



Roadway to Failure: Challenges and Solutions to Sustain the Municipal and Utility Lines Within the Growing Infrastructure System in the United States



Alice Long, Civil Engineering
Mentor: Dr. Claudia Garcia-Des Lauriers
Kellogg Honors College Capstone Project 2022

Introduction

Civil engineers are engineers that design and maintain buildings, roads, bridges, and other similar structures. They are the public works servants who are often not recognized to be important aspects to maintain a functioning society. A society that does not have access to their water supplies or strong buildings will hurt the average citizen to the point of even death. While not universal knowledge, under each home and business there are several utility lines for electricity, gas, and water that run throughout the entire city deep underneath the roads that are taken for transportation. Not all these lines solely connect to just the utility lines within a city boundary and connect to a greater county boundary along with source (i.e., Pomona's water lines are connected to the immediate surrounding cities along with its natural water resources at Mount Baldy and San Gabriel Mountains). Civil engineers design and maintain this system to ensure no environmental or unsafe disasters from happening to the average citizen.

Methods

Water is a human right that should be accessible at any time for a person. Civil engineers have the duty of care in their profession to maintain this basic human right by ensuring that the pipelines that are used for water distribution can work effectively in the environment they are in given a rapidly changing society. There are four main reasons for the potential deterioration of a water distribution network which is the aging of said infrastructure due to environmental factors, inadequate maintenance, not enough funds, and the lack of information (Aschilean et al., 2018). These four main reasons are all under the job description of a civil engineer except for funds. Since water distribution lines along with the roads built above them can be used by anyone as briefly shown in Figure 1 from Moerman, they are considered public works that should be funded by the state and federal government (Moerman et al., 2016). The allocation of tax funds to maintain these structures does not entirely on the shoulders of the civil engineers as they are not the lawmakers that determine the amount of funding each government item should be given; however, it should be noted that the civil engineer's knowledge regarding their disciplines combined with outside knowledge can help them convince citizens and lawmakers into allocating more of the tax dollar into infrastructure maintenance.

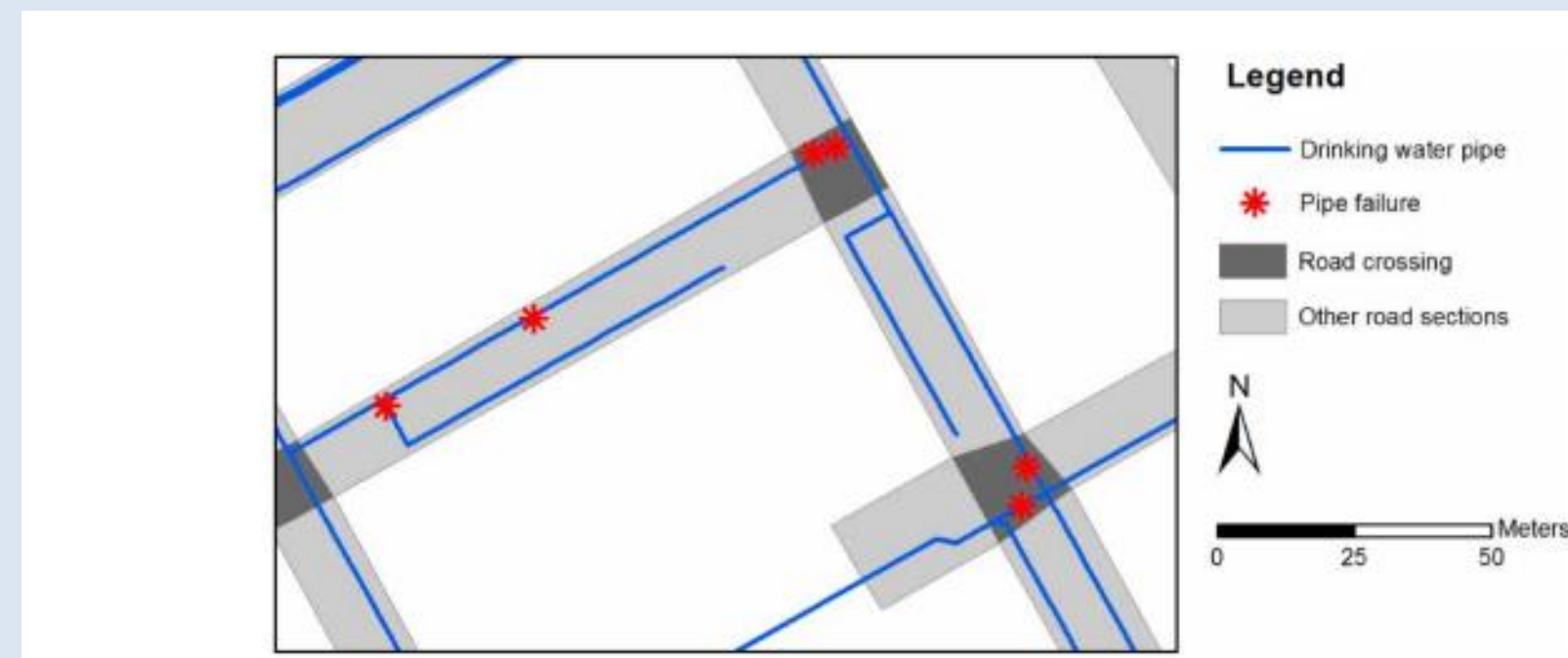


Figure 1. Spatial data of drinking water pipes in GIS taken from Moerman et al., 2016.

With discipline-based knowledge, a civil engineer has factual evidence to maintain why what they're doing needs more funds. Buried water pipes are exposed to several different types of external loads other than the water pressure within the pipe. These external loads include soil settling differences and traffic loads which can lead to the deterioration of said pipelines (Moerman et al., 2016). According to a study by Aschilean and others in 2018, an analysis of the possible relation between failures in the water supply network and road traffic was done for the city of Cluj-Napoca in Romania to see if the undergoing rehabilitation and modernization processes added more direct load towards the roads and the underlying water distribution networks. From this study, it was found that street road traffic exerts a certain "influence on the constituents of water distribution networks, depending on the building materials" of the water distribution pipelines along with the lifetime expectancy of the roadway building material (Aschilean et al., 2018). These two studies along with many others proved by other civil engineers help the credibility of the civil engineer.

Outside of their discipline knowledge, civil engineers have outside knowledge that can help sway the public along with lawmakers into allocating more tax funds to help maintain roads and distribution networks. This outside knowledge is on the more public servant side of informing and telling the public of the work they do in the form of social media. In 2020 there was more than 3 billion individuals around the world having at least one social media platform in their daily lives which makes it likely that there would be a good chunk of netizens being able to see and hear the civil engineer's words about what they do and why it is needed (Ashraf et al., 2021).

References

- Ashraf, M. A., Khan, M. N., Chohan, S. R., Khan, M., Rafique, W., Farid, M. F., & Khan, A. U. (2021, September 26). *Social media improves students' academic performance: Exploring the role of social media adoption in the open learning environment among international medical students in China*. Healthcare (Basel, Switzerland). Retrieved February 20, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8535783/>
- Aşchilean, I., Ilescu, M., Ciont, N., & Giurca, I. (2018, August 15). *The unfavourable impact of street traffic on Water Distribution Pipelines*. MDPI. Retrieved February 20, 2022, from <https://doi.org/10.3390/w10081086>
- Chen, Hsuan-Ting; Li, Xueqing (2017). *The Contribution of Mobile Social Media to Social Capital and Psychological Well-Being: Examining the Role of Communicative Use, Friending and Self-Disclosure*. *Computers in Human Behavior*, (), 50747563217303825-. doi:10.1016/j.chb.2017.06.011
- Moerman, A.; Wols, B. A.; Diemel, R. (2016). *The effects of traffic loads on drinking water main failure frequencies in the Netherlands*. *Water Practice and Technology*, 11(3), 524-530. doi:10.2166/wpt.2016.057
- Montag, C., Yang, H., & Elhai, J. D. (1AD, January 1). *On the psychology of TikTok use: A first glimpse from empirical findings*. *Frontiers*. Retrieved February 20, 2022, from <https://www.frontiersin.org/articles/10.3389/fpubh.2021.641673/full>
- N. H. de Leeuw R. & Buijzen M. (2016) Introducing positive media psychology to the field of children, adolescents, and media, *Journal of Children and Media*, 10:1, 39-46, DOI: 10.1080/17482798.2015.1121892

Results

Civil engineers are credible because of the technical knowledge that they understand and can apply. This knowledge can be applied with the use of social media platforms to help the average person understand what they as civil engineers do for the public benefit. Social media can ultimately have more benefits than detriments at times by serving as an educational tool and contribute to psychological well-being. On-the-go social media use has become "essential to everyday life" with more and more people having the accessibility to smartphones and the internet (Chen & Li 2017). There are mainly three types of social media uses: communicative, friending, and self-disclosure. Communicative focuses on how people contact acquaintances, friends, and family while friending is self-explanatory. Self-disclosure on the other hand refers to the "extent to which people reveal themselves via mobile social media" (Chen & Li 2017). Self-disclosure social media bridges the social differences between others and helps to connect people who would have never communicated together. With highly interactive platforms, social media provides a space for interactions between subject specialists, communities, etc (Ashraf et al., 2021).

Since social media is an integrated part of society and something that has been built upon, civil engineers do not really have to think too hard about the information they post if it is accessible to the community and it is credible backed up with facts; furthermore, it provides the civil engineer an opportunity to participate in something that's usually not within their field of discipline which would then help their own psychological well-being. These social media posts by actual civil engineers can also become a mean of escapism for viewers as not everyone lives a similar lifestyle to get an understanding of another person's life (Moerman et al., 2016). It was the need for escapism that caused social media platform Tiktok to skyrocket during the COVID-19 pandemic (Montag et al., 2021). With even just passive use of just browsing and consuming social media, civil engineers can use these platforms to inform their communities about why their work is important and why they need funds to secure the safety of overall community. Not only are they helping to inform netizens who might have never learned this information, but they are providing a health means of self-expression and psychological well-being.

Discussion & Conclusion

There are of course drawbacks to having a slightly more focus on the public worker side as a civil engineer. Some advantages and disadvantages can be found in Table 1. Not everyone is readily available to focus time on social media as their main job is to be a civil engineer not an influencer; furthermore, personality wise some engineers might not feel comfortable talking on camera or making social media posts. Introverts are less likely to make social media posts or go out of their way to do so compared to their extrovert counterparts. Active use of social media describes high engagement towards the social media platform and includes "commenting and uploading videos" (Montag et al., 2021). So, while it might be difficult for a person to put themselves out there and create content about their subject, it is easy to comment explaining your subject. A solution that can work for both introvert and/or busy civil engineers is just to merely communicate with the people in their communities rather than just those they work with. In their communities and sometimes in their families, not much technical knowledge is known about what civil engineering is and why it is important that they do what they do. By slowly explaining why road maintenance is important to a neighbor and their livelihood, they might be able to spread the knowledge of it to others. While this spread of knowledge will not be as fast as social media posts, each person is different and if they have a genuine desire to spread this knowledge, then something is better than nothing. More research can of course be done to see how engineers using social media can benefit a community.

Table 1. Advantages and Disadvantages of Social Media Use

Advantages	Disadvantages
<ul style="list-style-type: none">• Can improve the educational process of open learning (OL)• Quick spread of information that might not be common knowledge• Provides a means of escapism and entertainment purposes• Reduces loneliness	<ul style="list-style-type: none">• Privacy problems from both the poster and the viewer• Spread of misinformation can be common• Addictive and can drastically change lifestyle habits such as sleep disruption• Cyber bullying and harassment

Acknowledgements

I would love to thank Dr. Claudia Garcia-Des Lauriers for helping me out with guiding me with the organization of my research and poster especially with my prior issues with mentors for this project. I would also love to thank Kellogg Honors College for giving me the opportunity to do this project and for printing this poster out. Additionally, I would love to thank Dr. Peg Lamphier along with Dr. Ali Sharbat for guiding me to choose this topic to research more about.