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DETERMINATION OF REQUIREMENTS FOR THE DEVELOPMENT OF AN ONLINE FAULT REPORTING SYSTEM FOR UTILITY COMPANIES

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Abstract
This research work is therefore targeted at determining the requirements of the system suitable for developing an effective web-based fault reporting system for public utility companies. An electricity distribution company's fault reporting system with correct system requirements will serve as a viable channel for reporting faults that occur at the users' end. This will facilitate quick and efficient clearing of these faults for timely restoration of the electricity supply to users. This supports an electricity distribution system that will facilitate reliable and consistent delivery of quality services to users, reduce outages and downtimes, thereby enhancing productivity and national development. To achieve this, different online fault reporting systems were reviewed, including the existing case study power distribution company fault reporting system. The features and functions found present or lacking in the reviewed systems were critically analysed. and then with the help of a survey, determine accurately all requirements needed to build a fault reporting/management system that will not just be effective and efficient but also designed to overcome the lapses observed in the reviewed systems. Two groups of potential users were identified: the PHCN customers and the PHCN staff. PHCN customers will use the system to report electrical faults in their domain while PHCN staff will use the system for both system/fault management and fault reporting. Some requirements were proposed and packaged in the form of a questionnaire and then randomly distributed to the identified two groups of potential users. A total of 55 questionnaires were sent through e-mail to the respondents. The result and analysis of the survey conducted to determine the requirements of the online fault reporting system for Ikeja electricity distribution revealed that for the web-based system to be effective and efficient it should possess the following features: dynamic database, web interface, information display page, Fault description page, registration and login page, fault update page and track progress page. **Keywords:** Development, Online, Reporting, System, Utility

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1.1 Introduction

Public utility companies play a critical role in the socioeconomic lives of every nation. Power supply companies, for instance, ensure that the teaming population of the society (commercial and domestic consumers of electricity) is supplied with adequate electric power for commercial, industrial, and domestic activities for the overall sustainability of socioeconomic progress of the society. Water supply companies have similar responsibilities, ensuring a steady supply of clean water for both domestic and industrial use. The need for these utility companies to function effectively and efficiently cannot be overstressed. Unfortunately, due to the large number of users/customers, the operational infrastructure of these utility companies is usually vulnerable to faults due to high pressure on their facilities. Unrectified or delayed fault clearing can result in long outages leading to down times in industries and commercial set ups. The consequences of outages and down time are quite severe both for domestic and commercial users of electricity. This can include but not limited to: high cost of production occasioned by the need to run standby generators for long hours, loss of perishable goods at home and in some commercial establishments due to long power outage, laying off of workers due to reduced working time, etc. The overall impact of long outages stemming from unrectified of delayed system restoration is poor productivity and reduced national development. To ensure reliability and consistent delivery of quality services to users, electricity distribution companies should have a channel for reporting faults that occur at their end to facilitate quick and efficient clearing of these faults for timely restoration of electricity supply to users. This reduces outages and down times thereby enhancing productivity and national development.

The ability of an effective fault reporting system to increase the reliability an efficiency of any system cannot be over stressed. This is because it allows service providers to be in continuous touch with their customers, getting to know the faults and issues developing in their systems and helping to fix them as fast as possible. Fault reporting systems provides necessary data relating to faults and maintenance and which are very useful in speedy fixing of faults and effective planning against faulting repetition [1]. Online self-reporting system that allows patients to report toxicity symptoms has the ability to provide detailed and correct clinical data, facilitate speedy interventions in patients' cases, uplift patients' health and safety [2], improve level of interaction between patients and the hospital and help standardise data gathered from different locations. Similarly. Online incidence reporting system developed for a Japanese hospital has not only made patients safer, but has increased the speed of attending to patients and reduced situations that cause errors [3].

This research work is therefore devoted to reviewing different online fault reporting systems, analysing the features of and functions found present or lacking in the reviewed systems so as to aggregate suitable system requirements needed to build a fault reporting/management system that is effective and very efficient.

I. METHODOLOGY

The method adopted in this research involves reviewing different online fault reporting systems. analysing the features of and functions found present or lacking in the reviewed systems, and with the help of a survey using

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the result of the analysis to accurately aggregate all requirements needed to build a fault reporting/management system that will not just be effective and efficient but designed to overcome the lapses observed in the reviewed systems. Two groups of potential users of the case study utility company (PHCN) participated in the survey to determine which requirements (obtained from result of the analysis of the review of other online reporting system) are critical for the case study system. The two groups are the PHCN customers and the PHCN staff. PHCN customers will use the system to report electrical faults in their domain while PHCN staff will use the system for both system/fault management and fault reporting. Based on the result of the analysis of features/functionalities of other fault reporting systems studied, system requirements were proposed and packaged in form of questionnaire and then randomly distributed to the identified two groups of potential users. A total of 55 questionnaires were sent through e-mail to the respondents. Results of the survey were then analysed to determine the accurate requirements of the case study system, **2.1 PHCN fault online reporting system.**

The case study power distribution company for this research is the Ikeja Power Holding Company of Nigeria (PHCN). The ineffectiveness of the current PHCN online fault reporting system in creating a platform for quality fault reporting and management due to the absence of some key features and functionality inspired the motive for this project in the first place. As observed in

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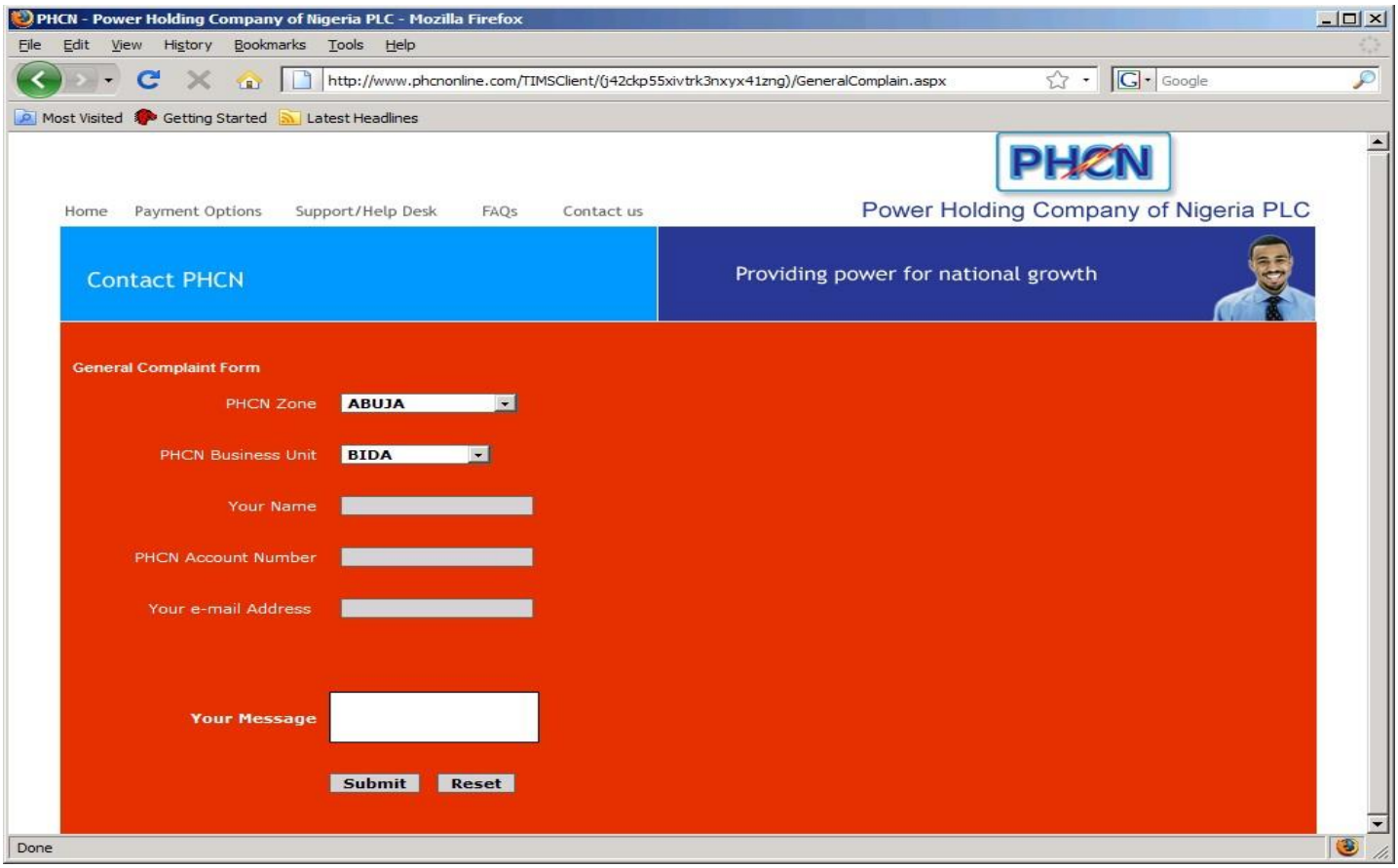

Figure 2.1: A screen shot of the current PHCN complaint form [4].

2.2 Other Fault reporting system

Access East Sussex online Fault reporting system: This system permits individuals and staff in the East Sussex area and environs to report faults or issues in the services offered by the council in their local areas. Though the system does not require a reporter to register or log in before logging a report; it provides fields for selecting fault location, fault category and further descriptions. Also fault status can be tracked in this system [5].

Kent County Council Fault reporting system: This system allows people in the Kent County Council area to report faults on roads, street lightings, environment and related facilities. No login or registration is required to use the system but personal details of reporter (names, telephone number e-mail address, etc) are required. Fields for filling in fault details and location are also provided. Reporters can check the progress of fault correction using this system [6].

Mahanagar Telephone Nigam limited Fault reporting system (MTNL): The fault reporting system allows their subscribers to report faults in their telephone, Garuda or broadband services. The system was designed to

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allow users select concerned service before being taken to the page for selecting fault category and filling up the field for telephone number and then fault details. Only those selecting the Garuda services are required to register and login. Users can check progress of fault correction in this system [7].

City of London Fault reporting system: The system allows users to report a variety of faults around the City of London. The system provides for the selection of fault category and then fault location. Fields for fault details and reporter's personal details must also be filled before report can be submitted. No login is required. Also, users cannot to check the progress of fault rectification with the system [8].

The Cabrini College (USA) Information Technology and Resources Reporting system: The system allows users (mainly students, staff and clients) to report problems developing in the Information technology facilities purchased from the college or those being used by the college's staff and students. Login is required to use the system, though the system generates the password needed to login each time a user wants to use the system. As a result, registration is not required. However, a user is required to provide his details and details of the fault during fault reporting. Reasonable information was provided by the system as regards the need to report faults using the system. It does not provide any means of tracking progress of fault correction [9].

Problem reporting system for users of Online-teach yourself system owned by the University of the State of New York (NYSED): The system does not require any login before you can use the system and as such, no registration is required. Details of the problem reporter and details of the fault itself must be provided to successfully login a problem. Reasonable information relating to the need to use the system and how to successfully use the system were provided [10].

North American and UK based Daeja Image System problem reporting system: The system allows their clients/customers to report problems encountered in the use their in-browser java applet image viewer "ViewOne". No registration and login is required to use the system. However very detailed information about the problem reporter and the problem being reported is required. Brief information about the process of problem reporting is also provided [11].

The city of Tallahassee problem reporting system, USA: This system helps residents to report issues in any of the services offered by the City governing authorities. No registration and login are required. Details of problem reporter required as well as that of the problem being reported. Reasonable information about the usefulness of the system and how to use it was provided [12].

I. MODELING AND ANALYSIS 3 COMPARATIVE ANALYSIS

From the above review of similar systems, we can observe that unlike the PHCN system, the other systems described, even though they lack certain vital features and functionalities have more capacity to build up a fault database. This is because the other systems made provisions for collecting data relating to faults reported (for instance: fault type/category and fault location), This information can be very useful for future planning as it relates to reducing frequency and duration of faults in the system. It was however observed that out of the nine

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systems compared, only two systems require the user to register or log into the system before being able to report fault. Even though this can increase the number of people willing to make fault report; systems without any provision for registration/login will remain very vulnerable to abuse, and the risk of logging in of unreliable information is also high. All the systems highlighted above were found to have required users to provide some personal details for identifying them. Most importantly, personal details of users will help service providers to locate both the fault and the fault reporter to facilitate prompt fixing of the fault. This is also a good strategy of limiting false report but is not enough to replace the need for registration and logging in. We can also observe from Table 3.1 that out of the nine systems compared, only three systems made provisions for tracking the progress of fixing of fault reported.

One can observe from the table that all the systems (except PHCN with rating "low") studied had only a moderate capacity to build up a comprehensive database needed to plan against fault re-occurrence. This system will be designed to improve on this area such that the system will have a comprehensive database to plan against frequent fault occurrences. Also, on the suitability for fault management, table 3.1 shows that all the systems (except

PHCN with rating "low") studied was rated moderate. This system will be designed to be an efficient and effective tool for fault management so as to help PHCN achieve high level of customer satisfaction. About 67% of the systems compared did not make provision for tracking of progress of fault correction. This system will improve on this area and as such will be designed to offer users a means of tracking the progress of fault clearing. Finally, on the ability to educate the users on fault issues about 50% of the compared systems were rated minimum while 50% was rated moderate. This is also another area of concern. This system will be designed to be an effective means of educating PHCN customers on fault and safety issues.

Generally, it can be observed that the PHCN system performed poorest of all the systems studied, and other systems studied performed either average or below average when rated against the outlined criteria. This system will therefore be designed to make up for the deficiencies observed in the systems studied while retaining their positive features.

PHCN (2011), what is currently playing the role of a fault reporting system is actually a complaint reporting system. The system allows any person make a complaint or report without first being registered or logging into the system. After selecting a zone and a business unit, the system provides the reporter with fields for entering his name, e-mail address, PHCN account number and then the report or complain. The above details are grossly insufficient for building up a comprehensive database for the company. This so because, as can be seen from figure 2.1, fields for logging in attributes of the fault (such as type of fault, date of occurrence, time of occurrence, address, etc) itself are totally lacking. There is also no feedback system that allows PHCN staff to update fault or complaint status neither does such feedback exist for allowing users to check progress of fault correction.

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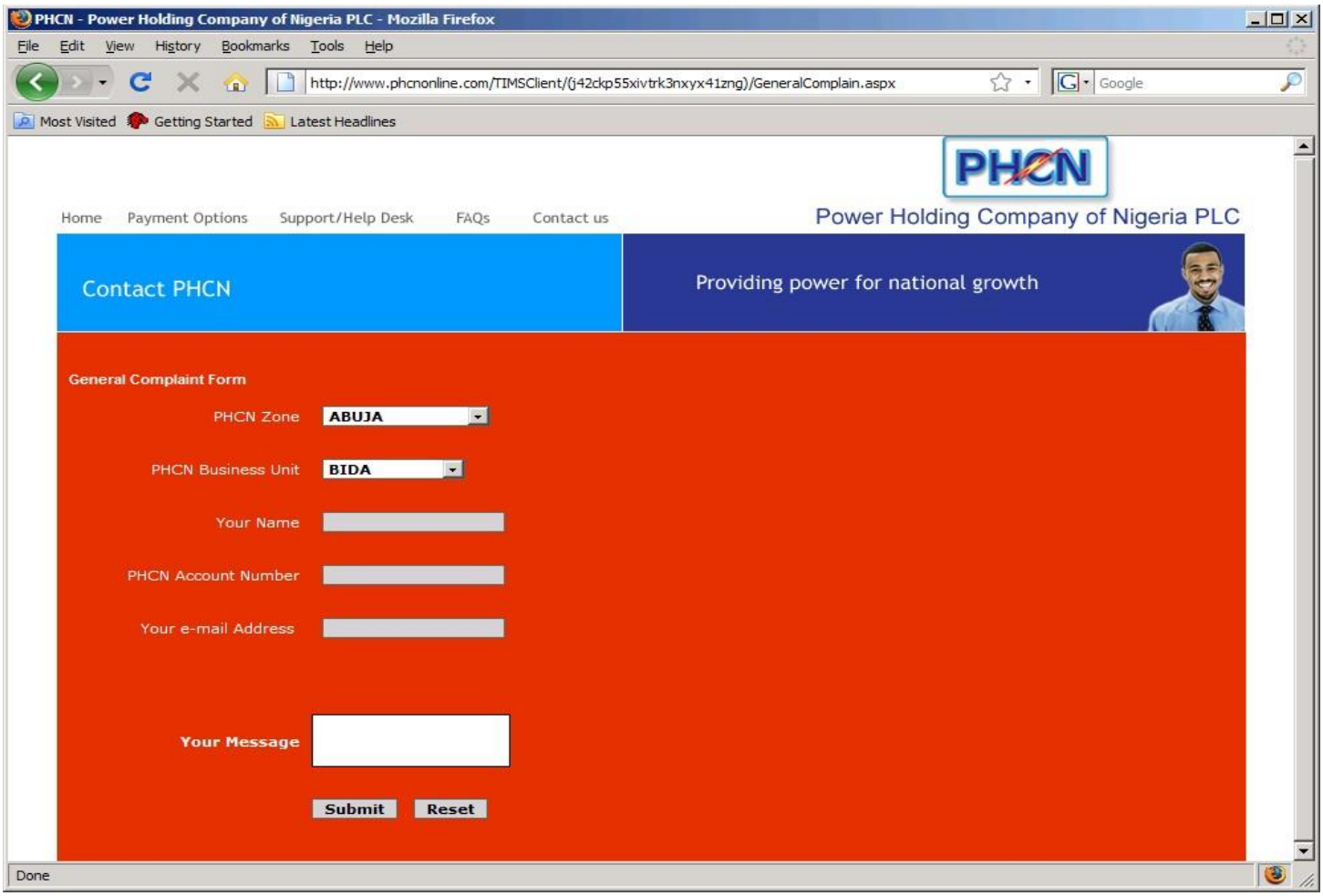

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One can observe from the table that all the systems (except PHCN with rating "low") studied had only a moderate capacity to build up a comprehensive database needed to plan against fault re-occurrence. This system will be designed to improve on this area such that the system will have a comprehensive database to plan against frequent fault occurrences. Also, on the suitability for fault management, table 3.1 shows that all the systems (except PHCN with rating "low") studied was rated moderate. This system will be designed to be an efficient and effective tool for fault management so as to help PHCN achieve high level of customer satisfaction. About 67% of the systems compared did not make provision for tracking of progress of fault correction. This system will improve on this area and as such will be designed to offer users a means of tracking the progress of fault clearing. Finally, on the ability to educate the users on fault issues about 50% of the compared systems were rated minimum while 50% was rated moderate. This is also another area of concern. This system will be designed to be an effective means of educating PHCN customers on fault and safety issues.

Generally, it can be observed that the PHCN system performed poorest of all the systems studied, and other systems studied performed either average or below average when rated against the outlined criteria. This system will therefore be designed to make up for the deficiencies observed in the systems studied while retaining their positive features.

TABLE 3.1: COMPARATIVE ANALYSIS OF DIFFERENT FAULT REPORTING SYSTEMS

	Capacity to build comprehensive database	**Provision for checking fault update by users**	**Suitability for fault management**	**Request for users' login and registration**	**Provision of information on fault issues**

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PHCN System	Low	Non	Low	Non	Non
East Sussex system	Moderate	Yes	Moderate	Non	Minimum
Kent council System	Moderate	Yes	Moderate	Non	Minimum
MTNL System	Moderate	Yes	Moderate	Yes (in one section only)	Minimum
City of London System	Moderate	Non	Moderate	Non	Moderate
The Cabrini College (USA)	Moderate	Non	Moderate	YES	Moderate
state of New York UNIVERSITY	Moderate	Non	Moderate	Non	Moderate
Daeja Image System	Moderate	Non	Moderate	Non	Minimum

City of Tallahassee	Moderate	Non	Moderate	Non	Moderate

III. RESULTS AND DISCUSSION 4 RESULTS OF PRIMARY RESEARCH

The aim of this primary research is to involve the potential users in determining the requirements of the system. Two groups of potential users have been identified: the PHCN customers and the PHCN staff. PHCN customers will use the system to report electrical faults in their domain while PHCN staff will use the system for both system/fault management and fault reporting. Some requirements were proposed and packaged in form of questionnaire and then randomly distributed to the identified two groups of potential users. A total of 55 questionnaires were sent through e-mail to the respondents. This was the quickest and most practical means of distributing the questionnaire as majority of the respondents live in Nigeria. Out of the number sent out, 11

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responded (10 phcn customers and 1 phcn staff) and their responses are presented in table 4.1 and table 4.2. The likert scale questionnaire was used because it is easy to respond to and analyse, and has the ability to show the extent to which a respondent approves or disapprove a view. There are ten likert formed questions and two open ended questions.

ANALYSIS OF PRIMARY RESEARCH (QUESTIONNAIRE)

Table 4.1: Tabulation of responses from PHCN customers

	Questions	**Strongly Agree Score (%)**	**Agree Score (%)**	**Disagree Score (%)**	**Strongly Disagree Score (%)**
1	A comprehensive database for capturing faults reported in customers' domains and PHCN facilities will assist PHCN in fault management, and planning against high outage duration and frequency.	90	10	0	0
2	An effective and efficient web interface (in form of a dynamic website) for the above system so as to allow PHCN customers and monitoring staff to report electrical faults in their domain, online, for prompt response by PHCN will improve PHCN services delivery to their customers.	60	50	0	0
3	The system should be displaying vital information that will educate users on fault issues and how best to handle PHCN facilities so as to minimise fault occurrences	70	30	0	0

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4	Vital information relating to the reported faults (such as fault type/category, fault time, description, location, etc,) should be captured by the database.	70	30	0	0
5	Such a system should require users to register and obtain a user ID and password before being able to use the system so as to regulate users' activities in the system.	33.3	0	11.1	0
6	The system should also be able to capture some details (name, address, phone number, email address) about the fault reporter to help in reaching him and the fault reported.	80	20	10	0
7	Rectification team should be able to update the system to indicate the status of the fault.	70	30	0	0
8	PHCN customers should be able to track or check the status (update) on the rectification of reported faults.	60	30	10	0
9	PHCN management should be able to use the system to allocate fault rectification jobs to their field staff.	40	60	0	0
10	The system should be able to prevent multiple reporting of faults that has already been reported.	50	20	30	0

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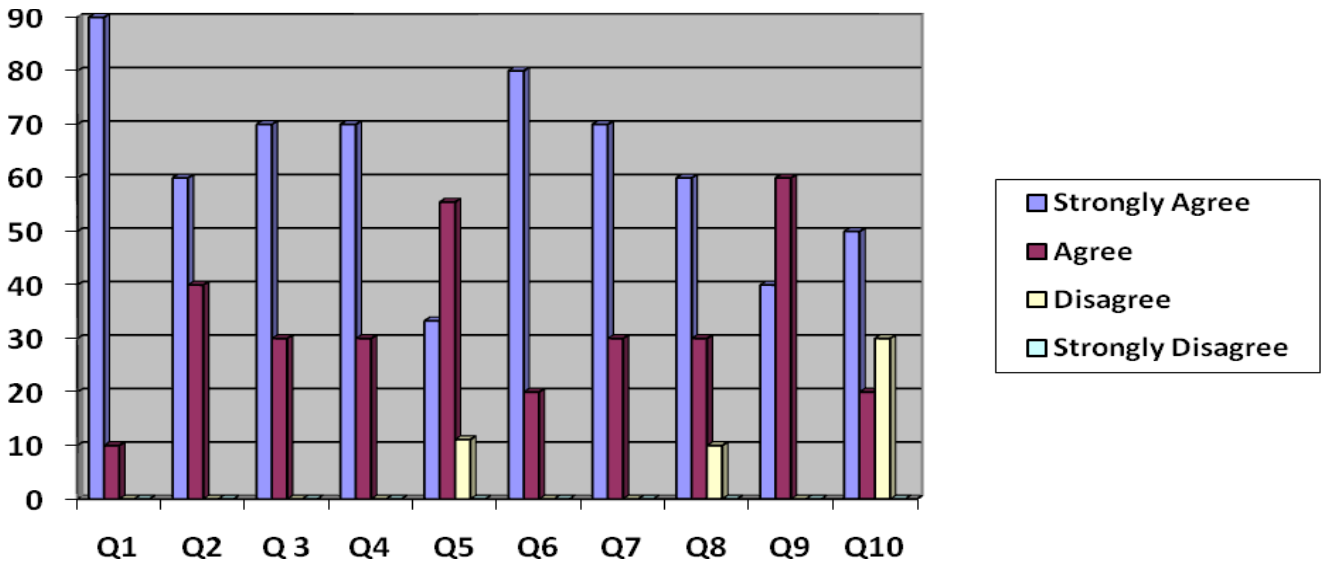

Figure 4.1: Component bar chart showing the response of PHCN customers to the questionnaire.

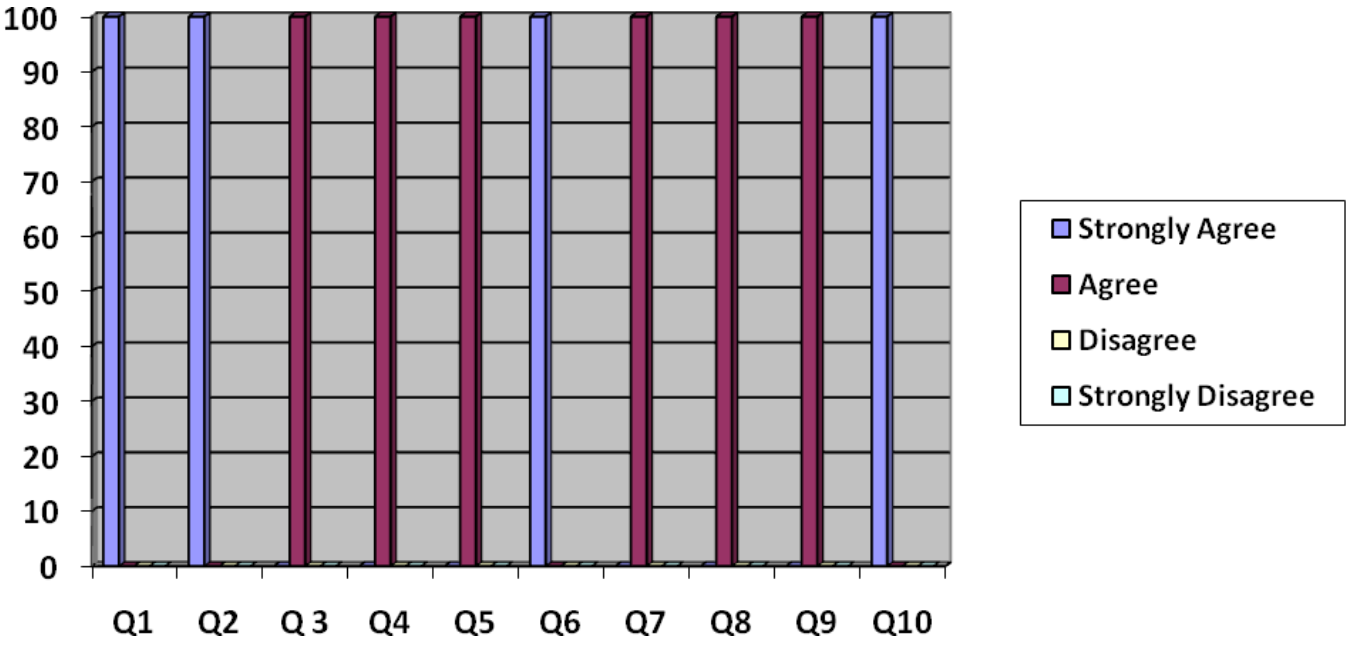

Figure 4.2: Component bar chart showing the response of PHCN staff to the questionnaire.

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Note: In the two figures above, the symbol 'Q' stands for question in the questionnaire. For example, Q1 in the charts represents Question 1 in the questionnaire.

ANALYSES OF REQUIREMENTS

From the tables 4.1 and 4.2 and figures 4.1 and 4.2 above, it is obvious that two groups of intended users (Phcn customers and staff) are fully in support of the proposed requirements for the system. This follows therefore that the intended users accept that a comprehensive database for capturing faults reported in customers' domains and PHCN facilities will assist PHCN in fault management, and planning against high outage duration and frequency. This shows that from the users' perspective, the project is worthwhile and will help in gathering data that will facilitate speedy fault fixing and drastic reduction of fault re-occurrence, which will be made possible by adequate planning and fault management

As regards the need for a web interface that will enable online report of faults, we observe from the tables and figures above that both sets of the respondents showed resounding support for the provision of web interface that will allow users to log in their fault reports, online, using the internet. This affirms that the initial proposal to incorporate a web interface in this design is in line with users' desire on the project.

On the need for the system to be able to display vital information that will educate users on fault issues and how best to handle PHCN facilities so as to minimise fault occurrences; the tables and charts above shows an overwhelming interest in the users to see the system be a source of enlightenment to them on issues relating to faults, safety measures and best practices in handling PHCN facilities.

From the tables and chats above, we observe also that respondents are of the view that fault reporters should provide the system with vital information relating to the fault (such as fault type, fault time, location, etc) for an automatic documentation in the database and also to equip the rectification team with the right information needed for speedy rectification of the fault.

The tables 4.1 and 4.2 and figures 4.1 and 4.2 above also show that both sets of users support the idea of user registration and login as a means of regulating users' activities in the system.

The tables and charts above also reveal that respondents are backing the need for users of the system to provide their details and details of the fault they are reporting. This will help PHCN repair team to respond quickly to the fault reported.

Both groups of users are also in support of the system being able to allow PHCN management to update the system and use the system for planning and fault management. They also support the idea of users being able to track progress of faults reported with the system.

Even though majority of the respondents in both groups support the idea of the system preventing multiple reporting of faults; a significant number of PHCN customers (30%) disagreed with this view point. They argued that users can employ multiple reporting of a particular fault to indicate how serious a fault is so as to push PHCN to act swiftly on it. The disadvantage of multiple reporting is the tendency to have the same information in the

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database thereby causing redundancy and occupying more memory space. This could also reduce the speed of the system. Effort will be made to see that multiple reporting is avoided as much as possible in this system.

IV. CONCLUSION

Some respondents outlined the existing means of reporting faults to PHCN. The means outlined are: Physical visiting of the PHCN nearest office, through phone calls and through e-mail messages. These methods can still work but reporting fault by going physically to the PHCN office can be time wasting, stressful and costly. While phone calls and e-mails remain fast means of fault reporting, they are not able to systematically capture and store fault information in an organised manner that will facilitate good planning and management of fault related issues in PHCN. Fortunately, the proposed online fault reporting/management system will serve not only as a very fast means of fault reporting but will provide a bank of regularly updated information needed to promptly respond to faults reported and plan well against their re-occurrence. It was concluded that while phone calls and e-mails remain fast means of fault reporting, they are not able to systematically capture and store fault information in an organised manner that will facilitate good planning and management of fault related issues in power distribution companies. Fortunately, the proposed online fault reporting/management system will serve not only as a very fast means of fault reporting but will provide a bank of regularly updated information needed to promptly respond to faults reported and plan well against their re-occurrence.

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