How Cultural Differences Affect Cross-Cultural Engineering Projects

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Language Culture

Less than one percent of American adults today are proficient in a foreign language that they studied in a U.S. classroom. Language understanding is the first step in connecting with another culture; a skill that is becoming more desirable in the modern workplace in today's globalizing society. While some companies reduce the language boundary in the workplace through artificial intelligence (AI), these technologies alone cannot help the user fully grasp another culture enough to reap all the benefits of cross-cultural projects. Under the lens of Actor-Network theory, this research paper identifies the benefits of cross-cultural engineering networks that exist today and how engineers, or actors, can access them. This is done through observing historical case studies of both successes and failures of cross-cultural projects and performing network analysis on the relationships that exist between the fields of cultural research and engineering today. Engineers from different places in the world bring unique problem-solving methods to the table and a cultural understanding forms the foundation for accessing and sharing these ideas. What follows will demonstrate how cultural discrepancies influence engineering practices and the results of intercultural engineering projects.

How Culture Impacts Engineering

The question this paper answers is: how do cultural discrepancies influence engineering practices and the results of intercultural engineering projects? This relationship is specifically observed through the auto-ethnographical experience of studying 3 unique cultures alongside engineering and science, technology, and society (STS). In order to draw out these answers, this paper explores cultural practices in engineering, mainly through the methods of historical case studies and network analysis. The historical cases include examples from both recent and not so recent history to show the progression of how countries work together and the change in desire to work together over all. This change inspires the network that will be analyzed as well. This analysis pertains to education, engineering subculture, and government interest which will be analyzed in Japan, Columbia, and the United States to show how the progression of cross-cultural engineering exists in the contemporary.

Relationship Between the Disciplines

In the University of Virginia's (UVA) College of Arts and Sciences, students are required to prove competency in another language or take at least 14 credits or 4 semesters worth of a sequence of classes in a foreign language (college.as.virginia.edu). This requirement does not exist within the School of Engineering and Applied Science (SEAS) despite the fact that engineers in SEAS are being encouraged more and more to prepare themselves for the global workplace. In recent years, this has become less of an issue due to the advancements of language translation applications from companies like Google and Microsoft. However, "hese apps work only when you speak very slowly and distinctly and in short sentences" (Murphy, 2013) making them less ideal for the engineering workplace when complex topics are being discussed at a quick pace and with many potential Three Letter Acronyms (TLA) (Slattery, 1971). Additionally, college language classes in particular, when compared to high school level courses, offer a very good window into cultural knowledge that applications like Google Translate and Duolingo cannot show you. Rashina Hoda, a professor of Information Technology at Monash University in Australia, points out that "given the increasing popularity of GSE (global software engineers), it is quite common nowadays to find software engineering (SE) professionals working in some sort of GSE setting, where the team is distributed across a city, country, or around the globe" (2017), confirming the desirability to understand the culture one may be embedded in during a project, if not for the sake of the project itself then for simply being able to appreciate the time in life spend around said project. Other academics, such as Rustam Shadiev, discuss how, “modern communication technology brings people into close proximity, exposes them to an increasing variety of culturally diverse people, and fosters a range of different relationships” which he and his colleagues are trying to bridge with a speech-based translation technology (2019). Language learning is becoming permeated by language processing algorithms like this, as well as artificial intelligence (AI); it is important that even if a language boundary is crossed, engineers can come to a cultural understanding. This paper discusses a few of these cultural boundaries such as education, language, and the opinion of engineers in a given country to determine what the benefits of gaining these skills in the engineering field could be.

Through this paper, my own experiences with foreign languages/cultures and knowledge gained in STS courses are used to bridge cultural divides in an effort to apply my engineering skills globally. Therefore, this paper focuses on specific cases to provide varying views on the subject which include Japan, Colombia, and the United States.

A Science, Tech., and Society Based Analysis

To analyze these concepts, this paper utilizes the technological determinism and actor network theory (ANT) (Cressman, 2009) frameworks of Science, Technology, and Society (STS) to show the evolution of this topic through time as well as how modern teams interact in a network of different cultures. For each country previously mentioned, this paper analyzes a specific case of how engineering differs in each location through a historical case. This analysis includes how it has functioned, failed, and been overcome in past projects to gauge the general effect. The network analysis aims to see why these case studies resulted in the way they did through analyzing the relationships of the people involved, their cultural background, and engineering experience. These frameworks are not without criticisms. Sven Modell is a professor of the University of Manchester in the United Kingdom and has a particularly relevant criticism of ANT. He describes how ANT has “the ability to be imbued with critical intent” but “is critical of [ANTs] tendency to downplay the significance of pre-existing, social structures and the concomitant neglect of enduring and ubiquitous states of structural stability as an ontological possibility.” (2019) In light of this, this paper specifically looks at social structures in the context of how they differ between cultures.

Engineering Culture Today

The significance of cultural competency has become decreasingly emphasized in the field of engineering as the fields of liberal arts and engineering have diverged in education as they have throughout history. It is true that engineering projects can and have proved to be very successful with only collaboration within a culture. Additionally, problems can be picked out from engineering projects in which the collaborative efforts of two cultures have caused issues in a project. These conclusions, while valid, do not shed light on the real importance of cross-cultural engineering. In fact, this type of project may not even be the highlight of what cross cultural engineering can be.

Particularly in the contemporary political sphere, it is important to observe the effects of green engineering. Climate change has brought the negative practices of negligent countries to effect places that don’t even have the capability of producing a carbon footprint. Likewise, industrialization has led farmers who don’t know any better to increase their carbon footprint to keep up with a global demand. Engineering focused on sustainability, or green engineering, aims to reduce this effect from a number of angles, from farming practices to renewable energies. (Anastas, 2003) In the wake of the events at Fukushima and Chernobyl, German particle physicist Gerhard Knies calculated that covering 1.2% of the Sahara Desert with solar panels would provide enough energy to replace all fossil fuels currently in use. While this idea was obviously not fulfilled as of today, “the Australian continent has the highest solar radiation per square metre of any continent and consequently some of the best solar energy resources in the world” showing that in the right conditions, solar energy on this scale can be effective. Therefore, the question that relates solar energy back to culture and engineering is why is this resource not used in other desert biomes of various countries like the United States, China, as well as the African countries near or within the Sahara Desert? Are there other situations in which the undertaking of large scale, cross cultural projects such as this have taken place? The answer, unsurprisingly, is yes. Staying on the theme of green engineering, some Scandinavian countries recently underwent an electrification process of their roads thanks to Japanese, German, and American electrical automotive technology. (Taljegard, 2017) The drawbacks that were of initial concern in this incident were those of infrastructure. Cars designed for long American highways, the fast Autobahn, or tight Japanese streets already pose some differences when compared to those in Scandinavia. Additionally, the power grid had to be adjusted to be able to create the charging port required for these vehicles. Luckily, in this case, the “new demand from an electrified transport sector in Scandinavia and Germany are mainly met by an increase in generation from wind power,” unlike here in the United States where electric vehicles have initially led to an increase in fossil fuel usage on the back end, essentially burning what would have been gas in the coal burning power plants. Firstly, many northern European countries are well suited to the use of wind generated power, just as Australia is well suited for using solar energy. In this case from somewhat recent history, Scandinavian streets were greatly improved with the addition of foreign electric vehicles. This, of course, does not take into account the economics and environmental impacts of importing. However, the crucial take away of this case is that the foreign engineering in Scandinavia not only provided direct improvement through better vehicles that would have otherwise been unavailable but also complimented the preexisting green engineering strategies that best suited the country. This is a prime example of showing how even without direct interaction between engineers of the respective countries, differences in culture can provide a positive impact when introduced to a new culture in the right way.

Some Japanese engineers in particular, such as Professor Takashi Kenjo, have noted how “Japan and the United Kingdom have a common style of writing for the technical and university textbooks that are reproduced in [the] respective country,” pointing to how these countries may easily begin collaboration after the translation of these books given how similar the two island natures treat their engineers and education. Additionally, Japan is turning its eyes outwards in engineering to begin hiring more engineers from abroad. (Kopp, 2019) Japan’s Japanese Accreditation Board for Engineering Education (JABEE) as well as Japanese Ministry of Economy have noted that there will be a deficit of 789,000 software engineers by 2030 which has become the primary driver for hiring more foreign engineers. Japan has opened the door to begin the cross-cultural exchange of engineering. However, here in particular, the language barrier is much higher as English (not to mention any of the other popular global languages) is not very popular outside of a few major cities in Japan. Even in those cities, most companies in Japan require a citizenship (or some kind of work visa) and a level of Japanese proficiency to work there (Minatogawa, 2015).

As discussed in the beginning of this section, cross cultural engineering has a few key definitions to be considered. Firstly, there is that of two different cultures coming together to complete one larger project. The second is one country performing or delivering engineering in a country of a different culture. Finally, there is the direct spread of education in engineering between two countries at the schooling level. It is important to consider all of these as most engineers may only see the first definition and be blinded to the full potential. Projects like the English Channel tunnel show how successful these projects can be in the eyes of history. However, there were many notable fractures in the project before completion due to a lack of cultural understanding that stemmed from the educational differences as well as how the respective countries viewed the engineers working on the project. (Buchanan, 1986) Obviously, global culture has changed since the time of the creation of the 'Chunnel,' but there is still more change on the horizon. Some cultures have realized the importance of working with other countries, especially in the area of energy production and renewable resources. In the United States, this barrier has not fallen as much due to lack of enthusiasm for learning language and therefore the culture of another country. Particularly, the recent political sphere has increased tensions and changed demands for which languages should be taught but even above this, some schools have begun to replace language learning with computer science, arguing that it achieves the same mental progression in the children learning. If students do not want to learn a language, then it will be hard to share the culture but at least in the United States, this is an important step to be taken in meeting Europe, Asia, as well as some African states in the readiness to work with engineers around the globe.

Conclusion:

Each corner of the globe contains vastly unique culture that has cultivated equally unique people and thought processes. A globalizing society not only means that these cultures have increasing contact, but also that some of them are starting to absorb or cross into each other. This has caused many great minds to be able to collaborate on projects together so far, but this phenomenon is fairly recent. While successful projects will continue to be completed across the globe, more niche problems will be able to be resolved through further collaboration. Most importantly, issues involving climate change and space exploration require global attention to advance as quickly as is necessary to solve them before it is too late. With an open exchange of knowledge and ideas, the future may not be a utopia, but maybe in accordance with one of the codes of the outdoors, we can leave it better than we found it.

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