Minimizing Underground Infrastructure Damages: Utility Locators' Perspectives

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ABSTRACT

Thousands of damages to underground utilities, including gas, water, and sewer, occur every year. Damages to underground utilities have a significant impact on national and local growth, as well as citizens' wellbeing. It is crucial to reduce damages to underground utilities. Currently, damage prevention effort consists of three-steps: (1) construction firms must contact state notification centers (one-call centers); which in turn (2) notify utility owners who must locate their utilities on the ground; and (3) construction firms (i.e., excavators) must respect marks and exercise care around marked utilities while excavating. This study investigates the perspectives of utility locators regarding current practices. Among other findings, the study reveals that the lack of clear communication between locators and excavators negatively impacts the current damage prevention process. The findings will contribute to better damage prevention processes and a lower number of strikes to underground utilities.

INTRODUCTION

Underground infrastructure is an integral component of any urban community. In the United States, the huge underground maze is made up of roughly 35 million miles (Nelson et al. 2012), and this number is expected to continually increase given population growth and the requirement to attain the provided services (i.e., sewer, water, and gas). Damages to subsurface utilities is a widespread issue that construction firms often face (Al-Bayati and Panzer 2019a). There were 341,609 unique reported damages to subsurface utilities in the United States and Canada in 2018, which is higher than the number of damages in 2016 and 2017 (Common Ground Alliance (CGA) DIRT 2018). Millions of miles of subsurface utilities, including gas, water, and sewer, have been installed underground, which increases the likelihood of striking them (Al-Bayati et al. 2019). The impacts of damages include project delays, costly repair expenses, environmental damages, and fatal and non-fatal injuries. Thus, direct and consequential costs could be substantial. The current practice to reduce damages to subsurface utilities consists of the following steps (Al-Bayati and Panzer 2019b):

1. Contractors (i.e., excavators) are required to contact one-call centers
2. One call center notifies utility owners
3. Utility owners must mark their utilities
4. Contractors should respect the marks and exercise care within the tolerance zone established around the marked utilities to avoid damages.

The key components of current damage prevention efforts are excavators, one call centers, and utility locators. This process is intended to form a loop of communication that informs different parties about the requirements, responsibilities, and steps needed to reduce damages to

subsurface utilities. Researchers have identified several root causes that contribute to subsurface utilities, including excavation practices (e.g., failure to use hand tools when needed, failure to protect/shore underground facilities, and improper backfilling practices), locating practices (e.g., utilities that have not been located, marks are faded or not maintained, and inaccurate marks), and notification error (e.g., failure to notify the one-call center/811 or providing wrong information). For example, there were 12,024 reported damages in the state of North Carolina in 2018. Figure 1 summarizes the causes of damages in 2018 based on information provided to NC 811 without the unknown inputs. The Other Causes category includes cases where damages were not a direct fault of any of the involved parties. Relying on these root causes as singular explanations, however, would be based on the assumption that the process happens in a vacuum where there is no overlap between the identified causes. The causes overlap in real life. Accordingly, this study aims to investigate the influence of lack of communication between the stakeholders (i.e., excavators, locators, and one call centers) on damages to subsurface utilities.

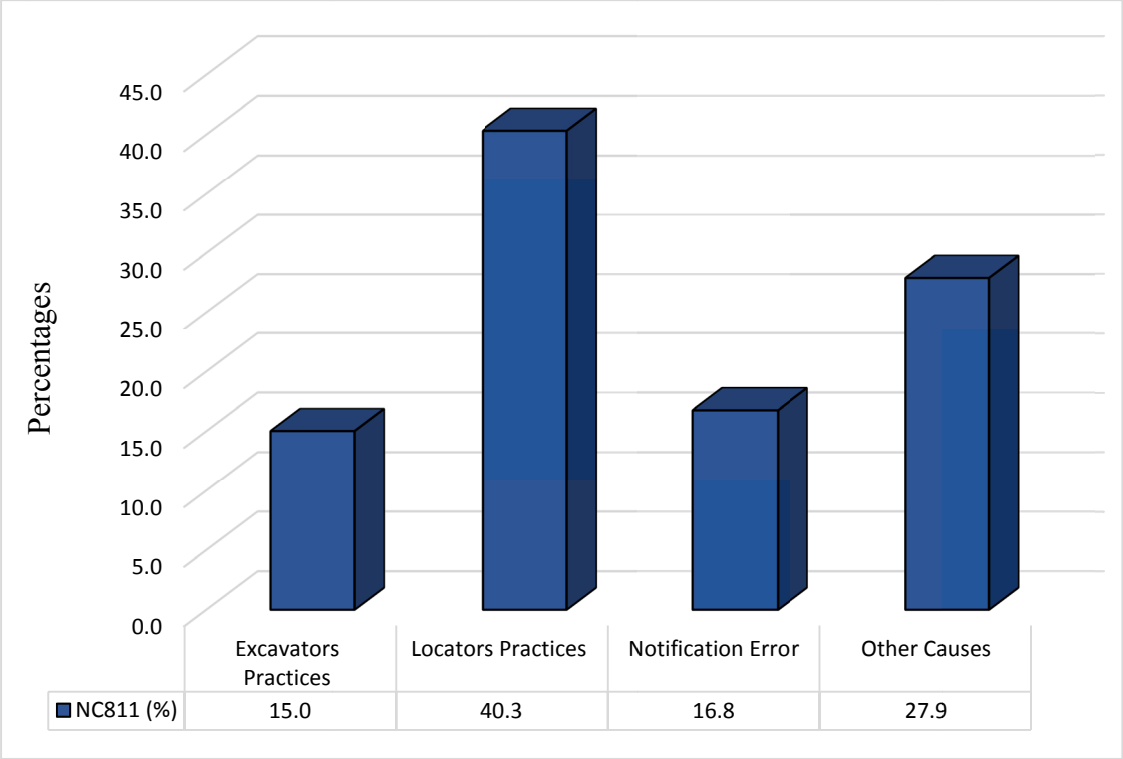

Figure. 1. Root Causes Proportions

METHODOLOGY

A partnership with the NC 811 notification center has been established to achieve the study goal. A survey was prepared to solicit the locators' opinions regarding six aspects: excavators provide white lining (i.e., marking excavation route to outline the dig site before the locator arrives), quality of the locate ticket information, accurate maps provided by utility owners, training quality, and locate equipment. The survey aims to assess the influence of factors other than the already identified factors. Accordingly, the responses were analyzed and scores were

generated for each of the questions. Furthermore, statistical analysis was conducted to measure the statistical significance of the responses.

FINDINGS

The survey was administered during Spring 2019, and 98 responses were received. The job titles of the respondents fell within the following categories: locate technician (n = 44, 44.9%), locate manager (n = 30, 30.6%), and locate supervisor (n = 24, 24.5%). The experience of participants fell within the following: more than 3 years of experience (n = 81, 82.6%), between 1-3 years of experience (n = 14, 14.3%), and less than 1 year of experience (n = 3, 3.1%). The educational background of respondents mostly falls within U.S. high school (n = 26, 26.5%) and some college or beyond (n = 68, 69.4%). The average age of participants is 43.2 years (SD = 11.1). Finally, the respondents came from North Carolina (n = 43, 43.9%), New Jersey (n = 10, 10.2%), California (n = 8, 8.2%), South Carolina (n = 6, 6.1%), and other states (n = 31, 31.6%). Participants were asked to score their confidence from 1 to 10, with 10 being *high* and 1 being *low confidence* in the following aspects:

- Utility owners' maps
- Locate equipment
- Excavators provide accurate locate description
- Excavators provide white lining
- Training provided to locators
- Quality of the locate ticket information

A factorial ANOVA was conducted to determine the significant statistical differences, if any, in confidence based on participants' feedback. The results indicate a statistically significant difference in the score of confidence (F = 322.96; df =5,579; $p < 0.001$). A statistically significant difference means that there is less than a 0.001 chance that the difference in scores could be attributed to random effects; however, the ANOVA test does not tell where the statistical differences lie. Accordingly, Tukey's Honestly Significant Difference (HSD) tests were conducted on all possible pairwise contrasts. The results revealed locators are less confident in providing white lining by excavators (score average 3.54), followed by locating description provided by excavators (score average 4.13), and quality of locating ticket information (score average 4.83). The locaters' confidence level in utility maps was found to be less than the training they received, as well as the locating equipment (score average 5.66). Overall, an average score of 5.66 suggests that utility maps do not provide the actual utility location on a regular basis (as planned versus as built), which requires further efforts to update utility maps. Table 1 illustrates the groups that were found to be significantly different ($p < 0.05$). The overall results indicate the there is a clear communication gap between locators and excavators (i.e., white lining and locate description). This lack of communication contributes to delayed and inaccurate locates, which in turn, increases the likelihood of striking underground utilities.

DISCUSSION

The influence of communication between stakeholders on subsurface utility damages has been rarely discussed in the literature. The findings of this study indicate the necessity of communication between stakeholders, especially locators and excavators, on the damage prevention process. Accordingly, the study reveals less confidence in crucial communication

aspects, including white lining, locate description, and ticket information (i.e., groups 1 and 2). This finding suggests that locators experience difficulties finding the excavation area. As a result, the damage prevention process appears to be negatively impacted by the lack of communicating identified by this study. Locators who arrive at a construction site where the excavation area is not clearly marked will spend a longer time locating unnecessary subsurface utilities, which could impact the overall accuracy. In 1998, the Pipeline and Hazardous Materials Safety Administration (PHMSA) convened a meeting of 16 industry stakeholders from underground utility safety and damage prevention industries that resulted in CGA's best practices guide (CGA 2019). Thus, it is hoped that the CGA Best Practices Committee considers the findings of this research as a potential inspiration for future recommended best practices. The accuracy of maps provided by the utility owners (i.e., group 3) seems to be a challenge that should be addressed by utility owners. Accurate maps are crucial to delivering accurate and timely locates. Lack of as-built information and drawings is a leading cause of damages, as suggested by Goodrum et al. (2008). Similarly, Makana et al. (2016) suggested that the lack of effective communication prevents data sharing between stakeholders, which increases the likelihood of damages. Finally, locators seem to be more confident about the training provided to them and their locate equipment.

Table 1. The locators' confidence from less to most confidence – ANOVA test

Group #	Aspect	Score Average
1	Excavator provided white lining	3.54
2	Excavators provide accurate locate description	4.13
	Quality of the locate ticket information	4.83
3	Utility provided maps	5.66
4	Training provided to you	7.34
	Locate equipment	8.14

CONCLUSION

The responsibility of protecting infrastructure from third party damage falls on all parties involved in the process, especially locators and excavators. The success of each element of the safe digging process is predicated by the action taken in the previous step. Therefore, all parties should review their contribution to the overall system and make corrections that can prevent damages. Additionally, the overall process should be well understood by stakeholders to help

protect life, health, and property. Damage prevention acts were proposed and implemented to ensure that workers and citizens are protected, and hence, damages are reduced. Beyond stakeholders' responsibilities, communication between involved parties is crucial to ensure the acts deliver their intended purpose. Accordingly, the findings of this study will aid in improving existing practices in damage prevention, and therefore reduce associated direct and consequential costs of damages. The authors hope this research can help others to follow suit in identifying the stress points within their own jurisdictions to affect meaningful industry change.

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