



Assessing the Environmental Impacts of Virtual Workplace Implementation in Nigerian Universities

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ABSTRACT

The aim of this study is to assess the environmental impacts of virtual workplace implementation in Nigerian Universities using the University of Benin as a case study. A comprehensive literature review, interview and questionnaire survey will be carried out in order to identify the major factors, barriers and risks of virtual workplace. A virtual workplace implementation framework will be developed and validated. This research will also involve the assessment of the levels of CO, SO₂ and NO₂ gases emanating from vehicles of some selected employees in order to determine their contribution of these gases to the atmosphere. While the environmental impacts of the implementation of the proposed framework will be carried out by measuring the level of air pollutant at two selected point within the University of Benin, and the expected reduction via the implementation of virtual workplace assuming that eligible virtual workers are allowed to work from home 1,2,3,4,5days per week. With the increase in the number of organizations and individuals embracing the concept of virtual working in Nigeria, the result of this proposed study will help organizations and individuals to make informed decision as regard the implementation of this emerging work practice and the expected impact as regard reduction in air pollution.

Keywords: Emission, Framework, implementation, Telecommuting, Teleworking.

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1. BACKGROUND TO THE STUDY

The environment in which work take place has changed speedily due to the adoption of information and communication technology tools in the workplace. According to IBM Global Technologies Services 2011, "people used to go to work, now work goes to the people". Information and communication technology has redefined the work place and altered not only where work is carried out but how work is being done nowadays, thereby making it possible for work to be performed from any convenient place outside the traditional office. The workplace is gradually shifting to virtual; that is powered by web of connection and collaboration by Information and communication technology. In virtual workplace, the employees work outside the office and often communicate with supervisors and other employees through electronic communication as against the one on one meeting (Cascio, 2000). Virtual work is defined as a work that is carried out of the traditional office with the help of technology (Olsen et al, 2015).

Examples of virtual work include hot-desking, hoteling, telecommuting, virtual team, global project teams, computer-mediated work, telework, distributed work, hoteling, home based work, and paperless office (Watson-Manheim & Belanger, 2002; Mihhailova et al, 2009; Raghuram et al, 2008). Telecommuting, teleworking and virtual teams are the three most common term used in virtual work research. There are several benefits that can be derived from the implementation of virtual work, these include savings in real estate, lower CO₂ emissions, reduced traffic congestion and commute time, provide opportunity for people leaving with disabilities, greater talent pool, decrease energy consumption, and less unnecessary meetings (Choo et al, 2005; Thompson & Caputo, 2009; Caldow, 2009; Obisi, 2016; PwC SA, 2015). However, despite the numerous benefits that can be derived with the implementation of virtual work, much research has not been carried out as regard developing an implementation framework for intending organization. Most of the past studies focus on leadership and the social aspect of virtual work. Unfortunately, such research does not help organization to make informed decision as regard implementing this emerging work process. Although there are numerous online publications and guidelines on the best approach to implement virtual work. However, quite a good number of these materials are not research based (Onpoint consulting, 2015).



The virtual workplace implementation approach adopted in developed world differs from one nation to another. For example some states in USA have developed a State policy that shows the minimum requirement and procedures that organization should follow in implementing telecommuting program. While others devise a telecommuting program that is financed by the state to aid organizations in implementing telecommuting program. In this approach the states assign expert to organizations who then work closely with them to plan, and initiate telecommuting programs customized to their desires. These program are often rendered free of charge by the states to the organizations (Statewide planning Program technical paper, 2002). Another common approach also used in the developed world involved the development of telework implementation toolkit by relevant authorities. The toolkit is often used as a guide and is designed to assist those charged with the responsibility of implementing telework program.

Several researchers have tried to quantify the impact of virtual workplace on vehicular emission and the resultant effect on air pollution. However, majority of the previous studies estimate the emission reduction using employee travel diary data (Kirtamura et al, 1990; Henderson et al, 1994; Koenig et al, 1996), while Choo et al, (2003) used nationwide data. This studies therefore seek to measure the expected emission reduction directly. Also, most of these studies reviewed were carried out in the developed world. The result obtained from such studies cannot be used to describe Nigeria context, as it may not be a true representation of the situation in Nigeria.

Research suggests that virtual work has the capacity to reduce the distance travelled by employee and also lessen the amount of air pollution resulting from vehicular emission. With the number of vehicles plying Nigeria roads said to have increased to 11.46 million as at first quarter of year 2017 according to a report from the National Bureau of statistics (Raji, 2017). Vehicular emission in developing countries is said to account for 40-80% of NO₂ and CO concentration (Olamijulu & Ana, 2013). This can be attributed to importation of used cars from the developed world and also poor maintenance culture from vehicle owners. It is common to see visible smoke emanating from the exhaust of most vehicles plying our major roads.

Vehicular emission constitute a serious threat to the environment and as well as the health of the people. The accumulation of air pollutant emitted by vehicles by human often lead to respiratory diseases, and other serious health problems especially in major cities where population level are often high (Abam and Unachukwu, 2009). The emission from vehicles contribute largely to green-house gases and the resultant impact of these gases lead to climate change (Irwin, 2004). The problems associated with vehicular emission is expected to increase greatly as the number of vehicle ownership increase worldwide (Olamijulo and Ana, 2013).

This study therefore examine the feasibility of implementing virtual workplace in Nigerian universities using the University of Benin as a case study. The study seek to develop a virtual workplace implementation framework, examine the benefits, risks, barriers, and also quantify the environmental impact of the implementation of virtual workplace at University of Benin, Benin City, and the expected savings in fuel from eligible virtual workers.

2. STATEMENT OF PROBLEM

This research is initiated due to the nonexistence of implementation framework for organizations that intend embracing virtual work process in Nigeria. Also, no study has been initiated till date in Nigeria to ascertain the impacts of the implementation of virtual work in the country as regard expected reductions in vehicular emissions and fuel savings. Since most of the studies reviewed focus on other countries with different environment. Therefore, the result and findings arrived from such studies cannot be used to describe the Nigeria situation.

3. OBJECTIVES

The aim of this research is to assess the environmental impact of virtual workplace implementation in Nigerian Universities and the objectives are:

- i. To develop a virtual workplace implementation framework.
- ii. Validation of framework.
- iii. To determine the impact of virtual workplace on air pollution.
- iv. To determine the effect of virtual workplace on fuel savings.



3.1 Relevance of the Study

With the gradual emergence of virtual work in Nigeria, it is important to develop an implementation framework that will help organizations to understand this work process and also help them to make informed decision regarding its adoption in the country. This framework will highlight the benefits, barriers, risks and challenges associated with this type of work arrangement. The research will also involve the assessment of the impact of virtual work on air pollution and fuel savings.

3.2 Related work on virtual workplace adoption/implementation

Bello & Asolu (2010) investigated the result of telecommuting and the effect on office space within the Lagos Island. The response from the questionnaire administered shows that respondents see teleworking as an alternative to daily office commuting. The study further reveals that employees related issues such as long commuting time and the soaring cost of office around the Lagos Island could force organizations to adopt teleworking. In a related study Ashaolu (2011) carried out a study that focus on employees whose workplaces are situated within the Lagos Island on their use of ICT and the desire to telework. The response from the questionnaire shows that respondents are willing to telework.

Vorster (2003) developed a theoretical framework for the implementation of virtual teams in South Africa. The framework was developed based on the review of past studies. The major drawback of this research is that it was purely descriptive and lack the usual rigor that other research based method such as case studies offers. In a related study, Fran 2016 developed a theoretic framework for the implementation of virtual workplace environment in South African banking sector. An empirical research approach involving the use of interviews and questionnaires was adopted in the research. The study fails to highlight how to practically implement the framework and also the research was based on a small sample population.

The Department of Broadband, Communications and the Digital Economy (DBCDE) Australia developed a telework kit in year 2013. The telework toolkit highlight the benefits, risks and also outline some set of implementation tools that will assist organizations in making informed decision as regard implementing telework program (DBCDE, 2013). In a related work, San Mateo County, California-office of sustainability developed a telework and flex-schedules toolkit. The telework toolkit provides information regarding the implementation of telework program. The toolkit describe three phases (planning phase, implementation phase and evaluation phase) that organizations can follow in establishing a successful telework pilot programs (San Mateo County, 2014). The State of Maryland developed an agency teleworking implementation manual that serves as an implementation guide for those charge with responsibility of implementing telework in their respective agency. The teleworking implementation manual identifies eleven steps that agencies should observed in setting up a teleworking program.

Yen and Mahmassani (1994) developed a framework to establish the relation between telecommuting and travel behaviour. The study provided a well-ordered examination of the telecommuting adoption process and also developed a mathematical model. The result obtained from the model gives a clear guideline as regards which factor and policies are likely to influence telecommuting adoption by employers and possibly participation by employees. Vora and Mahmassani (2002) developed an evaluation framework to support telecommuting and to ascertain the societal impacts of the telecommuting program. Three model types which include the ordinal probit, the dynamic probit and the generalized ordinal probit were used to model executives desire to support telecommuting and to determine factors which impact executive telecommuting adoption preferences.

Related work on vehicular emission in Nigerian cities

Several studies have been carried out in most major cities in Nigeria to ascertain the impact of vehicular emission on air quality within these cities. Ukpebor et al, (2009) did a research to assess the diurnal trend in CO concentration in some designated areas within Benin City. A total of five sampling location were selected which include Agbor pack, Ring road, New Benin, 2nd Junction and Sokponba road. The ambient CO concentration at the five sampling location were measured using a CO dosimeter on a half-hourly basis, four times weekly, and for a period of 16-week. The result of five sampling locations measured show a mean range of 14.8-28.3ppm. Which exceed 10.00ppm limit set by the Federal ministry of Environment, housing and Urban development. Sokponba road junction has the highest mean CO load of 28.3ppm. The high level of CO was attributed to emission from vehicular exhaust. Asin et al, (2016) measured the air quality in some selected road within Uyo metropolis in order to determine the impact of vehicular emission in the city. Four busy roads intersection were selected for the study and the level of CO, NO₂ and SO₂ were determined using a gas monitor. The average daily concentration measured were 24.40ppm (CO), 0.29ppm (NO₂) and 0.35ppm (SO₂) which exceed the limit set by the Federal Ministry of Environment.



Onaolapo et al, (2017) carried out a study to determine the effect of vehicular emission on ambient air quality in two selected area in Minna, Nigeria. Carbon monoxide (CO), sulphur dioxide (SO₂) and Nitrogen dioxide (NO₂) level were measured at the two selected areas using a gas measuring device. The result indicate that the levels of CO, SO₂ and NO₂ were in the range of 51.05±0.04ppm, 0.119±0.017ppm and 0.115±0.0299ppm respectively and these values were said to surpass the specified level by Federal Ministry of Environment.

4. METHODOLOGY

4.1 The Research Design

The research objectives will be achieved through the process in figure 1 and figure 2

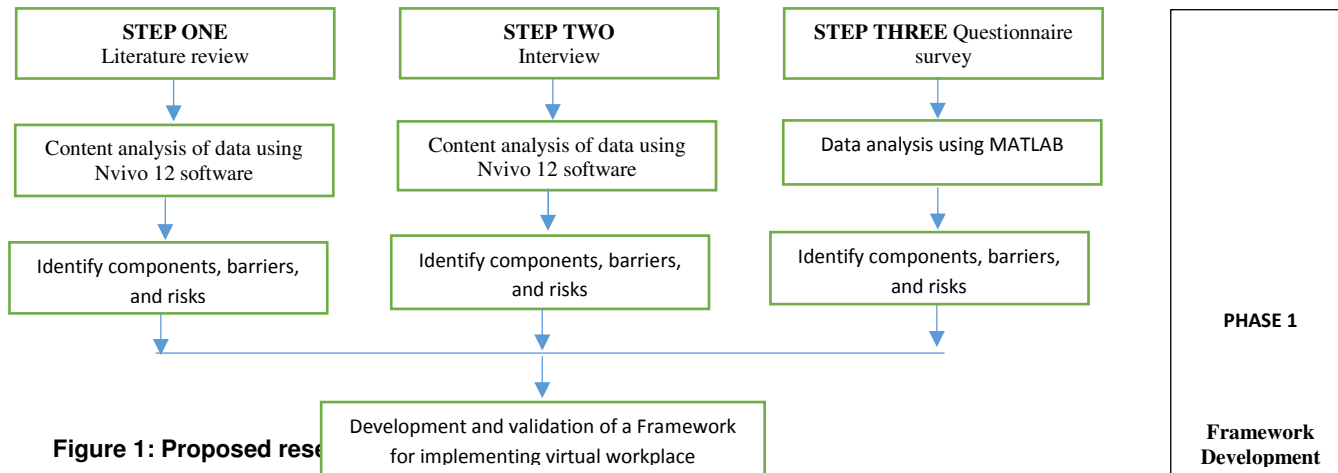


Figure 1: Proposed research methodology (Phase one)

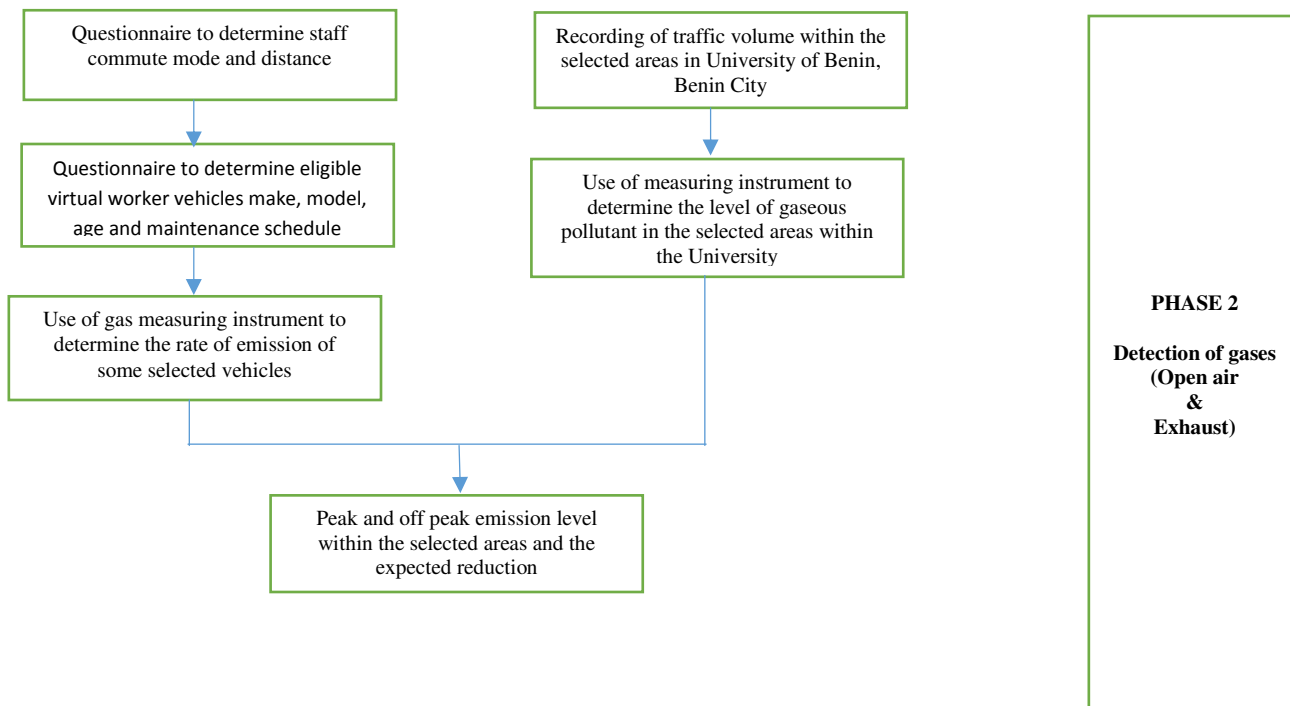


Figure 2: Proposed research methodology (Phase two)



4.2 Workflow of research process

Phase one: Framework development and validation

The development of the framework for the implementation of virtual workplace will be based on findings from comprehensive literature review, questionnaire survey and interview approach through which relevant data will be gathered and analysed. The framework will highlight the benefits, risks and certain critical barriers that can impair the implementation of virtual workplace if not properly addressed.

Steps that will be involved in phase one:

Step one: The first step of this research work will be the review of relevant literature and the subsequent content analysis of related documents. This will help in developing a comprehensive understanding of virtual workplace; identify the benefits, barriers, risks, challenges and other important factors. The data that will be gathered from the literature review will be analysed using the Nvivo 12 software and the findings will be merge with that of step two (interview) and step three (questionnaire survey) to develop the framework for implementing virtual workplace.

Step two: The aim of the interview is to obtain relevant information from workers currently working in virtual workplace regarding major factor, barriers, and risks associated with virtual workplace implementation. The data from the interview will be analysed using Nvivo 12 software.

Step three: The reason for initiating the questionnaire survey is to identify the factor, barriers and risk associated with the implementation of virtual workplace. The data analysis will be done using MATLAB. The findings from the content analysis of relevant literature and the survey (questionnaire and interview) will be merge to develop the proposed framework.

Framework Development

In order to develop the virtual workplace implementation framework for Nigerian Universities using the University of Benin as a case study, the organogram of the selected unit for the study will be thoroughly examined to determine the organizational structure, job description, work schedule and the likely changes that will take place in order to create a virtual workplace.

In assessing job that can be performed in virtual workplace arrangement, the following factors will be taken into consideration:

- Identify job that does not require direct supervision
- Identify the type of equipment required

Validation of proposed framework

The framework will be validated using the questionnaire based approach of expert opinion in virtual workplace. The validation will cover all aspects of the framework functionalities. The expert will examine critically the structure and content of the proposed framework. The feasibility of the framework will also be thoroughly examined during the validation process.

Phase two: Determination of the environmental impact of implementation of the proposed framework via the investigation of gases from vehicle exhaust and open air

In order to determine the environmental impact of the implementation of virtual workplace in Nigeria Universities using the University of Benin as case study, a questionnaire will be developed to determine the staff commute mode (such as personal car, public transport/commercial bus, motor bike, and walk) and distance, for those set of staff that are eligible for virtual workplace, and have their personal vehicles and do drive to work on a daily basis. The vehicles make, age, model, engine type, maintenance schedule and estimate of daily fuel usage will also be inquired. Other information that will be obtained include time it takes for eligible staff to leave home and arrive work. Vehicles will be randomly selected with the consent of the owner, a gas measuring device will be used to measure the level of sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and carbon monoxide (CO) gases emanating from exhaust of the vehicles of the eligible virtual workers in order to determine their contribution of these gaseous pollutant in the atmosphere within the University and the expected reduction via the introduction of virtual workplace in the University.

The second step will involve the open air sampling of gases at two selected point usually known for high vehicular traffic within the University of Benin in order to determine the concentration of vehicular emission within these two area (main gate and UBTH gate). Traffic volume within these selected areas will be determined and a gas measuring instrument will be used to measure the level of air pollutants within these selected area. While the level of sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and carbon monoxide (CO) will be measured during peak and off peak period using a gas measuring instrument. The gaseous emission measured will be compared with the WHO and FEPA limit for ambient conditions.



The result obtained in this phase will be used to model the amount of vehicular emission within the University of Benin, its impact in air quality and how much reduction can be achieved through the implementation of virtual work programme for eligible staff.

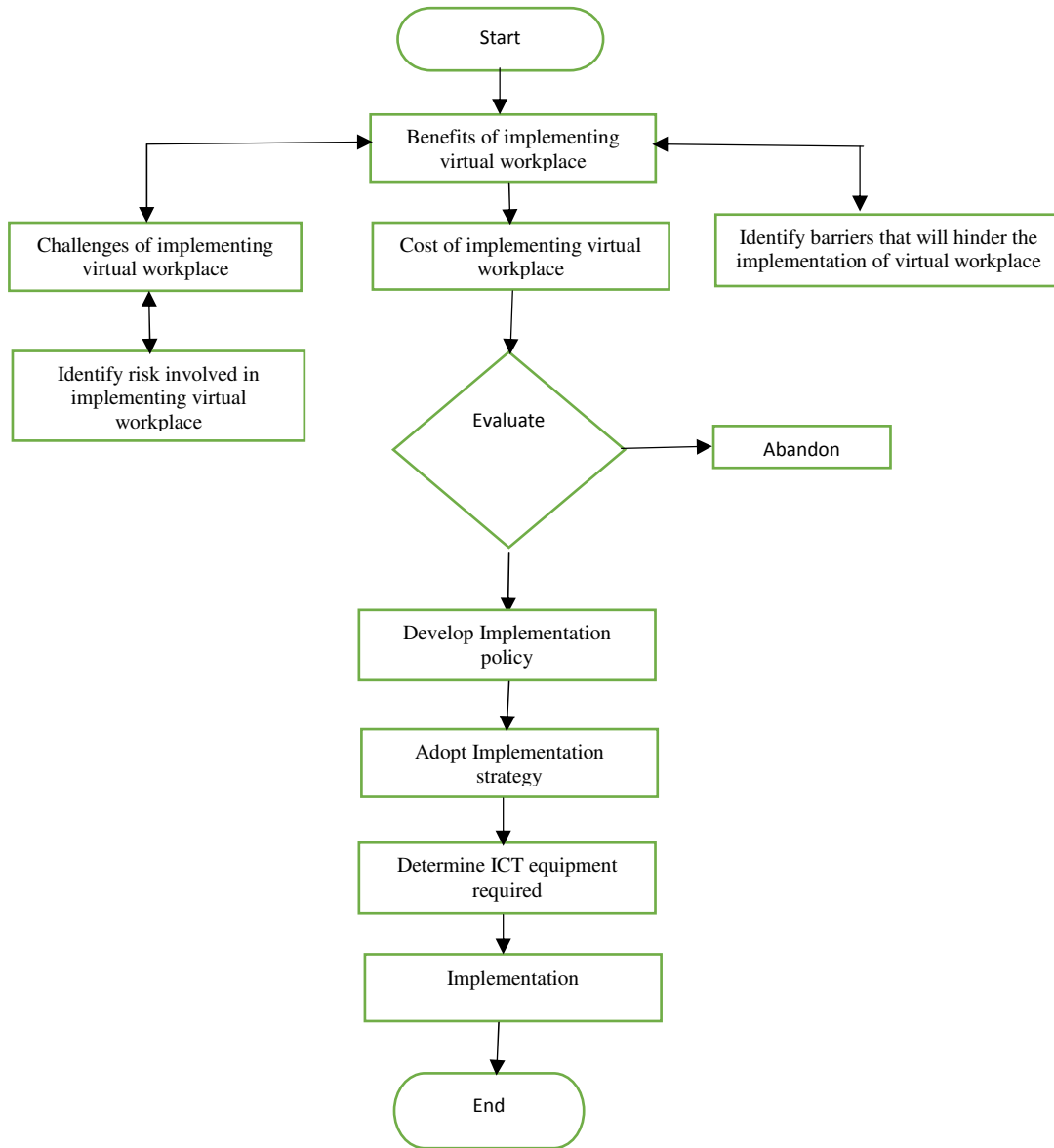


Figure 3: Flowchart for proposed virtual workplace implementation



5. DATA PRESENTATION AND EXPECTED RESULTS

The review of past literature has been concluded. While the interview and questionnaire survey is currently ongoing. It is expected that at the end of the current research, the implementation framework will be fully developed, and the environmental impact of the implementation of the proposed framework on vehicular emission and also the expected savings in fuel will be evaluated. The result for expected fuel savings will be housed in table 1.

Table 1: Result format for expected fuel savings and commute time from eligible virtual worker

Unit	Total numbers of eligible virtual worker	Eligible staff commute time to and fro work	Total daily fuel usage	Expected fuel savings if eligible virtual workers are allowed to work away from office in the following days:				
				1 day	2 days	3 days	4 days	5 days
Unit 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unit 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.....								
Unit N

In order to determine the daily fuel savings assuming that eligible staff are allowed to work from home. The total daily fuel usage of the eligible staff in each of the selected unit will be summed up together.

Table 2: Format for vehicle make, engine type and maintenance schedule result

Vehicle Make	Spark Ignition Gasoline Engine Type											Diesel Engine Type				
	Vehicle maintenance schedule			Two stroke engine					Four stroke engine type				Diesel Engine Type			
				Start emission	Running emission			Running emission	Start emission							
	Vehicle age	Replace spark plugs (How often?)	oil filter change (How often?)	Hot Start	Carbon monoxide	Sulphur dioxide	Nitrogen dioxide	Hot Start	Carbon monoxide	Sulphur dioxide	Nitrogen dioxide	Hot Start	Carbon monoxide	Sulphur dioxide	Nitrogen dioxide	
Vehicle Make 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vehicle Make 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vehicle Make 3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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Vehicle Make N

Emissions from motor vehicles are determined by the vehicle make, engine type and maintenance schedule (Asif et al, 1996). The vehicle make, engine type and maintenance schedule for eligible staff that have vehicle and do drive to work on a daily basis will be captured in Table 2. The two most common engine type are spark-ignition engine and diesel engine. The spark-ignition engine will further be classified into two stroke, and four stroke engine design. The hot start emission and the running emission of each of these engine type will be measured using a gas measuring device that will be attached to the exhaust of the vehicles. The vehicle maintenance schedule in terms of how often the eligible staff replace their vehicle spark plug and oil will also be captured in table 2. The result in table 2 and that of the open air gas sampling at the two selected point within the University of Benin will be used to determine the environmental impact of the implementation of the proposed framework on vehicular emission.



6. DISCUSSION OF FINDINGS

At the end of the current research, it is expected that a structural and mathematical model of the virtual workplace will be developed. Data on vehicular emission will be obtained and the expected reduction in emission via the implementation of virtual workplace will be determined. Also the staff commute mode, distance and expected saving in commute time will be determined assuming employees are allowed to work in a virtual workplace. The research will also come up with findings on impact of virtual workplace implementation on current work process and organizational structure.

7. CONCLUDING REMARKS

This proposed research work is aimed at developing a framework for the implementation of virtual workplace in Nigerian Universities using the University of Benin as a case study. The environmental impact of the implementation of the proposed framework as regard reduction in vehicular emission within the University of Benin will also be determined. The expected fuel savings will also be determined assuming that eligible virtual workers are allowed to work 1, 2, 3, 4, 5 days per week from home. The framework will help organizations that intend adopting virtual workplace arrangement to make informed decision as regards its implementation. This research will also help to quantify the environmental impact of virtual workplace on vehicular emission.

8. CONTRIBUTIONS TO KNOWLEDGE

At the end of this study, this research work is expected to contribute the following to knowledge:

- i. This research work would help to develop a framework that will assist organizations in implementation of virtual workplace in Nigeria.
- ii. Will provide an estimate of environmental impact of virtual work environment implementation as it relate reduction in vehicular emission.
- iii. Will provide data in terms of savings in fuel.

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