



Quantification Model for Understandability and Testability Index: A Design Stage

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Abstract: Quantification of understand ability and testability in the software development process at early stage is a standard of vital to software quality issues. The problem of maintain software is crucial for high quality software. Measuring understand ability and testability of high quality software system at design phase may help to improve the maintainability of software system. A understand ability and testability estimation model for object oriented design has been developed in this paper. The developed model establishes the relationship between Object Oriented Design constructs with understand ability and testability. The understand ability and testability quantification procedure can be accomplished. In this research paper highlights a multivariate linear regression for establishing the maintainability model in terms of understand ability and testability, consider as parameters of maintainability criteria. Understand ability and Testability is empirically validated. Also model observed by statistical value of the study.

Keywords: Understandability, Testability, Object Oriented Design, and Maintainability.

I. INTRODUCTION

Software Engineering has transformed into greatly basic order of study, practice and research [5, 9]. Everybody is striving to diminish the issues and to meet the reason for growing high calibre viable software that is conveyed on time, inside spending plan, and moreover fulfils the necessities. Software has moved toward becoming huge to extension in every aspect of person try [7]. There are not serious issues in the opportune, value, quality and upkeep of numerous software products. Software advancement process has the motivation behind comprehending these difficulties by creating highlight quality viable software inside time, money related arrangement. To accomplish this objective, we incorporate to focus in a firmly controlled manner on both the quality of the process and product use to build up the more satisfactory product. Software understands ability and testability is currently settled to be an imperative and particular software quality trademark. Understand ability and Testability is a standout amongst the most fundamental quality markers and its quantification prompts the possibilities of encouraging and enhancing a maintainable procedure.

II. MODEL DEVELOPMENT

Understandability and Testability measured new approach have been developed as a basis of metric values for considering design issues. Figure 1 shows the subsequent steps for model quantification. Figure 2, 3 shows correlation establishment among, Understand ability and Testability, Design Metrics, and describes the measuring process of evaluate the model. The exact estimations of these measurements can be related to the assistance of class graph [6, 10]. The quantifiable assessment is extremely steady to get trustworthiness record of software plan for ease maintainability Estimation. Maintainability characteristics includes keeping up the consistency, exactness, and dependability of information over its total software improvement life cycle [8, 11]. To compute maintainability it is smarter to investigate necessity develops by methods for maintainability traits that can be considered as Understand ability and Testability.

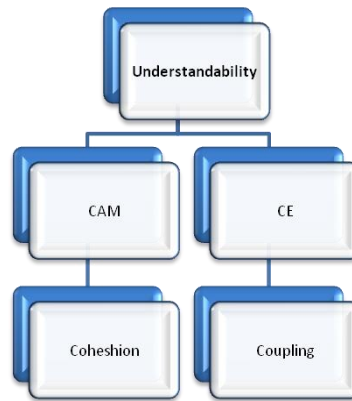


Figure1: Correlation between understandability and design issues

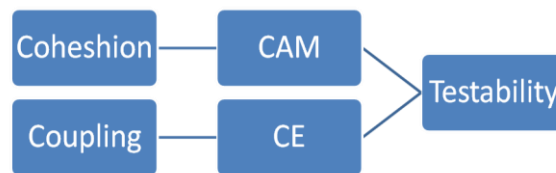


Figure 2: Correlation between testability and design issues

In order to developed the model of understandability and testability using the multiple linear equation. The equation 1 has presented the linear form of equation.

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \dots + \alpha_n X_n \dots \dots \dots Eq(1)$$

Where

- Y is dependent variable
- X₁, X₂, X₃,.....X_n are independent variables.
- $\alpha_1, \alpha_2, \dots, \alpha_n$ are the regression coefficient of the respective independent variable.
- α_0 is the regression intercept.

The values are taken for proposed model (understandability and testability) has associated from [1, 2, 3] that has been collected through large commercial object oriented systems. The values of Coupling Metrics (CE), Cohesion Metrics (CAM) are used to evaluate the understand ability and testability [4]. Using SPSS, correlation coefficients, men value, standard value is computed and model of understandability and testability measurement is thus formulated as given below in equation 2 and 3.

Table 1. Understandability Computed Table

Project	Standard Understandability	CE	CAM
P ₁	6.000	8	0.357143
P ₂	5.000	9	0.533333
P ₃	2.065	2	0.615385
P ₄	4.491	7	0.468750
P ₅	5.838	2	0.182796
P ₆	3.000	2	0.311111

$$\text{Understandability} = 5.76 + 0.368 * \text{CE} - 7.78 * \text{CAM} \quad (2)$$

Table 2 Model Summary for Understandability Measurement

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

	.856 ^a	.732	.665	1.629598
a. Predictors: (Constant) CE, CAM				

Table 3 Testability Computed Table

Project	Standard Testability	CE	CAM
P ₁	52.48	9	0.40000
P ₂	60.64	7	0.46875
P ₃	59.17	8	0.50000
P ₄	49.97	16	0.23333
P ₅	50.55	2	0.31111
P ₆	56.83	1	1.00000

$$\text{Testability} = 49.9 + 0.060 * \text{CE} + 9.4 * \text{CAM} \quad (3)$$

Table 4 Model Summary for Testability Measurement

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999 ^a	.998	.998	.130592
a. Predictors: (Constant), CAM, CE				

Table 1, 2, 3, 4 describes the quantified model equation for understandability and testability index and also given the model summary for proposed value. Model summary of proposed model describes the relationships between the dependent variables and independent variables. Dependent Variables are Understandability and Testability depends on the independent metrics values with equation 2 and equation 3.

III EMPIRICAL VALIDATION

This segment have highlighted that how significant proposed study, where quantified value and model are able to estimate the understand ability and testability of object oriented property. The Empirical evidence is information that verifies the truth or falsity of a claim. In the empiricist view, one can claim to have knowledge only when based on empirical evidence. To justify claiming approach for acceptance of model, an experimental validation of the proposed understand ability and testability model through design metrics has been carried out using samples. Table 5, 6 shown the calculated index for understand ability and testability.

Table 5. Understandability Data Table

Project	CE	CAM	Cal_Understandability	Std_ Understandability
P ₁	9.000	.444	5.614	5.000
P ₂	4.000	.750	1.397	1.520
P ₃	2.000	.667	1.309	1.510
P ₄	3.000	.667	1.677	2.065
P ₅	11.000	.223	8.071	7.023
P ₆	7.000	.171	7.003	5.275
P ₇	8.000	.325	6.176	6.134
P ₈	14.000	.291	8.649	7.000
P ₉	5.000	.533	3.451	3.118

P ₁₀	10.000	.350	1.787	1.570
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Table 6 Testability Data Table

Project	CE	CAM	Cal_Testability	Std_Testability
P ₁	1.000	1.000	59.360	54.790
P ₂	12.000	.207	53.127	53.490
P ₃	1.000	1.000	59.360	59.570
P ₄	5.000	.375	53.725	54.650
P ₅	6.000	.625	56.135	56.740
P ₆	1.000	.667	56.227	54.970
P ₇	8.000	1.000	59.780	54.990
P ₈	5.000	.350	53.490	53.870
P ₉	3.000	.500	54.780	53.155
P ₁₀	4.000	1.000	59.540	54.690

It is so important to insure the strength of proposed model for recognition. A 2 sample t test applies for prove the impact between standard understandability, testability and calculated understandability, testability. 2t-test is handy hypothesis tests in statistics when compare means.

Table 7 2 t- test between Standard understandability and Calculate understandability

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Calculate Understandability	4.79648	10	2.938470	.929226
	Standard Understandability	4.32310	10	2.376453	.751500

Table 8 2 t- test between Standard testability and Calculate testability

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Calculate Testability	56.55234	10	2.741411	.866910
	Standard Testability	55.09150	10	1.857522	.587400

Null hypothesis (H₀): There is no significant difference between Standard and Calculate index

H₀: $\mu_1 - \mu_2 = 0$

Alternate hypothesis (H_A): There is significant difference between Standard and Calculate index

H_A: $\mu_1 - \mu_2 \neq 0$

In the above hypothesis μ_1 and μ_2 are treated as sample means of population. Mean value and Standard Deviation value have been calculated for specified two samples and represented in table 7, 8. The p value of understandability and testability are 0.86, 0.69. Therefore alternate hypothesis directly discards and the null hypothesis is accepted. The developed equation used for understandability and testability is accepted.

IV. CONCLUSION

In this research work, we have developed an effective model for understandability and testability model through design metrics and using multiple linear regressions approach. Empirical analysis presented that understandability and testability model is statistically very positive impact and acceptable. The developed quantification equations evaluate the understandability and testability in term of design factors which are affected to quality factors. That validation technique observed that understandability and testability model is complete advancement, more sensible in nature.

REFERENCES

- [1] Mohammad Zunnun Khan et al, "Requirement Understandability Quantification Model Of Object Oriented Software", International Journal of Advanced Research in Computer Science, 8 (7), July-August 2017, 298-302.

- [2] MohdNazir, "An Empirical Validation of Understandability Quantification Model", Elsevier, 2012.
- [3] Mohammad Zunnun Khan et al, "Requirement Testability Quantification Model of Object Oriented Software", Oriental Journal of Computer Science and Technology, 2017.
- [4] M. Jureczko& L. Madeyski, "Towards identifying software project clusters with regard to defect prediction", IEEE, 2010.
- [5] J. Voas, Miller, "Improving the Software Development Process using Testability Research", pp. 114-121, IEEE Software (1992).
- [6] R.V. Binder, "Design for Testability in object-oriented Systems", Communications of the ACM. Vol. 37(9), pp. 87-101 (1994).
- [7] L. Zhao, "A new approach for software testability analysis", International Conference on Software Engineering, Proceedings of the 28th International Conference on Software Engineering, Shanghai, pp. 985-988, 2006. [6] J. Gao, S. Ming-Chih, "A Component Testability Model for Verification and Measurement", In Proceedings of the 29th Annual International Computer Software and Applications Conference, pages 211-218. IEEE Computer Society (2005). [7] G. Jimenez, S. Taj, and J. Weaver, "Design for Testability" in the Proceedings of the 9th Annual NCIA Conference, 2005.
- [8] Jungmayr, "Testability during Design", SoftwaretechnikTrends, Proceedings of the GI Working Group Test, Analysis and Verification of Software, Potsdam, pp. 10-11, 2002.
- [9] S. Jungmayr, "Reviewing Software Artifacts for Testability", EuroSTAR'99, Barcelona, Spain, 1999.
- [10] I. Sommerville, Software Engineering, 5th Edition, Addison Wesley, 1996.
- [11] Badri, M. and Toure, F. (2012) Empirical Analysis of ObjectOriented Design Metrics for Predicting Unit Testing Effort of Classes. Journal of Software Engineering and Applications, 5, 513- 526.<http://dx.doi.org/10.4236/jsea.2012.57060>