



**DEVELOPMENT OF EMPLOYEE
ATTENDANCE AND MANAGEMENT SYSTEM USING
QUICK RESPONSE (QR) CODE IN SORSOGON STATE
UNIVERSITY, CASTILLA CAMPUS, PHILIPPINES**

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Abstract:

This paper aimed to develop an Attendance System using a QR code which provided an easier and more efficient way of managing the employees' attendance records. This is a system in which the generated report was generated on a QR code. This study utilized the Rational Unified Process (RUP) method, a software engineering process that was designed with the aim of providing real-time analysis of development projects, to analyze the processes of the system. The phases - inception, elaboration, construction and transition - were also utilized in the development process of the system. A descriptive method was also employed to evaluate the system. QR Codes was generated and assigned to each of the employees of Sorsogon State University, Castilla Campus, who have alternative work-from-home schedule. Each of the employees scanned into the system the assigned QR code in order to confirm their attendance. Findings revealed that retrieval of basic information of employees, creating of travel orders, automation of computation of available leave credits and utilizing attendance using QR codes and generation of reports became more accessible, cost-effective and reduced the occurrences of errors. Also, based on the evaluation conducted, QR code as an attendance monitoring system generally met the acceptable expectation in terms of functionality, reliability, efficiency, accuracy, usability, maintainability and portability. It was concluded that the developed system was a user-friendly, efficient, cost-effective and adaptable solution for keeping track of employees' attendance through contactless transactions without sacrificing the reliability and accuracy of the attendance reports.

Keywords: attendance system, Quick Response (QR) code, attendance record, cost-effective

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1. Introduction

Employee time tracking became a challenging task for organizations during the unexpected and unprecedented pandemic situation in 2020 (Mitrefinch, 2020). On March 5, 2020, the Delhi government announced the suspension of biometric attendance in its office to contain the spread of coronavirus (Deo, 2020). This scenario happened around the globe affecting many of the academic and economic sectors as well as the psychological well-being of people. Thus, Washington Post suggested a touchless attendance system as a simple step that let the employees check-in without fear. Eliminating the need to clock-in through a touch-based communal system not only lowers the risk of coronavirus spreading in the place of work, but also allows the employees to check in fast (Fidentity, 2020).

Considering that COVID-19 pandemic continuously poses threats to one's health since March 17, 2020, the Sorsogon State University administration took precautionary measures and suspended the use of biometric fingerprint scanners and implemented alternative work schedules. The Human Resource Management Officer (HRMO) utilized (even until now) a logbook/attendance sheet to record the daily attendance of the employees who were assigned as front liners of the campus. Due to the shift from fingerprinting scanning to the manual attendance method, the HRMO found it more difficult in computing the attendance of each employee. This difficulty was experienced by the HRMO even before the pandemic happened. Another challenge faced by the HRMO is the increasing number of employees of SorSU, Castilla Campus which add to the bulk of other reports to be generated every day.

Further, Republic Act No. 11032 also known as Ease of Doing Business and Efficient Government Services Delivery Act of 2018 mandates that:

"...all government offices and agencies including local government units (LGUs) Government-Owned or Controlled Corporations (GOCCs) and other government instrumentalities to provide services covering business and non-business-related transactions, which adapts simplified procedures that will reduce red tape and expedite transitions in government."

Hence, these scenarios and issued government mandates motivate the researchers to develop the touchless attendance scheme without compromising the daily services and operations of Sorsogon State University (SorSU) to its clientele.

Quick Response (QR) Code usage has grown exponentially in today's contactless world and becoming a more preferred way of the transaction process. QR codes are frequently used due to their simplicity, cost-effectiveness and fast-tracking information that can be read easily by a digital device. Lopiccolo (2021) proves this and asserted that QR codes are rising in popularity in 2021 and utilized in directing traffic, business cards and brochures, providing coupons or discounts for products and services, for sharing digital menus for catering services, to name a few.

From the overview of QR code security based on the study of QR code generators (2020), QR codes are secured and can't be hacked because these are built using a square matrix with pixelated dots and can only be changed by access to the user account who created the QR code. Kumar and Kareemulla (2017), Sengupta, I., Jain, N., Shah, S., Jain, H., & Chandrani, A. (2020), Amirulloh, I., Iskandar, I., Apriyani, Y., Warnilah, A., Purnia, D. & Surahman, M. (2020) in their study, found that using QR Code for attendance is easy to use and it is a time saver. Also, Ahmad & Adli (2020) reported that QR Code Attendance System is very practical, accessible, and accurate based on staff attendance and could generate a quick report using google sheets thus monitoring is effective and easier to control. Further, Maleriado & Carreon (2018) proved that QR code as an attendance monitoring system is highly reliable, efficient, accurate, usable and highly acceptable in terms of security and confidentiality.

While several studies conducted on QR code attendance monitoring systems focused on the utilization of an internet connection to be able to generate data together with the fingerprinting for authentication, the present study on the other hand focuses on the QR code which can be generated even without internet connection (generation of the report can be accessed via pdf files, thus it is low cost but very efficient, effective, secured and confidential).

Indeed, developing an Employee Attendance and Management System using Quick Response (QR) code for Sorsogon State University, Castilla Campus (SorSU CC) is a possible solution to prevent the spread of COVID-19 with the same or better goal of efficiency, security and accuracy of results. The Quick Response (QR) code is highly secured as all the delicate data put away and transmitted is encoded, easy to utilize and cost-efficient management system (Kadu, et al., 2017). Utilizing this QR code could track information that can be read easily by a digital device and can store information quickly and safely.

Summing up, this study is a significant initiative in preventing the spread of COVID-19 by using a contactless attendance system. Also, this program promotes and monitors personnel in a very cost-effective and efficient manner. Further, adapting the QR code electronic-based attendance monitoring system is also essential in simplifying the checking of attendance more efficiently and at the same time can fast-track the generation of reports.

2. Objectives/purpose of the study

2.1 General objective

This study aimed to develop an Employee Attendance and Management System using Quick Response (QR) code for Sorsogon State University, Castilla Campus which provided an easier and more efficient way of managing attendance records.

2.2 Specific objectives

- To generate QR code using the information of employees such as employee's name, employee's ID number and position.
- To develop a system that will automatically manage the attendance of employees.
- To develop a system that automatically generates reports.
- To evaluate the system in terms of functionality, reliability, efficiency, accuracy, usability, maintainability and portability

3. Methodology

3.1 Research design

The study utilized descriptive methods to provide detailed data and information collected through the generated QR codes, development of the system and evaluation of the system. While this study could be done in the four campuses to further test its reliability and efficiency, this study delimited only in the context of SorSU, Castilla Campus in consideration of the safety and health protocols as well as travel restrictions and face-to-face interactions due to Covid-19 pandemic.

To address the safety and security of the information embedded in the QR code of each employee, the information that was embedded was only limited to the employee's name, ID number and position. To increase the security measures of the system, a capture photo scheme was the additional feature of the system as proof of employee's check-in and out. In other words, the employee cannot ask somebody to swipe his/her QR code.

3.2 Research methodology

The study needed a thorough and deeper analysis of the processes; thus, Rational Unified Process (RUP) method was used. RUP is a software engineering process that was designed with the aim of providing real-time analysis of development projects. As to the development process, the study utilized four phases commonly known as *inception*, *elaboration*, *construction* and *transition*.

a. Inception phase

This is about understanding the project scope and objectives and gathering enough information to confirm the feasibility of the study. The researchers conducted a direct interview with the Human Resource Management Officer (HRMO) regarding the process and computing the attendance of the employees. After collecting the information needed, the researchers conceptualized the manner of conducting the project taking into consideration its scope and objectives.

b. Elaboration phase

This phase makes the problem domain analysis and the architecture of the project get its basic form. The researchers analyzed the system needed in order to develop a better system and plan for the appropriate structure of the proposed system. UML Diagrams

were created to help understand how the system works. Flowcharts as shown in Figure 1 is a simple diagram that maps out a process and can be easily understood. This flowchart helped identify its essential steps and simultaneously offer the bigger picture of the process. Figure 1 illustrated the flow chart diagram of the attendance system utilized in this study.

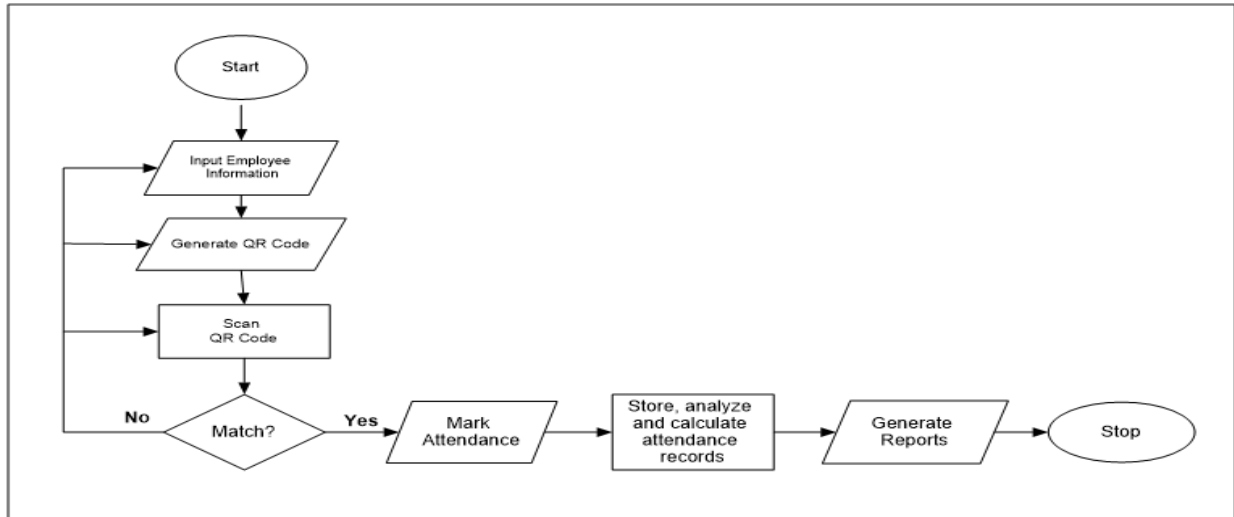


Figure 1: Attendance system flowchart



Figure 2: Use Case Diagram

This phase focuses on the development of a Use Case Diagram to identify the different users of the system. Figure 2 described the use case diagram for the proposed

system. After determining the users and processes, the researchers identified the entities needed for creating the database.

c. Construction phase

This involves system design, programming and testing. Using all the gathered information, the researchers were able to make a design that is appropriate to the feature of the system. The researchers gathered all the data needed for the database making and designing of the graphical user interface.

d. Transition phase

This is the final phase of the RUP which focused on moving the system from the development community to the user community and making it work in a real environment. The researchers validated the new system against user expectations and determined whether the objectives were met. The researchers tested the functionality of the developed system. An evaluation tool was used to determine if the users were satisfied with using the system. Recommendations were also considered. After the system passed the needed requirements and acceptability, the system was implemented and the orientation of all the end users was done.

3.3 Respondents

The SorSU, Castilla Campus non-teaching personnel and external information Technology (IT) experts were the respondents in evaluating the developed system. There were 20 respondents who evaluated the system. The evaluation tool contained questions and corresponding ratings to each question to test the effectiveness and efficiency of the developed system.

3.4 Research instrument

The developed system was evaluated using the ISO/IEC 91261 using quality characteristics such as functionality, reliability, usability, efficiency, maintainability and portability. It consists of evaluation criteria that measure the level of acceptability of the Attendance System using QR code.

3.5 Data collection and procedures

The following procedures were used in collecting the data, to wit:

a. Interview

An informal interview was conducted to collect data from the respondents particularly their comments and suggestions while testing the system.

b. Evaluation tool

The respondents interacted with the interface by scanning their QR codes into the system in order to confirm their attendance. Then, they evaluated the system using the

evaluation tool adapted from ISO 9126. Particularly, non-teaching personnel of SorSU-CC evaluated the usability of the system. HRMO and external IT specialists evaluated the system in terms of functionality, reliability, efficiency, accuracy, usability, maintainability and portability. To interpret the level of acceptability of the attendance system using the QR code, the following scale was used.

Table 1: Rating and verbal interpretation

Rating	Arbitrary scale	Verbal interpretation
5	4.21 - 5.0	Far more than what is expected
4	3.41 - 4.2	More than what is expected
3	2.61 - 3.4	Presence of the expectation
2	1.81 - 2.60	Less than what is expected
1	1.0 - 1.80	Absence of the expectation

4. Results and Discussion

The presentation, analysis and interpretation of the data gathered revealed the following findings:

4.1 Generation of QR code using the information of employees such as employee name, employee ID number and position

The system can manage the basic information of the employee which is the basis for the generation of the employee's QR code. Information embedded in the QR code was limited to the employee's name, ID number and position. HRMO can easily regenerate an employee's QR code when there are changes in the information or in case lost or misplaced. The system is also flexible in the generation of QR codes which can be in bulk and individual type of generating and printing of QR codes and doesn't need an internet connection in generating the QR code which is more useful and convenient (see Figure 3).

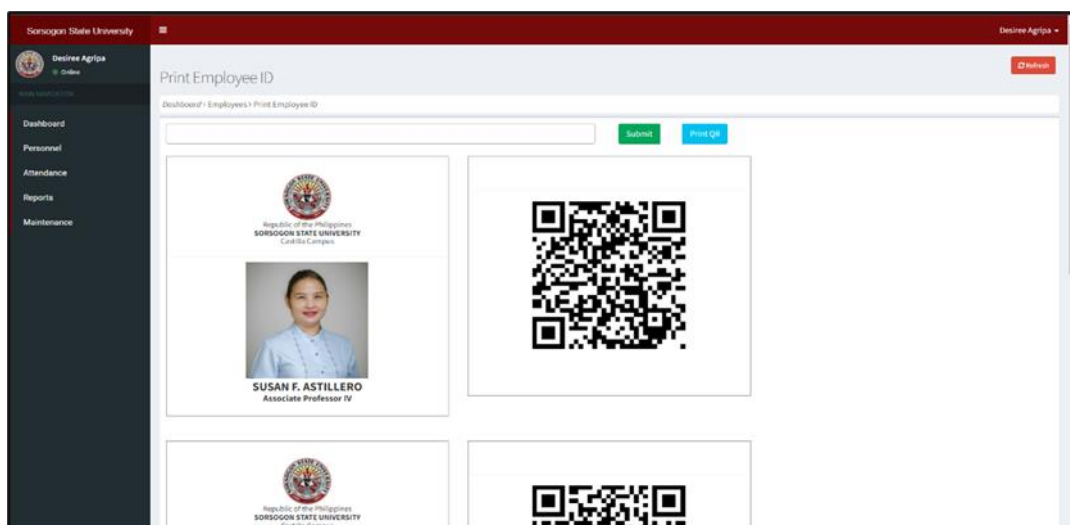


Figure 3: Employee QR code interface

4.2 Development of a system that automatically manages the attendance of employees

Work schedule, travel orders, leave application, absences and tardiness affect the overall attendance of an employee. The flexibility of employee work schedules is one of the features of the system. Using this feature, the HRMO can change the work schedule of an employee which adheres to the administrative implementation of the alternative work schedules. Also, the system was able to manage the creation and record keeping of travel orders and leave applications resulting in automated management of other attendance factors. Even though leave applications and travel orders can be created in the system, the scope was limited to which forms are to be printed and approval to be done manually.

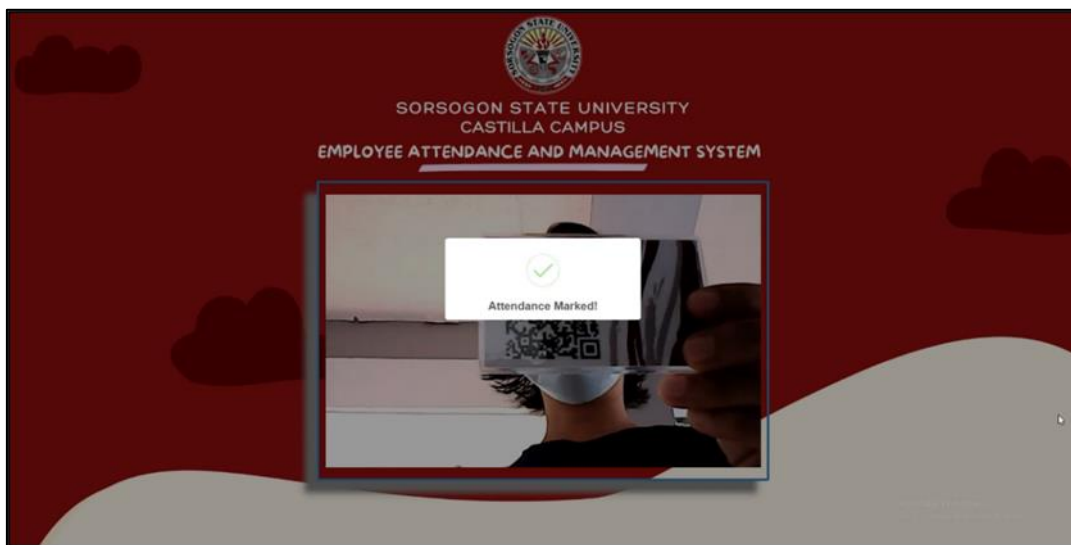


Figure 4: Marking of employee's attendance user interface

Manual attendance can also be used by the HRMO if an employee was unable to time out or other factors occur such as brownout. The attendance of employees is the basis of the system in generating the attendance reports and recorded for easy retrieval (see Figure 4).

4.3 Development of a system that automatically generates reports

Based on the attendance records and other attendance factors, the system can generate and reduce the amount of time in generating reports such as employee's basic information, work schedule, attendance reports like daily and monthly attendance, leave application and travel order reports. The generation of reports is flexible. This means that the HRMO can modify the content of reports. Reports can be printed directly with a connected printer or can be downloaded as a pdf file (see Figure 5).

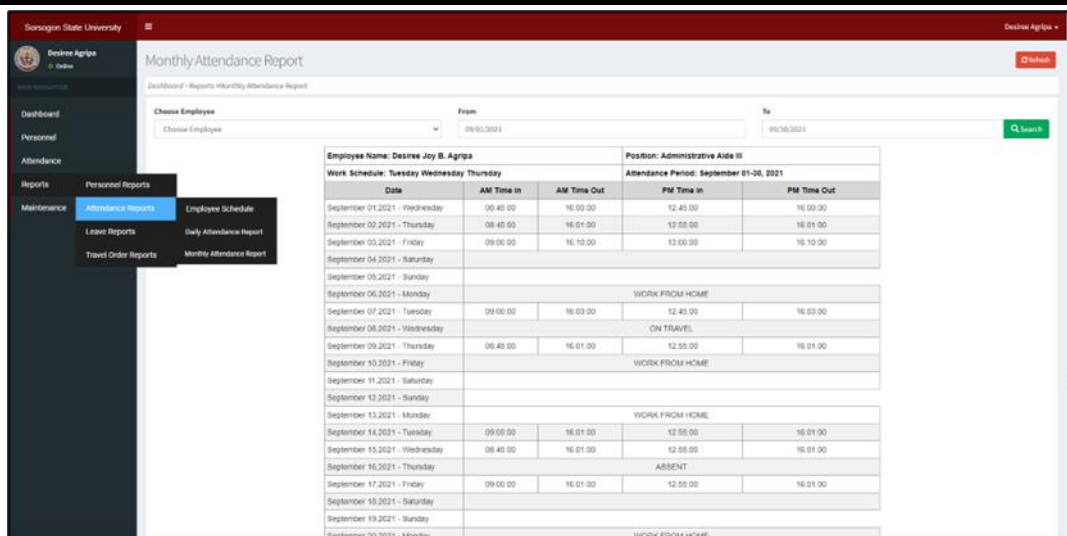


Figure 5: Attendance report interface

4.4 Evaluation of the system in terms of functionality, reliability, efficiency, accuracy, usability, maintainability and portability

Table 2: Evaluation Summary of the Attendance System using QR code

Software Quality	Respondent's overall	Verbal Interpretation
Functionality	4.0/5.0	More than what is expected
Reliability	3.0/5.0	Presence of the expectation
Usability	4.2/5.0	More than what is expected
Efficiency	3.9/5.0	More than what is expected
Maintainability	3.9/5.0	More than what is expected
Portability	3.9/5.0	More than what is expected
Weighted Mean	3.8/5.0	More than what is expected

There were 20 respondents who evaluated the system. The evaluation tool contains questions and corresponding ratings to each question to test the quality of the developed system. After the evaluation, the respondents gave a positive feedback (see Appendix). Table 2 shows the summary results of the evaluation of the quality of the system which has an overall weighted mean of 3.8/5.0. This means that the developed system has more than what is expected. In terms of functionality, the respondents' overall rating was 4.0/5.0 which means that the functions of the system managed relevant information, allowed updates of employee records and were efficient in keeping track of employees' attendance and was able to compute the leave credits of each employee correctly and efficiently.

The system was proven reliable as the respondents' overall rating of 3.0/5.0 indicating that the system was capable to handle faults committed by the users. The system also restricted the users from entering invalid data in the input forms.

In terms of usability, the system received a 4.2/5.0 rating indicating that it could be used easily by the employees even without proper training because the user interface can be easily understood.

The respondents rated the system's efficiency, maintainability and portability with 3.9/5.0. The system produced accurate outputs in generating attendance reports, leave cards, travel orders and other reports. Based on the evaluation result, the developed system can efficiently manage the employees' basic information, can easily generate travel orders, can competently automate the calculation of leave credits, can calculate a number of hours worked, and absences and eventually generate reports effectively.

5. Conclusions and Recommendations

In conclusion, this developed Employee Attendance and Management System showed positive feedback from SorSU – CC employees. The developed system showed a user-friendly, efficient, cost-effective and adaptable solution for keeping track of employees' attendance utilizing contactless transactions without sacrificing the reliability and accuracy of the attendance reports.

Based on the conclusions, the following were the recommendations:

- 1) It is recommended that the developed system be implemented for this will be of great help to the HRMO who is in charge of managing the attendance monitoring.
- 2) As an extension of this study, it is hereby recommended that this could be extended to other campuses of Sorsogon State University as well as to other agencies with similar attendance scheme procedures.
- 3) The future developer can add additional features to the maintenance of the Attendance System.
- 4) It is also recommended that the future developer could add more flexibility features in generating reports.
- 5) Future researcher/s could provide other privilege features to other users such as employees could have the privilege to view their information, leave application records, available leave credits and travel orders and the Campus administrator could also have the privilege to approve the leave and travel application using the system

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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Appendix: System evaluation results

**Table 3: Employee Attendance and Management System
for Sorsogon State University, Castilla Campus**

RESPONDENTS	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20
1.0 FUNCTIONALITY	4.0																			
Item 1.1	4	5	4	5	3	4	4	4	4	3	4	4	5	4	4	4	4	5	4	3
Item 1.2	4	3	4	5	3	4	4	4	4	4	4	4	5	4	4	4	4	5	3	3
Item 1.3	4	4	4	5	3	4	4	4	4	4	4	4	5	4	4	4	4	5	3	3
Mean	4.0	4.0	4.0	5.0	3.0	4.0	4.0	4.0	4.0	3.7	4.0	4.0	5.0	4.0	4.0	4.0	4.0	5.0	3.3	3.0
2.0 RELIABILITY	3.0																			
Item 2.1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Item 2.2	3	3	3	4	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3
Item 2.3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean	3.0	3.0	3.0	3.3	3.0	3.0	3.0	3.0	3.0	3.0	3.3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
3.0 USABILITY	4.2																			
Item 3.1	4	4	5	5	4	4	3	3	3	4	4	4	4	5	5	4	4	5	5	5
Item 3.2	5	4	5	4	4	4	4	3	3	4	4	4	4	4	5	4	5	5	5	5
Mean	4.5	4.0	5.0	4.5	4.0	4.0	3.5	3.0	3.0	4.0	4.0	4.0	4.0	4.5	5.0	4.0	4.5	5.0	5.0	5.0
4.0 EFFICIENCY	3.9																			
Item 4.1	4	4	4	4	4	4	3	4	3	4	4	5	3	4	5	3	3	3	3	4
Item 4.2	4	4	5	5	4	4	3	4	3	5	4	4	4	4	5	4	4	4	4	4
Mean	4	4	4.5	4.5	4	4	3	4	3	4.5	4	4.5	3.5	4	5	3.5	3.5	3.5	3.5	4
5 MAINTAINABILITY	3.9																			
Item 5.1	4	4	4	4	4	4	3	4	4	5	4	5	3	4	4	4	5	4	5	4
Item 5.2	4	5	4	3	4	4	3	4	4	4	3	4	3	4	4	4	4	5	4	4
Item 5.3	4	3	4	3	3	4	4	4	3	4	4	3	4	4	4	4	3	4	4	4
Mean	4.0	4.0	4.0	3.3	3.7	4.0	3.3	4.0	3.7	4.3	3.7	4.0	3.3	4.0	4.0	4.0	4.0	4.3	4.3	4.0
6.0 PORTABILITY	3.9																			
Item 6.1	4	3	3	4	4	3	4	4	4	4	4	4	4	3	3	3	4	4	4	3
Item 6.2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Item 6.3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mean	4.0	3.7	3.7	4.0	4.0	3.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.7	3.7	3.7	4.0	4.0	4.0	3.7
OVERALL MEAN	3.8																			

Evaluation Range		
Rating	Arbitrary Scale	Verbal Interpretation
5	4.21 - 5.0	Far more than what is expected
4	3.41 - 4.2	More than what is expected
3	2.61 - 3.4	Presence of the expectation
2	1.81 - 2.60	Less than what is expected
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