



INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

TRB Subject Code: 21-4 Utilities Accommodation
Publication No.: FHWA/IN/JTRP-2003/12, SPR-2451

October 2003
Final Report

IMAGING AND LOCATING BURIED UTILITIES

Introduction

Population growth and industrial expansion since World War II have resulted in increased infrastructure spending particularly in the United States (U.S). The urban underground has become a spider's web of utility lines, including phones, electricity, gas, cable TV, fiber optics, traffic signals, street lighting circuits, drainage and sanitary sewers and water mains. The deregulation of utility services has been adding to the problem of utility congestion as multiple service providers seek to place their networks underground.

New construction in urban areas and a growing number of rehabilitation and replacement projects undertaken to maintain and improve the aging infrastructure have often resulted in increased instances of damages to underground utilities, and undesirable consequences to contractors, project owners and citizens. These consequences include construction delays, design changes, claims, property damages, service breakdowns, disruption of neighboring business and even injuries and lost lives.

The costs of utility damages are very significant and on the rise. Generally, the total cost of damages

is underreported because only the direct costs of the emergency response and of repairing the damage are included. The American Institute of Constructors (AIC) reported that damage to utility lines is the third most important crisis for contractors, the other two issues being on-the-job accident requiring hospitalization and contractual dispute with a client resulting in litigation

The major objectives of this study were:

- a) to identify, through literature review and case studies, the state-of-the-art and the state-of-the-practice imaging technologies that have potential for being applied in locating underground utilities, and
- b) to analyze the conditions under which the use of these technologies is most appropriate because not all technologies can locate all types of utilities, or be used in all types of soil or at all depths.

Findings

This report evaluated and compared currently available systems for locating underground utilities. The synergistic use of the One-Call system and Subsurface Utility Engineering (SUE) is recommended to improve the safety of the underground pipelines and project efficiency in construction projects.

The report presents a comprehensive overview of various aspects of the new and rapidly growing SUE market. The cost-benefit analysis, based on seventy one (71) actual construction

projects where SUE was employed, revealed that more than four times the funds invested in the SUE service were returned to project owners, in the form of savings. The highest cost savings factor was the reduced number of utility relocations. This provides a strong indication that SUE is a promising tool for cost savings in highway construction projects particularly where utilities are congested.

The questionnaire surveys of State DOTs revealed an average increase of 17% in the

annual SUE program budget during the 1999-2001 period, high satisfaction with the use of SUE (> 90%), and an increasing number of states that have initiated the use of SUE for their highway construction projects. The questionnaire survey of the SUE industry revealed various aspects of SUE practices in the private sector. It revealed a rapid growth rate of SUE business (173%) in the past five years. The major clients are currently State DOTs (>50%). SUE firms are highly dependent on pipe and cable locators for the designating process and vacuum excavation system for the locating process.

The study examined a variety of underground utility imaging methods, interpretation of the results obtained from each imaging method and application of the method. Based on this analysis,

ten criteria were chosen to assist in the selection of the most appropriate imaging technology. The criteria include type of utility, material of utility, joint type of metallic pipe, special material for detection, access point to utility, surface condition, inner state of utility, soil type, the depth of utility and the diameter of utility. A multimedia educational tool was developed to facilitate a better understanding of underground utility locating systems by the many in the construction domain, particularly entry-level engineers who are relatively unfamiliar with these technologies. This tool also contains video streaming files for different imaging technologies recorded during the site visits by the research team. The video clips enable the users to observe the different steps in each of the major imaging technologies.

Implementation

A Decision Support System named IMAGTECH was developed, in order to provide a tool for the selection of appropriate imaging methods. When a user selects or inputs data that best matches the conditions at the proposed site, the application provides the most appropriate imaging method and two other alternatives with a level of

reliability assigned to each imaging method. The application can be used as a training tool to simulate utility locating operations. A multimedia education tool was also developed to facilitate better understanding of the underground utility locating systems for entry-level civil and construction engineers.

Contacts

For more information:

Prof. Dulcy Abraham
Principal Investigator
School of Civil Engineering
Purdue University
West Lafayette IN 47907
Phone: (765) 494-2239
Fax: (765) 494-0644

Prof. Daniel Halpin
Principal Investigator
School of Civil Engineering
Purdue University
West Lafayette IN 47907
Phone: (765) 494-2244
Fax: (765) 494-0644

Indiana Department of Transportation
Division of Research
1205 Montgomery Street
P.O. Box 2279
West Lafayette, IN 47906
Phone: (765) 463-1521
Fax: (765) 497-1665

Purdue University
Joint Transportation Research Program
School of Civil Engineering
West Lafayette, IN 47907-1284
Phone: (765) 494-9310
Fax: (765) 496-1105