Perception of Building Occupants on the use of Generating Sets

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Abstract

Poor power supply is a major bottleneck to the technological development of the country and this has forced building occupants to shift to dependence on generating sets of different types and brand which subject its users to myriad of effects. This study was aimed at assessing perception of the users of generators in buildings on the effects associated with its usage in Ibadan Metropolis, Nigeria. The study area was divided into core, transition and suburban residential zones. Multistage and quota sampling techniques were used to select respondents sampled in residential and commercial buildings respectively. Descriptive and inferential statistical techniques were used to analyse data collected. The study showed that 50.29%, 51.19%, 45.90% of residential buildings' respondents in the core, transition and suburban zone while 56.41%, 43.33% and 42.86% of occupants of commercial buildings in the corresponding core, transition and suburban zone indicated that hearing problem was the most physiological effect that the use of generating sets exposed them to. Cut injuries from the elcetro-mechanical components of generating sets were the most prominent injuries had by the occupants of residential buildings while irritation of the eyes during refueling was the most significant effect had by respondents in the commercial buildings. High cost of fuel and damage to electrical appliances were the most uncomfortable indicator with uncomfortability index of 0.804 and 0.776 in residential and commercial buildings respectively. The study also found that the use of generating sets had caused structional, functional and aesthetical effects on the building elements. It was recommended that there is dire need on the part of government to enhance environmental sustainability by provision of sustainable energy sources to buildings in view of the effects associated with the use of generating sets.

Keywords: Electricity, Power Crisis, Building, Occupants, Impact

Introduction

The shocks from the energy crisis in Nigeria have created some wedges in the national wheel of the effective management of industrial and other socio-economic programmes. Over 167 million people of Nigeria are depending on less than 3,000 to 5,000 MW of electricity with the recurrent multiple and unpredictable power outages. Most towns and cities in Nigeria are connected to the national power grid. However, supply from the national grid has become a major problem for about a decade and people have to seek for alternative sources of power supply (Sambo *et al*., 2009). In view of this, there is a paradigm shift of building occupants to dependence on off-grid power supplies which involves the use of generators of different types and capacities. This development has made the country to be running "generator economy" (Ahmad and Abubakar, 2012).

Nigeria has the highest concentrations of generators globally despite its rich energy source and more than 60 million people own generators to provide electricity for homes and businesses (British Broadcasting Corporation Africa, 2013). The impacts of the various types of generators used by occupants of buildings are enormous on environmental quality and people's health. This has elicited major concerns among environmentalists and other players in the built environment (Obadote, 2009). The use of generators is very common in most parts of Nigeria, and most small scale businesses that would have been essentially noiseless produce heavy noise pollution from generators (Akande and Ologe, 2001). This has resulted in the exposure of building users to a number of hazards associated with the use of generators in buildings. Common hazards are air, soil, noise and water pollution. These hazards not only affect users of the generators, but also affect people living in the neighborhood. The main health risks, as identified by the World Health Organization (2004) include pain and hearing fatigue, hearing impairment including tinnitus, annoyance, interference with social behaviour (aggressiveness, protest and helplessness), sleep disturbance, cardiovascular effects and hormonal responses.

The use of various types of engineering services in buildings like generating sets, air conditioners and refrigerators pose serious threat to the sustainability of both the indoor and outdoor environment. This is based on varying pollution potentials like air, noise impacts associated with their usage with a view to providing comfort in buildings (Wahab *et al*. 2011). The use of generators causes serious health problems to individuals and the society. The accompanied air pollution causes serious health problems depending on the concentration of exposure to the fumes emitted by the generators. Some of these health problems include toxic poisoning, birth defects, eye irritation, cancer and irritation of the respiratory systems. Other health implication of using generator is the noise pollution which is said to

have resulted in hearing losses for some Nigerians (Ahmad and Abubakar, 2012).

The South-Western part of Nigeria is unarguably one of the most urbanized parts of the country (Mabogunje, 1968; Onibokun, 1989; Aniah, 2001 and Jiboye 2011). A good number of occupants of residential and commercial buildings depend on generating sets in their daily itinerary by taking cognizance of the prevailing challenges posed by the epileptic power supply from the national grid. Past studies on generators used in buildings in Nigeria and especially in the study area; such as Ana *et al*., (2014); Stanley *et al*., (2011); Komolafe (2011); Sonibare *et al*., (2014) did not focus on the likely effects that are associated with the use of generators on the building occupants; hence the need for this study. Thus, the specific objective of the study was to assess the likely perception of occupants of residential and commercial buildings in Ibadan Metropolis, Nigeria on the use of generators.

Research Methodology

The study was carried out in Ibadan Metropolis, Oyo State, Nigeria and it focussed on the users of generators in the residential and commercial buildings of the study area. Ibadan is the capital of Oyo State in the southwestern part of Nigeria (Ayeni, 1994). The study area was divided into core, transition and suburban residential zones. The study population was made up of the residential and commercial buildings that existed in the three residential zones in each of the five local governments that made up Ibadan Metropolis. A multi-stage sampling technique was used to select 736 residential buildings across the zones of the study area while quota sampling was used to select 150 commercial buildings in the study area. In each of the classes of buildings sampled, one occupant was selected for the administration of questionnaires on issues that involved perception of the users of generators on the effects associated with its usage. Descriptive and inferential statistical techniques such as frequency distribution, chi-square, logistic regression analysis and relative importance index were used.

Findings and Discussions

Table 1 showed that out of the 886 questionnaires administered on the users of generators in the residential and commercial buildings sampled, 537 questionnaires were returned and found useful. This indicates a return rate of 60.61%. According to Babies (2005), a response rate of 40% was adjudged adequate for studies in built environment related researches, and this implies, that the 60.61% return rate should be adequate to substantiate findings of the study.

Table 1: Response Rate of the Questionnaires Administered

Respondents/ Users of Generator	Number Administered by Building Type	Number Collected by Building Type	Percentage Collected by Building Type (%)	Percentage Collected in All Buildings Sampled (%)
Residential Building	736	443	60.19	60.61
Commercial Building	150	94	62.67	
Total	886	537		

Identification and Assessment of the Impact of Generating Sets on the Environment and Users

The identification and assessment of the impact associated with the use of generating sets by respondents in the sampled buildings is presented in this section. It also involves perception of impact of generating sets by its users in both residential and commercial buildings on its negative effects as alternative means of power supply (physiological/medical and psychological), building elements and on the degree of their comfortability or uncomfortability with its use.

Impact of the Use of Generating Sets on the Respondents

The study found that a very large proportion of respondents in both residential and commercial buildings indicated that the use of generating sets had both psychological and physiological (medical) effects on them. About 50.29%, 51.19% and 45.90% of respondents in residential buildings in the core, transition and suburban zone respectively indicated that hearing problem was ranked as the most significant physiological (medical) effect that the use of generating sets had exposed them to. The results revealed that sleeplessness with response rate of 30.64%, 33.33% and 36.07% in core, transition and suburban zone respectively was ranked as the second disorder that its use had caused. Visibility problem was identified as the least significant medical effect that the use of generating sets had caused on respondents in the residential buildings (Table 2). The study found that hearing problem was also the most significant physiological effect that dependence on generating sets caused on respondents in the commercial buildings. Table 2 revealed that 56.41%, 43.33% and 42.86% of respondents in the core, transition and suburban zone respectively were most affected by hearing problem. Closer positioning of generating sets informed why choking effect was found as the second most rated disorder had by the occupants; 28.20%, 30.00% and 38.09% during the use of their generating sets in core, transition and suburban zone respectively (Table 2). In furtherance of the results gotten, the Pearson Chi-square test carried out

showed that there was significant relationship in the physiological effects of the generating sets across the zones of the study area (χ^2 = 40.827, p < 0.001). This was related to the response rate across the zones that significantly rated hearing problem as the most ranked medical effect that generating sets caused to the respondents.

Table 2: Effects of the Use of Generating Sets on the Physiological Conditions of Respondents

Residential Buildings									
Physiological/ Medical Effect	Core Zone			Transition Zone			Suburban Zone		
	F	(%)	Rank	F	(%)	Rank	F	(%)	Rank
Dizziness	5	2.89	4	1	1.19	4	2	3.28	4
Sleeplessness	53	30.64	2	28	33.33	2	22	36.07	2
Choking Sensation	25	14.45	3	11	13.10	3	7	11.47	3
Hearing problem	87	50.29	1	43	51.19	1	28	45.90	1
Visibility problem	3	1.73	5	1	1.19	4	2	3.28	4
Commercial Buildings									
Dizziness	2	5.13	4	2	6.67	4	1	4.76	4
Sleeplessness	4	10.26	3	5	16.67	3	3	14.29	3
Choking Sensation	11	28.20	2	9	30.00	2	8	38.09	2
Hearing problem	22	56.41	1	13	43.33	1	9	42.86	1
Visibility problem	0	0.00	5	1	3.33	5	0	0.00	5

The study also assessed responses of the occupants in the buildings sampled on the probable injuries that they could have had while pouring fuel into the tank component of their generating sets as specified in the best house-keeping practices on the use of funnel or otherwise. It was found that in the residential buildings, inhalation of fuel that led to dizziness and loss of composure in the core zone was ranked as the most severe injury had during fueling of their generators with 44.44% response rate, while cut injuries from the electro-mechanical components was most severe in transition and suburban zone respectively with 55.77% and 39.02% response rate. Equally, the study found that the next ranked injury that the occupants had during the use of their generators was irritation/redness of the eyes in core, transition and suburban zone with 42.86%, 32.69% and 34.15% response rate respectively. Cases of fire outbreak during refueling of generators occurred only in the core zone with response rate of 7.94% as shown in Table 3.

Thus, it was found that there existed a very strong relationship between the type and level of house-keeping practices adopted by the occupants of buildings and the severity of injuries suffered during the use of generating sets. The Chi-square test carried out thus indicated that there was significant relationship in the severity of injuries sustained by the respondents occupants across zones of the study area during the use of generating sets ($\chi^2 = 123.379$, $p < 0.001$).

Table 3: Severity of Injuries Sustained During Fuelling of Generating Sets by the Respondents

Residential Buildings									
Type of Injuries	Core Zone			Transition Zone			Suburban Zone		
	F	(%)	Rank	F	(%)	Rank	F	(%)	Rank
Cut injuries from its electro-mechanical components	5	3.97	4	29	55.77	1	16	39.02	1
Burn injuries during fuelling of generator	1	0.79	5	0	0.00	4	7	17.07	3
Inhalation of fuel leading to dizziness and loss of composure	56	44.44	1	6	11.54	3	4	9.76	4
Fire outbreak during refuelling of generator	10	7.94	3	0	0.00	4	0	0.00	5
Irritation/redness of the eyes during refuelling	54	42.86	2	17	32.69	2	14	34.15	2
Commercial Buildings									
Cut injuries from its electro-mechanical components	9	40.91	2	7	33.33	2	6	35.29	1
Burn injuries during fuelling of generator	0	0.00	4	0	0.00	5	5	29.41	2
Inhalation of fuel leading to dizziness and loss of composure	2	9.09	3	2	9.53	3	2	11.77	4
Fire outbreak during refuelling of generator	0	0.00	4	1	4.76	4	0	0.00	5
Irritation/redness of the eyes during refuelling	11	50.00	1	11	52.38	1	4	23.53	3

The study found that irritation of the eyes was the most significant medical effect had by the occupants of commercial buildings in core and transition zones with response rate of 50.00% and 52.38% respectively as shown in Table 3. However, in the suburban zone, it was found that cut injuries from the electro-mechanical components of the generators was ranked most with a response rate of 35.29%. In furtherance of the results obtained in the sampled buildings, the Chi-square test carried out showed that there was significant relationship between the residential zones and the injuries had by the building occupants ($\chi^2 = 114.497$, $p < 0.001$).

Further to the assessment of the perception of the users of generating sets in the buildings sampled, logistic regression indicated significance of the respective probability of physiological effects and severity of injuries had during its use. Table 4 showed that there was 0.4941 (49.41%) probability of the physiological effects and 0.5059 (50.59%) probability of the severity of injuries had by the users of generating sets. Also, based on the logistic regression analysis, the binary logistic model of the perception of respondents depicted the interrelationship that occurred in the severity of injuries had by the respondents.

Table 4: Logistic Regression Analysis of Effects of Generators on the Users

Variables in the Equation							
	B	S.E.	Wald	Df	P	Exp. (B)	Probability
(Likely physiological effects)	-0.023	0.011	4.28	1	0.039	0.977	0.494183
(Likely injuries)	0.024	0.009	7.551	1	0.006	1.024	0.505929
Constant	-1.325	0.255	26.945	1	0	0.266	

Impact of the Use of Generating Sets on the Building Elements

Findings of the study revealed that 39.46%, 35.36% and 36.11% of respondents indicated that dirtiness of floor which constituted maintenance challenge was the most significant effect that generating sets had on building elements in core, transition and suburban zone respectively (Table 5). This was closely followed by discolouration of paint on the building wall with responses of 34.59%, 27.27% and 27.78% in core, transition and suburban zones while vibration effect was rated as the least significant impact that its usage could cause on building elements. In the same vein, the study also showed that in the commercial buildings, discolouration of paint on the walls of buildings was the most significant impact of generators usage with response rate of 34.48%, 45.16% and 42.31% respectively in the core, transition and suburban zones. The trend of results obtained was

substantiated by the Chi-square carried out which showed that there was a significant relationship between the impacts of the building elements in different zones of the study area ($\chi^2 = 118.683$, $p < 0.001$). The results of the study are partly in agreement with Ahmad and Abubakar (2012); BBC Africa (2013); Sellappan (2013); Egunjobi (1988); Adigun *et al.* (2013) that different human activities caused hazards to the environment and its users due to exposures to substances both outdoor and indoor.

Table 5: Impact of the Use of Generating Sets on Buildings' Elements

Residential Buildings									
Impact on Building Elements	Core Zone			Transition Zone			Suburban Zone		
	F	(%)	Rank	F	(%)	Rank	F	(%)	Rank
Occurrence of crack on the building wall	13	7.03	4	19	19.19	3	16	14.81	4
Occurrence of crack on the building floor	25	13.51	3	16	16.16	4	18	16.67	3
Vibration effect on the building wall	10	5.41	5	2	2.02	5	5	4.63	5
Discolouration of paint on the wall	64	34.59	2	27	27.27	2	30	27.78	2
Dirtiness of the floor by the residue of the fuel	73	39.46	1	35	35.36	1	39	36.11	1
Commercial Buildings									
Occurrence of crack on the building wall	5	17.24	3	6	19.35	3	3	11.54	3
Occurrence of crack on the building floor	3	10.34	4	2	6.45	4	2	7.69	4
Vibration effect on the building wall	2	6.90	5	1	3.23	5	2	7.69	4
Discolouration of paint on the wall	10	34.48	1	14	45.16	1	11	42.31	1
Dirtiness of the floor by the residue of the fuel	9	31.04	2	8	25.81	2	8	30.77	2

Relative UnComfortability Index of the Use of Generators by the Occupants

The assessment of uncomfortability, impact of the use of generating sets by occupants of both residential and commercial buildings as alternative source of power supply is shown in Table 6. The relative uncomfortability indexes (RCI) of the variables associated with the use of generating sets were analysed. The cost of fuel, economic impact, with relative uncomfortability index (RCI = 0.804) was ranked as the most significant uncomfortable

indicator amongst occupants of residential buildings. The other indicators in order of their uncomfortability index were fluctuation of voltage (RCI = 0.784) and damage to domestic/electric appliances (RCI = 0.774) while the propensity of causing social friction with neighbours was ranked least with RCI = 0.69. The result of the perception of commercial buildings' occupants on their uncomfortability with the use of generating sets is shown in Table 6. The occurrence of damage to their electrical appliances (RCI = 0.776) was the most significant uncomfortable indicator. Similarly, this has major synergy with the ranking of fluctuation of voltage as the next uncomfortable indicator (RCI = 0.758) while the cost of fuelling of the generators (RCI = 0.754) was ranked third. However, pollution potential to soil, water and air was ranked least (RCI = 0.682). This is in agreement with NOI Polls (2015) which states that "dependence on generators in buildings caused damage to basic electrical appliances used indoor and would affect comfort drive of the occupants in view of their state of malfunctioning".

Table 6: Relative UnComfortability Index (RCI) of the Use of Generating Sets

Non-Satisfaction Indicator	RSI		Rank	
	Residential Users	Commercial Users	Residential Users	Commercial Users
Cost of fuel/fuelling	0.804	0.754	1	3
Fluctuation of voltage	0.784	0.758	2	2
Damage to electrical appliances	0.774	0.776	3	1
Potentiality of causing fire-outbreak	0.730	0.752	5	4
Cause of social friction with neighbours	0.690	0.694	7	5
Potentiality of causing health disorders	0.722	0.690	6	6
Pollution potential to soil, water and air	0.750	0.682	4	7

Conclusion and Recommendations

Results obtained from the study on the use of generating sets showed that it had physiological and psychological effects on the occupants of both residential and commercial buildings. The physiological impact of its use were found to cause disorders in the well-being of the users of the generators due to their exposures to the noise and emissions that affected air quality both indoor and outdoor. In all the zones, it was found that hearing problem was ranked as the most significant physiological (medical) effect that the use of generating sets had caused on occupants of residential buildings with response rate of 50.29%, 51.19% and 45.90% in core, transition and suburban zone respectively. Sleeplessness, a major psychological problem was also experienced as the trauma that the users of generating suffered during its use together with chocking sensation that were rated as the next

significant effects that its use had caused. An almost similar outlook of medical effects was felt by the users of generators in the commercial buildings. Hearing problem with response rate of 56.41%, 43.33% and 42.86% was also ranked most in the core, transition and suburban zone respectively. Equally, choking sensation and sleeplessness were ranked as the second and third effects that its use had caused.

The use of generators had caused varying types of injuries amongst the occupants of residential and commercial buildings in the study area. Cut-injuries were found to be the most prevalent amongst residential buildings occupants in the transition and suburban zone with response rate of 55.77% and 39.02% while inhalation of that led to dizziness was most prominent in the core zone with a response rate of 44.44%. However, in the commercial buildings, irritation of the eyes was most prevalent with response rate of 50.00% and 52.37% in the core and transition zone respectively. Generating sets had structural, functional and aesthetical effects on the building elements through the vibration-induced process and stains that it caused. In residential and commercial buildings, dirtiness of the floor and discolouration of the paint on the wall of their building element respectively were the most significant effects with response rate of 39.46% and 34.48% in their core zone respectively. Also, the study showed that high cost of fuel and damage to electrical appliances respectively were the most uncomfortable indicator of its use by respondents in residential and commercial buildings with relative uncomfortability index of 0.804 and 0.776 respectively. The study recommended that due to the various likely effects that the proliferation and use of generating sets might subject its users to; there is dire need on the part of government to enhance environmental sustainability by provision of sustainable energy sources to the buildings.

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