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Research Article

Engineering's Effects on Communities through an Ethical Framework

Bailey A. Reid, University of Dayton

Introduction

A research project was conducted in Canada involving the Mohawk community and its 7000 members. The goal of this project was prevention of Type 2 diabetes through the promotion of healthy activities such as better eating habits and increased physical activity in elementary-aged students. The significance of this project was its large dependence on community interaction and consultation, a significant departure from the typical research approach. In the research project conducted by Macaulay, Commanda, Freeman, Gibson, McCabe, Robbins, and Twohig (1999), community was involved in nearly every aspect of the project:

> It [the Mohawk community] participated in *(a)* developing the goal and objectives, *(b)* planning and implementing the intervention and evaluation, *(c)* outlining the obligations of researchers and community in the code of research ethics, *(d)* collecting and interpreting data, *(e)* reviewing lay and scientific publications, and *(f)* disseminating results. (para. 15)

The community was treated as a partner in the project's research, not an obstacle or problem for the researchers. This is significant in the adaptation of a "community-first" mindset, which is crucial when working with communities.

Communities are often treated as an obstacle or problem when conducting research or moving forward with a project. This mindset can lead to ethical issues involving the community and project leaders. This problem can lead to detrimental decisions that detract from progress for society as a whole. It is crucial that researchers and project leaders move away from this mindset and treat communities as collaborators when conducting research or implementing projects for the maximum effectiveness of the project.

One must also consider the different types of communities involved with a project. Communities aren't exclusively limited to the citizens that a project affects, but also include communities of professionals and practitioners. The communities within a professional field are also of importance when it comes to decision making and eventual effects on the communities a project directly affects. Ethical decision making is important in any community, not exclusively communities of citizens. It is within these communities of practitioners that guidelines for ethical treatment and approach to communities are established.

Within these professional communities, community-sensitive education that incorporates a multi-disciplinary ideal (Jamieson, Oakes, & Coyle, 2002; Strenecky & Ellis, 2012) is crucial to the adaptation of a "community-first" mindset. This article will highlight the approach of educating young engineering practitioners to be more sensitive to their effects on communities and to approach communities in an ethical manner. It is important that aspiring engineers be given an ethical basis for their interactions with communities to ensure that communities are not viewed as an obstacle, but rather partners within a project.

Engineering is at the forefront of innovation and progression in our society, but often has various impacts on the communities in which projects take place. This article focuses on several ethical guidelines established through education and engineering's effects on surrounding communities. Ethics inside of community actions and approach will also be explored.

Community

A community should not be defined only geographically, but by many factors such as common interests, ideologies, ancestry or history (Merriam-Webster, 2017). Communities feature relationships among its members whether new or previously established (Lucena, Schneider, & Leydens, 2010). Location is indeed a factor, but it can also be a virtual area such as a forum or organization. One must

also take into account the various levels of privilege. Qualities such as socioeconomic status, race, gender, etc. could possibly go against our ideals, but it is not the place of an engineer to relieve any such class of oppression. This project will not limit its exploration into community to strictly engineering. Other fields such as business and medical education feature many useful practices that could apply to engineering.

The idea of a community may seem fairly abstract, (Lucena, Schneider, & Leydens, 2010), but it is the task of the engineer to adapt and work with a community to let a project flourish properly. Community is a complex subject with many different aspects and complications. Engineers must be capable of taking these into account when attempting to progress forward with a project or an idea. Lucena, Schneider, and Leydens (2010) mention that engineers fail to see the complexity of the environments they operate in. Ideas and applications are often interpreted as universal. This causes an ignoring of the subtle differences among local, regional, or national contexts. These differences compromise the design and implementation of technologies for these areas. As stated previously, engineers must be able to adapt to the fluidity of a community to properly move forward with a project or an idea.

Education

An engineer's consciousness of community often has its roots in engineering education. A large portion of the material focused on engineering and community often include an engineer's perception of community being based in education. Engineering education has adapted to consider a wide range of factors: "Students are mandated to be able to function on multidisciplinary teams, to communicate effectively, and to understand a wide range of issues, including professional and ethical responsibility" (Jamieson, Oakes, & Coyle, 2002, p. 278). Many engineering curricula now require adaptive courses often revolving around a multidisciplinary approach to problems. "Students are taught the importance of developing contextual understanding and of recognizing that lived experiences generate different perceptions of reality" (Hopple & Choi-Fitzpatrick, 2017, para. 1). This instruction directly contributes to an engineer's foundation for community practices that adhere to ethical standards such as realizing different experiences create different conditions for different people (Hopple & Choi-Fitzpatrick, 2017).

It is important that an engineer going out into the field have some sort of basis on how they will interact with the communities that they will be influencing.

An interesting college course on the topic of complexity of engineering community practices is titled "Real Communities, Real Problems, Real Solutions An Interdisciplinary Approach" (Strenecky & Ellis, 2012). This course details that social problems faced by communities cannot be approached and solved effectively by one single discipline. "By bringing multiple perspectives, an interdisciplinary approach can frame and solve community problems in a rich, sustainable, and satisfactory way" (Strenecky & Ellis, 2012, p. 1). This multidisciplinary approach highlights that the field of engineering can in fact learn from other fields and incorporate practices instituted by several fields to create a more sustainable and stable set of community practices and standards.

Professional Communities

The medical education field displays some aspects of community that could possibly be beneficial for the field of engineering. "Medical education is thriving because it is shaped and nourished within a community of practice of collaborating teachers, practitioners and researchers" (Vleuten, 2014, p. 761). The medical research community has realized that research results and practice have been separated for far too long. A proper mixture of teachers, education practice, and research have allowed for "mutually stimulating bond" (Vleuten, 2014, p. 765). The field of engineering could utilize a method such as this by creating a closer connection between researchers, practitioners, and education. Creating this community could allow for a more stimulating conversation on proper engineering ethics. Streamlining this bond between areas of the field and creating closer connections would provide an environment in which community can be a focus and could be discussed. The unification of the various aspects of the engineering field and the opening of a dialogue for community practices in engineering could be pulled from this practice seen in the medical education field.

Philosophy professor at the University of Texas, Robert Solomon made interesting associations between communities and businesses, "He [Solomon] argues that, as members of a community, both business practitioners and the businesses themselves are subject to the general purposes of the community in which they are embedded" (King, 2001, p. 448). Solomon highlights that businesses are subject to the needs of communities as if they are members of the

communities themselves. As they are embedded in communities, they must be on the lookout for what is best for the community. “Solomon believes that the goal of business is not to make a profit, but to contribute to the prosperity of the community” (King, 2001, p. 487). Businesses are to forgo their necessity for profit if their actions on a community are questionable in nature. Community becomes the top priority for businesses involved in them.

Engineers in Community

This process of thinking could prove invaluable to the conscious engineer. This “community-first” state-of-mind would ensure that community would remain a focal point in the decision making of firms and for projects. What would best benefit the community? Are my actions impacting the surrounding area negatively? These are important questions that need to be asked when progressing with decisions that involve engineering. Engineers are not involved with a community to make profit. They are involved with a community for the betterment of the area as a whole. This community-conscious thinking would prove beneficial for the well-being of the community as a whole and the image of the engineers involved.

Engineers have recognized the need for their expertise in their surrounding communities. “They [community service agencies] must rely to a great extent upon technology for the delivery, coordination, accounting and improvement of the services they provide to the community. … They thus need the help of people with strong technical backgrounds” (Coyle, Jamieson & Oakes, 2005, p. 139). Communities now rely on not only the logistics provided by engineers, but their input and expertise on topics beyond their understanding. Museums, schools, etc. need engineers with strong backgrounds to support themselves.

An engineer’s input to a community is invaluable. There are often many areas that most citizens wouldn’t have a great understanding of and engineers must be willing to embrace their ability to fulfill this role as a bridge to what citizens of a community may not be able to understand. Engineers provide a missing link in the knowledge chain of a community. Barring one’s knowledge and practice from a community could prove detrimental to not-for-profits inside of a community and as a whole. Engineers play a key role in communities by providing time, services, and knowledge to their surrounding communities allowing them to grow and flourish.

The engineering field plays a complicated, important role in the communities the field is present in. Community importance has made its way into many

engineering education curricula. Engineering could utilize the practices of unification of aspects of the field as displayed by the medical education community and could establish a "community-first" mentality as displayed by the business community. Providing knowledge and valuable input is one of the greatest effects engineering has on their home communities.

Ethics in Community

Engineering's ethical impact on an area, community, or group of people is often brought into question when exploring engineering's effects on communities. Carl Mitcham (2009), professor of philosophy of technology from the Colorado School of Mines, believes in an interesting outlook on ethics in engineering. The ethical guidelines of engineers are established not by the actual engineers, but by those around them. This has inspired a change in engineering from "use and convenience" to "public safety, health, and welfare" (Mitcham, 2009, para. 1), as if engineers now hold a role more akin to civil servants. We see the establishment of an engineer's ethical bounds throughout past experiences typically involving failure or a breach in ethics.

Engineering disciplines often follow a common core of ethics typically containing seven clauses. Some variation of each clause is usually evident across engineering disciplines. These clauses include a Paramountcy Clause, which calls for engineers to uphold the health, safety and welfare of the public, (Schlossberger, 2012, p. 1334). The second clause involves consciousness of the environmental impact of the engineer's actions. A Competency Clause (p. 1334) exists outlining that an engineer is liable to only perform in areas of competence. The next clause reflects the honesty of engineers and integrity of their actions, (avoiding bribes or deceptive practices). Engineers are to work with colleagues in professional development and are to remain faithful as agents of their employers. And lastly, engineers are to increase the "competence" (Schlossberger, 2012, p. 1334) of the field as a whole. These basic clauses outline the ethical practices involved in the engineering field. These clauses are recognized by the National Society of Professional Engineers (NSPE), the American Society of Civil Engineers (ASCE), the American Society of Mechanical Engineers (ASME), and the Institute of Electrical and Electronics Engineers (IEEE).

The significance of these clauses is that their basis is in morality or standards of human behavior previously established as what we see as acceptable. Engineers

must be capable of decisions that have a moral basis rather than decisions purely focused on profit or economics. Many of these clauses have a basis on protecting groups of people or areas, what many would call communities.

While every clause has the well-being of those surrounding engineering in mind, the first two clauses, The Paramountcy Clause and the Environment/Sustainability Clause, display a notable focus on our typical understanding of community. The Paramountcy Clause mentions the welfare of the public. The decisions made by an engineer must have a basis in what is best for the community. This displays a direct correlation between how an engineer affects the community and the ethical basis behind this decision. The Environment/Sustainability Clause, while broader than the community itself, has a direct impact on the community. If the decision greatly impacts the community environment (literal environment or community life), extra care must be taken. These clauses have a basis on the engineer's community-conscious decision making established from early engineering education.

Conclusion

The complexity of how engineering affects surrounding communities is undoubtable. A conscious engineer must be prepared to examine these complexities and move forward with their practice in an ethical manner. There are valuable insights on community practices available to engineers from other fields such as the business field and the medical education field. These insights coupled with an education that embraces community involvement and focus allow for an engineer to make valuable, ethical decisions that benefit the communities they're involved in. Proper progression through engineering endeavors includes a large extent of community involvement and input to properly ensure the project is being executed in an ethical manner. These decisions conscious of ethical impact on the surrounding community prove pivotal and favorable for society as a whole.

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