Direct RESEARCH JOURNALS

**Direct Research Journal of Engineering and Information Technology**
**Vol. 7(1), pp. 1-5, May 2020**
**ISSN 2354-4155**
**DOI: https://doi.org/10.26765/DRJEIT44016779**
**Article Number: DRJEIT44016779**
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*Review paper*

# Engineering Profession: Ethics, Practice and Challenges in Nigeria (Comparison between Nigeria and other parts of the World)

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Received 30 March 2020; Accepted 9 May, 2020

Engineering professionals are always criticized on some occurrences of failures in engineering constructions, some of these occurrences were not even engineering, therefore, Engineers should not just be held responsible for the occurrences but an awareness need to be created to show the roles of every personnel on-site and the challenges being faced in the practice. It is all believed that whatever engineers do affects the society and its development therefore in order for the Engineers to meet up with the challenges of the time, they should be properly prepared to confront the moral, legal and ethical conduct of their actions. Case studies detailing occurrences, clashes, and accidents that took place are examined in preparing engineers to face this contemporary challenge. Ethical theories are presented as codes of ethics that different professional societies developed and which provide the structure for this pattern of professional practice. Solving conflict of interest problems that are encountered in practice helps explain the approaches to risk reduction, safety, and reduction of accidents. This paper presents the concept "Engineering Profession: ethics, practices and challenges in Nigerian context scoped to some Engineering construction industries located in Katsina. Five different Engineering firms were surveyed and the employees to the firms were interviewed. The results show that most of the employees are aware of the ethics and principles behind the engineering profession but confessed their inability to meet up with the expectations usually lies with their employers and to some extent with the government. Minor cases proved that the problems are multi-dimensional starting from the employer, Government down to beneficiaries. In general what was obtained from the study conducted in Katsina is similar to what has been obtained in some parts of the World as elaborated in this paper.

**Keywords:** Engineering practice, ethics and challenges

## INTRODUCTION

Engineering is a general term used to describe the ability to think and utilize the sciences based theories in solving one problem or the other for the purpose of improving the living standard of the creatures. Engineering discipline is of various branches and meant for different purposes, for example "Civil Engineering" is that branch of Engineering that deals with the design, constructions and maintenance of infrastructural facilities for the betterment of all Jesa et al. (2004). These infrastructures may include Building structures, hydraulic structures, Highways, Dams, Tunnels, Railways, Towers and Bridges etc.

Based on what has been introduced before, it can be understood that the practice of engineering like any other profession has some ethics and principles as such the implementation of such engineering principles/ethics may face one challenge or the other; therefore these formed the basis/contents of this paper presentation. The contents of this paper would be "The practice, Ethics and Challenges" as written on the title Professional Engineers and the Engineering Profession. Engineering practices in Nigeria is similar to what is being practiced in the other part of the world therefore they receive equal attention and challenges. There exist some convergences and divergences between the profession/practices and the professional Engineers as described below:

## What is ethics?

"Ethics" or "morals"— these two terms are regularly being used interchangeably—means those habits or customs that are standards of good conduct or character (Royal Academy of Engineering, 1976). To be ethical is to do the right thing; to consider the well-being of others as equal to your own; and to act in ways that aim to maximize the good.

To be ethical is to be righteous, in the sense that our conduct and character are grounded on principle and a commitment to doing our duty regardless of narrow self-interest. To be moral is to be fair and considerate of others, particularly to show them the respect we ourselves demand that acknowledges rights to life, liberty and property. Ethics is a discipline we freely embrace that regulates our baser instincts so as to promote a harmonious community and thereby reduce conflict and disorder. We expect others to order their behavior so as to not harm things of value and being ethical is the principal method for protecting.

According to Jesa et al. (2004) engineers must be properly prepared to face the moral, legal and ethical ramifications of their actions. They discussed ethical issues faced by engineering professional and the engineering profession. According to them the ethics can be taught and imparted into engineering professionals. Ethical practices in engineering are important as they are directly related to human safety and environment.

## ETHICAL PRINCIPLES (SEP) IN ENGINEERING

The Royal Academy of Engineering, in conjunction with the Engineering Council and a number of the leading professional engineering institutions developed the Statement of Ethical Principles (SEP) to describe, in general terms, the kinds of ethical considerations that a professional engineer will need to attend to, and how a principled engineer should seek to respond to the ethical issues they face (Royal Academy of Engineering, 1976). The SEP is intended not only to provide guidance and support to individual engineers, it also serves to reassure the public that engineers take their ethical obligations seriously. By categorizing the different kinds of ethical concerns that exist in engineering, the SEP represents the scope of ethics in engineering activities.

## Tours on Ethical Issues in Engineering

The four principles set out in the SEP are:

(i) Accuracy and rigour
(ii) Honesty and integrity
(iii) Respect for life, law and the public good, and
(iv) Responsible leadership: listening and informing

These four fundamental principles, in the words of the SEP, "should guide an engineer in achieving the high ideals of professional life" (Sunil, 2015).

Some of these principles apply to all professions equally; other principles have a stronger role to play in engineering. Much of the role of an engineer is taken up with making judgments, working with new technologies, and giving advice. So the need for accuracy and rigour, for maintaining up to date knowledge, and for care in representing the evidence accurately and not making claims that go beyond the evidence, is particularly crucial in engineering. Any inaccuracies may lead to accidents, failures, or even death.

A key reason behind producing a Statement of Ethical Principles for the engineering profession was that many professional engineers may face organizational challenges in thinking through ethical issues. Engineers almost always work for and with others – clients, employers and contractors – and may face conflict between their professional values and the demands made on them by others. Famously in the Challenger Shuttle disaster the engineer concerned with safety critical matters was exhorted by his manager to think like a manager not like an engineer. There may often be similar external pressures to stray from professional obligations, so it is helpful to have clarity on what those obligations are.

Of course, no engineer exists in a vacuum unconnected with the broader profession of which they are a part, and the society in which they live and work. While many of the cases studied in many research works focus on the choices made by individuals it is important to recognize the limits on what an individual acting alone can achieve. We might imagine cases in which the option that appears best from an ethical perspective is simply not available for the individual to choose – for example, it may be best for all businesses in an industry to employ the latest low emission technology, but if just one business were to take such action the increased costs (relative to competitors) could lead to bankruptcy (Engineering Council, 2003). In order to give more on the ethical principles in engineering, this paper looks at:

## Accuracy and rigour

Accuracy and rigour is the first principle listed in the Statement of Ethical Principles. This states that "professional engineers have a duty to ensure that they acquire and use wisely and faithfully the knowledge that is relevant to the engineering skills needed in their work in the service of others". Probably the most obvious reason why accuracy and rigour is important to professional engineers is that accuracy and attention to detail ensures better engineering solutions, just as inaccuracies and carelessness in engineering can mean failure of engineering projects, which can in many cases

mean financial failures, accidents, injuries and deaths (Engineering Council, 2003).

Professionalism also involves being honest about level and areas of competence, and never agreeing to work in areas in which you are not competent or not able to easily achieve competency. The temptation to do this can be generated by commercial considerations, for example a company bidding for a lucrative contract despite not having the correct skills and technical knowledge within its teams. The risk here is that engineers working on the project will make mistakes, as they may not be aware of the key mistakes to avoid, and mistakes in engineering projects have the potential to be catastrophic. Conversely an engineer employing their specialist skills within their area of expertise can make a significant and positive contribution to society. However, it is important to note that many engineering projects are novel, and will require previously untested skills and methods. In these cases it is an engineer's duty to ensure that risks are managed and steps taken to allow teams to acquire the appropriate skills – but above all to be honest about unknowns and skills gaps (Richard (2009). In such cases it may be possible to take steps that change the situation so that the best choice becomes available. Such changes could include, for example, government legislation that set limits on acceptable emissions. It is in situations such as these that we could identify not just a role for engineers individually, but also for engineering as a profession; where collective influence opens up a course of action that was closed to the individual (Richard (2009).

**Some few questions on "Engineering Practice, Ethics and Challenges"**

Why is ethics an integral part of professional life, and in particular the life of an engineering professional? The importance of ethics in the professions can be understood through thinking about what a professional is. The word 'professional' is hard to define, even for traditional professions such as medicine, law, accountancy and engineering. However broadly speaking there is agreement on common characteristics shared by all professions (Davis, 1998). Thus a professional:

(i) Has specialized skills and knowledge
(ii) Has acquired such knowledge and skills through a long period of training and study, and continues to maintain and update them through professional life
(iii) Has, as a result of this specialized expertise, significant power to affect individual clients and wider society
(iv) Belongs to a professional body which regulates their practice
(v) And as part of that self regulation adheres to ethical principles which the professional body oversees.

The expertise of professionals, and the domains over which they exercise that expertise, give them power to improve people's wellbeing, or to cause significant harm. This is perhaps most obvious in the case of doctors, whose actions can save lives or cause death, and affect quality of life in many more subtle ways. A patient needs to know that a medical professional is not just technically competent, but will exercise ethically informed judgment in treating them, acting only with consent, maintaining confidentiality, pursuing their best interests, and so on (Davis, 1998). While the actions of a medical professional typically affect individual patients directly, the decisions of engineering professionals have the potential to impact on the wellbeing of many hundreds or thousands of people. As a result of the power their skills bring, society places great trust in professionals to exercise those skills wisely. Thus common to all professions is a commitment to use expertise in pursuit of the public good. This creates a critical role for ethics, as the professional's adherence to ethical principles is a central part of the exercise of good professional judgment. Through this the professional both earns the trust of the public, and provides good reason for such trust to be continued (Richard, 2009).

In short, being a professional brings with it significant privileges in terms of effects on others, whether that be access to information about them, or capacity to affect their needs and interests. Those privileges bring with them important responsibilities, so professions and professional bodies need continually to earn the right to be entrusted with such responsibilities by showing that they exercise them in an ethical way.

**Ethics and engineering**

Engineers invent the future and their work affects the lives of millions people for better or worse. That raises enormous ethical issues in every branch of engineering from computing through biotechnology and energy to civil and aeronautical (source: Engineering ethics in practice survey).

**Ethics and Engineer**

Engineers work in many disciplines but all of them have the ability to affect societal wellbeing to a very significant extent. At one extreme, as Richard Bowen has noted, engineers play major roles in two enormously important aspects of human life.

On the one hand engineers can provide solutions for the more effective management and treatment of water resources. In a world in which a significant proportion of the global population do not have safe drinking water (estimated at 1.1 billion by the World Health Organization in 2004), such engineers have the power to do great good. On the other hand engineers are significant actors in the defence industry. In serving to defend people from aggressors this activity too has considerable potential to

do great good, but equally weapons can be used to cause considerable harm. The privilege of having the skills and knowledge to contribute so much to such important areas of life clearly brings with it the need for wise ethical judgments when exercising that privilege. But engineers also impact on individual and communal welfare in many direct and indirect ways. When a person steps on a bridge they need to know that engineers have wisely balanced the paramount importance of safety against demands for building within cost and achieving a pleasing aesthetic result. The location of a mining project requires good judgment; taking into account environmental and other impacts as well as adequately meeting technical and commercial requirements. Material and energy resources are used in the production, packaging and distribution of products that engineers design and make, and so the engineer must consider the sustainability of their methods.

Responsible engineers have to be aware of all these implications and act appropriately in light of them.

Clearly, then, engineering professionals need to be trusted across a vast range of human activity. Wise ethical judgment is as important for engineers as for any other profession. How, though, does ethics differ from basic common sense? There are many concrete examples which show that intelligent people with good common sense can disagree where ethics is concerned. Modern electronic devices that allow surveillance are often claimed to be valuable in countering terrorism, but people disagree as to whether the consequent invasion of privacy is warranted. Some see the production of wind-power as an environmentally sustainable way of meeting needs for electricity, but others claim the impact of the large turbines on the landscape to be environmentally damaging. The case studies in this paper provide further evidence of the limits of common sense for dealing with engineering ethics (Engineering Council,2003), Richard, (2009). Do such difficult cases show that ethical issues are merely subjective, with no right or wrong responses? They show only that it may not always be obvious what the right answer is, as even the most difficult dilemmas have 'wrong' answers. Keeping all citizens in their homes twenty four hours a day is not a warranted method for achieving security. Completely unregulated extraction of minerals should not be permitted. Identifying these wrong courses of action is not a mere matter of opinion – the aim of this presentation and the Statement of Ethical Principles is to confirm that it is possible to identify key considerations for reaching ethical judgments and to use reason in deploying those considerations into actions.

## SOME SCENARIOS IN ENGINEERING CONSTRUCTIONS

Engineering Ethics in Practice: where the challenges came?

A study was carried by a Researcher and an Engineer on the ethical issues that engineers face in the course of their work, and the support that they receive (or not) from their employers in dealing with them. The small survey was carried out in 2009 and 77 engineers responded. Although this was too limited a sample to draw broad conclusions, some insightful responses were given and may be found useful in dealing with these issues. (Richard (2009), A selection of anonymous comments are quoted or paraphrased in some descriptions and are hereby presented:

**Question**

Are there different pressures in your company which make it hard to always work in the way you feel is ethical.

**Answer:**

Inability of management to get to grips with the idea that everyone cannot do everything, and available competency is a constraint in some cases which needs to be considered. "Safety in construction requires continuous training and emphasizing"

The scenarios below give some brief engineering examples relating to accuracy and rigour as presented in Engineering Practice Guidelines and are quoted as:

"Anne is an engineer working for a company that has an opportunity to tender for some work on the construction of a new building. However, neither Anne nor anyone else at the company is familiar with one of the materials that the client wants to use in the project. Anne's boss suggests that they submit a tender for the work without saying anything about their lack of experience with the material, and in the meantime Anne can take the opportunity to learn what she can. Should Anne go along with this??"

"Bill is a software engineer who is asked to give an opinion in court as to the level of security offered by a company's data protection procedures.

Bill suspects that the system may not be completely secure, though he has not had the opportunity to inspect it as thoroughly as he would like. Should Bill accept the request to appear as an expert witness? If so, how should he phrase his testimony?"

"Claire is a mechanical engineer working on the design of a new make of car. The car has passed all of the legally required safety checks; nevertheless Claire believes that there may be a problem with the transmission that will only manifest itself after a few years' use. Claire has informed her manager, who has informed her that he does not believe the issue is severe enough to delay production until it is fixed. What should Claire do?"

These cases are designed to be challenging and to allow reflection on what the principle means in practice.
In conclusion, Engineers should always use the following as a guide to their practice.

**Acting with care and competence**

Professional engineers are to “always act with care and competence”

**Scenario**

David’s job title is ‘examining engineer’ and it is his responsibility to review and sign off the reports of inspectors who make visual examinations of rail bridges. These reports are intended to identify any defects and to monitor the rate of deterioration of any previously identified defects. All reports should be accompanied by photographs that support the written information (Sunil, 2015). David is one of a number of examining engineers who work together in a team, and he has become concerned that one of his colleagues, Kevin, may not be conducting his work to a standard that David thinks is appropriate. The engineers have worked together for over 10 years, and consider each other to be friends, but David has noticed what seems to be an increasing lack of interest from Kevin in his job. To back this up, Kevin has made light hearted remarks about the lack of detail in the reports that he is given and the poor quality of the photographs he receives and has given the impression that he signs them off anyway. Given the possible impact of this behaviour on the critical safety of rail bridges, David is contemplating taking his suspicions to the regional manager at the company. However, David is in a dilemma since even if Kevin is signing off reports.

## CONCLUSION

It is to be disclosed that the comparison shows good understanding that the clashes and challenges in engineering practice is similar worldwide but the magnitudes of some occurrences and causes varies from place to place. The clashes and interferences between employers, Government undue influence and ethics always lead to many failures in construction. Technical and engineering professionals always come across a situation where it is important to choose between profits and ethics. It is very important to impart ethical values in teaching system so that when these students become engineer they can take the decision form the human welfare point of view. The ethical standards are also important from safety and environmental considerations. This means that the four components of the statement of ethical principles (Accuracy and rigour, Honesty and integrity, Respect for life, law and the public good) are the backbone of engineering practice. When all these are met, another important aspect of engineering practice is (Responsible leadership: listening and informing).

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