CONTROLLING AND REDUCING THE FREQUENCY OF PAVEMENT UTILITY CUTS

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ABSTRACT

At an alarming rate, pavement utility cuts are becoming a major problem in the pavement infrastructure of the United States. Not only is the number of overall utility customers increasing with the growing US population, new and widely variable types of utilities are being developed constantly. In the first half of the twentieth century, the major utilities included water, wastewater, electricity, telephone and natural gas. By the end of the twentieth century, the volume and variety of utilities have increased dramatically, including cable television, an unprecedented increase in telephone customers, fiber optics, internet-related technology and cabling, and others.

This paper describes the need for developments in public policy and technology to reduce, or at least to control, street cuts and minimize damage to public infrastructure due to the ever-increasing activity of new and existing utility companies. This paper also describes the problems associated with extensive pavement utility cuts, and recommends potential solutions based on policies and technologies. Such recommendations include the advancement of trenchless technology applications and policies that can be implemented by cities, states, and other local governmental agencies to control the frequency of pavement utility cuts in the agency's pavements. This paper also includes case studies relating to shared resources, a potential policy for reducing the frequency of utility cuts.

Key Words

utility cut, pavement deterioration, trenchless technology, public utilities, franchise fee, right of way management policy, permit fees, shared resources

INTRODUCTION

Public policy developments to curb street cuts and minimize damage to public infrastructure evolved from routine requirements outlined in city or state codes for emergency rules to stop the ever-increasing activity of new and existing telecommunication companies. The rush of new companies requesting access to public right-of-way has magnified the need for better control of utility street cuts and improved standards for how cuts are repaired. This paper describes the problems associated with extensive pavement utility cuts, potential solutions based on policies and technologies, and then provides preliminary recommendations regarding the best policies and technologies to help reduce the frequency of pavement utility cuts.

Background

On February 8, 1996, The Telecommunications Act of 1996 *(1)* was signed into law. Overall, the intent of the bill was the development of competition in the telecommunications marketplace by allowing local telephone exchange carriers to provide long distance telephone service, as well as cable television, audio services, video programming services, interactive telecommunications and Internet access. Similarly, long distance providers, cable operators and utilities are now permitted to offer local exchange telephone service. The Act is complex and the rules and regulations adopted to implement the it have a significant impact on a state and/or local government's authority to manage access to, and use of, the rights-of-way (ROW) under its authority.

As can be expected, the frequency of pavement utility cuts has kept pace with the increase in telecommunication and other utility installation and construction. Pavement utility cuts are becoming a major problem in the pavement infrastructure of the United States. Not only is the number of overall utility customers increasing with the growing US population, new and widely variable types of utilities are constantly being developed. By the end of the twentieth century, the volume and variety of utilities have increased dramatically, including cable television, an unprecedented increase in telephone customers, fiber optics, internet-related technology and cabling, and others. Each of these new technological advances has seen tremendous growth throughout the past 50 years, and especially during the past 20 years. As an example, in 1996, the District of Columbia, a city of 572,000 residents and only 156 km^2 (61 mi^2) and 2,092 km (1,300 mi), had over 5,000 individual utility cuts *(2)*, and estimated over 6,000 cuts in 2000.

DISCUSSION OF THE PROBLEM

Public and private utilities are most often located in the public right-of-way, meaning that access to underground physical facilities often results in digging and backfilling trenches. Many times this means trenching into public roads: city streets, highways, and other public transportation facilities. Utility companies are constantly closing lanes, trenching pavements, and backfilling with what seems to be constantly declining quality in repairs. While it is true that the utility companies' financial success depends on their ability to place facilities and provide services to customers as quickly as possible, the detrimental effects on the public transportation infrastructure has been largely overlooked in the past.

San Francisco, like many other cities in the nation, confirmed its suspicion about the damage caused by utility street cuts after completing a study *(3)* on the effects of cuts on the life of pavement. The cities of Austin *(4)*, Cincinnati *(5)*, and Washington, DC *(2)*, also conducted similar studies within the past five years. These studies found that street cuts not only cause damage to the life of the streets but also cost millions of dollars to agencies in premature repair and street remediation expenses. Other financial impacts from utility cuts and poor repairs include traffic delays, increased congestion in urban areas and damage to both public and private vehicles.

Structural and Functional Deterioration

When utility companies, and others make cuts into the pavement for utility installations, not only do they affect the pavement structure itself, but also the other utilities under the national and local transportation infrastructure. Utility cuts into the pavement of the nation's highways and streets generally decrease their expected life span. There are two types of degradation that can occur – structural and functional – both of which can cause early "failure" of the pavement.

Structural Deterioration

Structural deterioration occurs when the pavement can no longer carry the loads for which it was designed without large deflections or deformations. Structural performance relates to a pavement's condition, or level of distress, which would affect its load-carrying capacity or would require maintenance or rehabilitation *(6)*.

Functional Deterioration

Functional deterioration occurs when the pavement no longer provides a smooth riding surface for vehicles and passengers. A pavement can sometimes experience functional deterioration while remaining structurally sound. However, it is less likely that a pavement that has experienced structural deterioration will remain functionally adequate.

Congestion of Utilities in National Infrastructure

One of the major recommendations of this paper is to increase the availability and technological soundness of trenchless technology applications. A problem with such construction is that the probability of accidentally rupturing existing underground utilities increases with increased congestion, or the density of utilities underground. This is not a problem solely associated with trenchless technology, however. Open trenching also poses a risk of disturbing existing utilities.

Public Impacts

There are several types of impacts that excessive trenching and utility cuts can have on the public. These include those that cost the public money directly and those that have indirect, or intangible, costs. Direct impacts are generally those that the public pays individually or collectively, whereas indirect impacts include those which are paid by society as a whole, and to which a specific price cannot be easily affixed.

Public Perception

In the public's perception, the highways and streets always seem to be under construction. If the road network is improved as a result of this construction, the public perception could be positive. However, a poor perception is often the result, due to the endless presence of utility cuts and poor repairs.

Traffic Delay

When a lane of traffic is temporarily made unavailable, and especially in heavily-trafficked areas, vehicles can be delayed due to decreased traffic capacity. If utility cuts are coordinated with joint trenching requirements, traffic delays can be minimized.

Costs to Local Business Due to Work Zones

Lane closures and other traffic control associated with utility cuts can impact local businesses by either limiting access to the business, or by deterring potential customers from navigating around the traffic control.

Costs to Users of the Highways and Streets

Direct impacts to users of a facility are often called user costs. These costs can include tangible items such as excess fuel, oil, maintenance, and time expended while negotiating a work zone, and the

associated traffic congestion that often accompanies lane closures. Several studies have been conducted to quantify user costs in various situations and work zone configurations *(7, 8 and 9)*.

Many of these user costs are also borne by the traveling public after the work zone has been removed, when a rough pavement remains. Studies have shown the relative incremental increase in user costs due to pavement roughness *(10, 11, and 12)*.

COMPENSATION FOR UTILITY CUTS

Typical right-of-way users are electric, gas, telephone, cable, communications, and fiber optic companies. These utilities and telecommunication companies use the surface, subsurface and airspace of a jurisdiction's alleys, sidewalks and streets; as well as tunnels, poles, conduits, and ducts to provide their customers service and transact business. It is important that public agencies be compensated for their direct costs related to utility construction through fees paid by the utility companies that use the public right-of-way. Information contained in this section is based on a survey of jurisdictions by George White and Carolyn Grant of MAXIMUS, Inc., (unpublished data).

It is apparent that significant right-of-way revenues are derived via franchise agreements or ordinances with utilities, telecommunications companies and cable providers. The majority of franchise fees, or equivalent revenue, is collected as percentages of the utilities' or providers' gross revenues or gross receipts. On an average, these fees range from 3% to 5% of utility gross revenues within a given jurisdiction. Other agencies are compensated in the form of linear foot fees, which can vary greatly, depending on the type of utility, expected future needs and business, and the negotiations undertaken between the utility and the agency.

Passage of the 1996 Telecommunications Act has had a major impact on jurisdictions. Some of the impacts include:

- Restricting a jurisdiction's right to control its rights-of-way,
- Limiting franchise fees, property taxes and other revenue,
- Prohibiting a jurisdiction's right to provide telecommunication or cable television service,
- Depriving jurisdictions of recourse to local circuit court,
- Utilizing existing right-of-way valuation methodologies, and
- Processing and evaluating requests for access to public right-of-way or easements by utilities and other companies.

Revenue Based Compensation

This method of payment is most common for local utilities, cable companies and competitive local exchange companies (CLECs). Local utilities include local exchange telephone companies, electric, gas, water and steam. CLECs are companies that compete with local exchange carriers in the area of providing access to long distance carriers, private line and local telephone service. Franchises or licenses are granted by jurisdictions to the three general categories of utility users of public rights-of-way, as shown in Table 1. Research of jurisdictions' rights-of-way compensation arrangements for the aforementioned categories indicates rights-of-way fees are generally assessed in the manner shown in Table 2. Table 3 shows the comparison of gross revenues derived from rights-of-way fees for the cities of Chicago, Houston, St. Louis, and New Orleans.

Gross receipts-based franchise agreements generally permit utilities to have unlimited access to public space and rights-of-way for a specific purpose such as providing electric or gas service within the jurisdiction. These franchises typically regulate conduits, buried cable and all other aspects of the utility's activities in public rights-of-way. In return for right-of-way access, the franchised utilities

agree to pay the jurisdiction based on a percentage of all gross receipts from operations within the jurisdiction. Utilities are typically required to pay property, utility and other taxes such as sale, use, special taxes and assessments for public improvements, in addition to gross receipts franchise fees.

Linear Foot Fee Compensation Basis

Generally, the linear foot charge is used for limited access to public right-of-way as in the case of a telecommunications operator building a limited network in a downtown urban area. Many jurisdictions use this method for fiber optic local loops, including interstate long distance carriers and interstate pipeline companies. For example, Atlanta and Chicago use the percentage of gross receipts model for utilities such as local exchange, electric and gas companies. Philadelphia, on the other hand, only charges a linear foot fee. This section, and others, refers to linear feet in the text where the term is used in the original sources, and meters where specific numerical values are discussed.

Summary

These two methods of compensation for franchises generally cover the cost for permits, approvals, inspections, and other administrative work by the agency to track and maintain the utility cuts conducted by the utility companies. Repair of the cuts is often left as the responsibility of the utility contractor, and must be paid in addition to the franchise fees.

These methods of compensation have worked well for cities and states when a limited number of long-term, well-established utility companies were the only tenants. With the passage of the 1996 Act, however, many hundreds of utility companies have requested access to the public right-of-way. In order to control and attempt to reduce the number of pavement utility cuts made in the ROW, policies and technologies must be adopted by governments both at the local and state levels. The following section describes some potential policies and technologies that may be useful to these agencies in their attempts to control and reduce the frequency of pavement utility cuts.

RECOMMENDED POTENTIAL SOLUTIONS

Controlling and/or reducing the frequency of pavement utility cuts includes can be effected from either policy- or technology-based actions by public agencies. Policies generally impose incentives and disincentives, requirements, or fees on utility companies in order to obtain approval to perform their necessary construction and maintenance of their utilities. Public agencies may also promote technological advances that eliminate the necessity of pavement cuts for utility construction and maintenance. Either method, or a combination of both, can be effective in controlling and reducing the frequency of pavement utility cuts.

Policy

Jurisdictions have the authority to manage public rights-of-way and to recover management and inspection costs. Management activities include, but limited to, establishing permit, regulation, construction, installation, performance bond and relocation requirements for utilities and other companies requesting to utilize the right-of-way. Three types of policies, which are in use or are proposed, are briefly discussed below.

Incentive-Based Policies

Coordination of excavation activities by jurisdictions is imperative to effectively manage the use of the right-of-way. To improve construction coordination, many jurisdictions are encouraging the use of trenchless technology as well as shared resources and shared trenches.

Trenchless technology is becoming more commonly used to meet underground construction needs. This technology provides an alternative to open trench construction in many cases and conditions. It is being used in many communities to lessen environmental and traffic impacts of open trench work. Other

benefits include lessening the loss of revenue to businesses along the utility alignment and avoidance of differential settlement in trench restorations. Some jurisdictions have developed policies to encourage utility companies and others seeking access to the public right-of-way to consider methods other than trenching.

Incentives can be developed to offer right-of-way users lower fees if these policies are utilized. Examples of this type of policy include the following.

Provide Incentives to Encourage Use of Trenchless Technology The majority of the state and city survey responses indicated trenchless technology, while utilized by utilities and others, was not a mandatory requirement but was strongly encouraged. Review of the fee structures provided did not uncover reduced or waived fees for use of this ever-growing technology. However, several jurisdictions are discussing whether or not to reward utilities for utilizing this desirable technology.

Require Justification for Not Using Trenchless Technology Upon receiving an application to excavate, many jurisdictions are discussing the use of trenchless technology with utility applicants. Often, trenchless may not be the feasible nor practicable from an engineering or budgetary standpoint.

Provide Incentives to Encourage Less Damaging Types of Cuts The survey respondents did not address this issue. However, jurisdictions are strengthening and monitoring the type of excavations being made, the quality of excavation repairs and the effect of excavations on pavement life. Because of these concerns, routine construction coordination meetings have become a necessity to effectively manage the installation and maintenance of utility facilities.

Provide Incentives to Encourage Coordination of Shared Trenches Between Utilities Whenever possible, the use or formation of a Utility Coordinating Committee (UCC) is helpful for new major utility installations. The permitting jurisdictions should always be represented at the committee's meetings. Utility coordination requires participation of privately owned utility companies, jurisdictions, regulating bodies, public works agencies, highway departments and other interested groups. Since it is in the public interest to share the right-of-way, government and private industry must join together in some sort of mutual planning action to protect the public interest. This action should include establishment of uniform regulations and a mutual liaison effort such as the Utility Coordinating Committee that will ensure a continuous formal interchange of information covering regulations, planning, designing, and scheduling of all major construction projects within the public right-of-way including the need for utilities to participate in joint trenching efforts. Failure for jurisdictions to perform this function adequately can result in liability to the jurisdictions and additional cost to the utilities. Typical problems addressed by UCCs include utility excavations in newly paved roads, disruption of essential utility service, injuries caused by inadvertent severing of utility facilities, location of utility poles, and environmental impacts of damaged facilities.

All states that responded to the survey stated that joint trenching was not a requirement but was encouraged. These same states agreed the number of excavations definitely could be reduced. The American Public Works Association has published the following actions to support highway/utility coordination. The following are potential activities by state and city agencies to encourage coordination *(13)*:

- Develop and share a highway improvement program.
- Include all construction and maintenance work in the highway improvement program planned for at least the next two years with longer time frames (5-6 years) desirable.
- Hold regular meetings between utility company personnel and highway personnel to discuss upcoming project development and construction activities.
- Notify utilities of projects prior to the design phase.

- Route plans of highway projects to utilities for comment during the design phase.
- Determine the impact of all projects on other facilities in or adjoining the ROW.
- Convene meetings of highway and utility personnel involved in project planning and development prior to each major phase of a project (planning, design and construction).
- Identify and resolve conflicts before construction.
- Share construction schedules with utilities.
- Develop one point of contact in the highway agency to work with utilities on a project from inception to completion.
- Publish maps each year showing municipality, county, state highway agency and utility projects.
- Publish detailed descriptions or directories of projects and list project schedules, managers, and telephone numbers.

The following suggestions are potential activities for utility companies when sharing with state or city agencies:

- Develop a utility master plan in conjunction with other public planning efforts.
- Provide capital improvement programs to highway agencies.
- Update utility system plans every two to five years and provide them to public works and highway agencies.
- Meet with local or state agencies to discuss projects, determine impacts, and explore alternatives to avoid potential conflicts.
- Develop one point of contact to work with the highway agency on resolution of potential conflicts.
- Seek to minimize the impact of utilities on highways with high traffic volumes, few alternative routes, or limited right-of-way.

While there are additional procedures that can be implemented, the aforementioned steps are imperative for a UCC to yield effective, positive results.

Provide Incentives to Encourage Coordination of Shared Resources Between Utilities The term *shared resource* is used to describe a new partnership approach to obtaining a different form or compensation/value from the public ROW. These are public-private arrangements where each party taps the special resources of the other. The private partner gains access to public ROW and the public partner gains access to some form of compensation, whether in-kind telecommunications facilities or services, cash, or both. Shared resource projects have three distinct features:

- Public private partnership.
- Private longitudinal access to public property (primarily roadway ROW) for telecommunications facilities.
- Compensation to the ROW owner above administrative costs.

Shared resource programs have been facilitated by the Federal Highway Administration's delegation of authority to states to determine their own utility accommodation policies and by the American Association of State Highway and Transportation Officials Board of Directors' resolution that recognized fiber optics as distinct from other utilities and sanctioned their longitudinal installation in freeway rights-of-way.

Survey data revealed that six states have already begun shared resource projects with significant benefit to their state and local communities. Other states have taken slightly different approaches. For

example, New York has an open request for proposals (RFP) that continuously seeks applicants to use their right of way for telecommunications. Minnesota and others have issued an RFP with a closing date and awarded the contract to a single company who in turn will install, operate and maintain a telecommunication facility for state and private use. The telecommunication provider usually is responsible for subleasing conduit space and fiber to others at fair and non-discriminatory rates. There does not appear at this time to be a single best model, but the shared resource approach appears to be a new tool that states can use to increase the valuation of the highway rights-of-way.

The following is a list of some pros and cons of the shared resource approach:

Pros:

- Flexible compensation provides telecommunication facilities, services, cash or all of the above.
- Avoids out-of-pocket cost of the state for installing telecommunications infrastructure.
- Speeds up installation of telecommunications throughout the state.
- Maximizes use of state assets (interstate ROW) not previously available.
- Facilitates telecommunications service to previously un-served areas such as rural communities.
- Ensures that states' telecommunications needs are met.
- Successful partnerships may lead to other mutually beneficial projects.

Cons:

- Lack of technical knowledge to implement new approach.
- Limited time – market conditions dictate private vendor interest.
- Determining the value of a bartered arrangement to the state is complicated.
- If compensation is similar to a barter arrangement, it is difficult to determine if proposed compensation is appropriate.
- May attract more telecommunication companies than can be supported in limited ROW space.

Fee-Based Policies

Most jurisdictions require right-of-way users to apply for and obtain permits for all pavement utility cuts for utility construction projects and maintenance activities. This process should minimize the impact of construction on residents and businesses by imposing appropriate fees, strict timelines for construction and requirement to install high-quality finished pavement repairs. Examples of this type of policy are discussed in this section.

Assess Appropriate Pavement Degradation Fees Jurisdictions around the US are conducting studies to determine the effects of utility cuts on the service life of pavements. Many of these jurisdictions accumulate data using pavement management systems to quantify the effects of the cuts and study current cuts practices. The results of these studies have confirmed that a city's streets are a valuable public asset, which the City holds in trust for its citizens. Therefore, it is reasonable and in the public interest to impose *pavement degradation fees* to be paid by excavators in order to recover the increased repaving and reconstruction costs caused by excavation which are currently borne by taxpayers. It is also reasonably in the public interest to structure the fee, and any exclusions, in a manner that discourages excavation in newly-paved streets and encourages excavators to minimize excavation and to coordinate necessary excavation with the City's repaving schedule. For the most part, these types of fees are higher for newer streets and lower for older streets including those scheduled for imminent repaving. It is recommended that proceeds from pavement degradation fees be allocated to a dedicated fund or account, instead of the general fund, that will be used solely for repaving and reconstruction of the City's streets.

Assess Appropriate Permit Fees Once implemented, it is important to monitor fee assessments to ensure companies are in compliance with negotiated terms; but most importantly to determine if the arrangement is working or if there should be contractual changes. Things to consider during this phase are:

- Is the jurisdiction recouping all of its direct and indirect costs associated with management of the applicable land or public utility easement? If not, the jurisdiction may consider increasing the fee assessed.
- Are the construction and maintenance activities being conducted in accordance with established jurisdiction rules and guidelines?
- Is there resale or sublease activity occurring that did not exist during the application phase?

The amount of the permit fees and associated inspection costs assessed are based on determined costs required to recover most, if not all, of the direct and indirect costs associated with the processing and issuing of permits and performing applicable inspections. Jurisdictions, for the most part, charge flat rates per street cut, rates per area or linear basis, annual rates or a combination thereof. However, inspection charges are typically based on either a flat rate, hourly rate or actual costs.

Require Contractors to Rent Traffic Lanes A method used extensively to limit the time during which a contractor will have traffic lanes closed to traffic is to rent the lane to the contractor. This practice is most often implemented in one of two ways. The first is for the contractor requesting a cut permit to be given a certain amount of time in which to complete his work. Beyond this amount of time, he must rent the lane from the agency until the repairs are complete to the satisfaction of the agency. The second method is that the contractor must rent the lane from the agency throughout the entire duration of the construction work.

Require Deposits to Protect Against Poor Repairs In addition to permit fees and inspection costs, some jurisdictions also may require deposits and/or performance bonds to ensure the public right-of-way, where the work occurred, is restored in accordance with the jurisdiction's requirements. Street/road excavations costs taxpayers additional money annually in increased street maintenance because of damage caused to the original life of the pavement.

Assess Penalties for Non-Compliance or Failed Repairs The City and County of San Francisco has one of the most stringent trench restoration requirements in the country. Permits for street excavations are required; the permitted backfilling materials and procedures are prescribed; and there is a three-year moratorium on excavation in newly surfaced or reconstructed streets.

Requirements-Based Policies

Many jurisdictions have developed and implemented regulations to preserve the life of streets within their jurisdiction. In summary, examples of requirements-based policies include:

Require Agency-Owned Utilities to Meet Repair Quality Standards Often, agency regulations and ordinances specifically exempt from the standards those utilities that are owned by the agency. However, most agency-owned utilities are water and wastewater. Sometimes these types of utilities require more excavation and pavement cuts, and to a greater extent than other utilities. In addition, when such utilities rupture, much greater damage is done to the pavement structure than if an electrical or telephone line is severed. In addition, in environments where agency-owned utilities are exempt from such requirements, and in order to save money for the agency, the cut repairs are sometimes made to a lower quality level than those required of private contractors.

Require Justification for not Using Trenchless Technology Upon receiving an application to excavate, many jurisdictions are discussing the use of trenchless technology with utility applicants. Often, trenchless may not be the feasible nor practicable from an engineering or economic standpoint.

However, in areas where an agency is encouraging or requiring the use of trenchless technology, a contractor can be asked to justify his reasons for not using it. The reasons can then be reviewed by the public works director or state utilities engineer, who will then either approve the request or ask for further justification. If the reasons submitted are not adequate to the agency's authorized representative, the request can be denied and the trenchless technology can be required. In situations such as this, however, the agency then takes much more responsibility for disruptions to the pavement, existing utilities, or other components of the ROW if problems arise.

Establish Moratorium Periods for New Pavements A pavement utility cut moratorium can be implemented by an agency to protect newly-built or rehabilitated pavements for a period of time after construction. In establishing such a policy, the agency must provide opportunities for the utility companies to perform their necessary work in the area prior to construction. There must also be a clause that allows utility cuts in cases of emergency. This type of requirements-based policy is likely the most common among city agencies today.

Require Repaving Area Larger than Cut to Mitigate Pavement Damage Many studies have indicated that a utility cut damages an area of pavement larger than the actual area of the excavation, and state and city agencies often require contractors to repave an area larger than the immediate area of the cut. The City of Houston, for example, requires the utility contractors reconstruct the street from curb to curb wherever a utility cut is made between them. Policies such as this must clearly describe the method of determining the area of pavement that must be reconstructed. One drawback to this approach may be that since making a utility cut damages the pavement, reconstructing the street in a larger area may not improve the situation, but may simply enlarge the affected area. Such reconstructions must be performed with an attempt to match the current elevations and conditions existing in the pavement structure. This type of reconstruction is easier to do in portland cement concrete pavements, since the new material can be tied into the existing material and can match the existing elevations more easily.

Enhance inspection and enforcement of specification requirements Often the inspection procedures in a city or state are less effective than they could be. Additional or enhanced regulations on the repair quality and inspection standards can greatly improve the overall quality of pavement utility cut repairs. The extra cost of such improvements to the inspection work force can be offset by fees established or adjusted to recover those costs.

Trenchless Technology

Trenchless technology has been used for all types of utilities including cable, conduit, and piping, providing services from initial placement to repair and rehabilitation. It was originally used in the oil industry and for major utility placement such as across rivers, but has become more prevalent in the past decade for public utility applications in urban and suburban settings. It is attractive as an alternative to traditional trenching operations because of its potential reduction of impact to the traveling public, existing utilities, and the infrastructure.

Methods and Usage

There are many variations in the application of trenchless technology. Some of these include trenchless drilling, tunneling, pipe jacking, horizontal auger boring, microtunneling, impact moling and ramming, and pipe bursting and replacement. The general concept is similar for each style of trenchless technology. For access under highways and streets, the trenchless contractor generally begins by digging an access pit on both sides of the roadway so that there is no impact on traffic or the pavement itself, as shown in Figure 1. Other applications forego the use of an access pit, and drill directly into the ground at an angle.

For smaller applications such as for cable or conduit, the contractor often drills a pilot hole to the other end of the run with a small drill head and transponder to coordinate position. At the other end, the drill

and transponder are replaced with another bit, which enlarges the small tunnel to the needed diameter as it is pulled back to its original location. Either simultaneously or later, the conduit is placed in the hole behind the enlarging bit.

Limitations

Several potential limitations, both technical and perceptive, can prevent the use of trenchless technology, especially in urban settings. These include damage to existing utilities, horizontal and vertical alignment of the utilities to be installed, the cost associated with trenchless technology, and the hesitation of many utility companies to use the technology.

While the risk of damaging existing underground utilities is reduced every year with improved locating technologies, it remains a potential problem. Normally, when damage occurs, it requires an emergency trench to repair the problem, especially in the case of water, wastewater, electricity or natural gas.

Subsurface Utility Engineering

A Purdue University report conducted for the Federal Highway Administration *(14)* describes Subsurface Utility Engineering (SUE) as an engineering process for accurately identifying the quality of subsurface utility information needed for highway plans, and for acquiring and managing that level of information during the development of a highway project. The Purdue report was commissioned by the FHWA to study the effectiveness of SUE as a means of reducing costs and delays on highway projects. This process can also be used for existing highway and street applications. The report states that:

> *Subsurface utility engineering is the convergence of new site characterization and data processing technologies that allows for the cost-effective collection, depiction, and management of existing utility information. These technologies encompass surface geophysics, surveying techniques, mapping techniques, CADD/GIS systems, etc. Rather than disclaiming responsibility for existing utility information, subsurface utility engineers certify utility information in accordance with a standard classification scheme (utility quality levels) that allows for a clearer allocation of risk between the project owner, project engineer, utility owner, and constructor.*

Besides the clearer allocation of risk between the parties involved in a utility installation, the use of improved technologies to identify and locate existing utilities can greatly aid in the implementation of trenchless technology policies or other policies intended to control or reduce the number of pavement utility cuts. The main contribution of this technology to the reduction of pavement utility cuts may be in reducing the number of emergency cuts required by damaged existing utilities.

CONCLUSIONS

The frequency of pavement utility cuts seems to be ever-increasing, due to increased demand for utilities, communications, and other facilities that require the use of underground space in the public right-of-way. This paper has presented several options for public agencies to explore in determining the most appropriate way to control the frequency of such cuts. The use of new technological advances can greatly reduce the frequency of these cuts in many situations. As the ability to detect and avoid existing utilities is improved, the use of such technology can only become more beneficial to the public infrastructure.

Implementation of the Telecommunications Act of 1996 has created many challenges for local, county and state jurisdictions as they attempt to manage developed rights-of-way usage policies and compensation methodologies. Lack of such management could result in excessive excavation activity that potentially might impact public safety; value of rights-of-way, local businesses, cost assessed taxpayers and deterioration of infrastructure. The execution of franchise, license, right-of-way, shared

resource and other agreements have yielded positive results for jurisdictions that are enforcing provisions governing permit issuance, construction, inspection, repair, and maintenance activities by utilities and other companies that have been permitted to utilize the public rights-of-way.

Three types of policies were identified that are designed to encourage alternative behavior with respect to utility cuts. The policies are incentive-based, fee-based and requirement-based. Each type of policy can affect the frequency of pavement utility cuts by placing explicit requirements on those cutting the pavement (requirement-based), by making pavement utility cuts more expensive by imposing appropriate fees in order to recover the true cost of the cuts (fee-based) or by providing an incentive to use new technologies where appropriate (incentive-based). Overall, these policy and technology recommendations can help public agencies reduce the frequency of pavement utility cuts, and thereby reduce the rate at which the local and national infrastructure deteriorates due to such cuts.

These policy and technology recommendations can help public agencies reduce the frequency of pavement utility cuts, and thereby reduce the rate at which the local and national infrastructure deteriorates due to such cuts.

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TABLE 1 Utility Users of Public Rights-of-Way

Type	*Category of Use*	*ROW Valuation Method*
Franchise	Local Distribution Networks (i.e. local exchange carrier, competitive access provider, water, steam, chilled water, electric, gas service and solid waste)	Percentage of Gross Revenues
License	Interstate Carriers (i.e. long distance telephone, gas pipe interstate)	Linear Foot Fee
License	Private Networks (i.e. hospitals, universities, private companies and non profit agencies)	Linear Foot Fee

TABLE 2 Rights-of-Way Assessment

Type	Compensation Method	Fee Range
Local distribution networks	Percent of gross revenue or receipts	.05% to 10%
Local distribution networks	Linear foot, Fee per access line	$0.003 to 18.04 per m
Interstate carriers	Flat fee / linear foot	$0.98 to $18.04 per m
Private networks	Flat fee / linear foot	$0.98 to $18.04 per m

TABLE 3 Gross Revenues from Rights-of-Way Fees

City	Electric Franchise Fee Revenue	Franchise Fee % Electric / Telephone	Telephone Franchise Fee Revenue
Chicago	$ 63,000,000	4%-Electric/ 3%-Telephone	$ 29,580,000
Houston	$ 60,000,000	4%- Electric/ Flat Fee- Telephone	$26,900,000
St. Louis*	$ 26,000,000	10%- Electric/ 10%- Telephone	$12,000,000
New Orleans	$ 9,000,000	2.5%- Electric/ 3% Telephone	$3,000,000

* St. Louis has a gross receipts tax instead of a franchise fee.

FIGURE 1 Illustration of access pit for trenchless technology under a highway pavement.