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Submission date: 08-Oct-2022 06:26PM (UTC+0700)
Submission ID: 1919941763
File name: Artikel_J5_To_AJSent.docx (206.48K)
Word count: 3471
Character count: 18407

SinkrOn
JURNAL & PENELITIAN TEKNIK INFORMATIKA

Sinkron : Jurnal dan Penelitian Teknik Informatika
Volume 5, Number 2, April 2021
DOI : https://doi.org/10.33395/sinkron.xxx.xxx

e-ISSN : 2541-2019
p-ISSN : 2541-044X

The MOORA Method for Selecting Software Applications: Price-Quality Ratio Approach

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Submitted : xxxxx | **Accepted** : xxxx | **Published** : xxxxx

Abstract: Seeing the rapid advancement of software applications in today's destructive era, the need for software applications is very reliable for the advancement industry of the 4.0 generation era. Especially in object-oriented software applications. The main objective of this research is to measure the technical capabilities of object-based software applications. Many techniques can be developed in object-based software applications such as class implementation, Inheritance, Encapsulation, Pollymorphys, Constructor, Accessor, Mutator, Visibility, Overriding, and Overloading. This technique is an advantage of object-based software applications. Taking advantage of these advantages causes difficulties in selecting and evaluating software. The test was carried out with the Multi Objective Optimization by Ratio Analysis (MOORA) method collaborated with the Price-Quality Ration approach. The results obtained are the selection of object-based software applications can be done optimally and provide efficiency on the benefits and costs incurred.

Keywords: Application Software, Optimum value, Cost-Benefit, MOORA, Price-Quality Ratio.

INTRODUCTION

The world of industry 4.0 is currently developing very rapidly which is accompanied by the development of research around the world which experiences destructive conditions that are completely uncertain with all the needs of various users, so that research needs are the most important part of the industry (Prasetyo & Sutopo, 2018) and it must be handled by all agencies both private and government agencies domestically. To answer all user needs, assistance and support for object-based software applications is needed.

The software application that is needed now is a software application that crosses the object so that it is necessary to do research on the technique used. Object-based software applications are in great demand and favored by many users, because in fact there are features that can be developed (Ayubi et al., 2015) such as making Class, Inheritance, Encapsulation, Pollymorphys, Constructor, Accessor, Mutator, Visibility, Overriding, and Overloading. Thus it becomes a real advantage and can be done by every user who tries and uses it.

With so many users applying it into the form of implementation in the form of software applications in various functions and uses, it makes it difficult for end-users to evaluate and select the software application which creates a big problem for which end-users is right to determine the selection of the software application. Thus, we need an appropriate method that can be used to evaluate and select software applications. There is a method that can help end-users, namely Multi-objective Optimization Ratio Analysis (MOORA). This method is one of the crystallizations of the Multi-criteria Decision Making (MCDM) (Aytaç Adalı & Tuş Işık, 2017). Where the assessment is carried out with many criteria as an alternative determinant. This method can also be collaborated with other methods such as the price-quality ratio (Siahaan et al., 2017), (Kundakci, 2016)(Kundakci, 2016)(Kundakci, 2016). The resulting ratio can be measured optimally according to the conditions of the budget that is owned, even though it is limited to providing optimal conditions, because the optimal is definitely the maximum but the maximum is not yet optimal.

The use of the MOORA method has two basic solutions, namely 1) Use that can be done without using the importance value of a number of criteria, and 2) Using the importance value, this value of interest is usually with the help of the Analytic Hierarchy Process (AHP) method (Saaty, 2009)as giving the weight of each criterion reference value, AHP is the best way to give preference weights in each problem method, on the grounds that it

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Volume 5, Number 2, April 2020
DOI : https://doi.org/10.33395/sinkron.xxx.xxx
e-ISSN : 2541-2019
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is objective and not set manually without careful consideration. So that the determination of preference weights becomes an independent form and is very objective. The connection with this research is not to use the value of importance but to directly determine the ratio system which leads to optimization and ranking values.

LITERATURE REVIEW

2.1. Multi-criteria Decision Making (MCDM).

Multi-criteria Decision Making (MCDM) is a multi-criteria selection technique. The methods that are widely used by researchers (Saaty, 2010) for problems related to the ranking system are one-way, meaning that there is no inversely proportional assessment, so this MCDM needs a comparison process with other methods (Mill, 2011). The MOORA method is part of the MCDM method whose working context is almost similar to the SAW method where, but the MOORA method can be developed into a comparison that is said to be a ratio with a certain variable (Tian et al., 2017), in this study the MOORA method is compared with variables price, this means to provide the optimal value of an item which has a benefit value for an item compared to the price variable. This does not mean to get the maximum value but to get an item with an optimal value, meaning that the acquisition of an item seen from the many benefits with the costs incurred is directly proportional to the two. This is the concept of an MCDM solution that can provide many criteria and many alternatives (Sarkar et al., 2015), because things like this create many difficulties in solving decision analytical and decision science, so that MCDM is able to provide an open and accurate picture.

2.2. Multi-objective Optimization by Ratio Analysis (MOORA).

The MOORA method has two solution approaches, where the approach that is often used is the first approach, namely by using the ratio system (Sarkar et al., 2015), while the second approach uses preferences which are seen from the importance of each criterion. The approach proposed is an approach using system ratios. This approach tends to determine the ratio to determine the optimization value (Kamila & Helma, 2019) which is followed by ranking of a number of alternatives with several stages.

The stages used with the MOORA method bind to the four methods or steps used (Kamila & Helma, 2019), (Stanujkic et al., 2012), namely: 1) determine pairwise matrices as a determinant of row data, pay attention to Equation (1) for filling pairwise matrices Data processing on pairwise matrices can be in the form of quantitative data or qualitative data. In fact, both qualitative and quantitative data can be used in the form of collaborative data. Qualitative data must first be converted into quantitative data so that it can be calculated, 2) determine the ratio system (ratio calculation) where the alternative value of each value i to objective j divided by the denominator value that represents all alternatives to goal j and each denominator objective is the square root of the addition of the alternative quantities from i to m towards the goal j pay attention to Equation (2), 3) Calculation of the optimization value that can be done by adding up the benefits (benefits) j to g then reducing the total cost (cost) g + 1 up to n for each alternative i where the total of the process is called the ratio system, consider Equation (3). There are times when the determination of the ratio value is based on the importance value of each criterion, where the value of each attribute must be multiplied by the weight of each criterion first, then determining the ratio value of each i for each row, this can be done by using Equation (4).

$$X = \begin{bmatrix} x_{11} & x_{21} & \cdots & x_{1,n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & x_{3n} \\ x_{m,1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

$$X^*_{(i,j)} = \frac{x_{(i,j)}}{\sqrt{\sum_{i=1}^{m} x^2_{(i,j)}}} \quad (2)$$

$$Y^i = \sum_{j=1}^{g} x_{(i,j)} - \sum_{j=g+1}^{n} x_{(i,j)} \quad (3)$$

$$Y^i = \sum_{j=1}^{g} x_{(i,j)}\, W_j x_{(i,j)} - \sum_{g+1}^{n} w_j x_{(i,j)} \quad (4)$$

2.3. Price-Quality Ratio.

The price-quality ratio approach is an objective method used to determine the quality to price ratio (Hidayatulloh & Naf'an, 2018)or an appreciation for the value of the rupiah that has been issued to determine the

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optimal value for the quality obtained (Ijadi Maghsoodi et al., 2018). The formula can be used to determine the value of the price-quality ratio by paying attention (Equation-5) and is quite simple.

$$Value\ of\ Money\ (VfM) = \frac{Quality}{Price} \quad (5)$$

METHOD

In this study, the price-quality of ratio is used to provide a value of appreciation for an object oriented programming (OOP) based software application that is collaborated with the MOORA method which compares the quality value of software applications with prices (Gadakh, 2011) attached to the application. the software.

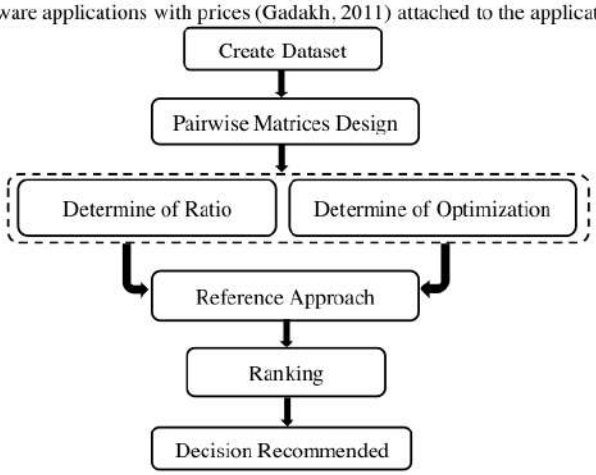

Figure 1. MOORA Algorithm.

RESULT

By paying attention to the MOORA algorithm, it is clear that there are several steps that must be taken to apply the MOORA method with the first concept, namely the ratio system. The first activity is to compile the dataset in the form of pairwise matrices, pay attention (Table-1), the second look for the system ratio value, the fourth determine the optimization of test results for software applications, and the fifth is a preference approach to assign rankings and recommend it as support for decision making.

Table 1
Definition of Criteria

No.	Criteria Name	Criteria Code	Type
1	Class structure	C1	Benefit
2	Inheritance	C2	Benefit
3	Encapsulation	C3	Benefit
4	Pollymorphys	C4	Benefit
5	Constructor	C5	Benefit
6	Accessor	C6	Benefit
7	Mutator	C7	Benefit
8	Visibility	C8	Benefit
9	Overriding	C9	Cost
10	Overloading	C10	Cost
11	Price	C11	Cost

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Pay attention to the definition of the criteria shown in (Table-1) which is the definition of a number of criteria so that the data processing process becomes simpler and easier in reading the results of the process carried out, making it easier to write the process results so that the relationship between the criteria and the results can be seen. There are as many as eleven criteria that are accronymed and the type of each criterion.

Table 2
Dataset View

Benefit Or Cost	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)
Criteria / Application (n)	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Appl-1	87	98	78	86	74	70	65	87	20	13	300
Appl-2	96	99	97	87	78	76	90	78	5	23	275
Appl-3	89	89	76	76	71	84	78	65	16	14	400
Appl-4	87	86	88	78	47	65	84	78	13	16	356
Appl-5	88	94	75	79	56	78	76	45	6	17	326
Appl-6	93	93	78	80	89	89	89	89	14	14	572
Appl-7	88	94	89	76	78	80	73	98	12	20	234
Appl-8	87	78	78	79	73	86	68	76	12	18	324
Appl-9	89	88	85	84	74	79	93	83	20	17	346
Appl-10	90	92	87	82	82	83	99	93	20	15	332

By paying attention (Table-2) that the data produced is a dataset obtained from the results of the assessment of ten applications that have passed the assessment selection, so how to determine which application is the priority in the best ranking consisting of eleven barometers of assessment Thus, we need a method that is able to correct the multi-criteria concept and determine the best decision from a number of object-based applications with an object-based assessment, so that the dataset needs to be carried out by placing the weights of the ten applications through the normalization process (Table-3). Thus the results of the normalization process can be processed using a special method to determine the ratio of the application either by determining price criteria or without price criteria, what will happen if the price is used as a comparison for software application products.

Table 3
Normalization View

Benefit Or Cost	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(+)	(-)	(-)	(-)
Criteria / Application	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
Appl-1	0.31	0.31	0.30	0.34	0.32	0.28	0.25	0.34	0.43	0.24	0.22
Appl-2	0.34	0.34	0.37	0.34	0.32	0.30	0.35	0.31	0.11	0.43	0.25
Appl-3	0.31	0.31	0.29	0.30	0.30	0.33	0.30	0.26	0.34	0.26	0.36
Appl-4	0.31	0.31	0.33	0.31	0.20	0.26	0.32	0.31	0.28	0.30	0.32
Appl-5	0.31	0.31	0.28	0.31	0.34	0.31	0.29	0.18	0.13	0.32	0.29
Appl-6	0.33	0.32	0.30	0.31	0.28	0.35	0.34	0.35	0.30	0.26	0.48
Appl-7	0.31	0.33	0.34	0.31	0.33	0.32	0.28	0.38	0.26	0.37	0.21
Appl-8	0.31	0.27	0.30	0.31	0.31	0.34	0.26	0.30	0.26	0.34	0.29
Appl-9	0.31	0.30	0.32	0.33	0.36	0.32	0.36	0.33	0.43	0.32	0.31
Appl-10	0.32	0.32	0.33	0.32	0.35	0.33	0.38	0.37	0.43	0.28	0.30

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Volume 5, Number 2, April 2020
DOI : https://doi.org/10.33395/sinkron.xxx.xxx
e-ISSN : 2541-2019
p-ISSN : 2541-044X

The next process that must be done is to determine the optimization value for each object-oriented software application by comparing the optimization ratio between entering the pricing criteria or determining the optimization value with the price as a comparison of the optimization ratio.

Table 4
Ranking of Application Software optimization values

Application Software	Nilai Optimasi	Ranking
Appl-1	1.524	10
Appl-2	2.142	1
Appl-3	1.979	8
Appl-4	1.756	9
Appl-5	1.803	7
Appl-6	2.124	2
Appl-7	1.958	4
Appl-8	1.804	6
Appl-9	1.881	5
Appl-10	2.005	3

Note (Table-4) which illustrates that the resulting optimization value involves a price criterion of eleven criteria which is the measurement, meaning that the criteria with a benefit and cost characteristic are all included in determining the value of the ratio, and those shown in (Table-5) are the same. as described in (Table-4) but price has an important role in determining the optimal ratio value, so that the presence of pricing criteria here results in global changes to the ranking system, meaning that the determination of an optimistic decision has been obtained, thus the optimal value that is owned by The selected software application has the highest ratio value. Note (Table-5).

Table 5
Ranking of Application Software optimization values with pricing

Ranking	Application Software	Pricing (Juta-Rp)	Nilai Optimasi
1	Appl-2	275	2.142
2	Appl-6	532	2.124
3	Appl-10	332	2.005
4	Appl-7	234	1.958
5	Appl-9	346	1.881
6	Appl-8	324	1.804
7	Appl-5	326	1.803
8	Appl-3	400	1.797
9	Appl-4	356	1.756
10	Appl-1	300	1.524

In stark contrast to the understanding contained in (Table-4) and (Table-5), where the optimization value process does not include pricing criteria in the ratio calculation process and pricing criteria are used as a comparison in determining the assessment of object-based software applications, so that it has differences. very sharp in determining the assessment of the software application, this is clearly the optimal choice of software applications. Note (Table-6) and (Table-7) the following.

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e-ISSN : 2541-2019
p-ISSN : 2541-044X

Table 6
Value of Application Software Optimization without pricing

Application Software	Nilai Optimasi	Price Quality Ratio	Ranking
Appl-1	1.524	6.635	4
Appl-2	2.142	8.645	2
Appl-3	1.979	4.985	9
Appl-4	1.756	5.473	8
Appl-5	1.803	6.138	6
Appl-6	2.124	4.431	10
Appl-7	1.958	9.286	1
Appl-8	1.804	6.177	5
Appl-9	1.881	6.032	7
Appl-10	2.005	6.702	3

After determining the price, there will be major changes where the price criteria have a very important role in determining the software application to become a selection and evaluation process that provides optimal choices in determining decision support. Thus, the determination of the value of the quality-price ratio will be used as a decision that provides instructions for the user to choose a software application product that has an optimum value. Note (Table-7) the following.

Table 7
Ranking of application software optimization value with price-quality ratio

Ranking	Application Software	Pricing (Juta-Rp)	Nilai Optimasi	Price Quality Ratio
1	Appl-7	326	1.958	9.286
2	Appl-2	532	2.142	8.645
3	Appl-10	300	2.005	6.702
4	Appl-1	275	1.524	6.635
5	Appl-8	400	1.804	6.177
6	Appl-5	346	1.803	6.138
7	Appl-9	356	1.881	6.032
8	Appl-4	234	1.756	5.473
9	Appl-3	332	1.797	4.985
10	Appl-6	324	2.124	4.431

By paying attention to the changes in the tables above, it is seen that to determine the value of the optimization on the effect of price, it is seen that it is very influential in determining the value of optimization in selecting and evaluating the product of this software application. In the calculation process using the MOORA method, it is very influential in determining the optimum value of this application software product. This means that the user is expected to take advantage of this method to obtain the product in an optimal way, meaning that the amount of costs that are owned by the acquisition of software applications in this case is very supportive in getting a very optimal value.

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e-ISSN : 2541-2019
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DISCUSSIONS

The use of the MOORA method is the best way to determine the evaluation and selection process, because it is part of the multi-criteria concept that uses many criteria, which requires that the MOORA method also takes into account the types of criteria that can provide benefit values and also cost values (costs), which needs to be considered once in determining the value of the ratio using this method is whether the assessment of the price quality ratio against pricing needs to be placed in it or removed from the table. If put in the table it doesn't seem right, because the value is getting bigger. Thus, if we want to use the benefit ratio, the price criteria should be excluded from the calculation table.

CONCLUSION

Determining the optimization value of object-based software applications is a way that can be done to obtain the optimum value of acquisition, and if it includes this price criterion, it has a major change in determining the ranking system. Unlike the case with including a preference for the weight of the criterion, this must be combined with other methods that are able to determine the weight value of each criterion, and usually the preference weight value is done in many ways and must use an appropriate method and should not be done in a way. set at will. The final results obtained from the analysis provide an illustration that if the price criteria are included in the process of calculating the Appl-2 price quality ratio, the role holder is the ranking, whereas if the price criteria are issued in the process, then the person holding the role as the ranking is controlled by Appl-7. who became the first rank. Thus, a better process for determining the price quality ratio, the price criteria should be outside the calculation and should be a comparison to the benefits, so that it becomes an optimal decision.

ACKNOWLEDGMENT

Thank you to my family who want to support in this research process which is very helpful both morally and materially, then to other parties I do not forget to thank STMIK Nusa Mandiri for providing support in the form of motivation to write this article, and the publishing party from the editorial staff. who are willing to accept this article even though it is in such a careful process in selecting the topic until this article is published.

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e-ISSN : 2541-2019
p-ISSN : 2541-044X

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