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Verification, Validation and Evaluation for Quality of Services of Expert System for Bus

Shuhairy Norhisham, Nor Hazwani Nor Khalid, Nur ain Md. Isa

Department of Civil Engineering, College of Engineering,
Universiti Tenaga Nasional, Kajang, Selangor, Malaysia.

Amiruddin Ismail, Muhammad Nazri Borhan

Department of Civil and Structural Engineering,
Faculty of Engineering and Build Environment,
Bangi, Selangor, Malaysia.

Abstract

In developing expert system for quality of services , there is five step methodology namely Task Analysis, Knowledge Acquisition, Prototyped Development, Expansion & Refinement And Finally Verification, Validation And Evaluation. In this paper is highlight of case study verification, validation and evaluation proses of the expert system. In this case study an expert system for quality of services for bus. In Verification proses, and couple of error had identified. It is a process to make sure the programming is complete. The verification proses done successfully. Validation process is a comparison with normal results calculation and checking with comparison with expert system output. Validation process had been validate same as normal calculation process. Same as Evaluation process, 5 evaluators had been assign to use the system and give and input of their experience using the system. Results showed BUS-QOS verification has yielded satisfactory results where the manual calculation and BUS-QOS is almost 100% match. Based through the results, it shows the advantages of using bus-QOS which is faster and encouraging in assessing level of service.

Keyword: Expert system, Verification, Validation, Evaluation, quality of services

I. INTRODUCTION

An expert system namely Bus Quality of Services Expert System (BUS-QOS) had been developed to check quality of services for bus. In developing this expert system 5 step

of methodology should be done for developing expert system. This paper, will focus on last part of developing expert system.

II. VERIFICATION, VALIDATION AND EVALUATION

BUS-QOS may be checked and approved to figure out that those systems may be fabricated as stated by the specifications. BUS-QOS verification is by the knowledge from engineers in the same field include the checking for those execution of the decisions ways, flow of framework thinking and the system overall part.

All the information include formulas and the reasoning parts have been verified and validated by the actual case and assumed data using the model developed in the BUS-QOS.

III. VERIFICATION OF BUS-QOS

System performance under different combinations of components, the route, and the valuesof variables and parameters of the rating level has been apply to guarantee those uniformity and stabilization of system.

The behavior of the graphical interface with the system was also tested and restructured to guarantee the structural of internal is right. It is done by specifying excess or regulation in the rules of production lost.

The content of conclusions and coding errors was reviewed and modified if necessary. Technical error was shown in Figure 1 and Figure 2 which was found in the bus-QOS. Several other factors in system errors are caused by incomplete programming language and using the wrong formula for attributes

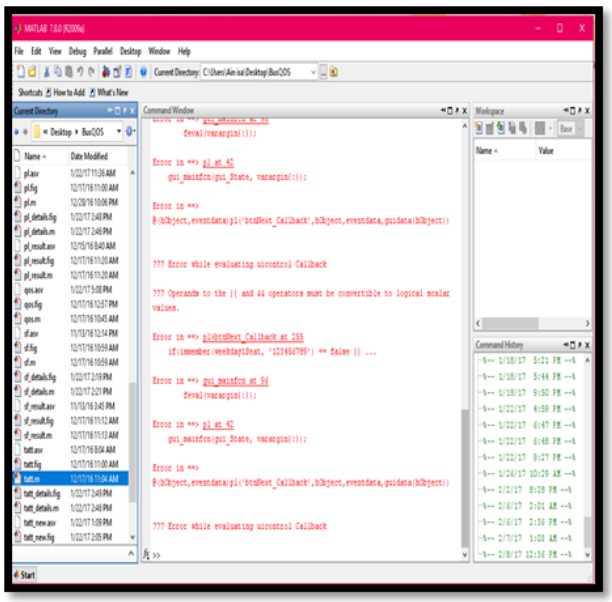

Figure 1: Example of technical error in BUS-QOS development

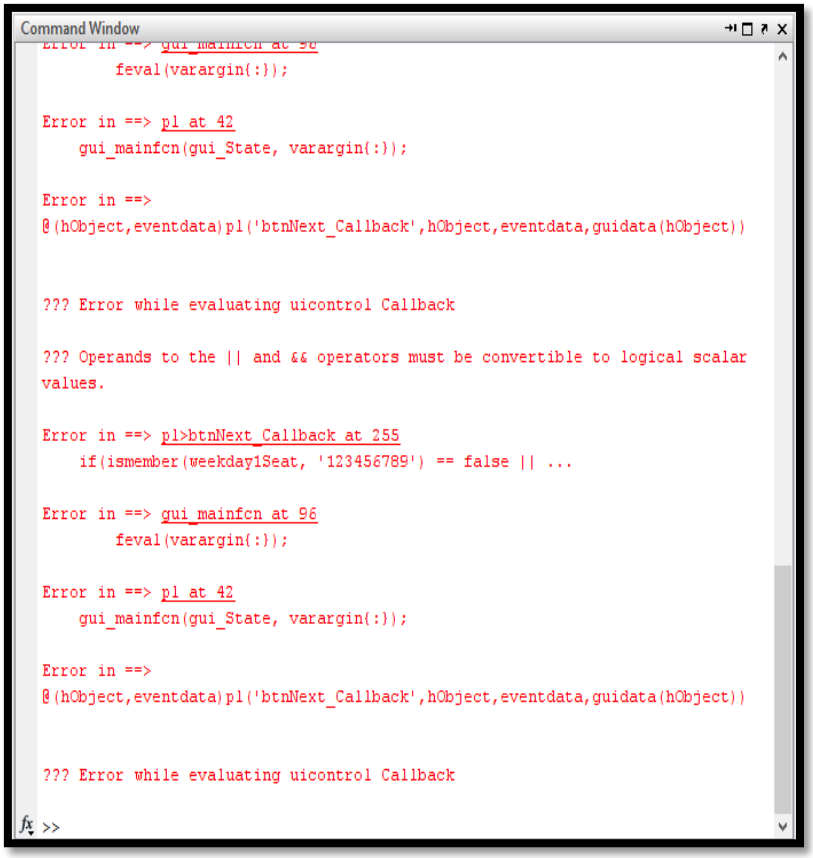

Figure 2: Example of technical error in BUS-QOS development

IV. VALIDATION OF BUS-QOS

BUS-QOS performance has been validated in two aspects which is calculation and reasoning. All the calculations and conclusions of assessment was confirmed using several data in Transit Capacity and Quality of Service Manual (3rd edition) and actual case studies in Kajang.

The decision in finding the suitable strategies is validating through the design experimental. The reason for this acceptance practice might have been should furnish a few measure of the correctness of the learning base.

Sample input data are taken from actual case studies in Kajang as shown in Table 1 for hour of services. The results obtained from the BUS-QOS is than compared to manual calculation as shown in Figure 4.

The results also show consistency between manual calculation and the BUS-QOS. While running, there is only multiple decimal point different but the final rating calculation results are consistent between manual and BUS-QOS

Data was taken from several case studies, to validate the results for quality of service between manual calculation compare with BUS-QOS. The following is the manual

calculation and the result of each attributes that is service frequency, hours of service, on time performance, transit auto travel time, headway adherence and passenger load

Table 1: Results Manual Calculation for Hours of Service

	First Bus	Last Bus	Hours of Service	Quality of Service
Case 1	6.00am	11.30pm	17 hrs 30 mins	B
Case 2	6.00am	10.00am	16 hrs	B

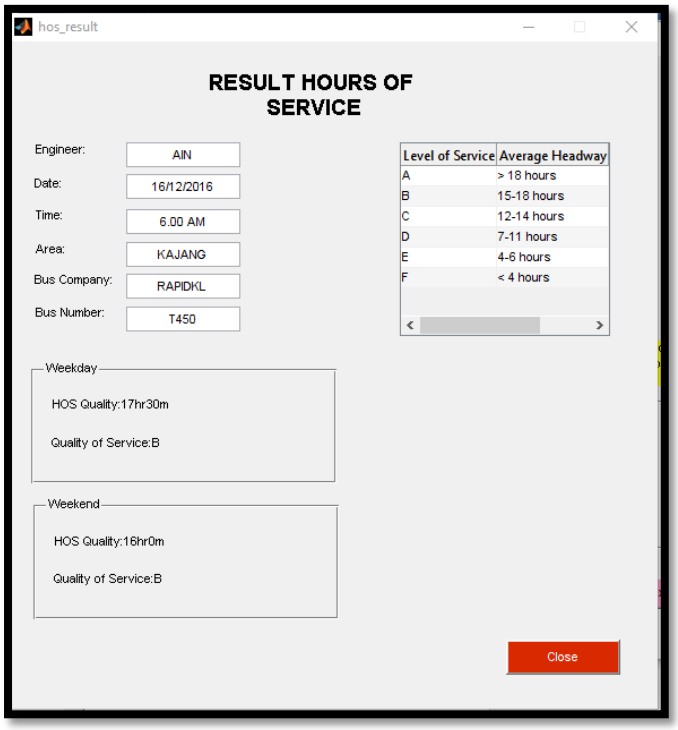

Figure 3: Results BUS-QOS Calculation for Hour of services

Table 2: Results Manual Calculation for Services Frequency

	Service Frequency Time Range	Average Service Frequency	Quality of Service
Case 1	30 – 45 mins	37.5 mins	E
Case 2	15 – 20 mins	17.5 mins	D

Figure 3 shows results from BUS-QOS and table 1 is a normal calculation as follow in guideline. Meanwhile, table 2 state manual results for hours of services to compare with figure 4, BUS-QOS results for services frequency.

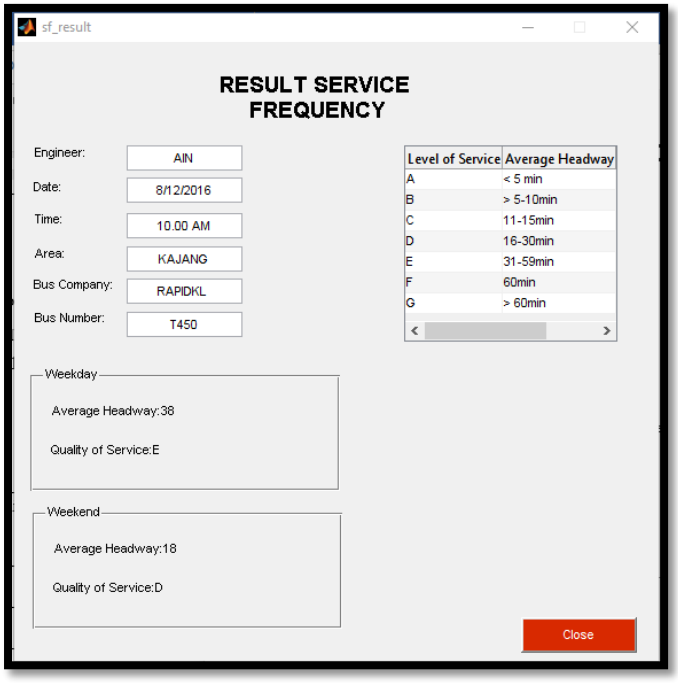

Figure 4: Result from BUS-QOS for services frequency

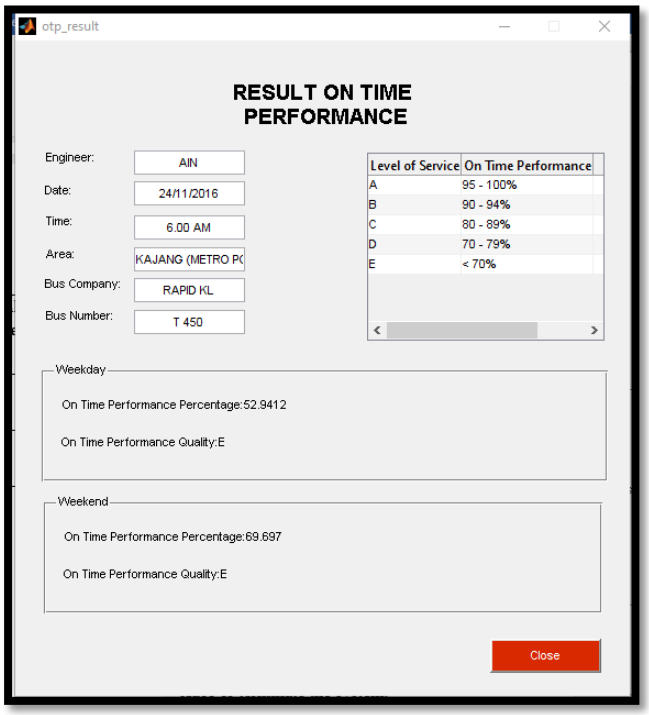

Figure 5: Result from BUS-QOS for on time performance

Table 3: Results Manual Calculation for On Time Performance

	Late Arrivals	Early Arrivals	On Time Arrivals	Total Arrivals	On Time Percentage	Quality of Service
Case 1	4	4	9	17	52%	E
Case 2	8	2	23	33	69%	E

Table 4: Results Manual Calculation for Transit Auto Travel Time

	Total Ratio	Average Ratio	Quality of Service
Case 1	4.09	1.37	C
Case 2	3.66	1.22	B

A comparison figure 5 from BUS-QOS and table 3 for on time performance and give the same results. For auto travel time, figure 6 from BUS-QOS and table 4 manual calculation was compared.

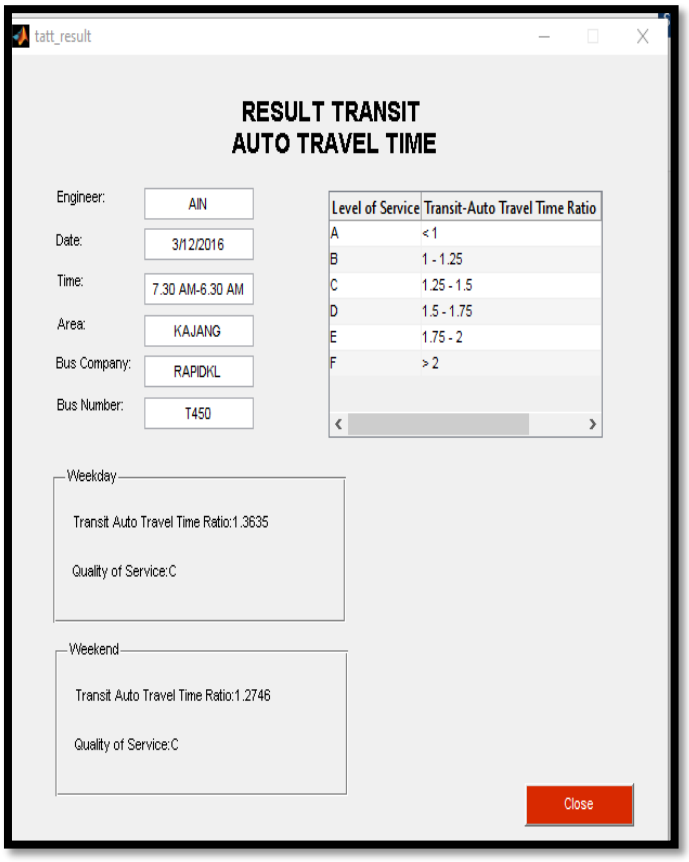

Figure 6: Result from BUS-QOS Auto Travel time

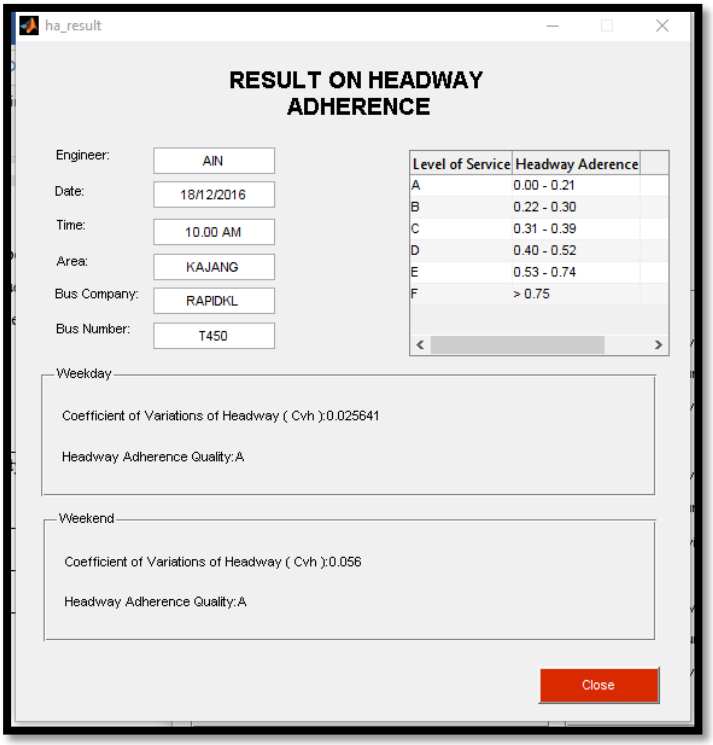

Figure 7: Result from BUS-QOS Passenger Load

Table 5: Results Manual Calculation for Passenger Load

	Total Passenger	**Load Factor**	**Quality of Service**
Case 1	242	0.59	64
	415	0.92	
	180	0.43	
Case 2	194	0.52	62
	132	0.35	
	448	0.99	

Table 6: Results Manual Calculation for Headway Adherence

	Mean Headway	**Standard Deviation Headway**	**Quality of Service**
Case 1	75 mins	2925 mins	0.02
Case 2	35 mins	625 mins	0.05

Figure 7 is the results from BUS-QOS for computing passenger load and table 5, shown the manual calculation by guideline. Finally the results is same when compare figure 8 and table 6 for headway adherence.

The results comparison between BUS-QOS and manual calculations was described below in Table 7. It shows that the result was same even though there were only different less in decimal point. This indicates that QOS Bus- has revealed excellent results in faster service quality determination.

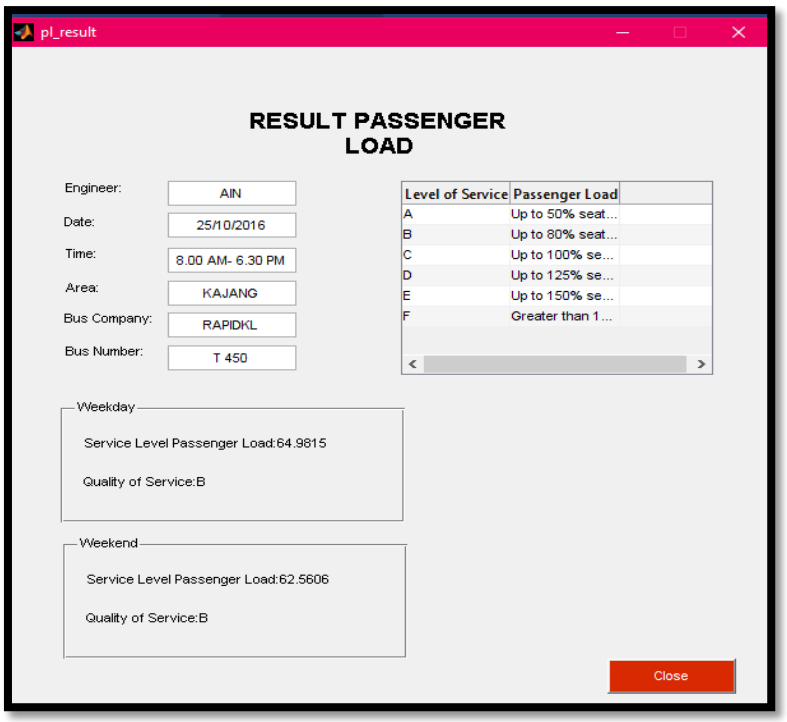

Figure 8: Result from BUS-QOS

Table 7: Comparison Results between BUS-QOS and Manual Calculation

Attributes		**Manual**	**BUS-QOS**
Hours of Service	Case 1	17 hrs 30 mins	17 hrs 30 mins
	Case 2	16 hrs	16 hrs
Service Frequency	Case 1	37.5 mins	38 mins
	Case 2	17.5 mins	18 mins
On Time Performance	Case 1	52%	52.9412%
	Case 2	69%	69.697%
Transit Auto Travel Time	Case 1	1.37	1.3635
	Case 2	1.22	1.2298
Passenger Load	Case 1	64	64.9815
	Case 2	62	62.5606
Headway Adherence	Case 1	0.02	0.025641
	Case 2	0.05	0.056

In order to obtain more accurate knowledge base, BUS-QOS overall performance has been confirmed by experimental design using case scenarios in the questionnaire that put all sub-modules in the prototype system.

The experts who participated have been involved in the verification process. Confirmation expert decision in each case study is represented by five semantic values: Strongly Agree, Agree, Do not Know, Do not Disagree and Strongly Agree.

The validation specialist case scenario is tabulated in Table 8. Results are from strongly agree to agree with the average value 3.92 as shown.

Table 8: Expert Evaluation Result on BUS-QOS

	Expert Evaluators						
	A	B	C	D	E	F	Average
Case 1	4.14	4.5	3.2	3.0	4.5	4.16	3.92
Case 2	4.14	4.5	3.2	3.0	4.5	4.16	3.92

A=Service Frequency B=Hours of Service C=On Time Performance

D=Headway Adherence E=Passenger Load F=Transit Auto Travel Time

V. EVALUATION OF BUS-QOS

Four evaluators participated in the evaluation of the entire system BUS-QOS. The evaluators are those engaged in the field of transport or the end user who is considered inexperienced in the quality of service.

Evaluation forms consists of a number of criteria such as user interface, presentation of the results, the usability of the system, the system efficiency and overall rating were to carry out this assessment. Easiness measured user interface and how user-friendly the system.

Results show gauge the adequacy and completeness of the system. Measured are usability and practical use in efficiency is considered effective. Overall rating assessed the overall evaluation system.

The results of the evaluation in the evaluation represented by five semantic values: Very Good, Good, Fair, Poor and Very Poor. Table 9 shows the results of the assessment of overall system. The majority evaluators noted good for those interface. Others noted from fair to excellent, this gives an average grading of 4.0 which is good

Table 9: Overall Evaluation of BUS-QOS

		Evaluator 1	Evaluator 2	Evaluator 3	Evaluator 4	Average
1	**User Interface**					
	• Easy to use	3	4	5	4	4
	• Friendly	3	5	4	5	4.25
2	**Result Presentation**					
	• Result is adequate	4	5	4	4	4.25
	• Result is complete	3	4	5	4	4
3	**System Applicability**					
	• System is useful	3	5	4	4	4
	• System is practical	3	5	4	4	4
4	**System's efficiency**					
	• System is effective	4	4	5	5	4.5
5	**Overall rating**	3	4	4	4	3.75

1=Very Poor 2=Poor 3=Fair 4=Good 5=Very Good

VI. CONCLUSION

These part portrays the BUS-QOS implementation with user interface design. Matlab were used to build the knowledge base of BUS-QOS because it is more convenient and reliable.

The next section describes the validation, verification and evaluation stages of development for BUS-QOS. Results for projects have been approved through the example data in real case studies. Summary confirmation of accuracy based on the output of the system is shown in Table 7.

Results showed BUS-QOS verification has yielded satisfactory results where the manual calculation and BUS-QOS is almost 100% match. Based through the results, it shows the advantages of using bus-QOS which is faster and encouraging in assessing level of service.

Generally, verification and evaluation of the results of this chapter show that the proposals on the appropriate quality of service is in line with experts and guidelines manual.

This system can also be accepted by the majority of users is involved in the evaluation process. However, a couple remarks have been accepted from the evaluators. The evaluator was suggested that the system will need a larger font on the button for convenience. In addition, this system needs to be improved before fully utilized outside

VII. ACKNOWLEDGEMENT

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