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A spatiotemporal database approach to the management of utility work schedules in transportation projects

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ABSTRACT

As more and more utility installation and/or maintenance activities are located in highly congested urban roadways, frequent pavement utility cuts in such areas may cause more traffic disruptions and reduce pavement lifespan and quality. One way to lessen such inconvenience to the traveling public is to combine utility activities together in the hope of reducing unnecessary pavement utility cuts, which requires extensive coordination of the utility owners involved and deliberate management of utility work schedules. In this research, an information model and a system based on spatiotemporal database techniques were proposed to help public road authorities manage utility work schedules better. Issues such as constraints of utility permits, pavement moratorium, and utility clearance restrictions were addressed, and examples showing real utility activities and constraints were elaborated to test the functionality of the proposed model. The model can serve as a new managerial tool to facilitate the utility coordination process between public road authorities and utility owners.

1. Introduction

As more and more people dwell in urban areas, an increasing number of utility installation and/or maintenance activities are located in such areas that make a great impact on paved roads. The steady escalation of the internet penetration rate demonstrates the need for more communication equipment such as fiber broadband lines or wireless access points to be deployed along urban roadways in the near future. In order to provide new services or maintain deteriorating utility networks, utility owners have to cut pavements open, install new utility facilities or fix identified problems, backfill proper materials, and restore road surfaces. Reports showed that in the District of Columbia, USA, there were over 5000 utility cuts in 1996 and over 6000 cuts in 2000 [1]; in New York City, more than 250,000 cuts a year were made in 1999, and the number increased by 8% each year [2]. Another study indicated that utility activities in the UK rank as the second major cause of traffic disruptions, with estimated delay costs of $13 billion dollars, and uneven pavement surfaces due to frequent utility cuts may further result in driver annoyance and other safety issues [2]. Researchers have pointed out that pavement utility cuts are a major problem in the transportation infrastructure of the USA, not only reducing the pavement life by 7–12 years [3] but creating serious financial stress on public road authorities [1,4]. In sum, pavement utility cuts are increasing, and a systematical approach to helping public road authorities alleviate the inconvenience caused to the traveling public is needed.

Since utility owners need to obtain permits from public road authorities before commencing their work [4,5], the authorities should be able to collect the schedules and maps of all planned utility activities. If an information model and a system considering both temporal and spatial properties of utility activities are utilized, the authorities may be able to detect any potential conflicts between these planned activities. Further, because encouraging utility owners to work together is generally recognized by public road authorities as a potential strategy to reduce unnecessary pavement utility cuts [6,7], it could be realized by examining these schedules from utility permits submitted in order to identify the utility activities that can be performed together. Additionally, using an information system capable of handling spatiotemporal data might help the authorities check more factors when issuing utility permits. For instance, newly constructed or overlaid roads require a certain period of pavement cut moratorium [3]. A comprehensive protection strategy for these roads against any utility work could be implemented if the pavement moratorium information can be completely entered into the system, and if the authorities can examine the space and time conflicts between the pavement moratorium and utility permit data. Currently, no such information systems or research studies exist. Hence, a managerial tool that can keep track of the schedule and geometric boundary of every planned utility activity is highly desired. Any

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