Importance of stability to assess the quality of Software Product Line Orthogonal Variability Model

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Abstract: In Software Product Line, quality assessment is very critical task because of the complexity of software systems. That's why the evaluation of quality attribute is very significant concept with reference to software product line orthogonal variability model. To identify whether the OVM is easy to stable will help to develop a successful product line. One of the important characteristic of maintainability is stability. Stability is the capability to avoid unexpected effects by modifications to the software. Stability plays a major role in development of successful product line. This paper intended to study the relation of stability quality attribute with orthogonal variability model product line.

Keywords: Orthogonal Variability Model, Stability, Software Product Line, Maintainability, Empirical evaluation.

1. INTRODUCTION:

There is remarkable change in software development from last few years. Many software methodologies came in existence for this purpose. But software product line methodology is such type which gained popularity in 1970 and developed as promising methodology in 1990. Software product line is "*A set of software intensive systems that share a common and managed set of features to satisfying the specific needs of a particular market segment or mission and that are developed from a common set of core assets [artifacts] in a prescribed way"* [1]. But quality is most critical factor in SPL because of its systematic reuse of product line, quality assurance is however more authoritative than in single project since a fault or insufficient design decision might propagate to more than a small number of products of families[2].

Instead of developing a separate product, the growing trend in software engineering is to develop multiple product and similar products at one time. Software product line engineering (SPLE) provides a solution to eliminate this type of problem. Line means a set of products those are linked and share commonalties like data structure, software components, some features and architecture etc[3].

1.1 OVM

Orthogonal variability model is one of the best approaches for modeling in SPL, that is used for documenting software product line variability [4]. In OVM, only variability can be documented. In this model VP (Variation Point) that documents a variable item and V(Variant) documents the possible instances of that variable item..

The following diagram shows the example of OVM Product line:(Ref from website).

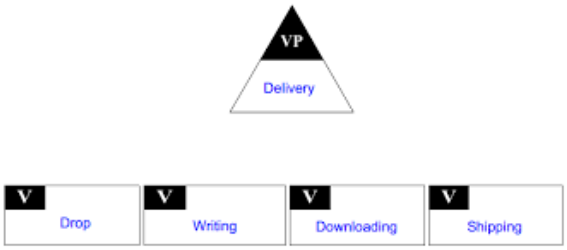

Figure 1.1 OVM Model

1.2 Stability & its importance in quality assess of software

According to ISO the term quality can be defined as "the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs[5]. For continue the function of any Product and evolve as needed, it is imperative to look upon all the quality attributed that may affect it in future. One of the most important challenges confronted by software developers is high cost of development, especially during software maintenance. This high cost of maintenance has been related to difficulty of stability and understanding programing code, particularly when code written by other person [6].We defines "stability" as a capability to avoid unexpected effects from modifications to the software. The stability of program is related to its maintainability and thus it is a very critical factor in overall quality [7]. Maintainability: Maintainability is according to ISO/IEC 9126 standard means "the capability of software product to be modified [8]. Modification may include correctness, improvements or adaptation of the software to changes in environment, in requirements and functional specifications[1].

2. EXPERIMENT DESIGN AND SETUP

A) VARIABLES

i. Independent Variables:

In our research we will develop our own independent variables. To which we categorize as independent because within the cause- effect relationship which is our major concern, they will represent the cause, i.e. we want to study if these metrics are or are not correlated with quality attribute stability of software product line OVM.

ii. Dependent Variables:

In our experiments the dependent variable will sub characteristics of maintainability i.e. stability.

A) *OBJECTS OF STUDY:*

The models that are included in experiment, some of them are changed from feature models. Some of feature models picked form Software Product Line Online Tools (SPLOT) and we changed then into OVM by own. Total there were 14 models that are selected by keeping in mind their understandability by the subjects of study. The language for the models is used English only.

B) VALIDATION OF DATA

Once we collected data, to ascertain the degree of consent among the subjects we employed the Cronbach'sAlpha[9] This analysis is important as the subject should reach a certain level of agreement else convincing conclusions cannot be drawn. That's why we used Cronbach's Alpha to retrieve the level of resemblance among the qualitative behavior of the participants. Results are shown in table 1.obtained from test.

Table1. Cronbach's alpha for degree of resemblance between the opinions of the participants

No of Items	Stability
14	.789

As seen in above table that the degree of similarity of all the participants is above than 7. It indicates that there exists a reasonable agreement between participants. As a result this stability analysis, we conclude that it is reliable for further analysis.

2.1 Data Analysis

All the OVM models which we used in our experiment are from different domain and thus form satisfactory set of objects of study. They are also differs in metric values. The data collected empirically is also quantitatively reasonable. The quantity of data validates this. We have 21000 data points as participants' opinion (14 OVM models and 150 participants 1 sub characteristics). We applied these techniques for few prospective:

Table.2 To study inter correlation between Stability and developed metrics

		RoAltVP	NTopV	NTopVP	PoV
Readability	Pearson Correlation	-.634	-295	-.255	-.041
	Sig.(2-tailed)	.015	.306	.380	.890

As we see in table one metrics out of four has Correlation between developed metrics and stability. But it does not mean that we cannot predict maintainability by using these metrics. That' why, we perform multiple regression analysis to prove this.

2.2 Multiple regression analysis performed to predict the model for Stability

Multiple regression analysis is an extension of linear regression[10]. That we used to predict the value of a variable based on the values of two or more other variables. The value of variable that we want to predict is dependent variable or that are used to predict this dependent variable value is called independent variable.

Table 3: Model Summary of Multiple Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.822	.675	.578	.334
2	.863	.745	.631	.312
a. Predictors(Constant):NTopV,IoV,RoMdtV				
b. Predictors(Constant):NTopV,IoV,RoMdtV,RoC				

Table 4: ANOVA

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.315	3	.772	6.926	.008[b]
	Residual	1.114	10	.111		
	Total	3.429	13			
2	Regression	2.553	4	.638	6.561	.009[b]
	Residual	.876	9	.097		
	Total	3.429	13			
a.Dependent Variable: Stability						
b.Predictors(Constant):NTopV,IoV,RoMdtV						
c.Predictors(Constant):NTopV,IoV,RoMdtV,RoC						

Table 5 Coefficients:

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	Constant	4.105	.679		6.045	.000
	NTopV	-.982	.233	-1.654	-4.215	.002
	IoV	1.033	.254	-1.309	4.061	.002
	RoMdtV	6.553	2.277	.961	2.877	.016
	NTopV	-1.131	.238	-1.904	-4.760	.001
	IoV	1.179	.255	1.493	4.617	.001
	RoMdtV	8.833	2.579	1.295	3.425	.008
	RoC	2.812	1.796	.326	1.466	.152
a.Dependent Variable: Stability						

iii. Inference:

In table 3, Independent variable ratio of No of top variants , Inclusion of Variants, ratio of mandatory variant collectively explain 82.2% of the variability of dependent variable i.e. stability. In another model No of top variants , Inclusion of Variants, ratio of mandatory variant, Rigidity of Configuration explain slightly higher ratio i.e. 86.3% variability of stability. Whereas, NTopV, IoV, RoMdtV, RoC explain only stability. Rest all the variables are omitted due to high level of tolerance. In table 4 model with indicators viz. RoAltVP, NTopV has high significance from all the defined metrics that's why it can be used for further experimentation. Thus from table 5 it can be said that RoMdtVP, IoV and NTopV can be used to form regression equation to calculate stability.

Form the table 5, it is clear that in case of stability there is not a single independent variable by which we can predict the model of stability. We can predict stability by using three or four metrics like NTopV, IoV, RoMdtV and RoC. But stability is not a very strong attribute by which we can predict the variability models.

Therefore referring to the results of table 5, we formed following equation:

Stability=1.616-1.131(NTopV)+1.179(IoV)+8.833(RoMdtV)+2.833(RoC)

3. Results Verification:

For the verification of results we calculated the values of 14 models by using the linear equation which we formed from regression analysis and then we compared these values to subjective opinions of respondents which we got through questionnaire. There is 80.5% similarity between opinions and values calculated from equation. This proves that we can predict the maintainability by using these metrics. Stability can predict the model for maintainability of OVM product line.

4. Conclusion and Future:

In Software Product line it is very important to assess the quality of product line at the early phase that' why it is very important research area. In the end, we can say that we successfully we developed four metrics, by using of which we will further assess the maintainability of orthogonal variability model product line. In future we will empirically and theoretically improve that the developed metrics can predict quality by using other sub characteristics of maintainability.

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