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ASSESSMENT OF THE AWARENESS OF THE CONTRIBUTIONS OF GHANA ATOMIC ENERGY COMMISSION TO THE INDUSTRIAL SECTOR OF GHANA: A CASE STUDY OF SELECTED MEDIA GROUPS IN THE GREATER ACCRA REGION

CALEB OWULAH

Ghana Atomic Energy Commission, Ghana

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Abstract: **Nuclear applications have been used to improve health delivery, agriculture, construction, and oil and gas industries in Ghana. Non-destructive testing (NDT) has been specifically used by the Ghana Atomic Energy Commission (GAEC) to test the integrity of welded structures and buildings. The majority of the GAEC's contributions are evidenced in scientific publications. The GAEC contributed 56.6% of research publications in the International Nuclear Information System (INIS) database although many of these research outputs are not known in Ghana. This study provides a basis to appreciate the role and level of awareness of nuclear technologies used in the Ghanaian industrial sector. A cross-sectional survey was conducted among thirty-two media practitioners in the Greater Accra Region to estimate the level of awareness of the GAEC's activities between 2006 and 2016. Findings showed a low awareness level of the GAEC's contributions to the industrial sector in Ghana. The study further revealed that most research and commercial activities during the 10 years studied were unpopular because of low media presence. Respondents who came across some achievements of the GAEC happened to be among the team of media that visited the GAEC during its 50th-anniversary celebration. The study showed prospects of nuclear technologies that could be pursued for the industrial sector.**

Keywords**: awareness, contribution, Ghana Atomic Energy Commission, industrial sector, media, research institute, nuclear technologies.**

1. INTRODUCTION

1.1 Background to the Study

Public Institutions contribute to the development of specific sectors of an economy. This becomes evident when the major contributions are recognized, and projections can be made to show how these institutions participate in national development. Ghana, a country striving to achieve a middle-income status needs to know how research outputs from Scientific Institutions support the industrial sector in contributing to the economy's growth.

In many industrialized and emerging countries, specific scientific technologies including nuclear have been depended upon immensely in developing various economic sectors. The International Atomic Energy Agency (IAEA) estimated that millions of people derive benefits from nuclear technologies daily (International Atomic Energy Agency, 2012) [19]. The Director-General of the IAEA, Yukiya Amano reiterated this statement in the Nuclear Technology for a Sustainable Future

document hosted on the United Nations (UN) Sustainable Development Goals Knowledge Platform by pointing out the contributions of the IAEA concerning the Sustainable Development Goals. The IAEA supports many member countries to make significant economic strides by utilizing nuclear applications in improving agriculture, industry, health, and environment, (International Atomic Energy Agency, 2012) [19]. It has been mentioned in annual reports of the Ghana Atomic Energy Commission (GAEC) [12]; [14]; [15] that nuclear applications have been used in the mining, construction, and oil and gas industries to boost productivity (Ghana Atomic Energy Commission, 2015) [13]. Indeed, nuclear applications have been in use across the length and breadth of Ghana to research and improve sustainable water delivery, agriculture, and health delivery for some years now (Ghana Atomic Energy Commission, 2013) [12].

Ghana - The Nuclear Agenda, (2013) [12] and the 2015 annual report of the National Nuclear Research Institute (NNRI) [30] highlighted how non-destructive testing (NDT) has been used to test the quality of welds in structures and buildings (e.g. during the construction of the Bui dam). NDT has also been used to support radiographic work in the petroleum industry. According to the NNRI, using nuclear techniques in the mines and the petroleum industries has over the years enhanced productivity in Ghana. (National Nuclear Research Institute, 2015) [30]. The GAEC is collaborating with the Ministry of Energy and other stakeholders, exploring the introduction of nuclear power into the country's energy mix (Ghana Atomic Energy Commission, 2016) [14]; Ghana Atomic Energy Commission (2013) .; & (International Atomic Energy Agency, 2016) [20]. These and other impacts of the GAEC over the years may be unknown or underestimated, creating a gap between the commercialization of research findings and effective promotions to the public.

1.2 Objectives of the Study

The main objective of this study is to evaluate the impacts of the GAEC's activities on the industrial sector of the economy of Ghana. The specific objectives are:

i. To explore the level of awareness of the GAEC's contribution within the industrial sector between 2006 and 2016 among media practitioners.

ii. To identify major nuclear applications deployed by the GAEC within the period under study.

iii. To find out the challenges and prospects of nuclear applications in the industrial sector.

iv. To identify factors that would help promote public knowledge of the GAEC's activities.

1.3 Research Questions

In addressing the gap of inadequate knowledge to the public on what the GAEC does, the fundamental question is: what is the impact of the GAEC activities on the industrial sector of the Ghanaian economy? The following sub-questions are put forward:

i. What is the awareness level within the media on the GAEC's contribution towards the industrial sector of Ghana over the last decade?

ii. What are some of the key nuclear applications that have been used by GAEC to resolve problems in the industrial sectors?

iii. What are the challenges and prospects of nuclear applications in the industrial sector?

iv. What factors would help promote public knowledge of the GAEC's activities?

1.4 Significance of the Study

This study is the first to relate the awareness of the impact of nuclear applications and research findings within a period concerning in the industrial sector of the Ghanaian economy. The significance of this study is to explore opinions from the public to objectively present what the GAEC is noted for. The outcome will augment the scarce empirical literature on the impact the GAEC has made towards the industrial sector during the past years and serve to publicize the mandate and activities of an institution established over fifty years ago. The outcome of this study will also bring the level of awareness of the impacts of nuclear technologies on Ghana's industrial sector.

1.5 Scope and Limitations of the Study

This study sought to determine the awareness level of the GAEC's activities concerning available nuclear applications in use to support the industrial sector of the Ghanaian economy. The assessment targeted the views of media practitioners from selected radio stations in the Greater Accra region of Ghana. The study did not cover the contributions of the GAEC to the Health and Agriculture sectors.

2. LITERATURE REVIEW

2.1 Establishment and Functions Atomic Energy Commission

The Ghana Atomic Energy Commission (GAEC) is one of the country's public institutions responsible for research and development under the Ministry of Science, Technology, and Innovation (MESTI). The GAEC is the only institution established to oversee the peaceful use of atomic energy for research and socio-economic advancement. The functions of the GAEC as established by Act 204 in 1963 are summarized into the promotion and application of nuclear and related technologies for the socio-economic developments of Ghana (Ghana Atomic Energy Commission, 2012) [11]. The foundation stone for the Atomic Complex was laid on 25th December 1964 (Ghana Atomic Energy Commission, 2003) [10].

In 2000, Act 588 was promulgated enjoining the GAEC to conduct and promote research and development through the commercialization of its outputs for the peaceful deployment of nuclear applications to improve agricultural productivity, ensuring food security, environmental protection, and industrial development among others (Ghana Pubishing Corporation, 2000) [16]; (Parliament of Ghana) [34]; Ghana - The Nuclear Agenda, (2013). To this end, the GAEC successfully apply some nuclear, biotechnology, and other related technologies in promoting its activities in several sectors of the Ghanaian economy. This was reported in Ghana - The Nuclear Agenda, (2013). The CSP of Ghana Atomic Energy Commission (2012) also mentioned specific projects promoted by the GAEC with the support of the IAEA. These include specialized laboratories and nuclear installations such as a research reactor, a pelletron accelerator, a gamma irradiation facility, and the two Radiotherapy Centres established the at the Korle-Bu Teaching Hospital and the Komfo Anokye Teaching Hospital.

2.2 Awareness Defined

The Oxford Dictionary defines awareness as "knowledge or perception about a fact". Awareness also means "knowing something or knowing that something exists" (Oxford, n.d.) [33]. Awareness expresses concerns about a well-informed interest in a particular situation or development.

Public awareness could be explained as the activities undertaken to ensure that knowledge or perception about facts and situations are well disseminated to inform a set of beneficiaries or members of society to enable them to appreciate the facts or situation. The perception is usually around the activities expected or being carried out by members of a society. According to Mcquerry (2018), good publicity is required to promote and organize awareness campaigns (McQuerrey, 2018) [28]. To create awareness in many institutions, programmes are usually well-designed with the aid of result-oriented communication techniques and strategies.

2.3 The Industrial Sector of Ghana

The industrial sector of Ghana as classified by the Ghana Statistical Service includes mining and quarrying, oil and gas, manufacturing, water and sewage, electricity, and the construction industry. The 2016 report on the Annual Gross Domestic Product published by the Ghana Statistical Service (GSS), showed that the industrial sector was the least growing sector (24.3%) with a decline in growth rate of -0.5% compared to -0.3% in 2015. Construction remained the largest activity performer within the industrial sector with a share of 13.7 percent (Ghana Statistical Service, 2017) [17].

2.4 Why the Assessment of a Public Research Institution?

Managing public institutions nowadays cannot be distinguished from what pertains within the private institutions; considering the strategies being used to make them become recognized. Research and development (R&D) outputs have contributed immensely to the foundation of advanced and developing countries. In many of these countries, the government spends on certain public institutions in anticipation of developing some critical sectors that will culminate into economic expansion and growth. (Martin, 1996) [27], in his study "The Use of Multiple Indicators in the Assessment of Basic Research" examined the need to assess government-funded basic research and came out with four main reasons:

(i) The increasing cost of infrastructure, equipment, and other facilities required to conduct scientific research. This is envisaged as scientific research institutions require some level of infrastructural development such as specialized laboratory space and specific equipment.

(ii) Countries that are into industrialization have witnessed limitations on the government's expenditure for research and development activities. Funding research and acquisition of major equipment is a challenge that may compel some governments to cut spending on such areas. In Ghana, successive governments within the Fourth Republic tried introducing this idea, perhaps led to the promulgation of the Ghana Atomic Energy Act, 2000 which mandates the GAEC to commercialize some of its research findings (Ghana Atomic Energy Commission, 2003) [10].

(iii) Governments now require accountability in every area of expenditure. The government of Ghana provides some funding to the GAEC yearly. It is therefore prudent reporting on how the funding received supported nuclear research to the benefit of the country (Irylne, Martin , & Isard, 1990) [21].

(iv) The emerging problems associated with peer review of expenditure in specific areas by nations have also been identified as one of the reasons why public institutions should be assessed. Organizations like the World Bank, the International Monetary Fund (IMF), and similar bodies set specific targets in advising governments that seek assistance from them.

A developing country like Ghana, over the years had unfortunately achieved little in terms of Gross Domestic Product (GDP) measurement through scientific research. As of 2016, research findings that were adopted by the industrial sector reduced from 105 to 70 and contribution of funding allocated to support research and development in Ghana remained at 0.05% of the GDP budget. (National Development Planning, Commission, 2017) [29].

2.5 The Concept of Creating Awareness in Public Institutions

A concept framework builds on an existing structure of theories studied and applied in a particular area. According to Ary, et al. (1996), the purpose of a concept is to simplify thoughts by introducing several events under a general heading (Ary, Jacobs, & Razavieh, 1996) [1]. The conceptual framework considered for this study is a reviewed and modified one from the Co-orientation model after Grunig and Hunt (1984) to support the assessment of awareness of the contributions of the GAEC (Grunig & Hunt, 1984) [18].

Co-orientation is the relationship between two or more groups of people towards a mutual relevance or interest (Bronn & Bronn, 2003) [4]. This concept requires two or more individuals co-oriented to something in common and to each other or they are oriented to and communicating on a matter of mutual interest. Co-orientation analysis can indicate communication states, agreement, accuracy, and congruency. Fig 1.0 shows the co-orientation model adopted and modified for this study. From this model, an agreement is reached when a stakeholder's perspective evaluation of an issue is the same as the organization's perspective of the stakeholder. In order words, an agreement is reached when stakeholders' perception of organization's view corresponds to the organization's evaluation of the same issue. The intrapersonal construct of congruency describes the extent to which the researcher's view (perceived agreement) matches the estimate of other people's views on an issue and vice versa. Accuracy indicates the extent to which the researcher's estimate matches the public's viewpoint, and vice versa. In this case, the stakeholder's perception of the organization's view is in line with the perception that the organization also has about the stakeholder. The co-orientation model is useful for decision-makers of agencies to improve communication and collaboration with stakeholders (Leong, McComas, & Decker, 2009) [24].

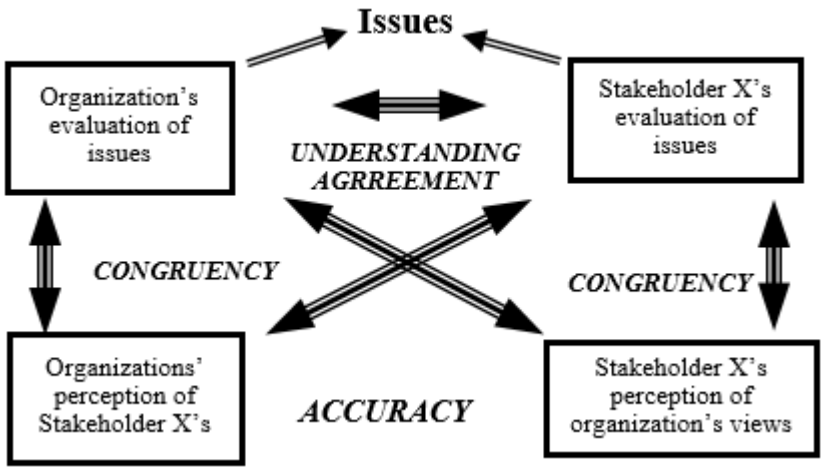

Fig. 1.0 - Modified co-orientation model.

Source: Adapted from McLeod, J. M. and Chaffee, S. H.,

Interpersonal Approaches to Communications Research, American Behavioral Scientist (1973).

Public relations activities are recognized as a relationship orientation for long-term productivity (Kaplan & Haenlein, 2009) [22]. These activities present neutral information to educate people about the contributions of an institution and could promote recognition especially when efforts are made to highlight publicity campaigns. Regular news articles, documentaries and presentations to discuss products and services could be used.

Within the past decade considered for the study, the public has advocated how organizations on which the government spends so much on their salaries could become self-sufficient in Ghana. This development triggered public attention to institutions like the GAEC. In an interview on Myjoyonline 2017, Nyarvor reported that the Director–General of the GAEC, lamented that many are not aware of the vital role the GAEC played in the development of various sectors of the Ghanaian economy and suspects a misconception about the role of the GAEC as well as the contributions Scientific research has made towards developing the nation (Nyavor, 2017) [31].

Marketing has been a business practice that creates awareness about products and services. (Barbu, 2011) [2] identified marketing as an essential tool for public services considering their role in national development. In their article; "The Increasing Importance of Public Marketing: Explanations, Applications and Limits of Marketing within Public Administration" by Kaplan and Haenlein (2009), noted that "public marketing (ie the application of marketing concepts and tools in public administration) is already a reality in a wide variety of countries" (Kaplan & Haenlein, 2009) [22]. This finding was supported by (Caruana, Ramaseshan, & Ewing, 1998) [5] who saw marketing concepts as very relevant to the regular operations of public institutions.

Public relations and publicity have been limited for a long time but are now inevitable in the public sector. (Walsh, 1994) [37], in his study on Marketing and Public Sector Management, revealed that the concept of achieving effective publicity has attracted the attention of the public in a similar manner as private institutions. To achieve this goal, dedicated units are formed for public relations to create awareness of what the institution does. Walsh (1994) noted that the need for public service is the failure to use marketing approaches and promotional techniques. Nowadays, many more government institutions are adopting approaches in marketing to engage and satisfy their clients. In her study on Public Sector Marketing: Importance and Characteristics, (Barbu, 2011) [2] noted that the most effective means of communication in a public enterprise that could yield results higher than the scope of promotion is the dependence on the staff members, whose skills, courtesy, and professionalism represent the corporate image of the institution. Her study revealed that an effective internal public relations campaign that communicates institutional activities serves to motivate employees and prepare them as ambassadors within the public (Barbu, 2011) [2]. The conclusion of her study advised that macro-marketing at ministerial and agency levels could be obstructed by reduced or no financial resources, and incompetence of staff.

2.6 Awareness Created by the IAEA on Contributions of Nuclear Applications

The International Atomic Energy Agency (IAEA) is an international body formed in October 1957 as an autonomous wing under the United Nations (UN) that regulates and promotes the peaceful use of nuclear technologies (Ghana Atomic Energy Commission, 2003) [10].

In creating awareness of the IAEA's activities, several publications such as scientific technical reports, annual reports, reviews, assessments, speeches, brochures, and fliers have been useful. The Agency's website contains nuclear and related technologies, achievements, reports, and many major information that can readily be assessed. Videos and documentaries are frequently posted on the Agency's website to tell some of the success stories of member countries. The forms used to communicate the Agency's plans and achievements are well coordinated to adequately attract and inform stakeholders and other beneficiaries. For example, "Power Applications" in the Annual Nuclear Technology Review of 2015 provided the status and achievements of the various nuclear technologies indicating the regions of application. The 2016 Annual report presented the number of nuclear power plants developed as of the end of December 2015 and stated where they can be located. This was further disaggregated into the number that was newly connected to the grids, the number that was shut down or decommissioned, the types of reactors, and some other relevant information over the years.

Projections towards the acquisition and utilization of nuclear power among member states, as illustrated in Fig.2.0 are easily accessible to predict the direction of the IAEA.

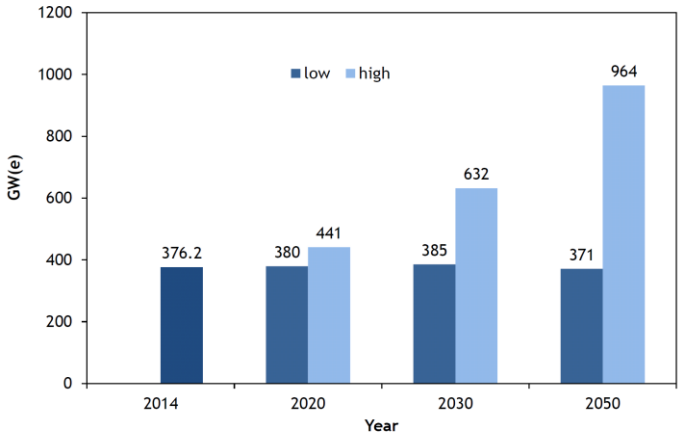

Fig. 2.0: Projections for world nuclear capacity

Source: Energy, Electricity and Nuclear Power Estimates for the Period up to 2050, IAEA Reference Data Series No. 1, 2015

The success story of how nuclear techniques have been used to study global-scale changes under "Understanding Changes in the Marine Environment using Nuclear Techniques" was published in the IAEA Nuclear Technology Review, 2015 and the Nuclear Technology Series.

2.7 Awareness of Contributions by the Malaysian Nuclear Agency

Malaysia joined the IAEA in January 1969 and the Malaysian Nuclear Agency (Nuclear Malaysia) was established in September 1972 as Tun Ismail Atomic Research Centre when the country's Cabinet decided that nuclear energy is the alternative to the oil crisis the country experienced in the early 1970's (Malaysia South-South Association, 2015) [26].

Information on the Nuclear Malaysia website indicates that as at 2013, Nuclear Malaysia had a research reactor and a gamma irradiation facility. As part of its achievements, the Institution had eighteen (18) patents and continues to provide technical support by using sealed sources as process diagnostics tools in the industrial sector (oil and gas, process & energy industries). The research reactor is used to analyse about 3000 samples benefiting industries, researchers, and the educational sector, which previously would have been done overseas. NDT is also applied to the manufacturing, construction as well as the oil and gas industry (Malaysia Nuclear Agency, 2016) [25].

Nuclear Malaysia has a unit for technology planning and development, responsible for commercializing of nuclear applications. According to Kasim et al. (n.d), the research and development (R&D) activities are market-driven and produce beneficial products in advanced materials, manufacturing, ICT, and biotechnology among others. Research is conducted in collaboration with industrial partners to come out with products that are beneficial to end users. It has been estimated by Kasim et al. (n.d) that over 6000 customers use nuclear applications in industry, agriculture, and the health sectors. The use of nuclear technologies in the Malaysian industry expanded as a result of capacity building where Nuclear Malaysia provided technical and infrastructural support in specialized areas like the use of irradiation to obtain new variants of flowers as well as using commercial tissue culture laboratory to produce 1.2 million plants in a year under the Malaysian Nuclear Agency. (Kasim, Daud, Ibrahim, & Musa) [23].

2.8 Creating Awareness of the GAEC's Contributions

The importance of publicizing the achievements of an institution serves to inform stakeholders and the public to understand the operations, and functions of a particular organization. The GAEC makes some of its achievements known through its annual reports that are submitted to the Ministry of Finance, MESTI and other stakeholders. The 2016 Annual report, for instance, mentioned the installation of a 1.7MeV Pelletron Accelerator for research (Ghana Atomic Energy Commission, 2017) [15].

In creating awareness, the GAEC had the opportunity to educate institutions and students (basic to tertiary level) who visited the offices and laboratories on some activities and achievements. The GAEC developed a National Public Relation Plan for 2002–2006 to promote nuclear-based technologies in the sectors of the Ghanaian Economy. The plan was also intended to increase public awareness of the benefits of nuclear applications and to improve the GAEC's corporate image (Ghana Atomic Energy Commission, 2012) [11]. The 2001 annual report of the Ghana Atomic Energy Commission (2001) revealed

that documentaries on some commercial services, potential and available resources were developed and made available to the public through outreach programmes. The Corporate Strategic Plan (2012-2016) had one of its key objectives to improve the corporate image of the GAEC. In 2012, the Business Development Unit (BDU) was transformed into a Technology Transfer and Marketing Centre (TTMC) while the Public Relations Unit was upgraded to the Office of Communication Public Affairs (OCPA) to link the GAEC's activities to the public to enhance the Institution's corporate image (Ghana Atomic Energy Commission, 2012) [11. It is, however, uncertain whether the desired awareness had been created.

2.9 Nuclear Applications in the Ghanaian Industrial Sector

Various sectors including the industrial sector in Ghana receive services from the GAEC. From the annual reports of the NNRI, the following were some major operations carried out within the industrial sector during the period under review. The GAEC conducted laboratory analysis for clients such as Coca-Cola Limited, Nestle Ghana Limited, Zeal Environmental Technologies Limited, and Plant Protection and services for some regulatory institutions. The GAEC was also involved in the regular repair, maintenance, and calibration of nuclear electronic equipment (Gamma camera and spectrometry at the Radiotherapy and the Nuclear Medicine Centre at the Korle-Bu Teaching Hospital (National Nuclear Research Institute, 2015) [30].

The NDT Laboratory of the GAEC has been involved in the testing of pipelines, and fuel storage tanks and for the thickness gauging of corrosion assessment of liquefied petroleum gas (LPG) storage vessels over the years (Ghana Atomic Energy Commission, 2012) [11]. According to contributions made by the GAEC as published in the GAEC at a Glance Handbook (2015), the GAEC's Mechanical Engineering workshop fabricated several underground fuel storage tanks for oil distribution companies in Ghana. A training centre has been established to train and certify welders for the industrial sector (National Development Planning, Commission, 2017) [29]. The Integrity of turbine blades such as turbines at Volta River Authority (VRA) and thermal plants has been assessed for effective functioning over the years by the GAEC. In collaboration with other stakeholders, the GAEC employs geophysical techniques in mineral and oil exploration. (Ghana Atomic Energy Commission, 2012) [11]. According to the 2015 annual report of the National Nuclear Research Institute, NDT evaluation services were conducted for institutions such as the oil distribution companies, Fan Milk Ghana Limited, West Hill Mall, and the Volta River Authority (VRA) thermal station. (National Nuclear Research Institute, 2015) [30].

3. METHODOLOGY

3.1 Study Design

The study undertook a case study utilizing qualitative approaches to solicit answers based on the co-orientation model. A cross-sectional survey was undertaken to collect primary data from three radio stations on the level of awareness about the various contributions of the GAEC between the years 2006 – 2016 (Saunders, Lewis, & Thornhill, 2012) [35]. Qualitative research provides a study into a social problem, by focusing on edifying a diverse, holistic depiction, reporting comprehensive views of informants (Creswell & Plano Clark, 2011) [7]. It is conducted in a normal setting as texts may be generated using interviews, results from notes taken during observations, or be drawn from existing documents such as meeting minutes, correspondence, organizational reports and websites, magazines, or newspapers (Bernard, 2002) [3]. The survey was related to some indicators provided by (Childers & Grunig, 1999) [6], in their publication on Guidelines for Measuring Relationships in Public Relations. Although the guidelines settled on some indicators that could be adopted in measuring relationships, to measure the awareness relationship between the GAEC and the public, the indicators; of familiarity, satisfaction, and trust which borders on competence and dependability were assessed. Two additional indicators; challenges and prospects were incorporated to support the assessment of the public's satisfaction with the GAEC's activities. The reliability of the relationship in the survey was measured by Cronbach's alpha.

3.2 Target Population

The media, (radio, television, newspapers, and magazines) are commonly used to reach out to a large population on several issues. In publicizing developmental events, news items, advertisements or documentaries on specific institutions are broadcast on radio and television stations over the years. This makes the media an active participant when advocating developmental agenda (OECD Publishing, 1996) [32] because they play intermediary roles by receiving, processing, and then disseminating information to the public. The target population for the study was sixty (60) media practitioners from two (2) media groups: Multimedia Group Limited and Oman FM (in the Greater Accra region. The study sought to conduct a survey on Joy FM, Adom FM, and Oman FM media practitioners (accessible population of 50) based on the assumption that these workers would have had some interaction on developmental issues with several institutions, including the GAEC within the past decade.

3.3 Sample Size

For the survey, sixteen (16) respondents were contacted from, Joy FM, twelve (12) from Adom FM, and an additional twelve (12) from Oman FM, which is the nearest radio station to the GAEC. These numbers present a fair representation of Joy FM as one of the earliest private radio stations established and it has more staff that could be contacted than Adom FM and Oman FM. A sample size of forty (40) was used. The respondents considered were in categories that would be able to fairly represent the different groups of staff within the media who are likely to come across the information being shared on the GAEC

3.4 Source of Data

The main source of data for this study was from the primary data which was collected from respondents with a self-administered questionnaire. The survey made use of multiple sources of secondary data from sources such as published documents, archival records, and interviews to aid in understanding the issues.

3.5 Sampling Technique

For this study, Convenience and Purposive sampling techniques were used. Convenience sampling has been explained by Dornyei as a non-random sampling method where members of the target population that meet certain criteria, such as easy accessibility, geographical proximity, or availability at a given time, are included in the study (Dornyei, 2007) [8]. Convenience sampling and Purposive sampling are nonprobability sampling techniques that are used to choose a sample of subjects from a target population (Etikan, Rukayya, & Alkassin, 2016) [9}.

3.6 Research Instrumentation

This study used a questionnaire designed by the researcher to assess the level of information the media has gathered concerning the GAEC. Questions were posed to directly get the opinions of the respondents to address the research objectives. Closed questions were asked and a Likert scale (5= Strongly agree; 4 = Agree; 3 = Neutral; 2 = Disagree and 1 = Strongly disagree) as well as "yes/no" responses were used to grade the level of awareness respondents had in terms of familiarity, satisfaction, and trust. Some of the questions were open-ended which allowed participants to freely write any response. The instrument was internally validated by selected students of Wisconsin International University College. Out of the forty (40) copies of questionnaires administered, thirty-two (32) were received, representing a response rate of 80.0%. The questionnaire was the main instrument, and the data was analyzed with the Statistical Package for Social Sciences. The instrument performed well in terms of Cronbach's alpha by dimension and at the overall level.

4. FINDINGS AND DISCUSSION

4.1 Background of Respondents

A summary of the background of the respondents used in the survey is presented in this section. A breakdown indicating the radio stations where the respondents were selected showed that many of the respondents (42.9%) were from Joy FM, followed by Adom FM (32.1%) and then Oman FM, (25%). Most of the respondents (87.5%) have been working with their current radio station for between 1-10 years. The academic qualifications of respondents showed that the majority (51.7%) possess 1st degrees, and (17.9%) have Diplomas. The age categories of the respondents range from 20 years to 50 years. Majority of the respondents were between 20-30 years (57.1%). Table 1.0 shows the distribution based on the functional areas of the respondents. The compilation indicates that 25% were reporters and 37.5% were classified as others, were sound Engineers, Broadcast Journalists, and National Service Personnel. This provided a broader representation of the respondents for the survey than anticipated.

Table 1.0: Distribution of Field of Work of Respondents

Area of Work	*Frequency*	*Percent*
Reporter	8	25.0
Presenter	5	15.6
Producer	7	21.9
Other	12	37.5
Total	32	100

Source: Author's fieldwork, June 2018

4.2 Exploring the level of awareness of the GAEC's contributions within the industrial sector

The first objective of the study considered exploring the level of awareness of the GAEC's contributions within the industrial sector between the years 2006 and 2016. The objective sought answers to whether the activities of the GAEC have been familiar among media practitioners. The questions called for conversant answers concerning the GAEC's activities to indicate whether respondents were well-informed or otherwise. In responding to whether respondents had ever heard of the GAEC, 71.9% had heard of the GAEC 15.6% had not and 12.5% abstained. This can be interpreted to mean that most media practitioners have heard about the GAEC. It followed that the majority of the respondents who heard of the activities of the GAEC mentioned the media as the source, with a few admitting to briefs from friends or a previous school they attended. Respondents who chose the media mentioned the specific sources to be television, newspaper, and radio. Surprisingly, none of the respondents mentioned the website of the GAEC. This clearly shows that when some efforts are directed towards the media to publicize the activities of the GAEC there is a high possibility of making a greater impact.

A small fraction of the respondents on the other hand got to know about the GAEC by virtue of where they live and by using the road in front of the organization. Table 6.0 presents the period within which respondents have heard of the GAEC. 40.6% of the respondents have heard of the Commission between 2006 and 2010 while only one person (3.1%) heard of the GAEC before 2006. Surprisingly, 9 respondents representing (28.1%) abstained from this question. Figure 3.0 gives a representation of information received by the respondents concerning the GAEC. Answers to the content of the information heard concerning the GAEC revealed that twelve respondents (37.5%) could not state or recollect the exact information content. 21.9% said they heard of nuclear applications in energy. The import is that a little more than half of the respondents (56%) do not know about the GAEC's activities.

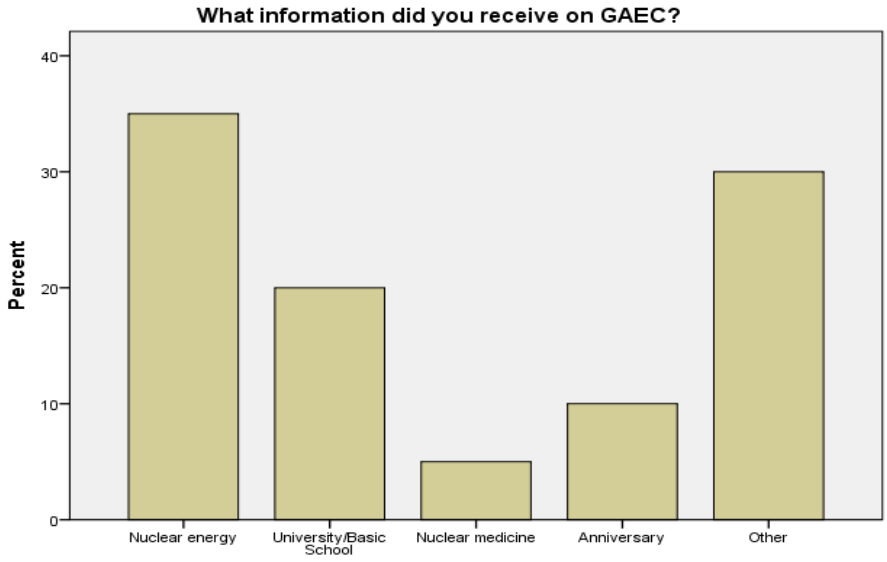

Figure 3.0: Nature of information received on GAEC

Source: Author's fieldwork, June 2018

The other areas mentioned by respondents were related to the GAEC hospital, the Veterinary clinic, and the Haasto Atomic Road. The information received by the respondents could not bring out the core scientific research activities or outputs concerning the industrial and other sectors of the Ghanaian economy. The respondents expressing knowledge on using nuclear technology for energy and medicine shows that some information has been available on the use of nuclear technologies in Ghana.

Respondents were asked whether they knew any field(s) where nuclear technology is used, in Ghana. 34.4% responded "no" and 28.1% abstained out of the total number of respondents. This shows that 62.5% were not prepared or could not mention any area where nuclear technologies are used in Ghana.

These questions were meant to confirm whether those who had heard of the GAEC and its activities could provide at least one area where nuclear technology is in use. Out of the total number of respondents, 62.5% abstained while the highest area mentioned was in medicine. This supports the perception that the public does not specifically know about the GAEC and its activities. Table 2.0 presents a statistical representation of the areas mentioned by respondents.

Table 2.0 - Respondents' view of some areas where nuclear technology could be applied in Ghana.

Areas	*Frequency*	*Percent*
Medicine	6	18.8
Energy	3	9.4
Industry	2	6.3
Agric.	1	3.1
All of the above	12	37.5
*Provided no answer	20	62.5
Total	32	100.0

Source: Author's fieldwork, June 2018

In finding out respondents' agreement with some nuclear applications that are safely being applied in various sectors of the Ghanaian economy daily, 37.5% of respondents strongly agreed, 40.6% agreed, and 21.9% were neutral to the accession. This shows that about 78% of the respondents are aware that there are nuclear applications that are used daily in Ghana.

Respondents were not well informed that the GAEC safely uses nuclear applications in sectors like health, agriculture, and industry as respondents strongly disagree 34.4%, with 43.8% disagreeing, 18.8% was neutral and only one person representing 3.1% agreeing. This finding is also surprising and a bit unexpected since a lot of them are aware that there are daily applications of nuclear technology in Ghana. This response might have been so because respondents may not be well informed in specific areas like agriculture and industry where nuclear technologies are applied.

4.3 Major Nuclear Applications Deployed by the GAEC in the Industrial Sector of Ghana

Some nuclear technologies are applied daily to resolve problems in the industrial sectors in Ghana. The Corporate Strategic Plan (2012-2016) and the brochures on activities of institutes of the GAEC have reported some areas where nuclear technology is applied in the industrial sector of Ghana. The second objective of the study looked out for bits of knowledge on some nuclear applications in the industrial sector by assessing disseminated information on some daily benefits of nuclear applications to industry. 40.6% of respondents strongly disagreed with 37.5% also disagreeing to the accession that one major area which the GAEC uses nuclear applications is in the detection of leakages in pipes and tanks that transport, or store petroleum products (LPG, petrol, and diesel) was sought. This raises concern that a large proportion of the public is ignorant about what nuclear technology does hence, a lot more public sensitization needs to be done to educate the public and especially, oil marketing companies who would be interested in patronizing the technology.

The opinion of respondents on whether they are aware that the GAEC has specialized laboratories and nuclear installations such as a research reactor and a gamma irradiation facility (GIF) to support the industrial sector showed that 40.6% of respondents remained neutral while 18.8% abstained to answering whether respondents had ever visited the GAEC to know the major nuclear installations available to support industrial activities. Again, this means over 50% of respondents are not aware of the existing laboratories and nuclear installations at the GAEC.

The questions in Table 3.0 sought to enquire respondents' knowledge of the capabilities of the GAEC staff. The findings revealed that majority of respondents either abstained, disagreed, or strongly disagreed with the questions posed. Respondents were asked whether they knew the GAEC provided technical expertise in mineral and water exploration and also whether the GAEC used expertise in nuclear technology in determining the quality of welds and cast concrete in constructions such as the Bui dam. While (18.8%) agreed to this application of nuclear technology, (15.6%) disagreed, and an overwhelming (65.7%) remained neutral as they had no idea of nuclear application.

The questions in Table 3.0 sought to enquire respondents' knowledge of the capabilities of the GAEC staff. The findings revealed that the majority of respondents either abstained, disagreed, or strongly disagreed with the questions posed. Respondents were asked whether they knew the GAEC provided technical expertise in mineral and water exploration and also whether the GAEC used expertise in nuclear technology in determining the quality of welds and cast concrete in constructions such as the Bui dam. While (18.8%) agreed to this application of nuclear technology, (15.6%) disagreed, and an overwhelming (65.7%) remained neutral as they had no idea of nuclear application.

Table 3.0 - Major nuclear applications deployed in the industrial sector of Ghana

S/N	*Awareness of nuclear applications deployed in the Ghanaian industrial sector*	*Respondents view*				
		Strongly agree	*Agree*	*Neutral*	*Disagree*	*Strongly disagree*
1	One major area that the GAEC uses nuclear applications is the detection of leakages in pipes and tanks that transport or store petroleum products (LPG, petrol, diesel).	0	0	7 (21.9%)	12 (37.5%)	13 (40.6%)
2	Another area where nuclear technology is applied is for scanning at the ports.	3 (9.4%)	10 (31.3%)	14 (43.8%)	5 (15.6%)	0
3	I learnt the GAEC has specialised laboratories and nuclear installations such as a research reactor and a gamma irradiation facility (GIF) to support the industrial sector.	0	1 (3.1%)	19 (59.4%)	4 (12.5%)	0
4	I have heard that the GAEC used expertise in nuclear technology in determining the quality of weld as well the quality of cast concrete in constructions such as the Bui dam.	0	6 (18.8%)	21 (65.7%)	5 (15.6%)	0
5	I am informed that the GAEC provided technical expertise in mineral and water exploration during the past 10 years.	0	2 (6.3%)	8 (25.0%)	16 (50.0%)	6 (18.8%)
6	I am aware the GAEC is collaborating with the Ministry of Energy, the VRA and other stakeholders to introduce nuclear energy into the country's energy mix.	0	11 (34.6%)	10 (30.8%)	11 (34.6%)	0

Source: Author's field work, June 2018

4.4 Prospects and Challenges of Nuclear Applications in the Industrial Sector

The third part of the objective considered some prospects and challenges of nuclear application within the industrial sector in Ghana. Attempts were made to establish the impacts of the GAEC's activities on the industrial sector of the Ghanaian economy between the years 2006-2016. Questions were asked to solicit ideas on the benefits that could be derived from nuclear technology in the industrial sector. Some of the respondents acknowledged that there is a high potential for the GAEC to contribute to the development of some sectors of the economy. Although some respondents think nuclear technologies could be applied to improve the industrial sector of Ghana through power generation for electricity. respondents could not indicate some industries that could make use of nuclear applications to accelerate productivity in Ghana. This further affirms the fact that the public has inadequate knowledge of areas in the industrial sector where nuclear technologies can be applied.

Respondents were asked to mention some challenges they think could prevent the application of nuclear technologies in Ghana and some challenging issues the GAEC needs to address. Many respondents expressed inadequate public education and low efforts from the management of the GAEC in publicizing nuclear applications in Ghana. Others stated the non-availability of information on nuclear matters as well as public safety issues. A few however, said no challenge would be faced in the implementation of nuclear application in Ghana because it is already being used in the health sector. This group of respondents thinks the GAEC is just not doing its job. These comments suggest the public's preparedness to accept the use of nuclear applications in different sectors of the economy. On whether there could be some anticipated challenge(s) faced by the GAEC in creating public awareness on the peaceful use of nuclear applications, a few of the respondents believe that the problems could be linked to managerial support or lack of public engagements and advertisements.

4.5 Factors that could help promote public knowledge of the GAEC's activities

The fourth objective of the study was to seek from the respondents, factors and strategies that the GAEC could pursue to promote its activities and achievements for recognition by the public. Respondents were asked whether they had ever come across some information on the achievement(s) of the GAEC which was because of the application of nuclear technology in industries in Ghana. This question was posed to unravel the types of education and sensitization materials that are used by the GAEC to enhance public knowledge of nuclear activities within the country. The responses showed that only 12.5% of respondents had seen information that relates to the achievements of the GAEC's activities. A relatively high number of

respondents (40.6%) abstained from answering the question while 46.9% of respondents said they had not seen any information on achievements. Respondents who came across some achievements of the GAEC said they were among the team of media that visited the GAEC during its 50th-anniversary celebration. 65.6% are not satisfied with the awareness created on activities of the GAEC within the past 10 years with 18.8% also abstaining. Only 15.6% of respondents were satisfied with the awareness created on the GAEC's activities. This was not surprising considering the perception that the level of awareness of the GAEC activities is low and the trend buttressed the fact that the public is unaware that nuclear technology is applied in the health, agricultural, and industrial sectors of the Ghanaian economy.

General comments about the GAEC were sought to appreciate the views and any perceptions that the public has on the GAEC. As explained by McQuerry in her article; "A Public face on your products and services" the answers from the respondents were expected to tout the innovations or any charitable works done by the GAEC (McQuerrey, 2018) [28]. However, comments given by most of the respondents indicated that the GAEC could do better to support the economy than it is currently doing. Some stated that efforts could be made to get potential clients identified to patronize the commercial products and services of the Commission. Respondents suggested more media presence through advertisements and documentaries on the activities of the GAEC could be pursued to increase awareness of the GAEC's activities.

These comments were the views of the respondents who have worked between 1-10 years with the media, and it could be that they have compared the publicity of the GAEC with what happens in other public institutions. These views could therefore be considered to improve any observed weakness and improve the expertise of personnel who may lack marketing vision in the implementation of marketing approaches to create the expected awareness.

5. SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

The results of the research showed a low level of awareness of the GAEC's research and commercial activities and were in congruence with the perceptions of the Management of the Organization. The results showed that most of the respondents (71.9%) have heard of the Institution the GAEC but only a fraction (12.5%) of the total respondents had come across some information on the achievements of the institution through the media. On average, less than 20% of the respondents have heard or know of some nuclear applications and activities that the GAEC offers as contributions to the industrial sector. A significant number of respondents (41%) have little knowledge of the use of nuclear technologies in the industrial sector by remaining neutral or not answering many of the questions to the third objective of this study. It was also revealed that a large proportion of respondents (65.6%) were dissatisfied with the awareness created on activities of the GAEC within the 10 years of the study.

Publicity strategies were the major challenges identified which should be given much devotion by the top management of the GAEC. It was deduced that research and commercialization outputs during the past ten years should be well documented and publicized. This suggests that the management of the GAEC could regularly engage the media on achievements. The public relations unit could publicize short documentaries and consolidate achievements from regular annual reports under "industry, health, or energy" to reveal the strides made in these sectors highlighting the achievements. This would also conform with the findings from the studies that showed that many public and private institutions are creating dedicated units for public relations and marketing to create awareness of their activities (Walsh, 1994) [37].

5.2 Conclusion

The results obtained from this study suggest that the public is not well informed about the research and commercial activities of the Ghana Atomic Energy Commission. As a result, major contributions to the industrial sector are not understood or easily recognized. Only a small fraction of the respondents (35%) were aware of the use of nuclear technology in generating electricity and none of the respondents agreed to the use of nuclear applications to detect leakages in pipes and storage tanks in the oil and gas industry. Respondents who came across some achievements of the GAEC said they were among the team of media that visited the GAEC during its 50th-anniversary celebration. According to the various annual reports reviewed for this study, the GAEC daily supports some key sectors of the economy, including the industrial sector. One major lesson drawn from the study is that personnel from the various media groups could hear of an organization but may not necessarily be much familiar with the major contributions that the organization has made to specific sectors of the economy. The gap that was identified narrowed down to very low publicity on activities of the GAEC. With the weaknesses shown in publicising the contributions made by the GAEC over the years, there is a need for the management of the GAEC to increase awareness of its activities to the public. This agrees with the finding in the work of Serriat (2017), in her book "Marketing in the Public Sector", where she noted that improvement in performance is achieved when public institutions customize and blend the Ps-product (or service), place, price and promotion (Serriat, 2017) [36].

5.3 Recommendations

One major lesson drawn from the study is that personnel from the various media groups would hear of a public institution but may not necessarily be familiar with the major contributions that the institution has on specific sectors of the economy. With the weaknesses shown in publicising the contributions of the GAEC over the years, there is a need for management to increase awareness of the GAEC's activities to the public. The key factors identified that could help promote public knowledge of the GAEC are:

1. The GAEC should strengthen its liaising efforts with key sections of the media (electronic and print) to disseminate information faster to the public.

2. Management could regularly engage the media on consolidated achievements in the form of short documentaries that will educate or provide updates to the public.

3. Priority should be given to improving the business competencies and skills of key Management staff to strengthen the GAEC's public relations to attract potential clients and stakeholders within the industrial sector.

4. Distribution of brochures and publications that can easily be utilised by stakeholders must be distributed to potential clients.

5. Management should put in place measures to sustain the awareness that will be created.

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