CHAPTER V

OTHER NONFUNCTIONAL REQUIREMENTS

In this chapter, the developers discuss the different sections of the nonfunctional requirements or the software quality attributes of the application. The following nonfunctional requirements to be addressed in this chapter are performance requirements, safety and security requirements, and the testing requirements.

1. Performance Requirements

Performance requirements refer to how well the system can do the tasks that are intended or required to do (Halligan, 2016). These requirements have lots of measures being used, like response time, throughput, and the likes. The general features of the application are also considered regarding how it affects the entirety of the application. Identifying these requirements is important because it would help the developers in identifying their improvements or changes to be made in the application overtime.

ASEAN Aid Map has four general features which are an adaptive user interface, informative content, user-friendly environment, and up-to-date information. Being adaptive refers to the traits of the application to adjust to new specifications or operating environment (SQA, 2016). ASEAN Aid map user interface is developed with a responsive design which can adapt to changes in screen resolution. Also, the adaptive feature of the application would mean that it is capable of running in different browsers. In the informative content feature, it refers to the ability of the application to provide information about the NGO and their projects occurring in particular places in Southeast Asia. There are also features which give information to NGO on what projects they can join in or what NGO they can partner with, and these suggestions are generated by the application itself. User-friendly pertains to the application environment which is easy to navigate. The design was organized in a way that the users do not experience menu lostness. With this feature, it ensures the users that they can obtain the results that they expect the application to give them. The up-to-date information indicates that the application shows recent updates or the newest information about the projects or their profile straight from the organizations themselves. The updated information is also delivered to other users of the application via notifications.

Table 14 shows the general features of the application together with the corresponding software quality attributes. These attributes would surely certify that the application is of quality with the features presented. The four general features of the application must be met to achieve the aimed quality of the developed application with the consequent software attributes. These characteristics were derived using different software quality models like Boehm’s and McCall’s Software Quality Model, The Test Eye’s, ISO 9126, and from the research paper entitled “Website Quality Assessment Criteria” by Moustakis. The software quality attribute of an adaptive user interface was derived from the ISO 9126. In terms of the user-friendly environment and up-to-date information features, the characteristics were identified with the help of Boehm and McCall’s model and The Test Eye’s. The research paper by Moustakis became the basis of the software quality attribute of an informative content feature.

|  |  |  |  |
| --- | --- | --- | --- |
| Product Features | Software Quality Attributes | Mean Value | Feature Mean Value |
| Adaptive User Interface | Adaptability | 90.6% | 90.6% |
| User-Friendly Environment | Consistency | 90% | 93% |
| Operability | 96% |
| Learnability | 93% |
| Up-to-date Information | Assurance | 100% | 96.7% |
| Consistency | 90% |
| Authorization | 100% |
| Informative Content | Completeness of content | 100% | 100% |

Table 15. ASEAN Aid Map Summary of Features and Attributes.

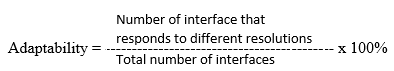
Table 15 also shows the computed values derived from the general features and their software quality attributes counterparts. The ASEAN Aid Map has a total of eight software quality attributes which signifies the whole performance of the application including its functions. With the general features, it can be determined which software quality attribute got the lowest and the highest mean value. The software quality attribute that got the lowest mean value is adaptability with 90.6% while assurance, authorization, and completeness of content got the highest value with 100%. Understandability got the highest feature mean value which is 100%, while portability got the lowest feature mean value which is 90.6%. Portability getting the lowest feature mean value signifies that the application needs to improve its ability to transfer from one environment to another. Understandability or the completeness of content getting the highest value means that the information that the application presents is comprehensive.

1. Software Quality Attributes and Metrics

In this section, the developers discussed the software quality attributes with its criteria for designing a system on how to meet its functional requirements. These criteria were identified based on the general features of the system that the developers have considered. The following metrics are listed to provide a proper and efficient way in measuring the features of the system.

1. Adaptability

Adaptability is a software quality attribute which refers to the level of how the system easily supports changes in environment and platform. If a system can easily adapt to the changes of the user’s environment without further hassle like working from a PC to a tablet, then it is considered to have high adaptability. With this attribute, the developers can test the environment and content of the system if it can adapt to changes. Adaptability is solved by the following formula that is being shown in Formula 1.

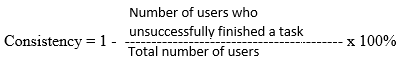


Formula 1. Adaptability Formula

The application has a total of 32 interfaces where repeating interfaces are counted as one, and 29 of it are responsive to different screen resolutions of the user. This indicates that the system is able to adapt to changes in resolution easily without affecting its functionalities. In solving the adaptability, the developers divided 29 which is the number of interfaces that adapted to changes in resolution by 32 which is the total number of interfaces and multiplied by 100%, resulting in 90.6%.

1. Consistency

This type of software quality attribute is denoted as the level of how the environment and behavior stay the same throughout the system. It shows that there is one look and feel that the user would not feel lost in using the system when transitioning from one function to another. This attribute shows that the system has uniformity in its data and content which displays the up-to-date information. The developers would use this attribute to measure the consistency of content and data of the system. Consistency is solved by the following formula that is being shown in Formula 2.

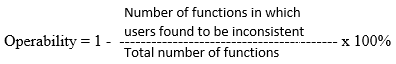


Formula 2. Consistency Formula

The application has a total of 30 different users who used the system for evaluation. Out of 30 users, there are three users who cannot finish a task after performing the other. The other 27 users said that the process flows and data content of system are consistent making it easy to follow. In solving the consistency, we deducted the three over 30 from one and multiplied it by 100%, resulting in 90%.

1. Operability

Operability is a software quality attribute that refers to how well the software system works when functioning. It is also an attribute that evaluates if the interfaces and functionalities of the system are functioning well. The developers used this attribute to identify which modules of the system are functioning and which is not. This attribute can help the developers locate the modules that need more improvement or fixes with regarding operability. Operability is solved by the following formula that is being shown in Formula 3.



Formula 3. Operability Formula

The application has a total of 56 functions for the whole system based on its function point analysis. The developers gathered different users to evaluate and test the functionalities of the system. Out of 56 functions, there were two functions that have been found inconsistent. These functions were beyond the control of the developers, but they would still makeup to fix the inconsistent functions. The result is 96% which is derived by deducting two which is the number of functions that are inconsistent over 56 which is the total number of functions from one and multiplying it by 100%. This indicates that the system has high operability and would provide correct and proper outputs to the intended users.

1. Learnability

This type of software quality attribute indicates the level of how fast the users can learn the operations of the system. It refers to the different effort of the different users in learning the application. If there is improvement in the time to finish a task means that the system has high learnability to the users. The developers used this attribute to know how understandable the flow of processes in the system. This attribute can contribute by helping the developers identifying improvements in terms of user engineering and aesthetics. Learnability is solved by the following formula that is being shown in Formula 4.



Formula 4. Learnability Formula

The developers gathered 30 different users to test and use the application. The users should perform a specific task for three times and the proponents track their task time in each try. At the end of the evaluation, the developers have acquired that out of 30 users, there were 28 users that improved their task time. The learnability of the system is then solved by dividing the total number of users which is 30 to the number of users that have improved task time which is 28 and multiplied it by 100% giving a result of 93%. This means that the learnability of the system is high and users can easily learn the processes of the system.

1. Assurance

This type of software quality attribute is referred as the level of how correct and timely the data and content of the system. It is also an attribute that ensures that the functionalities of the system match with its specifications. Assurance makes sure that the system performs in accordance with its specifications and fulfills the purpose of the user. This attribute helps improve the system to output accurate and precise data based on the features and functions. Assurance is solved by the following formula that is being shown in Formula 5.



Formula 5. Assurance Formula

The developers gathered 30 different users to test and evaluate the different functionalities of the system. They test them with an authorized account and tried different modules and processes. This evaluation is for the purpose of knowing which functions are not operating or functional. After the evaluation of the users, the developers found that all functions are functioning given of all the functions. The assurance of the system is solved by dividing the number of functional functions which is 38 by the total number of functions which is 38 and multiplied by 100%. The result is 100% which means that the system has high assurance rate.

1. Authorization

Authorization is denoted as the level of how the system handle what the user can do and see based on their authentication. It is a software quality attribute that measures the reliability of the system to provide proper modules to the authorized users. This attribute makes sure that unauthorized users would not be granted the same permission, access, and capabilities as the authorized user. Through this attribute, the proponents can identify the modules that are not present on authorized users and further improve the system. Authorization is solved by the following formula that is being shown in Formula 6.

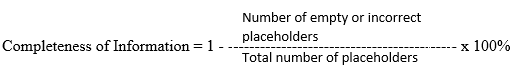


Formula 6. Authorization Formula

The ASEAN Aid Map is a web application that allows users to register for them to unlock and use the other modules and functions of the system. Aside from the modules that are present in the public, there are 16 modules that are given only to authenticated users. The developers gathered different users to register and test the system. After the evaluation and testing, the team got 16 out of 16 modules were given to authenticated users. With this test, authorization is solved by dividing 16 which is the number of present modules by 16 which is the expected number of modules in the system and got a result of 100% providing a result of 100%.

1. Completeness of Information

This type of software quality attribute refers to the level how the system captures the explanatory profile of the system with respect to the information contained within it. It also assures that the information should be presented in a directly usable format that the user need not require to decode, interpret, or calculate it. This attribute also expresses that the information provided must be correct and understandable. The developers would make use of this attribute to measure the wholeness of the content with the information gathered and provided. Completeness of Information is solved by the following formula that is being shown in Formula 7.



Formula 7. Completeness of Information Formula

The ASEAN Aid Map is a web application that has a mission which is to provide useful and understandable information to its intended users. The proponents gathered different users to evaluate and test the completeness of information of the system. The users have a registered account and test if the content of each placeholder in different views is displaying the correct information. After the evaluation and testing, the proponents found that zero out of 40 placeholders are not displaying proper information. Some minor problems are beyond the control of the developers but they are trying their best in fixing it. The completeness of information is solved by dividing zero which is the number of incorrect placeholders by 40 which is the total number of placeholders and deducting it to one and multiplied by 100% providing a result of 100%.

1. Function Point Analysis

Function point refers to the size of the application based on the internal and external characteristics and performance of the system. It was solved using its formula by multiplying the unadjusted function value and value adjustment factor. The unadjusted faction value is computed by multiplying the number of inputs, outputs, inquiries, files, and an external interface to its weighting factor. A weighting factor is a series of system characteristics which is scaled from zero to five. The ASEAN Aid Map system has a total count of 48.3. It is the value used in computing the response score summary and value augmented function points.

There are 14 questions raised after computing the total function point. The developers need to answer those questions using the rating scale from 0 to 5, where zero is the lowest or no influence, and five is the highest or essential characteristic. The total count is very significant in identifying the function point of the system. The total complexity adjustment response is the total value adjustment factor which is 1.13 that resulted in the total measurement of the function point of 288.15.

The cost of the project amounted to P144,075 which is composed of the hardware and software costs in the development stage. The duration of the system development of the ASEAN Aid Map is 36 weeks. This is comprised of activities such as title proposal, technical review, requirements gathering, scope formulation, prototyping, coding and testing, and finalization of the product. The total development cost of the proposed project is P104, 000 but due to the computation of the function point, the cost increased by P40,075. The developers finished the development in 38 weeks and the project has an estimated total augmented cost for the project is P144,075.

1. Safety and Security Requirements

The ASEAN Aid Map is a web application that can run on any browser and on any screen resolutions. Users can access the web application through its website using any browser on any operating system. Users have to make sure that essential requirements are there for the web application to perform its functions well. The ASEAN Aid Map requires registration for an organization to make us of all its modules and features. It is recommended that the users must complete their profile after registering to the system.

1. Testing Requirements

It is the requirements to assess the system in different ways to determine the consistency and efficiency of the said system. Testing is performed to provide users the reliability of the functions and attributes of the system. Different types of testing include unit testing, integration testing, and validation testing.

1. Unit Testing

Unit testing is usually done through the use of automated software, but it can also be executed manually. It is often intended to test modules and codes which the developers have made and goes through hand in hand testing. The proponents used black-box testing to know if the different components meet their specifications. They tested the functionalities one at a time to know if it functions or not. After execution, the developers verified the results. The developers were able to track functions that require optimization and improvement in both processing speed and efficiency. The testing helped the developers to merge codes to minimize execution time and were able to modify other parts of the code to improve performance and increase the efficiency of the system.

|  |  |
| --- | --- |
| Main Topics | Sub Topics |
| Organization | Sign-in and Sign-up for an account |
| Edit organization profile |
| Add and remove connections |
| Apply and invite collaboration |
| Project | Create project |
| Edit project |
| Update changes with collaboration and resources |
| Moving of finished projects to portfolio |
| Notification | Notify all types of requests |
| Notify new projects of connections |
| Donation | Donate resources for collaborated project |
| GIS | Display markers and number of project on locations |
| Messaging | Create message |
| Inbox for incoming messages |
| Reports | Generate statistical report |
| Generate summary report |
| FAQs | Provide list of questions and answers |
| Allow creation of new question |
| Performance Evaluation | Allow collaborators to evaluate performance of organization in finished projects |
| Matching | Provide suggestions based from matching results to organization |

Table 16. Web Application Criteria Table.

Table 16 shows the web application criteria table of the developed system. ASEAN Aid Map has different website criteria that need to be completed to output correct results that the application can yield. The developers must follow the listed criteria so that it would be easier for them to develop the system at a given time with its attributes and quality that can reach the expected standard.

1. Integration Testing

Integration testing is a software development process where program units are combined together and tested as groups in multiple ways. It also tests integration or interfaces between components, an interaction between different parts of the system such as an operating system, file system and hardware interfaces between systems.

The proponents identify hardware and software requirements for the user to meet and for them to experience maximum performance when accessing and using the said web application. Users can avoid lag and delay scenarios from the browser if they are able to meet these requirements. The system integrates authorization and authentication which means that the users need to register an account to maximize the potential of the application. The ASEAN Aid Map requires an internet connection for it to be accessed.

1. Understandability

In understandability standard, the proponents make sure that the text, colors, images, and other multimedia element would go in harmony and blends with the background and could not cause hassle to the users. The texts are also readable and do not require any decoding to reading the text. The information provided are also correct and gathered from the users.

1. Response Time

In response time standard, the proponents optimized the code that it would take less processing time in executing a function. With the improvements implemented, the response time of the system is faster because of fewer processes. Even though there is optimization with the system, internet speed on the part of the users is still a factor that is out of the control of the developers.

1. Validation Testing

Validation testing refers to the process of assessing the software during or at the end of the development phase to determine if it meets the needs of the clients or business (TutorialsPoint.com). This testing is also used to know if the application works or fulfills its intended use. The following shows the formula for validation testing.

Total Weight

Validation Testing = --------------------------

N

Where:

Total Weight = mean value of the criteria

N = number of users

Formula 8. Validation Testing Formula

Table 17 shows the validation testing scale and the interpretation of each computed scale. It displays the range of the possible results of the validation testing with its corresponding interpretation or assessment.

|  |  |
| --- | --- |
| Rate | Assessment |
| 5.00 – 4.21 | Very Good |
| 4.20 – 3.41 | Good |
| 3.40 – 2.61 | Average |
| 2.60 – 1.81 | Fair |
| 1.80 – 1.00 | Poor |

Table 17. Validation Testing Scale.

Table 17 is used as a guide in scoring the different software quality attributes if they are very good, good, average, fair, or poor. The poor rating ranges from 1.00 to 1.80, fair rating ranges from 1.80 to 2.60, average rating ranges from 2.61 to 3.40, and good rating ranges from 3.41 to 4.20.The very good rating ranges from 4.21 to 5.00 and is the highest rating. This is also the overall rating from the panels, interpolators, representatives of NGO, and other people who have knowledge on using the application. Based also on the individual evaluation of users, all of the mean scores are not below the inclusion range of the very good rating which means that they are satisfied on how the system features and functionalities. This signifies that the application is working accordingly to its intended use concerning its software attributes. Meanwhile, poor rating ranges from 1.00 to 1.80, and this indicates that there are a lot of improvements or changes to be made in the application with the specified software attributes.

|  |  |  |
| --- | --- | --- |
| Criteria | Mean Score | Interpretation |
| Accuracy | 4.70 | Very Good |
| Auditability | 4.63 | Very Good |
| Communication | 4.60 | Very Good |
| Completeness | 4.53 | Very Good |
| Conciseness | 4.47 | Very Good |
| Consistency and Understandability | 4.50 | Very Good |
| Controllability | 4.53 | Very Good |
| Data Commonality | 4.57 | Very Good |
| Decomposability | 4.70 | Very Good |
| Error Tolerance | 4.63 | Very Good |
| Execution Efficiency | 4.40 | Very Good |
| Expandability | 4.60 | Very Good |
| Generality | 4.60 | Very Good |
| Hardware Independence | 4.60 | Very Good |
| Instrumentation | 4.60 | Very Good |
| Modularity | 4.47 | Very Good |
| Observability | 4.70 | Very Good |
| Operability | 4.60 | Very Good |
| Security | 4.53 | Very Good |
| Self-Documentation | 4.47 | Very Good |
| Simplicity | 4.40 | Very Good |
| Software System Independence | 4.47 | Very Good |
| Traceability | 4.60 | Very Good |
| Training | 4.80 | Very Good |

Table 18. Validation Testing Result.

Table 18 shows the validation testing result with the criteria, mean score, and interpretation. The four criteria that got the highest mean scores are Training with 4.80 and accuracy, decomposability, and observability with 4.70. Training signifies that the features and functions of the application are usable to the degree to which the software helps in enabling new users to utilize the system. The application has a better accuracy or precision when it comes to the computations and its controls. Another is the decomposability of the application, which means that the modules can be individually tested. Observability on the other hand is distinct outputs are generated and other factors affecting it are visible. Simplicity and execution efficiency both got the lowest mean score which is 4.40. Simplicity getting a low score signifies that the application design needs to be further improved, but regarding the development process, the application is considered complex. As for execution efficiency in the application, the performing of tasks must be further developed in the sense that it can get done in a short amount of time, and less effort. Furthermore, there are other criteria with high mean scores and matches with the software quality attributes that the team has identified.

In conclusion, this chapter presented and explained the nonfunctional requirements of the developed application. The discussion also includes the different formula of the software quality attributes, how it was derived and solved. All data and values used in the evaluation and validation of the various software attributes were gathered from different NGO who were able to use the application first hand. The results of the testing were computed and generated using the given formula, and this helped the developers in identifying which got the highest or the lowest scores.