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Evaluation of PHP Framework Measured Using Object-Oriented Metrics with the Analytic Hierarchy Process

R Setiyawan [1], W Gata [2], Elbiansyah [3], D Ardiansyah [4], D Yuliandari [5], D Wijayanti [6], F P Harmono [7], Y Komalasari [8], M Lase [9], and M H Fakhriza [10]

[1] Master of Computer Science, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia
[2] Master of Computer Science, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia
[3] Master of Computer Science, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia
[4] Master of Computer Science, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia
[5] Information System, *Universitas Bina Sarana Informatika*, Indonesia
[6] Information System, *Universitas Bina Sarana Informatika*, Indonesia
[7] Information System, *Universitas Bina Sarana Informatika*, Indonesia
[8] Information Technology, *Universitas Bina Sarana Informatika*, Indonesia
[9] Information Technology, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia
[10] Information Technology, Postgraduate Program, *STMIK Nusa Mandiri*, Indonesia

E-mail: 14002193@nusamandiri.ac.id

Abstract. The existence of various PHP frameworks may become one alternative choice in developing a web application that PT XYZ wants to evaluate its Wisanggeni internal PHP framework in order to measure how far the design quality of Wisanggeni framework is working. An evaluation on PHP framework using object-oriented metric parameter and design quality is then conducted in this research. The results of measurement conducted using object-oriented metric parameters for each framework are evaluated with the Analytic Hierarchy Process (AHP) method to determine the best framework model design quality used as a reference for the development of Wisanggeni. This study also uses a combination of PHPDepend and PHPMetrics devices to measure the values of object-oriented metrics in each PHP framework. The research final result is that each framework has one value representing each framework's quality in which the quality of Wisanggeni framework is almost to the same with the Laravel and CodeIgniter framework .

Keywords: framework, PHP, AHP, object-oriented, metric, quality design.

1. Introduction

Based on the research conducted by Standish Group International, there were 7400 developed information technology projects. The result showed that only 16.2% was completed in accordance with the planning, 31.1% experienced delays, and 52.7% experienced cost overrun up to 189%. Those IT projects failed due to the ineffectiveness of time, cost, and function [4]. Famous Indonesian companies, such as Kompas.com, Okezone.com, Urbanesia.com, bejubel.com as well as PT XYZ use their frameworks to save the time in developing their IT projects. PT XYZ has an internal framework to develop its system called Wisanggeni PHP framework. The use of this framework is [15] to create the programming standards as one option to reduce the problems. In the past few years, there were various PHP frameworks offering several conveniences with various features related to the software

development using the concept of object orientation which encourages PT XYZ to evaluate its Wisanggeni framework. Based on Skvorc, a survey on the Site points using a framework was conducted by the system developers in Indonesia. The frameworks preferred by the system developers are the CodeIgniter and Laravel framework that those become highly familiar among the system developers which can save the time in understanding processes related to how those frameworks are working.

The concept of object orientation has also encouraged the developers to make applications using different implementation techniques and patterns [8]. Various patterns of object orientation implementation also lead to different opinions in viewing the software quality. The software quality measurement conducted [11] based on the software's object design aspects is one field which is recently still developed. Some previous researches have produced the software quality measurement devices translated into several parameters, such as Metrics for Object-Oriented Software Engineering [13] and Metrics for Object-Oriented Design [12]. However, with these various parameter values, it seems still to be very difficult to determine which software has the better quality. Thus, we need a general method to combine these overall values into a value interpreting the software quality to the others.

Because the application domain also influences the design and implementation structure , a quality comparison should be made on a number of applications in the same domain. In making a comparison, [7] there are several parameters used based on the existing quality. Thus, the Analytic Hierarchy Process [9] method is selected as the multicriteria comparison method which generates rankings from several alternatives based on certain criteria generally used in all software types, such as desktop applications, web applications, class libraries, or APIs [8].

Several previous studies have been conducted with similar objectives regarding to the quality of software design, by Rosenberg and Hyatt [2], discussing the Software Assurance Technology Center (SATC) in NASA Goddard Space Flight Center which is approaching to the metrics by first identifying the attributes associated with the object-oriented development. Researches on SATC have produced a combination of traditional metrics and metrics [3] that measure the unique structures of object-oriented development. Each metric [16] has various weights which may affect some software's quality. The research conducted by Misra [1] has proposed that the need for a criteria evaluation for a clear object-oriented metric [10] which is in software is by evaluating its measurement theory. The method to empirically assess a good object-oriented quality design [5] is simple and may support a reasonable estimation for several factors, such as functionability, efficiency, understandability, and maintainability [14] which determine the assessment measurement for an object-oriented programming. Measurements should include most features needed for evaluation and validation of object-oriented metrics [1]. Hermawan and Mursanto [8] have conducted another approach in ranking the Java-based ERP software with CKJM 1.8-based ranking device which produces a parameter for collecting the metrics intended to measure the software quality based on six object-oriented metrics proposed by Chidamber and Kemerer [13] considering the design quality perspectives. Latelay and Azhari [6] have evaluated the software parameter quality with the six object-oriented metrics proposed by Chidamber and Kemerer [13]. The calculation of both high and low values obtained from those six metrics may affect the quality of factors related to each metric. From those multicriteria problems, one effort provided as a solution is by implementing the AHP method.

Table 1 shows similar researches conducted on metric-related software. Based on the literature study of previous researches that the evaluation of PHP framework design quality comparison conducted with AHP method has never been made before. The closest one is with that conducted by Hermawan and Mursanto [8], yet the difference in this study is that the PHP framework object is conducted on the problems which have been described before. Thus this research aims at evaluating and ranking the PHP Framework based on OO (Object-Oriented) Metrics.

Table 1. Research on Metrics-Related Software

No	Previous Research	Result
1	Rosenberg & Hyaat	Produces a combination of traditional metrics and metrics measuring the unique structure of object-oriented development [2].
2	Jamali	Identifies several OO metrics used in analysing the object-oriented programming development [10].
3	Misra	Produces evaluation criteria on the object-oriented programming paradigm [1].
4	Latelay and Azhari	Suggests the use of six Chidamber and Kemerer metrics to evaluate the software quality [6].
5	Hermawan dan Mursanto	Generates general ranking methods using Java software with a combination of AHP concepts, OO metrics, and software quality [8].

2. Methodology

The proposed settlement process will be divided into several stages for the research analysis process as explained in Figure 1.
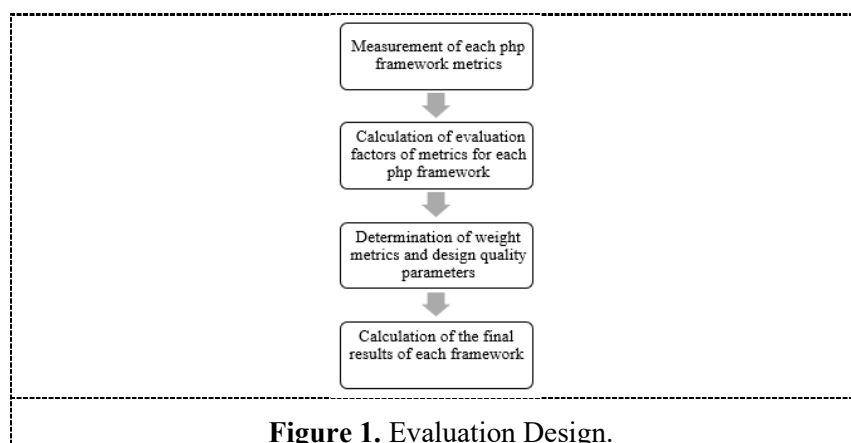
Figure 1. Evaluation Design.

The final result expected from this method is that each framework has one value interpreting the software design quality as shown in Figure 2. Thus, the value may determine the software design's PHP framework quality.
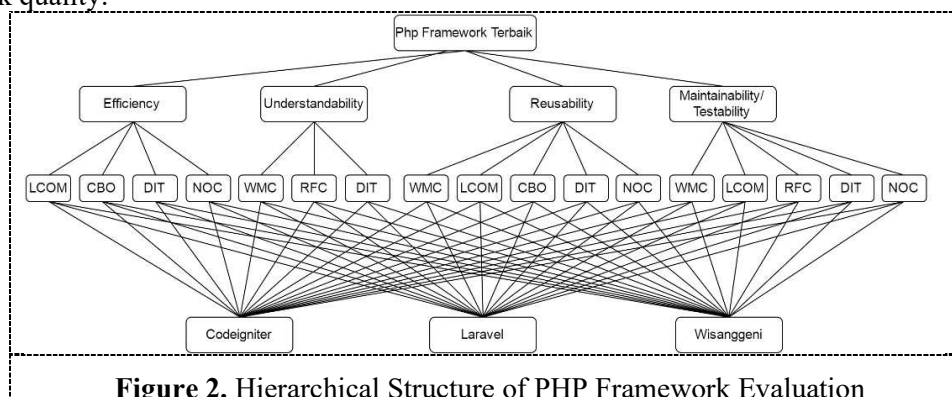

Figure 2. Hierarchical Structure of PHP Framework Evaluation

2.1. Metric Measurement of each PHP framework

At this stage, the OO measurement on the same metrics is conducted at each PHP framework. Many software or devices may be used to measure the metrics. Each device has both advantages and disadvantages. However, the calculations which support this study are those conducted with PHPDepend and PHPMetrics. Both types of matric software are specified for the PHP programming languages. The combination of two PHPDepend and PHPMetrics devices may support the metric calculation of the Chidamber Kemerer object-oriented PHP source code.

2.2. Calculating the factors evaluating the metric values for each PHP framework

Evaluation of metric values is conducted using the measurement values. The calculation is made using the AHP method to obtain the evaluation values of metric factors for each PHP framework. The stages to obtain the evaluation values of metric factors for each PHP framework are presented in Figure 3.

Figure 3. Metric Value Evaluation Stages.
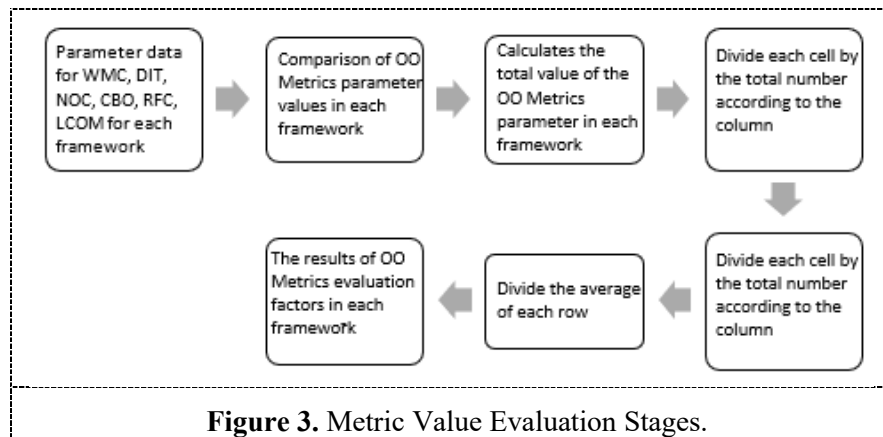
2.3. Determining the metric weights and design quality parameters

The evaluation of design quality parameters is influenced by the metrics as presented in Table 1. To get an evaluation factor for each design quality parameter, the evaluation value of PHP framework with the metric weights is influenced by the design quality as shown in Table 2.

Table 2. Calculation of Design Quality Evaluation Factors.

Software Quality	PHP Framework
Efficiency	$(EF)_{DIT} \times (MW)_{DIT} +$ $(EF)_{CBO} \times (MW)_{CBO} +$ $(EF)_{NOC} \times (MW)_{NOC} +$ $(EF)_{LCOM} \times (MW)_{LCOM}$
Understandability	$(EF)_{WMC} \times (MW)_{WMC} +$ $(EF)_{DIT} \times (MW)_{DIT} +$ $(EF)_{RFC} \times (MW)_{RFC}$
Reusability	$(EF)_{WMC} \times (MW)_{WMC} +$ $(EF)_{DIT} \times (MW)_{DIT} +$ $(EF)_{CBO} \times (MW)_{CBO} +$ $(EF)_{NOC} \times (MW)_{NOC} +$ $(EF)_{LCOM} \times (MW)_{LCOM}$
Maintainability/Testability	$(EF)_{WMC} \times (MW)_{WMC} +$ $(EF)_{DIT} \times (MW)_{DIT} +$ $(EF)_{NOC} \times (MW)_{NOC} +$ $(EF)_{RFC} \times (MW)_{RFC} +$ $(EF)_{LCOM} \times (MW)_{LCOM}$

Evaluation Factor (EF) and Metric Weight (MW) are adjusted to the values in the selected PHP framework.

2.4. Each framework's final result calculation of
Each framework's final result calculation multiplies the weight quality (WQ) with the calculation result of evaluation factor. Evaluation factor (EF) is adjusted with the related items, including the evaluated three PHP frameworks.

Table 3. Final results of each framework

PHP Framework	Software Quality
CodeIgniter PHP Framework, Laravel, Wisanggeni	$(EF)Efficiency \times (WQ)Efficiency +$ $(EF)Understandability \times$ $(WQ)Understandability +$ $(EF)Reusability \times (WQ)Reusability +$ $(EF)Maintainability \times$ $(WQ)Maintainability$

3. Result
After measuring the metrics' PHP framework compare each metric and calculate the design quality with the AHP method.

3.1. The measurement results of the metric value's PHP framework
The measurement of metric values' PHP framework using a combination of PHPDepend and PHPMetrics devices containing CK metrics produce the matric values of each PHP framework.
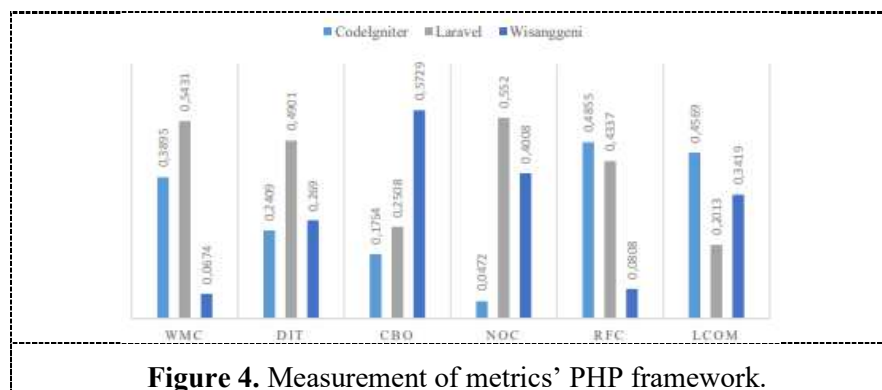

Figure 4. Measurement of metrics' PHP framework.

3.2. The results of PHP framework using AHP method
The calculation of design quality evaluation factor using AHP method is conducted with the values as presented in Figure 5.
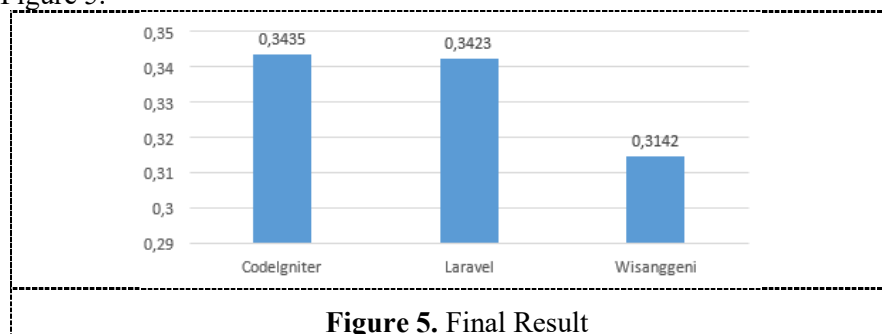

Figure 5. Final Result

4. Conclusion

This study has evaluated the Wisanggeni comparing to the CodeIgniter and Laravel PHP frameworks based on the software design quality as well as the Chidamber and Kemerer object-oriented metrics using the Analytical Hierarchy Process method. The CodeIgniter has the highest value of all by 0.3435. of The Laravel is at the second position with The value difference of only 0.0012, while the Wisanggeni has the lowest value when compared to that of both Laravel and CodeIgniter PHP framework with the value of 0.3142 as shown in Figure 5. The quality of Wisanggeni framework is almost to the same with that of both Laravel and CodeIgniter framework with a difference of only 0.02.The framework evaluation final result in this study may be used as a reference for developing the Wisanggeni PHP framework.

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