FINAL REPORT

STUDY MISSION TO THE

ROAD ADMINISTRATION INFORMATION CENTER

(ROADIC)

TOKYO, JAPAN

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GEOSPATIAL INFORMATION & TECHNOLOGY ASSOCIATION

ROADIC Task Force

Background and Introduction

In early 1990, the Geospatial Information & Technology Association, then known as AM/FM International, established an affiliate of the association in Japan. At the outset of this relationship, an organization called the Road Administration Information Center (ROADIC) became interested and involved in the activities of the Japanese affiliate. Several of the original founders of ROADIC were also instrumental in the creation and development of GITA-Japan. In addition, many geospatial professionals from Japanese utilities, government agencies and private sector companies began to take part in GITA's annual conference in the United States.

As the relationship evolved, ROADIC began to capitalize on the conference, using the technical educational program as a forum for identifying specific implementations of geospatial technology that were of interest to the organization at the time. ROADIC began to organize "study missions" to North American utilities, cities and other government agencies and private sector companies that were selected by ROADIC on the basis of their presentations at the annual conference. As GITA was also active in Europe, visits to European utility and government organizations were also included, and a pattern of alternating trips to North America and Europe every other year emerged.

These study missions, typically held in October, have occurred every year since 1990, with the exception of 2001 when the 9/11 terrorist attacks interrupted the trend. GITA staff has been instrumental in assisting ROADIC with identifying and providing introductions to appropriate host organizations (usually five or six sites per trip), establishing contact with hosts, and arranging the technical visits.

The ROADIC delegation typically consists of twelve to eighteen individuals representing Japanese utility organizations, government agencies and private sector service providers. The group prepares a list of questions about each site targeted for a visit prior to departure and sends each host a list of participants and information about ROADIC and their objectives.

During the on site tours, a Japanese translator ensures that all important points about a project or implementation are understood and assists the group in a debriefing session at the end of each visit. Individual perspectives and impressions are discussed and analyzed and a summary report is made of each site visit. After returning to Japan, the information is further processed and studied and the ROADIC system adjusted to include any particularly worthwhile ideas obtained from the host sites.

It is largely because of this annual system of continuous improvement that the ROADIC system of Japan has become a world-class example of multi-organizational cooperation and information sharing. The Japanese public is the clear beneficiary of this unique approach.

A Powerful Stimulus for Action

The terrorist attacks that befell the United States on September 11, 2001 had immediate and wide-ranging effects on virtually all aspects of our everyday life. The consequences of these events will be felt long into the foreseeable future. The concept of "Homeland Security", virtually non-existent prior to that day is now something that Americans – and others around the world – have become accustomed to on a daily basis as we travel, watch television news, gather in large crowds, or enter public facilities. Our national economy, profoundly affected, has just recently begun to recover and our legal system is struggling to deal with implications of increased security versus perceived loss of personal liberty across a broad spectrum. Decisions we used to make routinely without thinking about security have taken on a different dimension.

The response and recovery we saw in New York City and Washington, DC was an incredible display of teamwork, sacrifice, dedication and resolve. Ironically, the situation shed a bright light on the value and use of geospatial information: the ability to share critical data was never so urgent. In New York City, over 70 local government agencies, utilities, military organizations, first responders, and private sector companies of all types were able to forge a coordinated response and recovery effort due primarily to the wealth of digital data that was able to be shared – and shared *quickly* - for a common purpose. By no means was this a perfect scenario. In addressing a Steering Committee of the Federal Geographic Data Committee in Washington, DC in 2003, Department of Homeland Security CIO Steve Cooper said, "Everything we had was used in the response. What wasn't there cost lives."

So what *is* the perfect scenario? What kind of system or approach should we have to be better prepared in the event there is a next time? Beyond terrorism, how can we best position ourselves to deal with severe natural disasters – much more frequent and deadly in their aggregate than terrorist attacks? Day to day damage to the infrastructure as a result of routine excavation activity occurs across North America costing billions of dollars and significant numbers of lives, albeit with far less public notice. How can we effectively provide for Homeland Security *and* address critical infrastructure protection at a local level at a time when local budgets are so severely strained?

In considering answers to these questions, the leadership of GITA determined that a first-hand look at a national integrated system to manage and protect the infrastructure was long overdue. That system, the Road Administration Information System, is what ROADIC is all about.

The ROADIC Study Mission

The concept for a Study Mission to Japan was discussed in several meetings of the Geospatial Leadership Coalition (GLC), a forum for infrastructure-based associations and government agencies to discuss common needs and interests related to the use of geospatial technology. Eventually a team of eight people representing the broadest possible range of utility industry markets, government and private sector expertise was assembled. Partial funding for the Study Mission was provided by the GLC, but team members mostly covered their own expenses – in some cases personally.

The Study Mission was organized to coincide with the annual meeting of GITA-Japan, and that offered additional opportunities for an international discussion on a variety of issues related to Homeland Security, government policy and geospatial technology. Study Mission members delivered individual presentations and participated in joint panel discussions with their Japanese counterparts. In addition, separate technical visits were made to the offices of individual ROADIC member organizations, during which individual corporate strategies and processes revealed additional perspectives on how ROADIC functions.

A list of Study Mission members as well as organizations visited appears in Appendix A to this final report. Also, a paper entitled, *"Road Administration Information Center's National Utility Coordination and Protection Program"* written by ROADIC Study Mission Team Leader Dave DiSera, Vice President, EMA, Inc., appears as Appendix B. This paper, written a year earlier after an initial visit to a ROADIC satellite installation, was prepared to provide a general overview of the basic premise of ROADIC and its organizational layers.

The remainder of this final report is a summary of the comments, impressions and perspectives of the members of the Study Mission, organized into general areas. The nature of the Study Mission, the relatively short period of the visits, as well as some occasional language difficulties along the way, precluded an in-depth detailed document. However, enough information was gathered by participants and provided by our ever-gracious Japanese hosts that a unanimous conclusion was reached: ROADIC is a world-class example worthy of emulation.

The experience gained on this Study Mission will benefit GITA, our members, and the citizens they serve, as our association continues to pursue initiatives to support Homeland Security and critical infrastructure protection.

Japan's Road Administration and Information Center

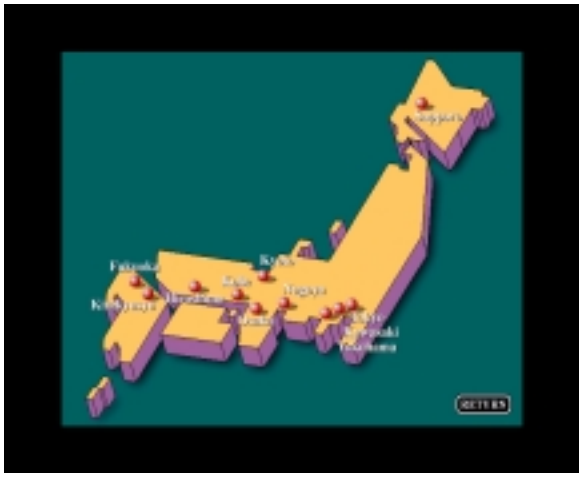
Political, Jurisdictional, and Legal Aspects

The Road Administration Information Center (ROADIC) was originally created in 1986 as a result of several large-scale gas explosions that killed and injured hundreds of people and caused tremendous damage. These accidents were the result of a lack of knowledge of underground infrastructure assets that were encountered during excavation and construction activities. Given the nature of Japan's densely crowded urban areas, most of the critical infrastructure lies beneath the roadways.

The gas line explosions and the need to coordinate road construction, coupled with available funding at the ministry level, lent significant impetus to the formation of ROADIC. The Japanese national government saw the need to develop an approach to preserve public safety and to improve response to accidents involving this significantly expanding public energy source. Consequently, it took the lead to organize ROADIC through its Ministry of Construction, Bureau of Roads, which proactively enabled the foundation of the program in 1986.

ROADIC was formally established as non-profit organization for utilities after a year of research by a specially formed Inquiry Committee, which recommended that the organization be created as a public entity.

A consortium of public and private members, ROADIC was set up as a national project in order to manage and protect the public utilities within the right-of-way. Following a successful initial implementation in metropolitan Tokyo in the mid-1980s, additional branches have been established in 12 major urban centers throughout Japan. Cities include Tokyo (23 separate Wards), Sapporo, Chiba, Kawasaki, Yokohama, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Kitakyushu and Fukuoka.



These 12 branches coordinate with local government agencies and public utility companies including electric, gas, water, sewer, trains, subways and communications.

ROADIC is governed by a twenty-member board of directors, presided over by a Chairman, with advisement by a Board of Trustees. The board members are, for the most part, the local Prefectoral Road Administrators and utility representatives. The Ministry of Construction continues to play a fundamental role in the ROADIC program by coordinating with individual cities seeking to enter into the program.

Economic Considerations and Benefits

The national government, under the auspices of the Ministry of Construction, provided significant initial funding and other support.

The original cost of establishing the ROADIC program was in the range of ¥ 9.5 billion, or US$ 8.7 million, sixty percent of which was funded by the national government. The remainder was contributed by interested local governments and utility companies.

The 2003 annual operating budget is ¥ 3.4 billion, or approximately US$3.1 million. The national government provides 50% of the annual operating funds. The balance is divided among the individual regional member organizations: 10% from local government entities, and 40% from private utilities and other organizations. So, in effect, both taxpayers and ratepayers are supporting ROADIC operations.

One of the major issues facing ROADIC today is reducing costs of its programs and services. Data and system maintenance are the major cost components associated with the program. Ease of use also remains a primary concern.

Several of the resulting benefits of the ROADIC program are associated with cost savings involving utility and construction coordination/management, and time reduction for Road Administrators managing the permit process.

For example, Road Administrators and utility companies can access road maps and information on existing underground and aboveground facilities on-line from terminals that are linked to databases at each of ROADIC's branch locations. This system enables immediate access to utility and road data, planned designs of new utility facilities, and coordination of work schedules associated with construction and maintenance activities. Such specific asset management functions include:

- Renewal planning of assets and facilities
- Pipeline network analysis
- Design/provision for permit application
- Construction
- Data updating
- Data maintenance

It should be noted that cities determine work schedules, not the public utilities companies.

Additional Organizational Membership

The leadership of ROADIC actively encourages new member organizations to join in the various regions, and long-range plans include the establishment of ROADIC branches in additional regions. The newest of the twelve branches, in Chiba Prefecture, began providing services in April 2002.

When a new branch is accepted into ROADIC, local government entities and utilities must agree on a set of basic rules for participation, including cost sharing. There is a "buy-in" fee that is levied, and that is applied to offset existing system expansion. In addition, new entrants pay for all input and conversion costs and are responsible for setting up their own local committees.

Existing practice is that members submit paper maps to the ROADIC Data Center for digitizing and updating to the ROADIC database. The central site does the data entry. This information is not submitted electronically, which is an activity that should reduce cost to ROADIC if implemented.

Technology Issues

The Road Administration Information System (ROADIS) is a custom-developed computer mapping software product developed by Tokyo Gas called TUMSY (for Total Utility Mapping System). TUMSY supports a number of functions in the areas of facility management, disaster management and emergency operations.

Users access ROADIS primarily from a client server environment. ROADIS can either be set up as a centralized or decentralized configuration depending of the participant's technical environment. In addition, Tokyo Gas developed a Windows CE-based PDA application called TUMSY BOY, for use by field personnel to access, report, and output data.

The TUMSY software provides typical Geographic Information System (GIS) functionality, including:

Database Management

- Common database design and structure
- Map and data output
- Data collection and registration of disparate data sets
- Back up and recovery functions
- Map data export for use in other systems

Mapping

- Common database standard for design and management of data
- Standard mapping functions
- Spatial and linear analysis
- Geometric calculation routines and basis design functions

Spatial Data Processing

- Spatial data processing of graphic features
- Spatial data display and data manipulation functions
- Data export functions to other GIS programs

The ROADIS database is based on a standard database format that is separated into a landbase (e.g., road, planimetric, and terrain features) database and road utilities (e.g., separate underground and aboveground utility features) database. This format ensures standard data exchange involving input and output of landbase and utilities data. In addition to utility data, ROADIS includes data on structure and building material of the underground facilities.

The ROADIS also is integrated with a permitting system. All construction permits within the ROW are issued and managed centrally at the local level. This ensures proper coordination between all road and utility work.

It should be noted that ROADIC is currently evaluating how to improve the system's ease of use, for example, by increasing the use of fiber optics to enhance communications and improve coordination among members.

Perhaps surprisingly, ROADIC does not employ the Internet in routine operations. Since member organizations access the ROADIC host system directly, there is no immediate need, and data is restricted to members. Inasmuch as members are paying the tab, this may be appropriate, but it is also very restrictive. Even using an intranet would facilitate the update of information.

Data sharing issues are not significant, since the data is updated on an annual basis. It is not totally clear why the database is updated so infrequently, given the number of changes to the system on an annual basis.

There are no plans at present to release the data to the public through an e-government initiative. Most of the e-government activities were focused upon government-to-government data availability, and there seem to be no incentives to broaden this to public use.

It was not clear whether metadata for the holdings are prepared. If metadata existed, it could be made available on the Internet to inform the public that these data are available. This might prove to be an additional revenue stream.

Web-based deployment is envisioned for the future, with a target accuracy of +/-10 to20 centimeters.

ROADIC uses the concept of an “expert user group” to decide what new software to implement each year. This group also sets the priorities for new development.

The general plan is to review the entire system every 10 to 20 years, adding more branches and organizations along the way. Hardware updates are made every five years. Software continues to improve and the system is updated periodically.

Individual Participating Institutions

Tokyo Gas Company was the primary non-government driver of ROADIC, providing the original landbase of the project. Local government agencies are responsible for the cost of developing and maintaining the landbase beyond what was originally provided by Tokyo Gas. Representation is based on an equitable formula.

Nearly all of the principal utilities—both public and private—in each of the twelve centers are members of ROADIC. Significantly, however, Tokyo Electric is not a participant, and the national telecommunications company, NTT, participates only on a limited basis. In addition, police, fire and ambulance departments are not participating in the project. For instance, the Tokyo Police Department doesn’t need the level of accuracy provided by the ROADIC landbase (± 10-20 cm). Further, the ROADIS landbase doesn’t cover the same service area monitored by the Tokyo Police Department.

The cities do not seem to encourage the participation of the police, fire and ambulance departments, and could be losing the long-term financial benefit of the “collect data once and use it multiple times” philosophy.

Public agencies, which cover the cost of converting and maintaining their data in ROADIS, pay a larger percentage of the project’s cost than do those from the private sector. Among the public

agencies, the road agency pays the most because of the cost of maintaining the base maps. Membership in ROADIC doesn't appear to be limited to government and private agencies. Anyone can join ROADIC, even if only to access market information.

Labor Unions and Contractors

Unions seem to be less influential in Japan than in North America. At the Water Commission, a contractor (who was a retired agency worker) was credited with maintaining the operation of the GIS. Non-owners of the infrastructure do not play a major role in any aspect of ROADIC.

The Ministry of Construction oversees the ROADIC program in a regulatory capacity. The cities administer the day-to-day activities associated with the design of new utility facilities, in addition to coordinating the work schedules of construction and maintenance projects. Several presenters mentioned a lack of national regulatory standards.

Interorganizational Relationships

ROADIC coordinates with local government agencies and public utility companies including electric, gas, water, sewer, trains, subways and communications. ROADIC is operated jointly by the Center, the road administrators in the national government, the City of Tokyo, 12 designated municipalities, and the utility companies operating within those cities. Members enter into a contractual agreement, similar to a proprietary/confidentiality agreement, with ROADIC. Many of the twenty people on ROADIC's board are local road administrators.

Other coordinating agencies include the national highway offices, under the Ministry of Land, Infrastructure and Transport. These federal offices have jurisdiction over certain road facilities in the participating cities.

ROADIC serves as the focal point for all permit requests, although it is not clear how the requests are prioritized and approved. All members submit a pre-construction drawing to ROADIC before work begins. Non-emergency work is planned well in advance and is fully coordinated to minimize traffic disruptions and unnecessary opening of pavement.

Surprisingly, some significant field information (such as that provided by Tokyo Gas) is submitted only on an annual basis. There appears to be no real interest in having data updated on a real-time basis. One could certainly argue that the high-populous centers are close to being completely built out and the land database does not vary significantly, but that's not the case for suburban areas or rural cities, both of which are potential member markets for ROADIC. It is possible (not confirmed) that ROADIC's information

is updated based on true as-built information, and not just construction plans that have been marked “as-built.” More information, particularly about liability issues related to providing information later found to be outdated and inaccurate, is desired.

Standards

Standards do not appear to be a major issue for ROADIC—the road information and utility location data are standardized. TUMSY, the software application built as the original system for Tokyo Gas, provided data later adopted by ROADIC. In effect, it has become the default standard. This is a sensitive cultural issue, in that most of the North American GIS community agrees that it is inappropriate to allow one vendor to dictate data standards. In fact, the North American industry is spending a lot of effort focusing on common data standards and system interoperability. ROADIC’s approach to interoperability is, in essence, using one vendor. The fire and police departments, in addition to other agencies, could not use the data unless they adopted a one vendor system.

Additionally, not all public utility companies are using the TUMSY system. For example, NTT (the national telecommunications company) uses its own custom program.

Communication between ROADIC and its member organizations is coordinated to ensure that layering schemes are understood. This process has evolved over the years to become a routine operation. Since all members utilize the same land base, individual organizations add their respective facilities on top of this base.

These specifications assist with the translation of data. Data within ROADIS is updated quarterly to yearly by each member, depending on the degree of change or updates to their respective data.

New standards are added through committee activity and a subsequent consensus-building process. In this regard, the bottom-up, quick implementation of the project may prove to be a drawback. Several representatives remarked that had ROADIC followed the North American model of developing standards from a top-down aspect, the product, while admittedly taking longer to develop, would have been improved. It is likely that the agencies with the most advanced systems and largest staffs lead the process of adding new standards.

Internal Relationships

ROADIC is organized into three departments: General Affairs, Planning and Systems Development. ROADIC maintains its own staff of about 80 people, many of whom previously worked at member organizations and have a great deal of experience. The majority of employees seem to be based at the 12 member centers. Some work is contracted out as needed.

A group of experts, consisting of one representative from each of ROADIC's 12 member centers, meets once a year to discuss developments and organizational issues. ROADIC also has many technical committees.

Critical Infrastructure Protection

The Japanese seem to have little concern for protection against terrorism; the nation's critical infrastructure protection (CIP) is driven more by natural phenomena such as earthquakes, tsunami, floods and volcanic activity.

At this point, ROADIC's only purposes seem to provide for road maintenance, construction, and limited management of facilities on the roads.

ROADIC was not designed or mandated to provide for although the information provided by ROADIC could be used for CIP. Specifically, ROADIC is enabling government agencies and public utility companies, through the use of GIS technology, to increase coordination and sharing of vital facility related information in order to support disaster planning and recovery activities, such as the recent Kobe earthquake and past gas explosions.

Tokyo Gas is using the TUMSY system to coordinate emergency response with each city. The system connects the main control room at Tokyo Gas to computers installed in emergency vehicles for purposes of dispatch of service crews, retrieval of data, operations and management, reporting of progress, and coordination with city departments and other utility companies.

Safety – Worker and Public

The ROADIC program was created to ensure public safety. Due to a series of gas explosions, ROADIC (and subsequently ROADIS) was created to comprehensively supervise disparate road and utility data within the right of way. As the foundation of the system, GIS technology enables road administrators and public utility companies to better safeguard the public during a disaster.

Productivity and Return on Investment (ROI)

ROADIC officials indicated that ROI or any cost benefit was not the business driver when the program was set up. The business driver was crisis management at the time the ROADIC program was started. Controlling damage caused by earthquakes and subsequent fires was the focus.

No significant financial analysis is currently ongoing among the members of the ROADIC program. However it was implied that this will become more of an issue in the near future. An official at one public utility company in Tokyo provided some anecdotal comments supporting the desire to document ROI. The individual indicated that due to improved access to data of other public utility companies, along with permit and construction coordination, the benefit to cost ratio was in the range of 10 to 1.

Public Image/Public Relations

Public image played a very significant role in the initial development period of ROADIC. The fact that hundreds of people were killed and injured as a result of a major gas explosion required the national government of Japan to take action to ensure the future safety of its citizens. This was the impetus for the creation of the ROADIC program and ROADIS system.

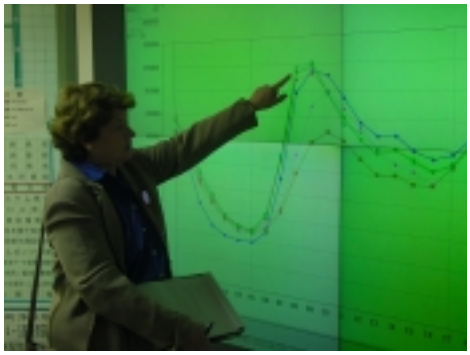
There is no doubt that ROADIC is continually involved with self-promotion and they are keenly aware of their image. The audience is government and potential new public utility companies. There appeared to be little or no attempt to publicize to the public the activities of ROADIC.

Coordinated Activities

There are a number of coordinated activities involving research, planning, construction and maintenance between the federal and local government agencies and public utility companies. These coordination activities include:

- Research on the use of under road space and systems for more efficient use of this space
- Research on administration systems to manage roads and below ground facilities and assets to keep up with the increasing amount of utilities to support the growing needs of the population
- Proliferation of new technologies and standardization of the road and utility management systems

- Collection, analyses and distribution of the latest data on roads and facilities
- Management of the road and facility systems
- Improving the use of existing road space above and below the surface
- Submission of applications for road occupancy permits
- Coordination of road work schedules
- Administration of common power cable conduits
- Administration and protection of roads and underground facilities



ROADIC does not mandate any location standards; this is left to the individual public utility companies. In addition, uniform color code for separate utilities is used within ROADIS.

The ROADIC permit process is the mechanism to coordinate construction obstructions within the right of way. Actual excavation coordination is left to the individual public utility company.

Risk Management/Liability

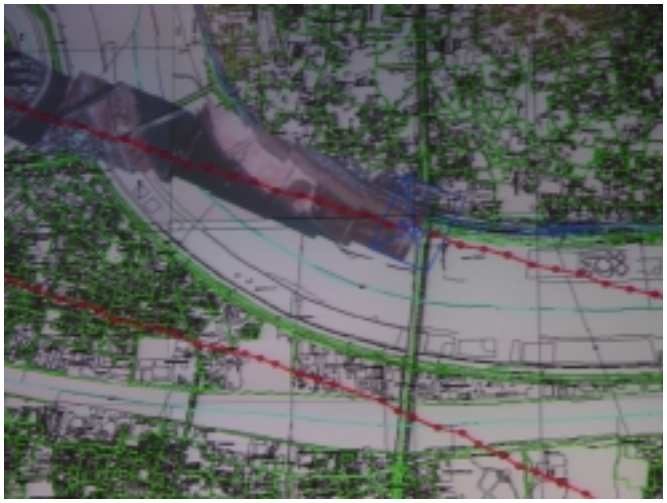
Because ROADIS is a "closed" system, data and system access is limited to those organizations that are members. Therefore, risk management and liability would appear to be the responsibility of the individual members. Restricting access to data and the system is enforced by a membership agreement with each member. This agreement includes strict system and data security policies. There is a process set up for new organizations interested in becoming members. The Board members make the decision as to whether another organization is allowed to join depending largely on their financial contribution. Security or risk management/liability was not a major concern with regard to new or existing organizations gaining access to the system due to the closed network (VPN) configuration. Concern about risk and liability appears to be directed more to recent lawsuits resulting from accidental gas main explosions and timeliness of response during recovery to reduce any further injury, death or destruction.

With regard to system backups, the ROADIS databases are backed up daily in branch offices, monthly backups take place using an external archival supplier, and backup data is sent periodically to branches for disaster recovery purposes.

Shared Reduced Costs

Sixty percent of the cost of the original program was funded by the national government. The remaining amount was covered by the public utility companies. Today, the annual operating budget is approximately $31 million US and is paid by the members though an annual contribution. This cost is divided among the 12 different cities. Any amount of each member's annual contribution that is not used in operations is reinvested back into the program for ongoing system improvements. These improvements include creating more data, improving the accuracy of existing data, upgrading hardware and software, and simplifying the use of the existing software functionality.

Development of the common landbase map, access to member public utility company data, and ROADIS applications are the best examples of shared reduced costs. In addition, hardware is upgraded every five years and software is upgraded periodically, resulting in shared cost reductions and increased efficiencies.



Enhanced Effectiveness

Enhanced effectiveness has been a direct result of the development of a common infrastructure database, standards, work practices and software applications that are used by all member organizations. This has greatly improved overall collaboration and coordination among the cities and public utility companies involving construction planning and operations. The result has been minimized disruptions and increased accident prevention, as well as reduced overall planning and construction costs.

Improved Communication

ROADIS is operated jointly by the ROADIC, the road administrators in the national government, the City of Tokyo and its 23 wards, 11 designated cities, and the public utility companies operating within these municipalities. Because the program is federally mandated, cities and public utility companies are required to comply with the related ROADIC standards and processes. This enables advanced planning, improved coordination, and more effective construction and protection of public utilities within the right of way. As a result, members have sufficient time to respond to their respective needs and make adjustments accordingly.

The concept of using a common infrastructure database for all members has been discussed extensively throughout the United States over the years. The ROADIC program serves as an example of how such a program can be accomplished in the U.S. Additionally, once this data is obtained, it can be marketed to potential members who also have a need for this information. A key point to consider for something similar to ROADIC in North America would be the need for strict proprietary agreements with member utilities. Liability issues would also need to be addressed.