UML-B Survey Questionnaires and Responses

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1. Introduction

This document presents the data obtained from a survey conducted on the UML-B method [1]. The survey aimed to assess the usability of the method, particularly the notation used, from the developers' perspective. The usability in the assessment context means the understandability, learnability, operability and attractiveness of the notation in supporting the modelling process. The assessment was conducted by using a usability evaluation framework namely the Cognitive Dimensions of Notations (CD) [2-3] with the usability criteria suggested by the International Organization for Standardization (ISO) [4-6]. As usability depends on the notation and the tools provided by the environment, the framework was also used to evaluate the tools accompanied the UML-B method, namely the Rational Rose [7] and the U2B tool [8], whenever appropriate.

This document is intended to record the responses rather than explain the survey. The detailed explanation of the survey execution and data analysis are included in [9]. The data presented in this document are based on ten respondents, who responded to the survey so far. The data are expected to expand in future.

2. Questions and Results

The following paragraphs present the responses for each of the questions in the UML-B survey questionnaires. The first fourteen questions reflect the dimensions of the Cognitive Dimensions framework while the subsequent five questions represent some of the usability aspects suggested by the ISO. The last question is comments for further improvement.

2.1 Visibility and Juxtaposability (ISO: Operability/Attractiveness)

Question: If you need to compare different parts of your UML-B model (e.g. between diagrams or windows of different operations etc.), how easy is it to view them at the same time in Rose?

Very Difficult				Very Easy
-2	-1	0	1	2
Why?				

This question assessed the ability of the UML-B method to allow the user to view every component of its model simultaneously or view two related components side by side at a time. Due to the fact that the current version of UML-B method resides in the Rational Rose application, the assessment particularly concerned the ability of the application to support the above user's activities.

The Table 1 below shows the distribution of answers. It can be seen that three of the respondents considered the activities as "easy" and "very easy". They commented that navigation in Rose was generally easy as they could view different parts of the model at the same time by opening several windows. For instance, the application allowed them to compare different operations either from one class or different classes simultaneously. They also found that switching around the windows was pretty straightforward.

There were four respondents who regarded the activities as "neither difficult nor easy", which contributed to the median value. These respondents had a mixture of agreement on the ability of the application to support the activities. They agreed that the application supported the viewing of multiple windows. However, having to view several windows and switch between them at the same time was problematic. For instance, they had difficulties in viewing a class diagram and its statechart diagrams at the same time, which made the process of mapping the operations in the class diagram and the transitions in the statechart diagrams tedious and error-prone. Besides, having several displayed windows at the same time could be confusing.

The remaining respondents considered the activities as "difficult" since besides the above limitations, they discovered other user-friendliness issues. They found that some common modelling functionality was not visible on the toolbar. For instance, there was no **Aggregation** icon on the toolbar and they needed to get it through several intricate steps, which was not obvious. In fact, they found that the **Help** in the application was not so helpful.

Table 1. "Visibility and Juxtaposability" dimension					
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
difficult		difficult		easy	
		nor easy			
0	3	4	1	2	10
Median :	0				

2.2. Viscosity (ISO: Operability)

Question: If you need to rebuild/restructure your UML-B model(e.g. due to change in ideas or requirements or solutions), how easy is it to make the changes?

Very Difficult				Very Easy
-2	-1	0	1	2

Are there any particular changes that are particularly difficult or tedious to make? If Yes, which ones?

This question assessed the degree of effort required by the user to perform a change in the UML-B model. The change in this regard includes editing the diagrams and the respective semantics of the model in Rose as well as retranslating the model to a B

model by using the U2B tool. The question required the respondents to indicate the difficulty level and state any particular changes that they found difficult or tedious to make.

The Table 2 below shows the distribution of answers. It can be seen that six of the respondents considered the task as "easy" and "very easy". This resulted in the typical comment or median as "easy". Since these respondents found that the process was easy, most of these respondents did not state any specific changes that they thought would be difficult. However, two of the respondents commented that Rose did not support some changes automatically. For instance, if a variable name was changed in the class diagram, the change was not reflected in other parts such as in the statechart diagram or in the semantics where the variable name was used. The similar situation occurred for the variable deletion. Thus, the changes had to be done manually by visiting the respective parts of the model.

The remaining respondents, who considered the changes as "difficult", highlighted other issues such as Rose did not support undo and drag-and-drop operations. One respondent highlighted that when a deletion was made in the diagram panel, the item would still exist in the model although it did not appear on the diagram. The right way to do the deletion is to do it in the navigation panel, which seemed not obvious to the respondent.

Table 2. "Viscosity" dimension					
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
difficult		difficult		easy	
		nor easy			
0	4	0	5	1	10
Median : 1					

None of the respondents mentioned any difficulty with the U2B tool.

2.3. Diffuseness (ISO: Operability)

Question: How simple is it to describe what you intend when modelling your UML-B model?

Very Difficult				Very Easy
-2	-1	0	1	2
Why?				

This question assessed the complexity or verbosity of the notation used in the UML-B method to express a meaning. The notation in the method includes the use of class and statechart diagrams of UML and the use of B syntax. The question required the respondents to indicate how simple to describe what they intended in the model.

The Table 3 below shows the distribution of answers. It can be seen that six of the respondents considered the task as "simple" and "very simple". This resulted in the typical comment or median as "simple". These respondents generally agreed that the

UML diagrams made the modelling process easier. They started the process by identifying the main objects or entities involved in the problem domain and connecting the entities using the appropriate relationships. The diagrams acted as a base for them to add specification details using the B syntax. These respondents nevertheless admitted that they needed to think in object-oriented way during the process.

Three respondents commented the task as "neither complicated nor simple". One respondent believed that the diffuseness would depend on the problem at hand. Two of the respondents thought that the task was not simple due to lack of documentation on the method. The remaining one respondent who thought the task as "complicated" had difficulty in dealing with the UML diagrams and the B syntax at the same time. Because there were several ways to specify the B syntax for the operations, either in the specification window of the class diagram or the statechart diagram, the respondent found it to be confusing.

Table 3. "Diffuseness" dimension					
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
Difficult		difficult		easy	
		nor easy			
0	1	3	4	2	10
Median : 1					

2.4. Error Proneness (ISO: Operability)

Question:

How easy is it to make mistakes when modelling the diagrams in your UML-B model?

Very Difficult -2	-1	0	1	Very Easy 2
Why?				

How easy is it to make mistakes when defining the formal semantics in microB clauses for the diagrams in your UML-B model?

Very Difficult			Very Easy		
-2	-1	0	1	2	
Why?					

This question assessed the tendency of the notation to induce mistakes. Since the notation of the UML-B method involves the UML diagrams and the B syntax, the question were divided into two parts. One was meant to assess the diagrams and the other was for the B syntax. The question required the respondents to indicate how easy to make mistakes when modelling the diagrams and defining the formal semantics using the B syntax.

The Table 4.1 and 4.2 below show the distribution of answers. It can be seen that six of the respondents considered making mistakes in the diagrams as "neither difficult nor easy", which contributed to the median value. These respondents agreed that modelling using the diagrams was simple. However, since the diagrams would be translated to a B model at the end, they had to be more careful and conscious. Each time they added a feature to the diagrams, they tended to transform the UML-B model to the B model using the U2B tool in order to see the effects. They wanted to ensure the added feature had the effect that they intended in the B model, besides being able to verify the model using the prover.

Two respondents commented that making mistakes in diagrams was "easy" and "very easy" because of the limitation of the Rose application itself, which did not synchronise the changes made to the class diagram with the statechart diagram. The mistakes were not obvious until they run the prover. In addition, one respondent found that the multiplicity of associations had to be given more thought during the modelling. This was because unsuitable multiplicity could violate the invariants of the B model even though the multiplicity seemed to make sense in the diagrams. The remaining two respondents thought it was "difficult" to make mistakes because even if they did, the mistakes could easily be identified and corrected.

In contrast, eight of the respondents believed that it was "easy" and "very easy" to make mistakes when defining the formal semantics using the B syntax. Since the semantics had to be specified literally through typing, there was always a tendency to make mistakes such as wrong variables names, data types, inappropriate use of clauses and typos. Moreover, the syntax checking had to be done manually as there was no such facility in Rose. Having the semantics scattered around different parts of the models made the task troublesome, as the semantics could not be viewed easily at once. Any mistakes in applying the B syntax could only be realised when they transformed the UML-B model to a B model and run the prover. Several respondents also highlighted that the mistakes were "easy" to make due to lack of understanding, documentation and experience on the UML-B method. In fact, they were also new in the B method and were novice users of UML, which made them prone to errors.

The remaining two respondents believed that it was "difficult" to make mistakes due to the formality imposed by the B syntax.

Table 4.1 "Error Proneness" dimension: Diagram					
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
Difficult		difficult		easy	
		nor easy			
0	2	6	1	1	10
Median : 0					

Table 4	4.2 "Error	Proneness	⁷ dimens	ion: Sy	ntax
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
Difficult		difficult		easy	
		nor easy			
0	2	0	6	2	10

Median: 1

2.5. Progressive Evaluation (ISO: Operability)

Question: Can you stop modelling your UML-B model at any time you like and check your work so far (i.e. by translating it to B model using U2B and performing model validation and verification in B tools)?

No Not Sure Yes

Why?

This question assessed the ability of the UML-B method to allow the user to evaluate his or her work in progress at any time. The evaluation process involves the transformation of the UML-B model to the B model using the U2B tool and the execution of the prover. The question required the respondents to indicate whether or not it is possible to stop modelling at any time to check their work so far. The respondents had to state why if it was not possible.

The Table 5 below shows the distribution of answers. It can be seen that majority of the answers were "yes". The remaining respondents were not sure or thought it was not always possible depending on at what stage they stopped. They believed major elements of the UML-B model needed to be specified correctly before translating the model to the B model. Otherwise, they found that the error messages generated by the U2B tool and the prover were too intimidating.

Table 5. "Progressive Evaluation" dimension	n
	-

	_		
No	Not Sure	Yes	Total
1	2	7	10

2.6. Hard Mental Operations (ISO: Understandability/Learnability)

Question: Do you find any complex or difficult tasks to work out in your head when modelling your UML-B model?

No Not Sure Yes

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If Yes, what are they?

This question assessed the degree of mental processes required for the user to understand the notation and to keep track of what is happening. The question required the respondents to indicate whether or not they found any complex or difficult tasks to work out in their heads when modelling the UML-B model. The respondents had to state what the difficulty was, if any.

The Table 6 below shows the distribution of answers. It can be seen that six of the respondents stated the answer as "no". One of these respondents commented that the visual aspect of the UML-B model helped in reducing the hard mental operations, which would exist in the traditional B modelling.

Four respondents found some complex tasks to work out in their heads. Two of the respondents found that writing correct semantics for the model was hard. One respondent discovered that by having semantics in the statechart diagram made the transformed B model more complex. For instance, the transitions in the statechart diagram were translated as nested conditions in the B model, which seemed to create conflicts with the already defined conditions. One respondent believed that having to consider and integrate two modelling styles, UML and B, at the same time was indeed a mental burden.

Table 6. "Hard Mental Operations" dimensio
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No	Not Sure	Yes	Total
6	0	4	10

2.7. Consistency (ISO: Understandability/Learnability)

Question: Are there any parts in the UML-B model that seem to be similar in functionality but the UML-B method makes them appear different?

No Not Sure Yes

If Yes, what are they?

This question assessed whether similar semantics in the notation are presented in a similar syntactic manner. The question required the respondents to indicate whether or not they found any parts in the model that seem to be similar in functionality but the method makes them appear different. The respondents had to state what the parts were, if any.

The Table 7 below shows the distribution of answers. It can be seen that six of the respondents stated the answer as "no". The remaining respondents were not sure whether or not the parts exist.

Table 7. "Consistency" dimension					
No	Not Sure	Yes	Total		
6	4	0	10		

2.8. Hidden Dependencies (ISO: Understandability/Learnability)

Question: Do you find any structure dependencies in UML-B model (i.e. one part explicitly relies upon or is determined by or uses or requires another part) where the dependency is not fully visible?

No Not Sure Yes

If Yes, what are they?

This question assessed whether there is any relationship between two parts such that one of them is dependent on the other but the dependency is not fully visible. The question required the respondents to indicate whether or not they found any structure dependencies in the model. If they did, the respondents had to state what parts that were involved.

The Table 8 below shows the distribution of answers. It can be seen that four of the respondents stated the answer as "yes". These respondents found that as pieces of information were scattered around different parts of the UML-B model, the relationship between these parts were not so visible until the model was generated to a B model by the U2B tool. Besides, there was implicit B syntax (other than the ones that they explicitly stated), which was created automatically by the U2B tool based on certain elements in the diagrams. The respondents found that it was not obvious, which they took some time to absorb.

The remaining respondents stated that they did not find any hidden dependencies.

Ta	ble 8.	"Hidden Depe	ndencies'	' dimension
	No	Not Sure	Yes	Total
_	6	0	4	10

2.9. Secondary Notation (ISO: Attractiveness)

Question: Does Rose allow you to make notes or convey extra information beyond the UML-B model to yourself (e.g. comments, use different fonts, layout)?

No Not Sure Yes

If Yes, please state the possible actions.

This question assessed the ability of the UML-B method to allow the user to provide supporting information to the model by using notation other than the official semantics. As the UML-B model resides in the Rose application, the assessment particularly concerned the ability of the application to support the above user's activity. The question required the respondents to indicate whether or not they could make notes or convey extra information beyond the model to themselves. The respondents had to state the possible actions, if any.

The Table 9 below shows the distribution of answers. It can be seen that all respondents stated the answer as "yes". The respondents found that the notes and the documentation facility in Rose were very useful for this purpose.

Table 9.	"Secondary	Notation"	dimension

Tuble 7	Deconduly	tounon	unitension
No	Not Sure	Yes	Total
0	0	10	10

2.10. Role Expressiveness (ISO: Understandability/Learnability)

Question:

How easy is it to determine what each diagram (and its components) is for in the UML-B model as a whole?

Very Difficult			Very Easy		
-2	-1	0	1	2	
Why?					
How easy is it to whole?	determine wł	nat each micro	B clause is for	in the UML-B	modelas a

Very Difficult				Very Easy
-2	-1	0	1	2

Why?

Are there any parts that you simply include just because it is always been that way (without exactly knowing what the purposes)?

This question assessed whether the purpose of each component in the model is obvious and the user can directly imply how it relates to the whole model. The question required the respondents to indicate how easy to determine what each diagram and syntax is for in the UML-B model as a whole. In addition, the question also asked whether the respondents included any component in the model without exactly knowing its purpose.

The Table 10.1 and 10.2 below show the distribution of answers. For the diagrams, it can be seen that five of the respondents considered the task as "easy" and "very easy". This resulted in the typical comment or median as "easy". These respondents found the concepts of UML diagrams were easy to grasp. There were a lot of resources on the UML concepts that they could refer. Once the concepts were known, they could easily differentiate the role of each part of the diagrams.

On the other hand, four respondents considered the task as "neither difficult nor easy". These respondents did not really understand why they needed to have the statechart diagrams, as they believed they could simply use the class diagrams to specify the behaviours. In addition, they were also quite confused about the roles of **Precondition** and **Post-condition** in the diagrams. As far as the UML-B modelling was concerned, they believed they could merely use the **Semantics**.

For the B syntax, four respondents considered the task as "neither difficult nor easy". Despite being taught on the B method, these respondents faced some difficulties in dealing with the B syntax. Three respondents considered the task as "difficult" due to the same reason. They believed more experience and time were required to fully understand the roles of B syntax in the UML-B model and how they could work together. Besides, they believed more comprehensive documentation should be available to support them in the process.

Three respondents found the task as "easy" particularly after the major parts of the model had been illustrated using the diagrams. The structure of the diagrams somehow helped them in determining the roles of the B syntax.

Two respondents found that there were parts that they simply included without knowing the purpose; the statechart diagram and the **Post-condition**.

Table 10.1	"Role Exp	oressivenes	s" dime	nsion:]	Diagram
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
difficult		difficult		easy	
		nor easy			
0	1	4	4	1	10
Median: 1					
-					

Table 10.2 "Role Expressiveness" dimension: Syntax						
-2	-1	0	1	2	Total	
V.	Difficult	Neither	Easy	V.		
difficult		difficult		easy		
		nor easy				
0	3	4	3	0	10	
Median: 0						

2.11. Closeness of Mapping (ISO: Operability)

Question: How well does the UML-B method allow you to describe your problem accurately and completely as what you intend?

Very Bad			Very Good				
-2	-1	0	1	2			
Why?							

This question assessed the mapping between the notation used in the UML-B method and the problem domain. The question required the respondents to indicate how well the method allowed them to describe their problem accurately and completely as what they intended.

The Table 11 below shows the distribution of answers. It can be seen that six of the respondents regarded the mapping as "good" and "very good". This resulted in the typical comment or median as "good". Three of the respondents believed that the mapping was achieved easily because of the UML notation and its object-oriented concept. Two respondents commented that the UML and Rose had guided them through the modelling process in a logical way, which helped in ensuring a complete model to be developed. They started the modelling with the UML diagrams, which provided the overview of the whole system. The overview later leaded them to specify the system behaviours in more detail and systematically. One of the respondents believed that the UML-B method and the U2B tool were useful for the development of a B model, which would be different if the B model was developed from scratch.

Four respondents considered the mapping was "neither bad nor good". The respondents found several occasions where they wanted to add certain features to the model, which seemed to be logical in the UML, but did not work well in the UML-B model. In turn, they had to change slightly the way they normally did in the UML modelling in order to accommodate the UML-B modelling style.

Table 11. "Closeness of Mapping" dimension						
-2	-1	0	1	2	Total	
V.	Bad	Neither	Good	V.		
Bad		bad nor		good		
		nood				

Δ

0

6

10

2.12. Provisionality (ISO: Operability)

0

Median: 1

Question: How well does the UML-B method allow you to play around with your model (e.g. when you are testing your ideas/solutions, without being sure what the effects will be)?

Very Bad	1	0	1	Very Good	
-2	-1	U	1	2	
Why?					
Which part	of the meth	hod help or prev	vent you to de	o this?	

0

This question assessed the flexibility of the notation used in the UML-B method. The question required the respondents to indicate how well the method allowed them to play around with the model without being sure what the effect would be. The respondents were required to state which parts of the method that allowed or prevented them to do so.

The Table 12 below shows the distribution of answers. It can be seen that five of the respondents commented that the notation was not good enough for them to play around with the model. These respondents agreed that they could make any changes to the UML-B model in order test any new ideas. However, their main concern was that they needed to transform the UML-B model to a B model each time they made changes so that they could test the model using the prover. Otherwise, there was no way they could be sure whether or not the ideas were correct, as Rose did not support any syntax or model checking.

Four respondents found that they could easily play around with the model. These respondents believed that the concepts of UML in the UML-B model had made the process easier. Although they admitted that they needed to transform the UML-B model to a B model in order to test the effects, they did not found it as a burden. Being able to test the model using the prover was regarded as one of the method's strength.

Table 12. "Provisionality" dimension						
-2	-1	0	1	2	Total	
V.	Bad	Neither	Good	V.		
Bad		bad nor		good		
		good				
2	3	1	3	1	10	
Median :	- 0.5					

2.13. Premature Commitment (ISO: Attractiveness/Operability)

Question: Can you go about any task in any order you lik e in the UML-B method?

No Not Sure Yes

Why?

This question assessed whether the notation used in the UML-B method enforces the user to make decisions prior to modelling or there is any task ordering constraints. The question required the respondents to indicate whether or not they could go about any task in any order they liked.

The Table 13 below shows the distribution of answers for question (13). It can be seen that nine of the respondents commented that there was no task ordering constraints. They generally believed that they could start modelling as they liked. However, they found it was more logical to start with the diagrams before specifying the semantics for the operations using the B syntax.

Table 13.	"Premature	Commitment"	dimension
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No	Not Sure	Yes	Total
0	1	9	10

2.14. Abstraction Management (ISO: Attractiveness/Operability)

Question: Does the UML-B method insist you start the modelling task by defining or grouping things first before you can do anything else?

No Not Sure Yes

If Yes, what sort of things?

This question assessed whether the notation used in the UML-B method enforces any level of grouping mechanism. The question required the respondents to indicate whether the method insisted they start modelling task by defining or grouping things before they could do anything else.

The Table 14 below shows the distribution of answers. It can be seen that six of the respondents commented that they did not think the method insisted them to define or group things when they started the modelling. They generally found the process was natural. They would define or group things whenever required.

On the other hand, three respondents found that they had to define the classes needed and group the attributes and operations according to those classes, before they could proceed.

Fal	ble 14.	"Abstraction	Management"	' dimension
	No	Not Sure	Yes	Total

1

3

10

2.15. Learnability of the UML-B Method

6

Question: How easy is it to learn the UML-B method compared to the traditional B method?

Very Difficult				Very Easy
-2	-1	0	1	2

Are there any particular parts in the UML-B method that are particularly difficult to learn and understand how they work? If Yes, which ones?

The question assessed the learnability of the UML-B method. The question required the respondents to indicate how easy to learn the UML-B method compared to the traditional B method. The respondents were also required to indicate any particular parts of the method that were particularly difficult to learn and understand how they work.

The Table 15 below shows the distribution of answers. It can be seen that four of the respondents found that the UML-B method was "difficult" and "very difficult" to learn. These respondents believed that the method was difficult to learn because they had to integrate two concepts of modelling, that is, UML and B. As the U2B tool did the transformation to a B model automatically, they also found that they needed to understand how the transformation was done. They had to know what effects that he generated B model would have for each feature that they added on the UML-B model. The familiarity with the accompanied tools such as Rose was also believed to play a role on the method's learnability.

Three respondents thought the method was "neither difficult nor easy" to learn. Similarly, three respondents commented the method as "easy" and "very easy" to learn. These respondents believed that learning the method was easy because of the UML diagrams. However, they would foresee that learning the method would become difficult if they had not been taught on the UML and the B method.

Table 15. Learnability of UML-B method					
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
difficult		difficult		easy	
		nor easy			
3	1	3	2	1	10
Median : 0					

2.16. Learnability of the U2B Tool

Question: How easy is	t it to learn	and use the U2B to	ol?	
Very Difficu	lt	0	V	ery Easy
-2	-1	U	1	2
Why?				
Has the tool	l met its pur	pose and your expe	ctation (i.e. is it u	seful)?
Yes, a lot	Yes	Yes, a little	Not Sure	No
Why?				

This question assessed the learnability of the U2B tool that accompanied the UML-B method. The U2B tool is a tool that generates a UML-B model to a B model so that it could be verified by the B provers. The question required the respondents to indicate how easy to learn and use the U2B tool. The respondents were also required to indicate whether the tool had met its purpose and their expectation.

The Table 16.1 and 16.2 below show the distribution of answers. It can be seen that all of the respondents found that he U2B tool was "easy" and "very easy" to learn and use. These respondents generally found the process was very straightforward despite the lack of documentation on how to use the tool. By simply following a short instruction and clicking a button, their UML-B model had been automatically transformed to a B model.

Five respondents agreed that the tool had successfully met its purpose and their expectation. The tool had helped them in developing a correct model. These respondents would consider using the UML-B method to generate a B model rather than developing a B model from scratch. However, some of them admitted that using the tool for the first time was quite daunting as the tool generated a vast amount of syntax. They therefore had to understand why and how the transformation was done. Four respondents thought the tool had helped them "a little" as it only transformed the UML-B to a B model. Much of the difficult tasks such as specifying correct semantics and verifying the model still needed to be done by them.

	Table 16.	1 Learnabi	lity of U	12B	
-2	-1	0	1	2	Total
V.	Difficult	Neither	Easy	V.	
difficult		difficult		easy	
		nor easy			
0	0	0	5	5	10
Median :	1.5				
	Table	16.2 Utility	v of U2B		
-2	-1	0	1	2	Total
No	Not sure	Yes,	Yes	Yes,	
		a little		a lot	
0	1	4	5	0	10

2.17. Usefulness of the Documentation

Question: How useful do you find the available manual and documentation on the UML-B method?

Very Useless -2	-1	0	1	Very Useful 2
Why?				

The question assessed the usefulness of the available manual and documentation on the UML-B method.

The Table 17 below shows the distribution of answers. It can be seen that five of the respondents found that the documentation on the UML-B method was "neither useful nor useless". These respondents generally found that the documentation on the UML-B method was quite complicated to understand. In fact, they found that the presentation slide used during the lecture was more useful than the documentation. They used the slide extensively during the model development.

Four respondents commented that the documentation was "useless". These respondents found that the documentation merely discussed the theory underlying the method rather than specific examples on how to build a UML-B model step-by-step from scratch. They faced some difficulties in understanding the practical aspect of the method such as why certain things should be done in certain ways. They would expect more comprehensive documentation on the method.

One respondent found that the documentation was useful.

Table 17. Usefulness of Documentation					
-2	-1	0	1	2	Total
V.	Useless	Neither	Useful	V.	
useless		useless		useful	
		nor			
		useful			
0	4	5	1	0	10
Median : 0					

2.18. Accessibility of the UML-B Method

Question: How easy is it to become familiar with the UML-B method and be able to use it in your task efficiently without referring to the documentation?

Very Difficult -2	-1	0	1	Very Easy 2	
Why?					

This question assessed the accessibility of the UML-B method. In particular, the question required the respondents to indicate how easy to become familiar with the method and to be able to use it in their task efficiently without referring to the documentation.

The Table 18 below shows the distribution of answers. It can be seen that four of the respondents found that it was "easy" and "very easy" to become familiar with the method. Once they were clear on how to use the notation correctly and had some practice in using it, the task was pretty straightforward where the documentation could be neglected. However, they admitted that the difficult part was to understand how the notation and the transformation worked as a whole.

Four respondents felt that the task was "difficult" and "very difficult" because the method integrates both UML and B. They found that learning these two notations particularly the B syntax had consumed much of their time. Moreover, they needed to learn how the two notations should be integrated in the UML-B model. They found that using the method was easy but mastering it was quite difficult.

Two respondents commented the task as "neither difficult nor easy". There were some parts of the method such as statechart and association that required them to refer to the documentation quite often.

Table 18. UML-B method's accessibility								
-2	-1	0	1	2	Total			
V.	Difficult	Neither	Easy	V.				
difficult		difficult		easy				
		nor easy						
1	3	2	2	2	10			
Median : 0								

2.19. Operability of the UML-B Method

Question: How easy is it to do modelling using the UML-B method compared to the traditional B method?

Very Difficult				Very Easy
-2	-1	0	1	2

If you are given the choice in modelling, which method would you choose: UML-B or B? Why?

This question assessed the operability of the UML-B method. In particular, the question required the respondents to indicate how easy to do modelling using the UML-B method compared to the traditional B method. The respondents were also required to indicate their choice in modelling, that is, which method that they would prefer to use in modelling.

The Table 19.1 and 19.2 below show the distribution of answers. It can be seen that four of the respondents found that it was "easy" and "very easy" to model a system using the UML-B method compared to the traditional B method. These respondents

generally agreed that the modelling was easy using the UML-B method because the main elements of the model could be illustrated graphically using the UML diagrams. The diagrams indeed made the process of specifying semantics for the model more obvious. Besides, they found that much of the effort and trouble in modelling a B specification could be overcome due to the automatic transformation provided by the U2B tool. The tool was seen as capable of preventing more errors to be made on the model.

Four respondents regarded the task was "difficult" and "very difficult" because they had to integrate both styles of modelling, UML and B, at the same time. Having several different ways to specify the semantics, the UML-B method had caused some confusion to these respondents. In addition, the lack of training and comprehensive documentation was also a factor that made the method difficult to them.

In general, six respondents preferred the UML-B method to the traditional B method. Despite the limitations mentioned above, these respondents believed that the UML-B method would be useful and easier to use, if they were given more time and exposure to the method. They could see the potential of the method as it is much more closer to the realism.

Table 19.1 UML-B method's operability								
-2	-1		0	1	2	Total		
V	. Diffic	ult Ne	either	Easy	V.			
diffic	cult	dif	ficult		easy			
		nor	easy					
1	3		2	4	0	10		
Medi	an : 0							
Table 19.2 Method attractiveness								
	UML-B	В	B	oth	Total	_		
	6	2	,	2	10	_		

2.20. Further Improvement

Question: Can you think of obvious ways that the design of the UML-B method and U2B could be improved? What are they?

The last question of the survey provided the respondents an opportunity to raise any issue of using the UML-B method and the U2B tool. The respondents were also allowed to suggest any possible improvement that could be made on the method and its accompanied tools. Below are some of the issues and areas for improvement highlighted by the respondents:

- Provide syntax checking at the early stage, that is, during the UML-B model stage rather than having to transform the model **b** a B model to do the simple syntax checking.
- Provide dropdown list for the B syntax where the user could select the appropriate ones in order to avoid typos.
- Provide automatic changes in all the respective parts of the model.
- Provide a more functional and user-friendly interface for the U2B.
- Provide more comprehensive documentation on the method and its accompanied tools.

3. Summary

This document presents the feedback received from the survey conducted on the UML-B method. The survey investigated the usability of the method, particularly the notation used. The main purpose of the document is to record the survey responses (raw data) rather than analysis. The data act as the basis for the analysis documented in [9].

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