27	FarizAfifFauzan	FAF	Workload	1
28	FarizAfifFauzan	FAF	Knowledge	1
29	Rahmadani	RMD	Skill	57
30	Rahmadani	RMD	Speed	74.11
31	Rahmadani	RMD	Workload	4
32	Rahmadani	RMD	Knowledge	1

6. Compile a pairwise comparison matrix for each developer data at each criterion level
7. Calculates the priority vector of elements on each criterion in the hierarchy. The calculation of priority vectors is done by calculating the eigenvectors.
8. Calculates the maximum eigenvalues
9. Perform a consistency test on each pairwise comparison matrix[20]
   - Calculating the Consistency Index with the equation

$$C1 = \frac{\lambda_{max} - n}{n - 1} \quad (1)$$

   - Calculating the Consistency Ratio with the equation $CR = \frac{CI}{R1}$, if CR≤10% then the matrix is consistent

     If there is an inconsistent pairwise comparison matrix, then the pairwise comparison is corrected.

   - Calculate a_{ij} then choose a_{ij} which has a_{ij} most deviated from 1 as an entry of the causes of inconsistency
   - Change a_{ij} the cause of the inconsistency to be W_i / W_j

10. Create a matrix of pairs back to take decisions with:
    - Computes the geometric mean for each criterion
    - The results of calculating each criterion from the entire hierarchy are then made pairwise

comparisons again obtained from the calculation of the rounded geometric mean.

11. Converting the pairwise comparison weightings into fuzzy triangular numbers.
12. Weight vector normalization calculation.
13. Analyze the results by ranking each criterion to get conclusions and suggestions from the evaluation results
14. Make conclusions and suggestions

6. RESULT AND DISCUSSION

The result of Fuzzy AHP for selecting a developer to work on a project is a list of developers who have been ranked so that decision-makers can choose which alternative developers will be appointed to work on a project. Below are the ranking results obtained

Kriteria	Alternatif						
	MES	ASE	MTR	ISE	NHF	FAF	RMD
Knowledge	0.0548	0.02419	0.14236	0.27035	0.0548	0.02142	0.02142
Skill	0.08177	0.01152	0.03038	0.03038	0.07619	0.00531	0.03038
Workload	0.00927	0.02373	0.00927	0.00927	0.02373	0.02373	0.00184
Speed	0.01815	0.00513	0.0049	0.00218	0.00111	0.00218	0.01024
SUM	0.16398	0.06458	0.1869	0.31217	0.15584	0.05264	0.06388

Figure 5: Weight for each alternative

Developer	Initial Name	Existing Method		New Method F-AHP	
		Workload Value	Rangking	Weight	Rangking
Muhamad Eldi Sudrajat	MES	2	2	0.163978751	3
Azhar Setiawan	ASE	1	1	0.064582939	5
Mukhtarom	MTR	2	2	0.186904656	2
Ibnu Setiawan	ISE	2	2	0.312173592	1
Nur Hazhifah	NHF	1	1	0.155836317	4
Fariz Afif Fauzan	FAF	1	1	0.052642321	7
Rahmadani	RMD	4	3	0.063881424	6

Figure 6 : Comparison ranking alternatives for selection developer between existing method with new method F-AHP

The picture above is a ranking comparison between the old method and the new method, in the old method the ranking is obtained from rank one to rank three, rank one is three people, namely AzharSetiawan, Nur Hazhifah, and FarizAfifFauzan, rank two there are three people, namely Muhamad EldiSudrajat, Mukhtarom, and Ibnu Setiawan, and in third place, there is one person, namely Rahmadani, and this ranking is very difficult for decision-makers to choose a suitable developer to work on a project because there are multiple rankings that are double, while in ranking with the new method, a ranking is obtained that is consecutively from rank one to rank seven, namely, Mrs. Setiawan's first rank, Muhtarom's second rank, Muhamad EldiSudrajat's third rank, Nur Hazhifah's fourth rank, AzharSetiawan's fifth rank, Rahmadani's sixth rank, and FarizAfifFauzan's seventh rank. And this is very easy for decision-makers because the results of the ranking are not double.

7. CONCLUSION

It can be concluded that this new method is much better when compared to the old method, because the old method obtained double rankings, while the ranking with the new method was obtained sequential rankings that were not double, making it easier for decision-makers to decide to choose which developer is suitable for working on a project.

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