Institute for Civil Infrastructure Systems
New York University
Cornell University
Polytechnic University of New York
University of Southern California

Urban Utility Center
Polytechnic University of New York

Urban Application of Trenchless Technology: Social Costs and Model Contract Practices

A Summary Report of the 2000 Life Extension Technologies Forum

(Draft #1)

A joint workshop of the Institute for Civil Infrastructure Systems and The Urban Utility Center

Consolidated Edison Learning Center in Long Island City, Queens, NY
June 29, 2000

Prepared by Mara Cusker, ICIS Research Assistant, with Stephen James, Consultant.

URBAN APPLICATION OF TRENCHLESS TECHNOLOGY: SOCIAL COSTS AND MODEL CONTRACT PRACTICES 2000 LIFE EXTENSION TECHNOLOGIES FORUM SUMMARY REPORT

The Con Edison Learning Center, New York City

Summary by Mara Cusker (Graduate Research Assistant) and Stephen James (Consultant) at ICIS

INTRODUCTION

In recent years, urban development has proceeded at unprecedented rates. Increasing levels of investment in construction and numbers of work permits issued reflect this rapid pace of activity in the built environment. In June 2000, a facilitated day-long forum brought together stakeholders from government, industry, and academia who are familiar with the development process and the challenges of urban infrastructure planning, construction, and renewal and relevant institutional policies and contract practices. These stakeholders discussed new approaches for undergrounding construction and, with a focus on trenchless technologies, evaluated their potential for reducing the social consequences of construction. Con Edison, the New York City Department of Environmental Protection, KeySpan Energy, and other organizations provided support for the forum.

Invited speakers provided an overview of non-disruptive or trenchless technologies, highlighted and, to some extent, quantified the social costs of utility excavations, and offered examples of model contract practices and other incentives for using trenchless technologies and accounting for the social costs. Short presentations were followed by facilitated open discussions of these and other relevant issues. The ultimate objective of the forum was to develop a consensus-based framework for the use of non-disruptive technologies as an alternative to conventional open cut or cut and cover construction for the renewal and maintenance of urban utility systems.

The Institute for Civil Infrastructure Systems (ICIS) works to advance activities that integrate a broad range of interests in infrastructure planning and investment and that improve the sustainability of infrastructure systems. ICIS actively explores advanced construction and rehabilitation technologies, known collectively as *life extension technologies* (LET), that renew infrastructure, prolong service life, and minimize long-term costs and disruptions. This forum was part of the ongoing efforts of ICIS and the Urban Utility Center of Polytechnic University of New York to bring together experts in the utility and construction industries, representatives of public agencies that own and manage urban infrastructure, and academics in the fields of engineering, planning, and social sciences, to discuss experiences, opportunities, and challenges in the field of LET. In August 1999, ICIS and the Urban Utility Center held a two day international workshop on LET in Long Island City, Queens with sponsorship from Con Edison, the New York City Department of Environmental Protection, and other organizations. At that event, participants from around the world examined in presentations a number of the technical, economic, social, political and regulatory issues related to various trenchless and data acquisition technologies. Their discussions highlighted the need for a heightened awareness of and improved accounting for the social costs of infrastructure maintenance and construction.

Based on several key lessons learned in that first workshop, ICIS and the Urban Utility Center teamed up to continue the dialogue in this forum which expanded the discussion to a focus on the

social costs of utility work in urban environments. The forum also addressed opportunities to reduce these costs using non-disruptive or trenchless technologies and institutional mechanisms to more systematically identify and reduce these costs and provide opportunities for their use where they are beneficial. The forum was designed to stimulate increased interest in these topics among participants and to provide ICIS and the Urban Utility Center with direction for future research and events.

PARTICIPANTS AND AGENDA

Participants in the discussion forum represented utilities, the construction and contracting industries, research institutions, and state and municipal agencies engaged in planning and utility management and development. While their knowledge of, experience with, and use of trenchless technologies and their motivations for participating varied, the discussion revealed a number of shared interests and concerns among the diverse stakeholders. Engineers and managers from gas and electric utilities in the New York region identified both the benefits of and obstacles to more pervasive use of advanced non-disruptive technologies in urban utility construction and maintenance. Similarly, representatives from New York City and State agencies with jurisdiction over transportation and utility infrastructure described their experiences with trenchless technologies as well as the barriers they encounter or perceive in efforts to account for social costs and to increase the use of non-disruptive technologies. Industry experts provided further information on trenchless technology applications and on the institutional contexts and contracting practices that potentially stimulate or retard their use. Participants representing the research groups outlined the agenda and facilitated discussion. (See the Appendix for the agenda and list of participants.)

Introductory remarks were given by Professor Tom O'Rourke from Cornell University and ICIS, Professor Ilan Juran from Polytechnic University and the Urban Utility Center, and Commissioner Joel Miele of the New York City Department of Environmental Protection. This was followed by a formal presentation by James Thomson, President of Jason Consultants, which provided an overview of international best practices in minimizing social and environmental disruption using trenchless technologies. Next, the first discussion session addressed the advantages of and barriers to assessing social and environmental costs in decision-making on utility excavation and construction approaches. Speakers presented brief case studies of utility and public agency experiences with quantifying these costs and with implementing trenchless technologies. The next discussion session focused on current and potential mechanisms for promoting non-disruptive technologies in public policies and contracts. The forum concluded with a number of focused resolutions and directions for future research and efforts to identify new technologies that can reduce the social costs of construction.

PRESENTATION: JAMES THOMSON, JASON CONSULTANTS WORLDWIDE EXPERIENCE AND BEST PRACTICES WITH TRENCHLESS CONSTRUCTION

Thomson began by noting that there is a marked clash of interests between surface and subsurface uses of the streets, or in other words, between communities and utilities. He explained that the true cost of utility work includes not only the direct costs—those factors important from the perspective of a utility budget (contract payments, third party plant diversions, third party damages, traffic management costs)—but also indirect costs related to the impacts of subsurface work on surface activities. These indirect costs include damage to public and private property, reduced highway life, increased traffic and pedestrian delays, loss of

business revenue, loss of street amenities, increased air pollution, and increased degradation of natural resources, including street trees and other vegetation. Although these disruption and traffic costs are significant, especially in urban settings, they are rarely quantified or considered in utility excavation cost assessments. Jason Consultants determined that the annual cost of traffic delay borne by the public in the UK due to utility construction is $2.1 billion. In New York City, traffic delay costs are likely even higher because of the higher density. These social costs rise in direct proportion to the duration of construction and road occupation.

Thomson briefly described several alternative technologies to open cut excavations. These technologies, collectively known as trenchless technologies, include impact moling and rod pushing, directional drilling, microtunnelling, pipe bursting, slip lining, and cured-in-place and close-fit linings. These approaches not only minimize traffic disruptions but, if used appropriately, are often less expensive and less labor- and time-intensive than conventional open-cut utility construction methods.

Thomson emphasized that while trenchless technologies can reduce indirect and social costs and can be competitive with traditional techniques in direct cost, they should not be pushed as a solution for all utility construction. Trenchless technologies should be applied to a wider range of construction projects and more widely accepted as a feasible engineering approach but should be used only when appropriate for a project and only by contractors who are familiar with the technologies. Thomson said that he has noticed too much promotion and salesmanship in the trenchless technology field and too little real understanding of the technologies. Jobs done poorly with trenchless technology, he said, can be even more disruptive than open-cut jobs.

Next, Thomson reviewed different approaches to trenchless technologies among other nations. He cited the United Kingdom's New Roads and Street Works Act of 1991 as an ineffective piece of national legislation intended to encourage utilities to choose construction methods that minimize disruption to traffic and communities. The UK is now moving towards imposing road occupation charges for utility work. Thomson attributes Germany's leading role in trenchless technology development and application to its stringent environmental regulations and commitment to minimizing community disruptions. Thomson cited the high density and levels of congestion in Japan, Singapore, Thailand, and Hong Kong as reasons for their active promotion of trenchless utility work. These nations have been innovative both in legislation that encourages or mandates trenchless work and in the technologies they have adapted for their often unique sewer, utility, and geological characteristics.

Thomson concluded with recommendations for increasing the use of non-disruptive construction technologies in the U.S. He suggested that the reluctance among engineers and utilities to try new technologies is due largely to the litigious nature of the U.S. and a preference for "safe," proven methods. There is a need for both public and legislative pressure on engineers, utilities, and public agencies to choose methods that reduce the social costs of their work by minimizing open cuts and the duration of projects. He proposed that the highway administration designate as "sensitive" those streets that carry the greatest volume of traffic and require utilities to submit impact statements for construction projects that would include several alternatives and calculate costs based on traffic delays and other environmental and social disruptions. The highway administration could then review impacts, require alternative methods, and coordinate work among utilities to minimize impacts.

DISCUSSION

Participants unanimously recognized the significance of the social costs of utility and other infrastructure disruptions and discussion returned again and again to the fundamental question of how to incorporate these costs systematically in utility and public decision-making and in ways that ensure that non-disruptive technologies are chosen, or at least considered, more often. Recognizing that efforts to internalize social costs must begin with those costs that are most unambiguous and universal, a number of speakers suggested that the social cost of *time* can be leveraged most readily and effectively to promote nondisruptive construction. Because the social and environmental impacts of the duration of a construction job are usually tightly correlated with the time and labor expenses of the job, technologies that reduce the time-intensity of construction offer a "win-win" solution. This concept, while attractive and accessible, has not yet been embraced by most utilities, contractors, or the public for a number of reasons. While representatives of utilities and public agencies reported successful experience with using trenchless and other non-disruptive technologies and a growing interest within their utilities and agencies to expand these uses, many acknowledged that these applications have been limited and fragmented and that traditional open-cut excavations remain common. Speakers identified several barriers to wider acceptance and deployment of advanced technologies and proposed a number of solutions to overcoming these barriers.

BARRIERS

One barrier is that many engineers, contractors, and utility owners are unfamiliar with advanced technologies. That unfamiliarity, together with a lack of specifications and guidelines for their use, makes engineers resistant to using these technologies. Because construction work is often procured through a competitive bidding process, contractors offer to perform low cost, low risk methods with which they are familiar to improve their chances of being awarded a contract for the lowest bid. Even where utility owners permit the use of alternative construction methods, contractors most often offer the traditional, proven methods to avoid the unknown cost of failure. The increased cost associated with the increased risk of using unfamiliar technology leads owners to specify and contractors to bid traditional open-cut excavation methods.

A second barrier, and one tightly linked with the first, is the low market demand for trenchless technologies in much of the U.S. and, as a consequence, the high cost of equipment. While advanced technologies have proven more cost-effective than open-cut excavations in many cases, the high capital costs of equipment, combined with workers' unfamiliarity with these technologies, make them a less competitive alternative than traditional excavation and construction methods and equipment. Contractors indicated during the discussion, however, that they could bring more technology to the market if utility owners specified the advanced technologies more often (which means overcoming the first barrier.)

A third barrier to more widespread use of non-disruptive technologies is the density of subsurface infrastructure found in older urban areas like New York City. Further compounding the problem is a lack of centralized and accurate utility mapping and information on the status of subsurface pipes and other obstacles which makes open-cut excavations the only safe (low risk) option for underground work. Other factors, like the often very shallow depth of utility infrastructure in New York City or the age or poor condition of subsurface infrastructure also make trenchless technology options much more difficult to apply.

NEEDS AND SOLUTIONS

Just as many of these barriers are interrelated, so are the needs and solutions speakers proposed to overcome them. A first prerequisite for increased acceptance and use of non-disruptive technologies is more and better ***education and training*** about the technologies and about the indirect costs of construction. Education is needed for those who use the technologies, those who determine engineering specifications, and those who demand the services of these engineers and contractors. While there is no "one-size-fits-all" trenchless technology or universal formula for determining what technology or method to use, experts can develop guidelines and specifications based on international experience with different technologies. Guidelines should quantify the related disruption criteria such as job duration, surface area affected, labor needs, etc. for different technologies. This cumulative set of updated specifications should guide decision-making on subsurface work by providing a range of options that are based on engineering standards, include both traditional and state-of-the-art technologies, and assess a more complete range of costs and benefits for each option.

While a better-educated group of contractors and engineers working under updated specifications is likely to consider a broader range of approaches to utility work and employ advanced technologies more often, a complementary step towards increasing these outcomes is increasing the provision of direct ***incentives and/or policy mandates*** for reducing disruption. By providing bonuses for reductions in construction time and/or neighborhood or environmental disruptions, utility owners would encourage contractors to compete to do the fastest or least disruptive job. Many speakers mentioned that the New York State Department of Transportation's current program of A + B bidding, in which the awarding of a contract depends in part on a duration of work estimate, is a successful example of using a monetary incentive to achieve faster and, when including social costs, less costly work. An alternative means of driving both utility owners and contractors towards less time-consuming, non-disruptive technologies are legislative mandates such as the lane-rental policies used in nations in Europe and Asia. A utility owner required to pay a fee for the duration of street work and/or surface area affected is likely to choose contractors who can complete the work in the most timely, least disruptive manner.

Improving the ***communication and coordination*** among utility owners was identified as a solution to a number of the barriers to reducing utility construction disruption. By coordinating their agendas, work schedules, resources, and data, utility owners could establish a more accurate and efficient foundation for decisions about infrastructure construction and renewal efforts. As the current frenzy of telecommunication investment in existing subsurface infrastructure reveals, utility owners can benefit from sharing infrastructure, using "dead" pipes through which to run new utility lines, bundling services, and coordinating construction work. Utility partnerships could provide for a common GIS database of subsurface infrastructure, joint infrastructure renewal projects, shared investment in trenchless technologies, and ultimately the critical mass of demand for these technologies that will drive the costs down. Consensus among utility owners on an updated set of specifications, like that described above, would help to institutionalize social cost quantification and consideration of non-disruptive technologies.

The development of new or advancement of existing ***technologies*** will enhance the propagation of non-disruptive methods in the future. Three main issues of technology were mentioned as areas that should be advanced or improved. First, several utility owner representatives expressed reservations about using some techniques because of concerns about materials and reliability. A

representative from the New York City Department of Environmental Protection (DEP), responsible for the City's water supply system, revealed concerns, for example, about the use of polyethylene liners (PE) and their potential impacts on water quality. Second, most participants agreed that increasing the reliability and standardization of GIS mapping systems would significantly promote the use of non-disruptive technology by improving the accuracy of the planning and routing of new subsurface infrastructure. Similarly, a third technology need identified was the development of look-ahead radar or subsurface sensing technologies that permit contractors to accurately map and mark subsurface obstructions. Improving the reliability of mapping and detection of subsurface obstructions were also seen as necessary to reducing contractors' risks and ultimately the costs of implementing non-disruptive technology.

A final important focus for stimulating implementation of non-disruptive technologies are efforts to ***engage and energize the public*** about less disruptive alternatives to traditional open-cut utility work. Current efforts to introduce non-disruptive technologies into mainstream utility practices underestimate the potential of public support. The general public is largely unaware both of its ability to demand a reduction in social and environmental costs and of the feasibility of alternatives to traditional open-cut street work. More so than individual politicians or business owners, homeowners concerned about street construction and traffic delays can collectively pressure community governing boards and utilities to minimize disruptions. The public is less likely to be interested in the trenchless technologies themselves than in the direct benefits of their applications for communities. Public interest in and support for more social-cost oriented infrastructure decision-making could be achieved through more positive press on non-disruptive utility projects or, as one speaker suggested, through a public campaign with a battle cry like "Cheaper! Faster! Better!"

RESOLUTIONS AND FUTURE DIRECTIONS

The discussion forum leveraged the experience and insight of a diverse group of stakeholders to come to these key conclusions:

- There is no universal formula for non-disruptive construction; we have to set an agenda for reducing disruptions, evolve flexible practices and guidelines, and use trenchless technologies when appropriate.
- Partnering among utilities, including telecommunications firms, will be necessary to achieve economies of scale and overcome some of the technical barriers, such as a lack of accurate GIS, and ultimately improve the context for the use of innovative infrastructure construction and renewal methods.
- We can't underestimate the importance of public perception and participation: the public will be energized about reductions in delays and disruptions. They can direct this energy towards pressuring local and state policy makers to demand, through incentives or mandates, social-cost accounting for construction practices and less disruptive utility work.

Life Extension Technologies Discussion Forum

June 29, 2000 - Con Edison Learning Center:

"Urban Application of Trenchless Technology:
Social Costs and Model Contract Practices"

8:30am – 9:00am: Refreshments

9.00am – 9.05am: Welcome
Randy Goffred, Anthony Hranicka, ConEdison

9:05am – 9:15am: Introduction,
Tom O'Rourke, Ilan Juran

9:15am – 9:35am: Introductory Comments
Joel Miele
Department of Environmental Protection

9:35am – 9:50am: Worldwide Experience and Best Practices with Trenchless Construction
James Thomson
Jason Consultants

9:50am – 10:00am: Introduction of Delegates
Delegates

10:00am – 12:45pm: Session I:

Social Costs, Barriers and Incentives for Deployment of Trenchless Technology

10:00am – 11:15am: **Advantages and Cost Benefit Analysis, with Case Studies Examples**

11:15am – 11:30am: Coffee Break

11:30am – 12:45pm: **Environmental, Economical & Social Impacts Assessment**

12:45pm – 2:00pm: Lunch

2:00pm – 5:00pm: Session II:

Model Contract Practices

2:15pm – 3:30pm: **Current Practices and Potential for Improvements**

3.30pm – 3.45pm: Coffee Break

3.45pm – 5.00pm: **Recommendations for Improved Practices**

5.00pm – 5.30pm:

Resolutions and Future Directions

6.30pm: **Dinner** hosted by Keyspan Energy

ICIS Life Extension Technology Discussion Forum
Urban Application of Trenchless Technology: Social Costs and Model Contract Practices
Con Edison Learning Center, June 29, 2000

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