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Risk analysis in managing an engineering facility during Covid-19 crisis: A case study

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ABSTRACT

The aim of this project was to carry out risk analysis in managing Engineering Facility during Covid-19 crisis-a case study of the Mife Construction Nigeria Limited located in Port Harcourt. The analysis was carried out among workers in four units which include asphalt unit, purchasing, maintenance and workshop units. The analysis explored perception, awareness and practice of Covid-19 management among workers managing Engineering Facility. Data was obtained from these units via questionnaire method and SPSS tool was used for the computation. Both probabilistic and deterministic methods were used to analyse the risk exposures. Reliability indices which include mean, variance, probability and standard deviation and regression model were used to determine the coefficient of variation while the FOSM was used to determine the reliability index. Risk exposure of workers for the four units: Asphalt, Purchasing, maintenance and Workshop are 0.7095, 0.9971, 0.7002 and 0.6579 respectively. The probability of safety was also evaluated for the four units as Asphalt = 0.761, Purchasing = 0.840, Engineering = 0.758 and Workshop = 0.745 respectively. The acceptable probability of safety is greater than or equal to 0.9, it was observed that only the Purchasing Unit had a very close value to the probability of safety and it is considered to have the highest probability of safety or reliability while Workshop Unit had the lowest probability of safety and it is therefore considered to be at risk in managing the spread of Covid-19.

Keywords: Risk, analysis, managing, engineering facility, Covid-19, Crisis.

1. INTRODUCTION

The World Health Organization (WHO), in December 2019, obtained reviews on clusters of pneumonia instances of unknown reasons in Wuhan City, Hubei Province of China. The Chinese government eventually diagnosed a singular pressure of Corona virus (SARS-COV 2) because the causative agent (Adepoju, 2020; Bai et al., 2020; Bauch & Oraby, 2013; Brug et al., 2004; Burrell et al., 2016). Sequel to the recommendation of the International Health Regulation Emergency Committee, the Director-General of the WHO declared the COVID-19 outbreak as a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 and characterised it as an epidemic on eleven March 2020 (Busybuddies, 2020; Chan et al., 2019; Chen et al., 2020;

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Choi & Yang, 2010; Ebenso & Out, 2020). The outbreak has been pronounced in all continents, with first case in Africa pronounced in Egypt in February 2020 (Guan et al., 2003; Heymann & Shindo, 2020; Huang et al., 2020). Globally, over 2.6 million showed instances and over 186,000 deaths were recorded (Hughes et al., 2009).

COVID-19, from the family of Corona virus (others include SARS, H5N1, H1N1 and MERS), is a contagious respiratory illness transmitted through the eyes, nose and mouth, via droplets from coughs and sneezes, close contact with infected person and contaminated surfaces. It has an incubation period of approximately one to fourteen days (Hughes et al., 2009; Hussain et al., 2012; Jin et al., 2020). The symptoms include cough, fever and shortness of breath and it is diagnosed through a laboratory test (Kampf et al., 2020). The contagion could lead to severe respiratory problems or death, particularly among the elderly and persons with underlying chronic illnesses. Some infected persons however, are carriers for the virus with no symptoms while others may experience only a mild illness and recover easily (Kramer et al., 2006; Kucharski & Althaus, 2015; Kupferschmidt, 2020). As there is currently no cure or vaccine for the COVID-19; medical treatments are limited to supportive measures aimed at relieving symptoms, use of research drugs and therapeutics (Leppin & Aro, 2009). Nigeria is one of the 210 countries affected globally. The first case was confirmed in Lagos State on 27 February 2020. This index case was a 44-year-old man, an Italian citizen who returned from Milan, Italy, on 24 February and presented at a health facility on 26 February 2020 (Li et al., 2020; Liu et al., 2020). Following the confirmation of the index case, 216 people were identified as contacts to be followed up. Of these, 45 travelled out of Nigeria and one of the remaining 176 countries was confirmed to be positive for COVID-19 on 9 March 2020 (NCDC) (Lu et al., 2020; Mailman School of Public Health, 2017).

The country has continued to experience an increase in the number of cases, which has spread across several states. While majority of the initial cases were imported, most of the new cases have no travel history or contact with such people. This is highly suggestive of ongoing community transmission. Under the current circumstances, the Primary Health Care (PHC) Centres remain the most likely port of call for community members who develop symptoms that could be suggestive of COVID-19. The Primary Health Care system is the bedrock of the country's health system and the Community Health Workers (CHWs) are considered to be its backbone for several reasons (Mailman School of Public Health, 2017; Nigeria Centre for Disease Control; 2020, Nigeria Centre for Disease Control, 2020; Oluwatayo, 2012; Perry et al., 2016). In addition to contributing to several successful immunizations, maternal, newborn, child health and reproductive health services, CHWs also played a critical role in the epidemic response to the 2014 Ebola Viral Disease Outbreak (EVD) across several West African countries, including Nigeria (Rothe et al., 2019). In the face of continued COVID-19 community transmission, the health system may likely become overwhelmed with increased risk of health workers' infection.

As of 10th of April 2020, over 9,000 contacts have been traced (Chen et al., 2020), which is an average of 3.5 contacts per confirmed case. About 118,000 house-holds were visited for active case searches within 2 days in Lagos, among which 119 confirmed cases were identified (Sookaromdee & Wiwanitkit, 2020). The continued increase in the number of cases has overwhelmed the human resources for health involved in the various aspects of response activities, particularly contact tracing. The COVID-19 outbreak is also coming at a time when the country is currently battling with Lassa fever outbreak and preparing for certification exercise to be declared polio-free (Perry et al., 2016; Rothe et al., 2019; Sookaromdee & Wiwanitkit, 2020; UNCTAD, 2020; UNESCO, 2020; Wang et al., 2020). As of the Epidemiological week 16 of the year 2020, the country has recorded 979 confirmed cases and 188 deaths (CFR 19.2%), against 546 confirmed cases and 123 deaths (CFR 22.5%) in the corresponding epidemiological week of 2019 (WHO, 2020). Given the importance of knowledge of precautionary activities in curbing the spread of infectious diseases such as the novel COVID-19, it is essential to research on the risk analysis in Managing an Engineering Facility during Covid-19 Crisis. The aim of this study is to analyse the risk in managing an Engineering Facility during Covid-19 Crisis in Mife Construction Nigeria Limited, Rivers State.

This study will be of help to the Management and Staff of Mife Construction Nigeria Limited, engineers, contractors and student's, because it would give more insight into how the risks and poor management of Covid 19 virus will affect workers managing Engineering during Covid-19 crisis and how they can properly harness them so as to enable them achieve their respective project goals and to deliver quality service as regarding treatment and taking care of the infected workers without worrisome and health deprivation (World Economic Forum, 2020; World Health Organization, 2019; World Health Organization, 2020; Worldometer, 2020; Yu et al., 2020). Also, the study will profit stakeholders in the health management sector in Rivers state and Nigeria as a whole to help them in understanding the significant effect and importance of risk and management of covid 19 crisis so as to take cognizance of it during master planning as well as the factors affecting the implementation of health expansion project in Nigeria.

Lastly, it will help to stimulate student and other researchers to carry out further researches in the field. Research like this is essential to analyse the risk management of engineering facility during Covid-19 crisis, because it will provide management with data that they can use in making inferences about the project delivery. Thus, the results of this study may prove useful for academics; business and government in the field of medical science, environmental science, health management, Engineering management as well as researchers (Zhou et al., 2020). The scope of the study is to carry out risk analysis in managing an engineering facility during Covid-19 in Mife Construction Nigeria Limited, Rivers State, Nigeria. The nature of the study is such that the focus on the Asphalt mixing, Purchasing, maintenance and workshop unit of Mife Construction Nigeria Limited. The study would make a contribution to knowledge by defining ways of improvement that can lead to the health sustainability and the development of the region. While effort is made to make the study as detailed as it should be. The entire work is within the defined scope here presented.

2. MATERIALS AND METHODS

Research Design

The descriptive survey design was adopted for this study and asserts that a descriptive survey is the collecting of data on and describing in a systematic manner, the characteristics, feature or facts about a given population. It involves observing and describing the behaviour of a subject without influencing it in any way. The research will use a descriptive research design which generally describes the characteristics of a particular situation, event or case. Kerlinger's study considered survey research as social scientific research that focused on people, the vital facts of people and their beliefs, opinions, attitudes and behaviours. The design will be used because the researcher will use primary data in getting appropriate data to achieve the objectives of the study. This design is, therefore, appropriate for this study since it was meant to obtain data from respondents through questionnaire on evaluation of Risk Analysis of Managing Corona Virus in Rivers State using Reliability Analysis.

Area of the Study

The study was carried out in Rivers State and it was focused on Mife Construction Nigeria Limited, Rivers State. Rivers State is a state in the Niger Delta region of Nigeria. Formed in 1967, when it split from the former Eastern Region, Rivers State borders Imo, Abia and Anambra States to the north, Akwa Ibom State to the east and Bayelsa and Delta states to the west. The state capital, Port Harcourt, is a metropolis that is considered the commercial center of the Nigerian oil industry (Huang et al., 2020).

With a population of 5,198,716 as of the 2006 census, Rivers State is the 6th most populous state in the country (Liu et al., 2020). Rivers State is a diverse state that is home to many ethnic groups, including the Ikwerre, Ogba, Ijaw and Ogoni people. The state is particularly noted for its linguistic diversity, with 28 indigenous languages being said to be spoken in Rivers State. The 26th largest state by area, Rivers States' geography is dominated by the numerous rivers that flow through it, including the Bonny River (Huang et al., 2020). The economy of Rivers State is dominated by the state's booming petroleum industry. Though the rise of the oil industry has led to increased revenue for the state government, mismanagement and corruption have prevented the state from meaningfully tackling rampant poverty.

Population of the Study

The population of this study is the staff of Mife Construction Nigeria Limited, Rivers State working in Asphalt, Purchasing, Maintenance and Workshop units respectively, which comprises of one thousand thirty (1030) male and seven hundred (700) female in the study areas in Rivers State. They were used to ascertain the Risk Analysis in Managing an Engineering Facility during Covid-19 crisis in Mife Construction Nigeria Limited using Reliability Analysis.

Sampling Techniques

To determine sample size for the study, four designations of interest were selected from the four study units, Asphalt, Purchasing, Maintenance and Workshop units. The researcher did this in his opinion that those selected are most clearly the representative of the object of the research. The inclusive criteria for choosing the four designations include the experience of workers and also their daily working activities in the units (for the use of the respondents). Based on these criteria, Safety Engineers, Senior staff, Junior staff and Casuals were selected for this study.

Research Instrument

The instrument for data collection for this study will be self-structure questionnaires title "Risk Analysis in Managing an Engineering Facility during Covid-19 crisis" in Mife Construction Nigeria Limited using Reliability Analysis (RAMEFC)". The questionnaire was in two sections namely Section A and B. Section A of the questionnaire was used to generate demographic data from respondents while Section B had questionnaire items addressing the extent to which Risk Analysis of Managing an Engineering Facility during Covid-19 Crisis in Rivers State using Reliability Analysis. This section of the questionnaire is structured using the four-point Likert rating scale response pattern of Very High Extent (VHE)=5 points, High Extent (HE)=4, Moderate Extent=3, Low Extent (LE)=2 points, and Very Low Extent (VLE)=1 point.

Validation of the Instrument

The instrument was subject to face and content validation to ensure the appropriateness of the questionnaire. For the validation of the instrument, the researcher presented it to his supervisor and two experts from Engineering Management Department in the Faculty of Engineering, Rivers State University. Their input was used in making necessary adjustment in the instrument.

Reliability of the Instrument

The reliability of the questionnaire was determined through Interrater reliability of 0.89. After two weeks, a fresh copy of the questionnaire was re-administered to the respondents.

Methods

The following methods were adopted in this research: Data collection, application of statistical Models for data analysis, probability distribution analysis, regression analysis and reliability index analysis.

Method of Data Collection

The researcher relied on primary data using a questionnaire which was administered by giving orientation and explanation for selected respondents about the purpose of the questionnaire with the help of the team leaders and technical managers. They are simplified in order that all respondents have a common understanding and meaning of each of the questions. Secondary data was used from the internet, journals and library.

Method of Data Analysis

All collected data by researcher was analysed using mean and standard deviation as tool to analyse the mean. Four-point Likert rating scale response pattern of Very High Extent (VHE)=5 points, High Extent (HE)= 4, Moderate Extent= 3, Low Extent (LE)= 2 points and Very Low Extent (VLE)=1 point, while those below 3.50. This is because 3.50 is the lower true limit of Agree. For testing the hypotheses, if the calculated t-value is equal or greater than the t-table value (t-critical), the null hypothesis was rejected at 0.05 level of significance otherwise accepted.

Basic Statistical Models

Statistical models aid the analysis of data whether it is grouped or ungrouped data, the important of these been the mean, standard deviation, variance and coefficient of variation whose formulas are presented in equations 1 to 4.

$$\text{Mean } (\mu) = \frac{\sum Xi}{N} \quad (1)$$

$$\text{Standard Deviation } (\sigma) = \sqrt{\frac{\sum (Xi - \mu)^2}{N}} \quad (2)$$

$$\text{Variance } (\sigma^2) = \frac{\sum (Xi - \mu)^2}{N} \quad (3)$$

$$\text{Coefficient of Variation (C.V)} = \frac{\sigma}{\mu} X\ 100\% \quad (4)$$

Where: μ = mean, σ = Standard deviation, N = population size, Xi = each value from the population.

Note: Ratio of the standard deviation to the mean is known as the coefficient of variation and as such provides a normalized measure of the spread. It is multiplied by 100 so that it can be expressed in percentage.

Probability Distributions

Certain natural occurrence has random behaviours, from the nature of their randomness we can build a theoretical probability model or distribution. Such a model is known as probability distribution. The most important of these models are as follows: Binomial Distribution, Poisson Distribution and Normal Distribution.

Binomial Distribution

If we denote the probability that n Bernoulli trials have r successes and (n-r) failures by

Pr (X = r); then: Pr (X = r) = $n_{C_r} p^r q^{n-r}$ (5)

And $n_{C_r} = \frac{n!}{(n-r)!r!}$ (6)

Where: p = probability of success/safety, q = probability of failure/risk, n = number of trials

if we denote the mean and standard deviation of a binomial distribution by μ and σ respectively then:

Mean (μ) = np (7)

Standard Deviation (σ) = $\sqrt{npq}$ (8)

Variance (σ^2) = npq (9)

Poisson Distribution

When the number of trials is very large and the probability of success is comparatively small, the binomial distribution may not be a very suitable model for random experiments with repeated trials. A discrete probability distribution which is more suitable for this purpose is the poison distribution and is defined as:

Pr (x) = $\frac{\lambda^x e^{-\lambda}}{x!}$ For x = 0, 1, 2, 3, … (10)

Where: λ= np; is the mean of success/safety and e = 2.718

If we denote the mean and standard deviation of a Poisson distribution by μ and σ respectively then:

Mean (μ) = λ= np (11)

Standard Deviation (σ) = $\sqrt{\lambda = \text{np}}$ (12)

Variance (σ^2) = λ= np (13)

Normal Distribution

Normal distribution occurs whenever a random variable is affected by a sum of random effects such that no single factor dominates. Empirically, most statistical distribution of continuous nature can describe a function called normal distribution function and takes the form in equation (14):

P(x) = $\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$ (14)

If we put y = P(x), and Z = $\frac{x-\mu}{\sigma}$ (15)

Equation (14) then becomes:

y = $\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(Z)^2}$ (16)

with the mean of Z being zero and the corresponding standard deviation being 1. In the language of probability, we say that the distribution has been standardized and Z is called standardized score, or Z-score given by:

Z = $\frac{x-\mu}{\sigma}$ (17)

Thus:

P(Z) = $\frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(Z)^2}$ (18)

Regression Analysis

There are four major types of regression analysis which are: Linear Regression, Polynomial Regression, Multiple Regression and Non- Linear Regression.

Linear Regression

The mathematical expression for fitting a straight line to a set of paired observations (x_1, y_1), (x_2, y_2), … (x_n, y_n) is given by:

Y = $a_0 a_1 x + e$ (19)

Where a_0 and a_1 are the coefficient representing the intercept and the slope respectively and e is the error or residual between the model and the observations which can be represented by rearranging (19):

$$e = y - a_0 - a_1 \quad (20)$$

to determine the values of a0 and a1 equation (21) is differentiated with respect to each coefficient

$$S_r = \sum_{i=1}^{n}(y_i - a_0 - a_1 xi)^2 \quad (21)$$

Where S_r = sum of squares of residuals

$$\frac{\partial S_r}{\partial a_0} = -2\sum(y_i - a_0 - a_1 xi) \quad (22)$$

$$\frac{\partial S_r}{\partial a_1} = -2\sum[(y_i - a_0 - a_1 xi)xi] \quad (23)$$

Setting the derivatives equal to zero yields:

$$0 = \sum y_i - \sum a_0 - \sum a_1 x_i \quad (24)$$

$$0 = \sum y_i xi - \sum a_0 xi - \sum a_1 {x_i}^2 \quad (25)$$

Solving equations (24) and (25) simultaneously to obtain:

$$a_1 = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum {x_i}^2 - (\sum x_i)^2} \quad (26)$$

$$a_0 = \bar{y} - a_1 \bar{x} \quad (27)$$

$$r^2 = \frac{S_t - S_r}{S_t} \quad (28)$$

$$r = \frac{n\sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{n\sum {x_i}^2 - (\sum x_i)^2}\sqrt{n\sum {y_i}^2 - (\sum y_i)^2}} \quad (29)$$

Where: S_r = sum of squares of the residuals, S_t= standard deviation, r^2 = coefficient of determination, r = coefficient of correlation, for a perfect fit, $S_r = 0$ and $r = r^2 = 1$, signifying that the line explains 100% of the variability of the data.

Polynomial Regression

$$y = a_0 + a_1 x + a_2 x^2 + e \quad (30)$$

$$S_r = \sum_{i=1}^{n}(y_i - a_0 - a_1 x_i - a_2 {x_i}^2)^2 \quad (31)$$

Differentiating equation (31) with respect to a_0, a_1, and a_2 respectively

$$\frac{\partial S_r}{\partial a_0} = -2\sum\left(y_i - a_0 - a_1 xi - a_2 x_i^2\right) \quad (32)$$

$$\frac{\partial S_r}{\partial a_1} = -2\sum x_i\left(y_i - a_0 - a_1 xi - a_2 x_i^2\right) \quad (33)$$

$$\frac{\partial S_r}{\partial a_2} = -2\sum {x_i}^2\left(y_i - a_0 - a_1 xi - a_2 x_i^2\right) \quad (34)$$

Solving equation (32) to (34) simultaneously and setting the partial derivatives equal to zero we obtain:

$$(n)a_0 + (\sum x_i)a_1 + (\sum {x_i}^2)a_2 = \sum y_i \quad (35)$$

$$(\sum x_i)a_0 + \left(\sum x_i^2\right)a_1 + \left(\sum x_i^3\right)a_2 = \sum x_i y_i \quad (36)$$

$$\left(\sum x_i^2\right)a_0 + \left(\sum x_i^3\right)a_1 + \left(\sum x_i^4\right)a_2 = \sum x_i^2 y_i \quad (37)$$

Multiple Linear Regression

$$y = a_0 + a_1 x_1 + a_2 x_2 + e \quad (38)$$

$$S_r = \sum_1^n (y_i - a_0 - a_1 x_{1i} - a_2 x_{2i})^2 \quad (39)$$

Differentiating equation (39) with respect to each unknown coefficient

$$\frac{\partial S_r}{\partial a_0} = -2\sum(y_i - a_0 - a_1 x_{1i} - a_2 x_{2i}) \quad (40)$$

$$\frac{\partial S_r}{\partial a_1} = -2\sum x_{1i}(y_i - a_0 - a_1 x_{1i} - a_2 x_{2i}) \quad (41)$$

$$\frac{\partial S_r}{\partial a_2} = -2\sum x_{2i}(y_i - a_0 - a_1 xi - a_2 x_{2i}) \quad (42)$$

Setting the partial derivatives equal to zero and rearranging to obtain

$$\begin{bmatrix} n & \sum x_{1i} & \sum x_{2i} \\ \sum x_{1i} & \sum x_{1i}^2 & \sum x_{1i}x_{2i} \\ \sum x_{2i} & \sum x_{1i}x_{2i} & \sum x_{2i}^2 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum x_{1i} y_i \\ \sum x_{2i}\, y_i \end{bmatrix} \quad (43)$$

Non- Linear Regression

$$y_i = f(x_i, a_0, a_1, \dots, a_m) + e_i \quad (44)$$

Where y_i = a measured value of the dependent variable $f(x_i, a_0, a_1, \ldots, a_m)$. For the sake of convenience equation (44) can be expressed as:

$$y_i = f(x_i) + e_i \quad (45)$$

The non- linear model can be expanded in Taylors series as follows:

$$f(x_i)_{j+1} = f x_{ij} + \frac{\partial f x_{ij}}{\partial a_0}\ \Delta a_0 + \frac{\partial f x_{ij}}{\partial a_1}\ \Delta a_1 \quad (46)$$

Where j = the initial guess, j+1 = the prediction, Δa_0 = $a_{0,j+i}$-$a_{0,j}$, and Δa_1 = $a_{1,j+1}$-$a_{1,j}$

In matrix form

$$[D] = [Z_j][\Delta A] + [E] \quad (47)$$

Where:

$$[Z_j] = \begin{bmatrix} \frac{\partial f_1}{\partial a_0} & \frac{\partial f_1}{\partial a_1} \\ \frac{\partial f_2}{\partial a_0} & \frac{\partial f_2}{\partial a_1} \\ \frac{\partial f_n}{\partial a_0} & \frac{\partial f_n}{\partial a_1} \end{bmatrix} \quad (48)$$

$$[D] = \begin{bmatrix} y_1 - f(x_1) \\ y_2 - f(x_2) \\ y_n - f(x_n) \end{bmatrix} \quad (49)$$

$$[\Delta A] = \begin{bmatrix} \Delta a_0 \\ \Delta a_1 \\ \Delta a_m \end{bmatrix} \quad (50)$$

Reliability Index

The estimation of risk probability is calculated by integration of the joint density function over the risk domain, that is the region in which g (R, Q) < 0**.** Where R and Q are random variables. This probability is often difficult to evaluate, so the concept of a reliability index is used to quantify such estimates.

$$Z_R = \frac{R - \mu_R}{\sigma_R} \quad (51)$$

$$Z_Q = \frac{R - \mu_Q}{\sigma_Q} \quad (52)$$

The variables Z_R and Z_Q are called reduced variables.

First Order Second Moment Method (FOSM)

This makes use of only mean and variance of the random variables. The reliability index can be calculated by taking the ratio of the mean (μ_z) and standard deviation (σ_z).

$$\beta = \frac{\mu_z}{\sigma_z} \quad (53)$$

Where β *is known as reliability index*

Alternatively, reliability index can also be obtained using Hasofer-Lind's formular

$$\beta = \frac{a_0 + \sum_{i=1}^{n} a_i \mu_{xi}}{\sqrt{\sum_{i=1}^{n} (a_i \sigma_{xi})^2}} \quad (54)$$

Where a_i terms (i = 0, 1, 2, …n) are constants and the xi terms are uncorrelated random variables.

Advanced First – Order Second Moment Method (AFOSM)

Reliability index for this case is computed as

$$\beta = \frac{\mu_R - \mu_S}{\sqrt{\sigma_R^2 + \sigma_S^2}} \quad (55)$$

3. RESULTS AND DISCUSSION

Results

The findings of the research study are presented in this research article. These results are presented in the same chronological sequence as they appear in the questionnaire. It shows the socio-demographic characteristics of the study sample (346 respondents) which centres were from the four (4) study units. (Asphalt, Purchasing, Engineering and Workshop units). Out of all the 346 respondents, the Table 1 below shows that 36.9% was allocated to Purchasing Unit (127 questionnaires), 34.3% was allocated to

Maintenance Unit (119 questionnaires), 10.9% was allocated to Workshop Unit (38 questionnaires), 17.9% was allocated to Asphalt Unit (62 questionnaires).

Table 1 The Distribution of Questionnaire in Response to the Response and Declined Rate

Respondent Sectoral Group	% Allocated	Questionnaire Administered	% Actual Response	% Declined rate
Asphalt	17.9	62	82	18
Purchasing	36.9	127	88.2	11.8
Maintenance	34.3	119	84	16
Workshop	10.9	38	84.2	15.8
Total	100	346		

Figure 1 shows percent of questionnaires administered in each sectorial group and Figure 2 demonstrates the actual percent response in each sector (location) whereas Figure 3 illustrates the actual percent response in each sector (location).

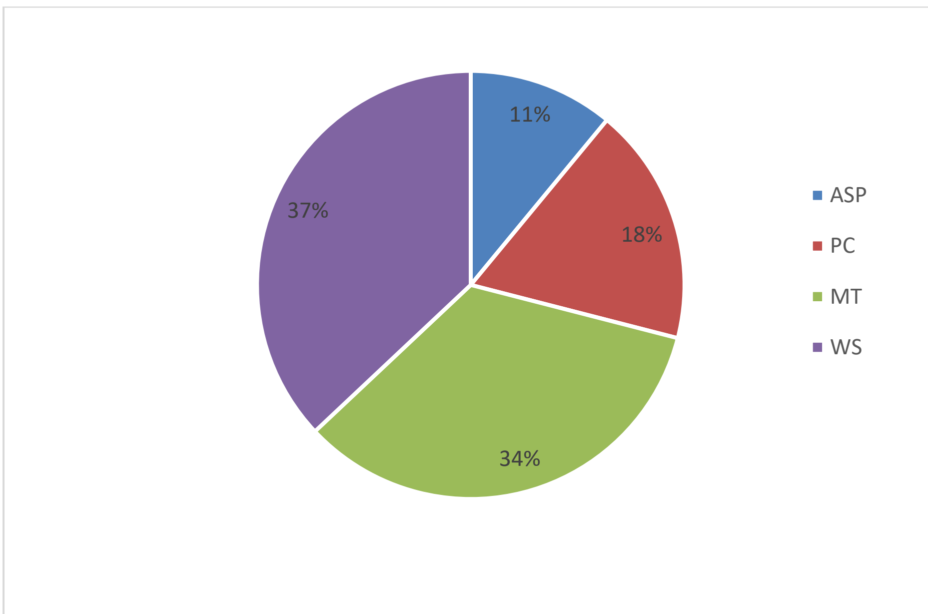

Figure 1 Percent of Questionnaires Administered in each Sectorial Group

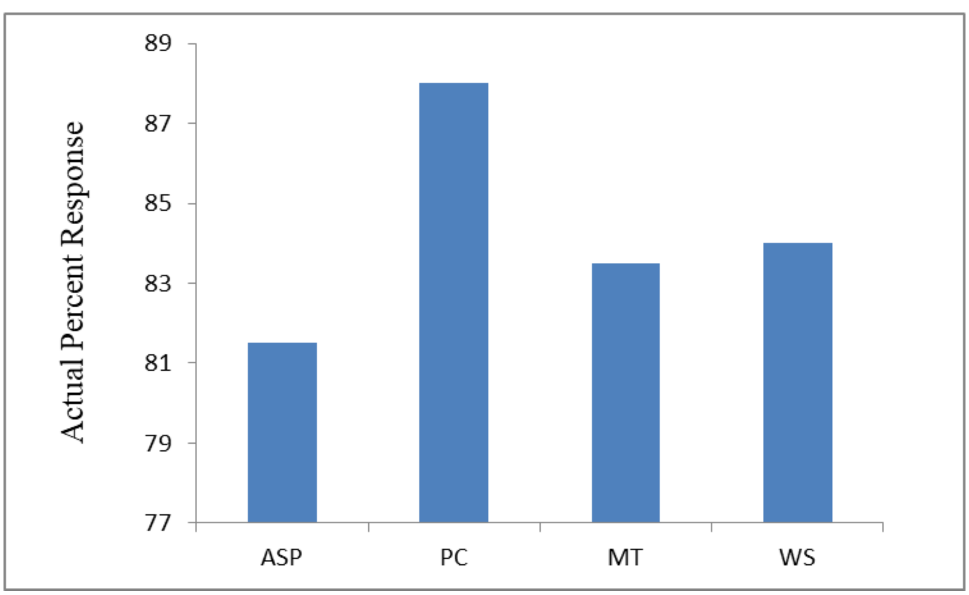

Figure 2 Actual Percent Response in Each Sector (Location)

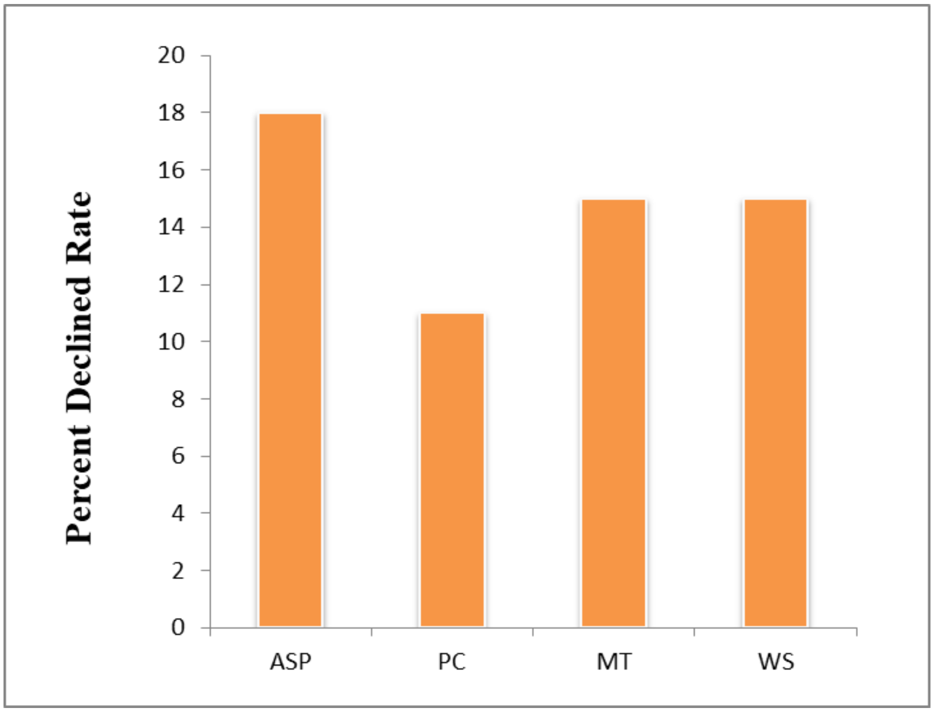

Figure 3 Percent Decline Rate in Each Sector (Location)

Characteristics of Respondents

Primary data were collected from respondents who worked in the 4 study centres with different educational backgrounds, work experience and responsibilities that possess different job categories in the centres. Secondary data on risk analysis of managing coronavirus were extracted from questionnaires, journals and library and then analyzed, triangulated and interpreted using the same reliability techniques. Out of the 346 questionnaires that were administered, a response rate of 89.3% and declined rate of 10.7% was achieved. (That is 309 responses and 37 declines) across the four study centres are shown in Table 2. The overall response rate is depicted in the table below.

Table 2 The Sectoral Group and Designations of Questionnaires with Actual and Response Rate.

S/N	Respondent Sectoral Group	Designations	No of Responses Expected	Actual Response	Declined Rate
1	Asphalt	Safety Engrs	2	2	0
		Senior Staff	4	3	1
		Junior Staff	9	7	2
		Casuals	47	43	4
		Total	62	55	7
2	Purchasing	Structural	4	3	1
		Senior Staff	13	9	4
		Junior Staff	7	6	1
		Casuals	103	94	9
		Total	127	112	15
3	Maintenance	Structural	5	4	1
		Senior Staff	12	10	2
		Junior Staff	9	7	2
		Casuals	93	89	4
		Total	119	110	9
4	Workshop	Construction	2	2	0

		Senior Staff	6	5	1
		Junior Staff	7	6	1
		Casuals	23	19	4
		Total	38	32	6
		Grand total	346	309	37

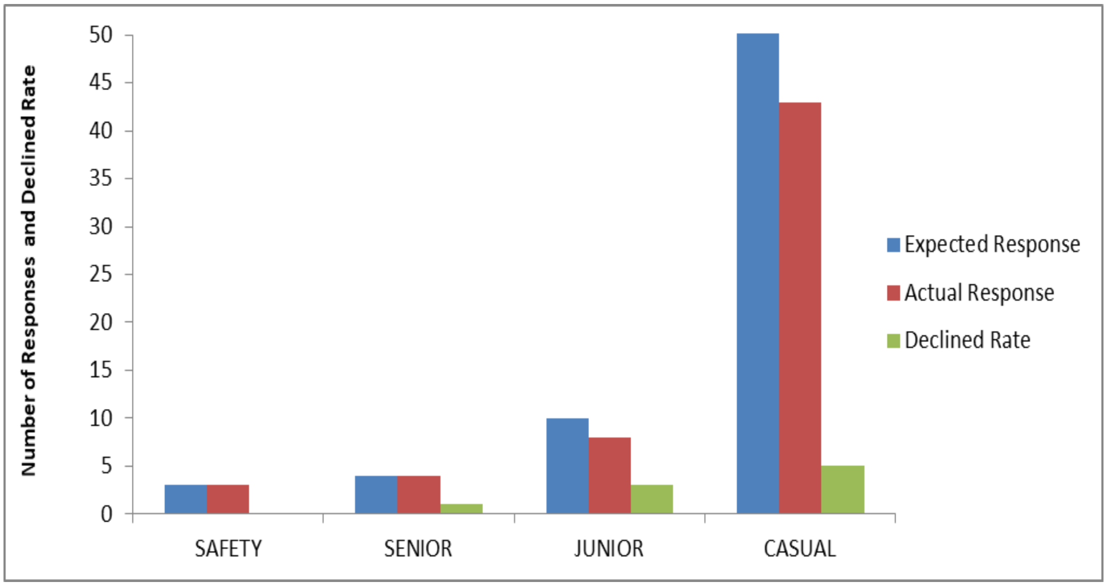

Figure 4 Chart Showing the Responses and Declined Rate of Asphalt Unit

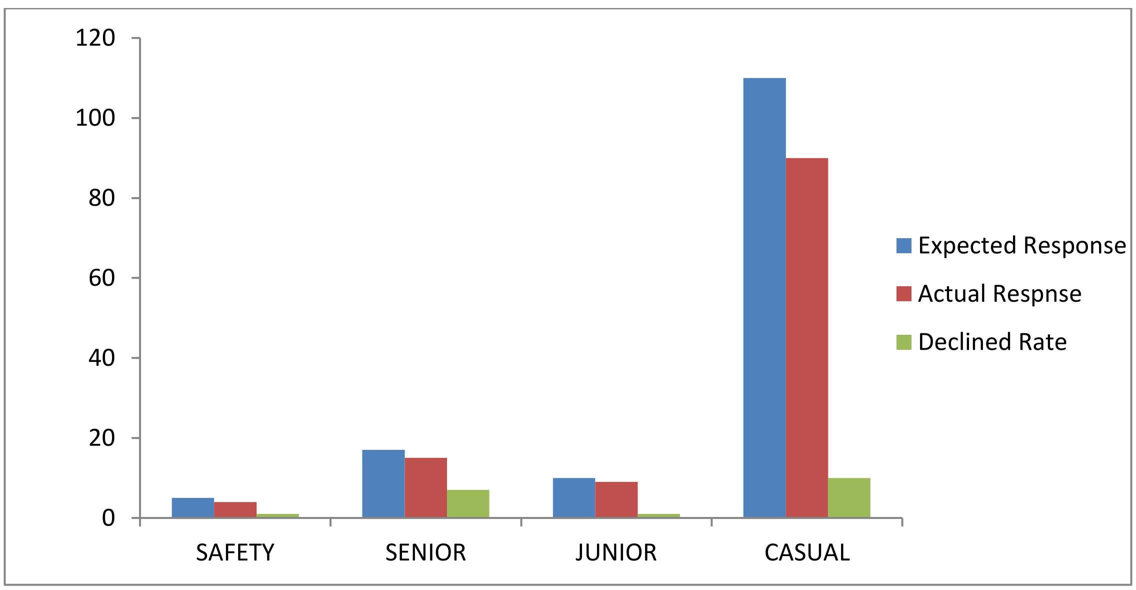

Figure 5 Chart Showing the Responses and Declined Rate of Purchasing Unit

Figure 4 shows the chart of the responses and declined rate of asphalt unit whereas the Figure 5 demonstrates the chart showing the responses and declined rate of purchasing unit. Figure 6 showcases the chart showing the responses and declined rate of maintenance unit and Figure 7 illustrates the chart showing the responses and declined rate of workshop unit.

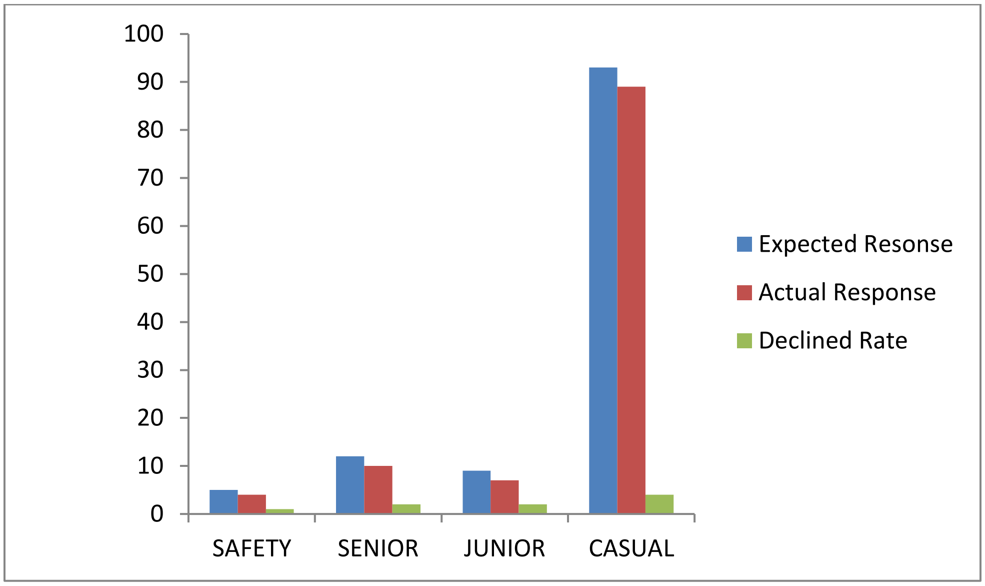

Figure 6 Chart Showing the Responses and Declined Rate of Maintenance Unit

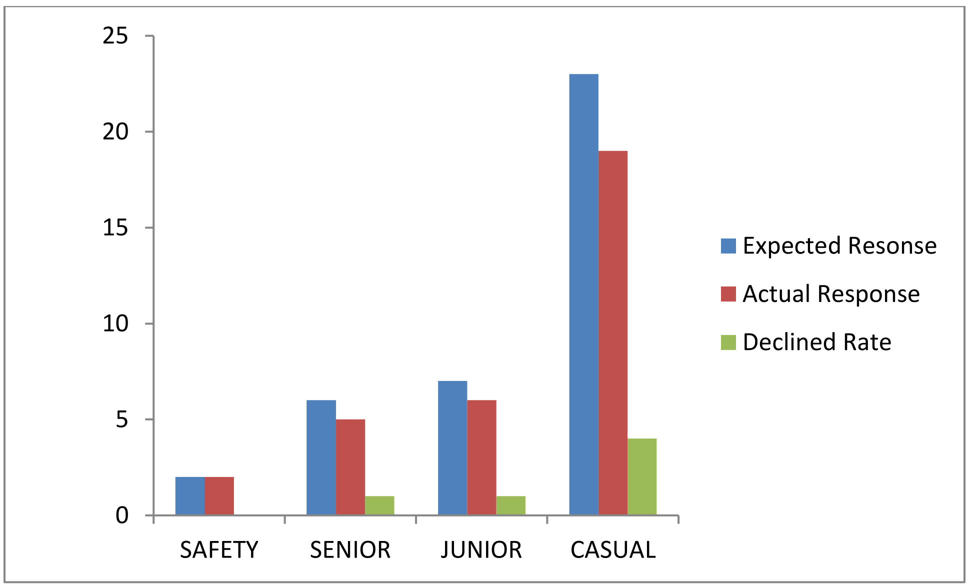

Figure 7 Chart Showing the Responses and Declined Rate of Workshop Unit

Work Experience of Respondents

The Table 3 below indicates the working experience of the employees who participated in the study. The objective was to determine how long they have stayed in the Ministry of Health facilities and determine their experience in managing coronavirus. The data gathered shows majority of the respondents representing 67.4% have worked more than 4-7 years in the Ministry of Health facilities in Rivers state. The mean of years of work experience of the respondents is between 2-7 years respectively.

Table 3 Report on Designation to the corresponding Service Year and Frequency

S/N	Designations	Service Year	Frequency
1.	Engineers	2	2
		3	1
		4	0
		5	5
		6	3
		7	2
		Total	13

2	Senior Staff	2	3
		3	7
		4	14
		5	1
		6	2
		7	8
		Total	35
3	Junior Staff	2	8
		3	6
		4	1
		5	4
		6	8
		7	5
		Total	32
		Grand total	80

Workload Among Health Workers

The rapid spread of COVID 19 and the severity of symptoms it can cause in a segment of infected individuals has acutely taxed the limits of health care facilities is shown in Figure 8. Though the following graph shows for the overall 42% have mentioned of increased workload, it is in fact higher among the responders who were directly involved in COVID 19 responses (51%).

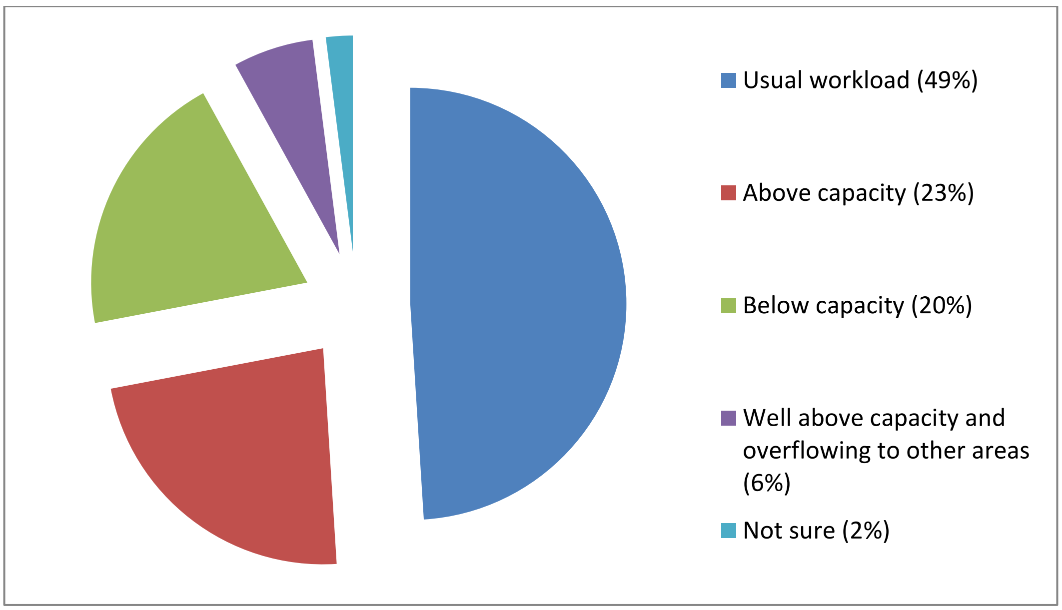

Figure 8 Chart Showing Workload due to COVID-19 in the Mife Construction Nigeria Limited.

Reliability Results

Table 4 shows the results obtained from four locations: Ashalt, Workshop, Maintenance and Purchasing Units respectively in terms of Mean, Standard Deviation and Reliability index. Purchasing had the highest value for mean and standard deviation but had the least value for reliability index because reliability index is calculated as a ratio of the mean to the standard deviation. Workshop had the least value of mean and standard deviation but had the highest value of reliability index. Reliability indices are a relative measure of the current condition and provides a qualitative estimate of the structural performance. Structures with relatively high reliability indices will be expected to perform well. If the value of reliability index is too low, then such a structure may be classified as been at risk. From table 4, Workshop has the highest reliability index followed by Ashalt, Maintenance and finally Workshop. We can conclude from our analysis that Workshop will perform better than all other locations, however this needs further analysis to determine the probability of safety which must be greater than or equal to 0.9 before will can conclude that the structure is completely reliable safe or reliable.

Table 4 Reliability Index from Four Different Locations

Location	Mean	Standard Deviation	Reliability Index
Asphalt	26.5	37.3497	0.7095
Workshop	16.25	16.2967	0.9971
Maintenance	51	72.8377	0.7002
Purchasing	55	83.5943	0.6579

Variation of Probability of Safety and Risk with Reliability Index for Asphalt

Figure 9 determined the reliability index of Asphalt to be 0.7095 there was still the need to know if this value is acceptable or reliable in terms of probability of safety which ranges from zero to one. When its value is 1 then we say that is perfect reliability meaning 100% confidence that the structure is safe when this value is zero means absence of reliability or unreliability. From figure 1 the reliability or probability of safety is 0.761 which is less than 0.9, hence this structure is still at risk but as the reliability is increased so does the reliability tends to approach the value of 1 which is perfect reliability. At a reliability index value of 2 (which means the reliability was increased by a factor of 2) we observe that the structure is now reliable, hence there is need to increase certain designations of health workers to match up the number of patience to be able manage Corona Virus effectively. Ratio of workers to casuals in Asphalt are as follows: Safety Engineers to Casuals = 1:27, Senior Staff to Casuals = 1:14, Junior Staff to Casuals = 1:6. Note that P(S) is the probability of success or safety while P(F) is the probability of failure or risk.

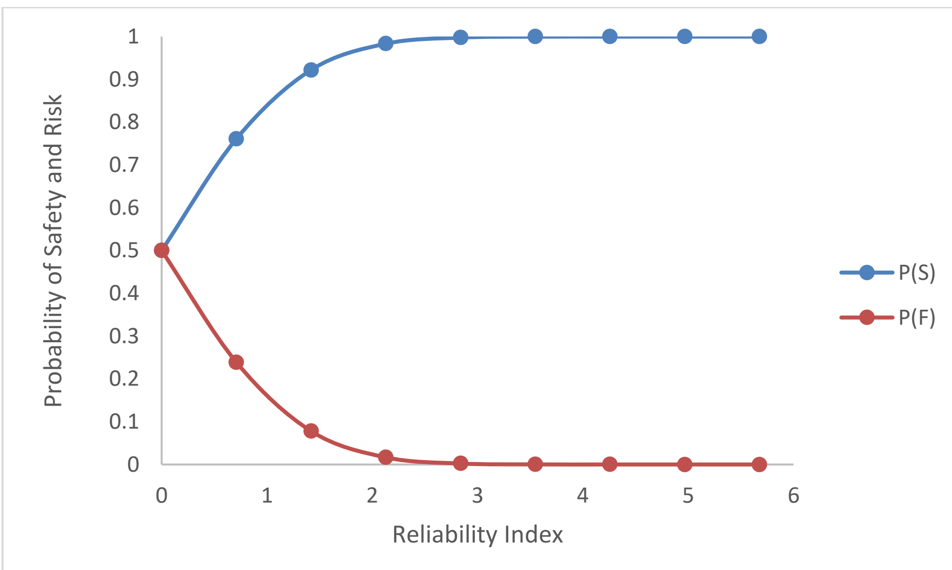

Figure 9 Profile Plot Probability of Safety and Risk Versus Reliability Index for Asphalt Unit

Variation of Probability of Safety and Risk with Reliability Index for Workshop

This demonstrates the characteristics of the workshop experience of the workers in terms of probability and reliability is presented in Figure 10.

Having determined the reliability index of Workshop to be 0.9971 there was still the need to know if this value is acceptable or reliable in terms of probability of safety which ranges from zero to one. When its value is 1 then we say that is perfect reliability meaning 100% confidence that the structure is safe when this value is zero means absence of reliability or unreliability. From figure 1 the reliability or probability of safety is 0.89 which is approximately equal to 0.9, hence this structure can be said be very close or almost reliable but is still at risk, as the reliability index is increased so does the reliability tends to approach the value of 1 which is perfect reliability. At a reliability index value of 2 (which means the reliability was increased by a factor of 2) we observe that the structure is now reliable, hence there is need to increase certain designations of health workers to match up the number of patience to be able manage Corona Virus effectively. Ratio of workers to casuals in Workshop are as follows: Construction Engineers to

Casuals = 1:13, Senior Staff to Casuals = 1:4, Junior Staff to Casuals = 1:3. Note that P(S) is the probability of success or safety while P(F) is the probability of failure or risk.

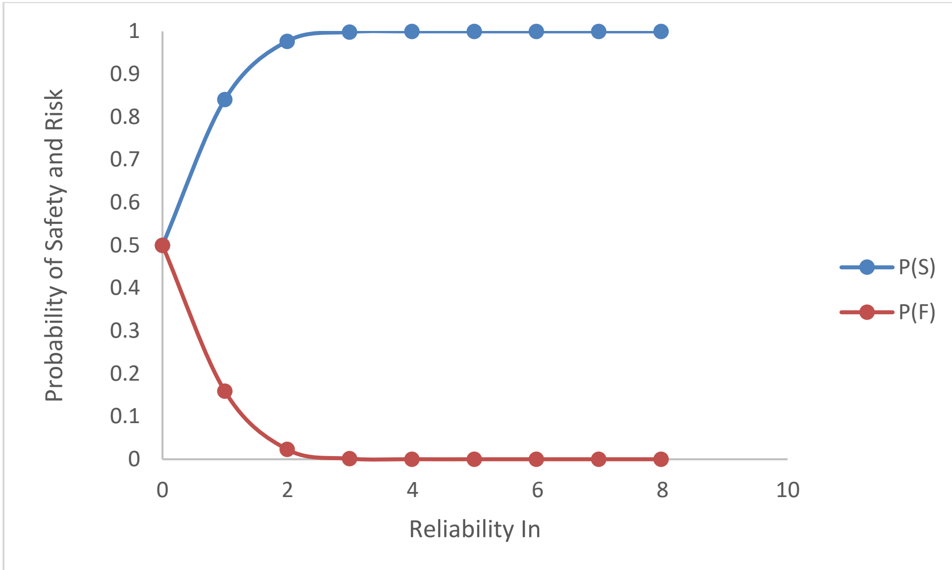

Figure 10 Profile Plot Probability of Safety and Risk Versus Reliability Index for Workshop

Variation of Probability of Safety and Risk with Reliability Index for Maintenance Unit

Figure 11 shows the variation of probability of safety and risk with reliability index for maintenance unit

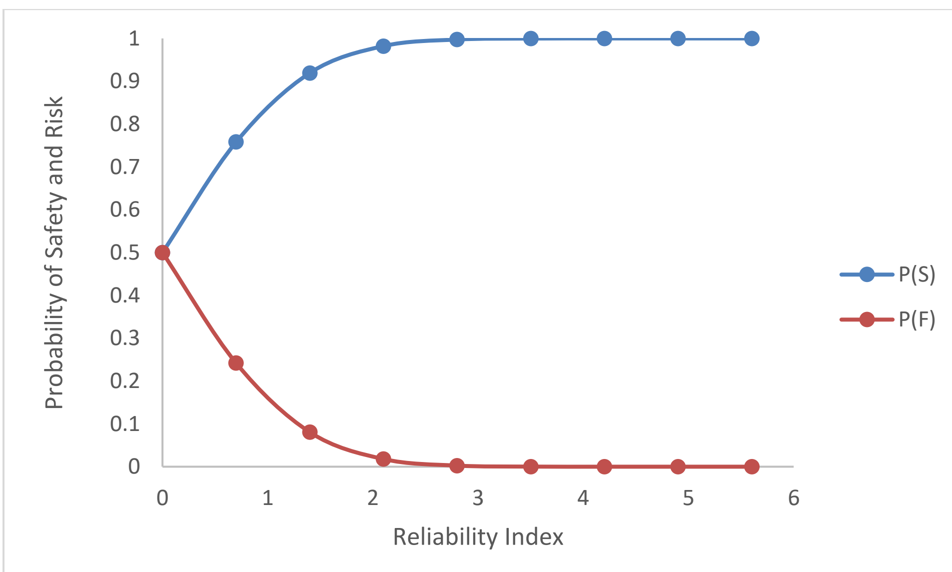

Figure 11 Profile Plot Probability of Safety and Risk Versus Reliability Index for Maintenance Unit

Having determined the reliability index of Maintenance to be 0.7002 there was still the need to know if this value is acceptable or reliable in terms of probability of safety which ranges from zero to one. When its value is 1 then we say that is perfect reliability meaning 100% confidence that the structure is safe when this value is zero means absence of reliability or unreliability. From figure 1 the reliability or probability of safety is 0.7581 which is less than 0.9, hence this structure is still at risk but as the reliability is increased so does the reliability tends to approach the value of 1 which is perfect reliability. At a reliability index value of 2 (which means the reliability was increased by a factor of 2) we observe that the structure is now reliable, hence there is need to increase certain designations of health workers to match up the number of patience to be able manage Corona Virus effectively. Ratio of workers to casuals in Maintenance are as follows: Structural Engineers to Casuals = 1:20, Senior Staff to Casuals = 1:8, Junior Staff to Casuals = 1:10. Note that P(S) is the probability of success or safety while P(F) is the probability of failure or risk.

Variation of Probability of Safety and Risk with Reliability Index for Purchasing Unit

Figure 12 demonstrates the variation of probability of safety and risk with reliability index for purchasing unit

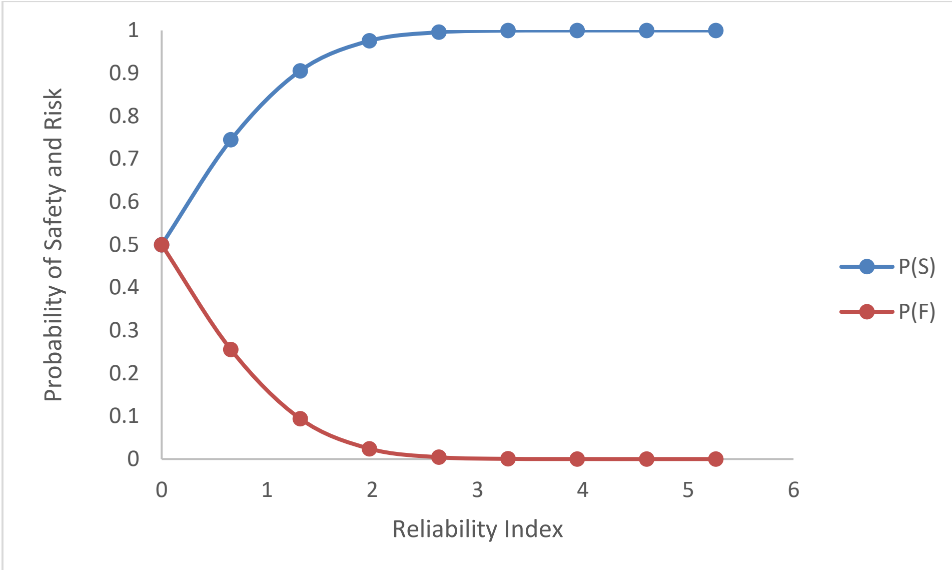

Figure 12 Profile Plot Probability of Safety and Risk Versus Reliability Index for Purchasing Unit

Having determined the reliability index of Purchasing Unit to be 0.6579 there was still the need to know if this value is acceptable or reliable in terms of probability of safety which ranges from zero to one. When its value is 1 then we say that is perfect reliability meaning 100% confidence that the structure is safe when this value is zero means absence of reliability or unreliability. From figure 1 the reliability or probability of safety is 0.7581 which is less than 0.9, hence this structure is still at risk but as the reliability is increased so does the reliability tends to approach the value of 1 which is perfect reliability. At a reliability index value of 2 (which means the reliability was increased by a factor of 2) we observe that the structure is now reliable, hence there is need to increase certain designations of health workers to match up the number of patience to be able manage Corona Virus effectively. Ratio of workers to casuals in PURCHASING UNIT are as follows: Structural Engineers to Casuals = 1:30, Senior Staff to Casuals = 1:8, Junior Staff to Casuals = 1:15. Note that P(S) is the probability of success or safety while P(F) is the probability of failure or risk.

Discussion

COVID-19 infection is still a rapidly spreading global health problem affecting all sectors and poses a significant threat to public health. Given the serious threats imposed by COVID-19 and the recent emergence of a COVID-19 vaccine, preventive measures play an essential role in reducing infection rates and controlling the spread of the disease. This indicates the necessity of public adherence to preventive and control measures, which is affected by their knowledge, attitudes and practices. Health care workers acquired COVID-19 infection at a higher rate than the general population. In the present study, it is reported that the prevalence rate of COVID-19 among health care workers is on the increase. As such, health care workers working throughout the world should have satisfactory knowledge about all features of the disease such as established prevention strategies, proposed treatment, diagnosis and clinical manifestation and be able to manage it in their health care facility.

4. CONCLUSION

This work has been able to achieve its objectives as follows: Firstly, basic statistical models such as Mean, Standard deviation, Variance and Coefficient of variation were applied in analysing the data obtained from Asphalt, Purchasing, Maintenance and Workshop Units. Secondly, Probability distribution analysis were carried out to determine the probability of % actual response and % decline rate based on the number of questionnaires that were administered in each of the four centres above. The values for percent actual response for Asphalt, Purchasing, Engineering and Workshop were determined as 82%, 88.2%, 84% and 84.2% while the percent of decline rate were 18%, 11.8%, 16% and 15.8% respectively.

Thirdly, Regression analysis were carried out to obtain the relationship between the probability of safety and risk versus reliability index and it was observed that the probability of safety reached approximately 0.9 or 90% while probability of risk was close to 0.1 or 10%. Fourthly, the reliability index of the Asphalt, Workshop, Maintenance and Purchasing were determined to be 0.7095, 0.9971, 0.7602 and 0.6579 respectively. This result shows that the reliability index in all four units is well above 0.5 which indicates that the centres have a reliability value close to 1 which is taken as maximum or perfect reliability.

Finally, the ratio of workers in the four units were determined as follows: For Asphalt; Safety Engineers to Casuals is 1:27, Senior Staff to Casuals is 1:14, Junior Staff to Casuals is 1:6. For Workshop; Construction Engineers to Casuals is 1:13, Senior Staff to Casuals is 1:4, Junior Staff to Casuals is 1:3. For Engineering; Structural Engineers to Casuals is1:20, Senior Staff to Casuals is 1:8, Junior Staff to Casuals is 1:10. For Purchasing; Structural Engineers to Casuals is 1:30, Senior Staff to Casuals is 1:8, Junior Shaft to Casuals is 1:15.

Ethical issues

Not applicable.

Informed consent

Not applicable.

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This study has not received any external funding.

Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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