TOWN +GOWN: NYC

Under the Ground: Planning, Management, and Utilization
DYCD, 2 Lafayette, 14th Floor Auditorium
January 29, 2020, 8:30 a.m. to Noon

AGENDA

8:30 a.m.—8:45 a.m.	**Introduction and Welcome** Terri Matthews, Town+Gown:NYC
8:45 a.m.—9:45 a.m.	**Sustainable Urban Subsurface Systems Workshop: Update** Debra Laefer, NYU/Tandon
9:45 a.m.—10:45 a.m.	**Sea Level Rise and Hurricane Impacts on NYC's Subway System** George Deodatis, Columbia
10:45 a.m.—11:45 a.m.	**How Use of the Underground Enhances Resiliency** Priscilla Nelson, Colorado School of Mines
11:45 a.m.—Noon	**Utilidor Update** Terri Matthews

Introduction. This event picks up from work in *Town+Gown: NYC* on subsurface issues that focused on the utilidor, a technical solution to what is known as 'the spaghetti subsurface problem'.[1] The utilidor is a subsurface "systems of systems" infrastructure that contains utility infrastructure delivering essential public commodities, such as water supply and waste water treatment, energy (gas and electricity) and telecommunications. From the time of the 1901 construction of the BMT line[2] to the post-9/11 reconstruction of Lower Manhattan, engineers around the city have proposed various versions of the utilidor as a solution to permit the rationalization of all utility infrastructure, which are now buried in the dirt, the same as when they originally went in at the end of the 19th century.

In New York City, utility infrastructure is a combination of city-owned infrastructure—water and sewer distribution and collection—and privately-owned infrastructure occupying the roadway under various concession-type agreements—electric, steam, gas and telecom.[3] A utilidor is a separate infrastructure element that can house all utility infrastructure located with respect to each other based on the rules of physics. It protects the utility infrastructure from the elements—and from each other—under the ground. It permits easier access than the current process of digging into the streets to find the infrastructure for emergencies, for routine 'state of good repair' activities and for adding new capacity. Implementing utilidors is also thought to extend the life cycle of streets on top of them, saving both public and private capital over the long term.

In June 2006, City agencies involved in roadway construction engaged in a *Value Management Study on Roadway Repair Technology and Best Practices* to investigate ways to improve and maintain street infrastructure at a lower cost per mile, with less disruption. A primary objective was developing a menu of technologies and techniques to maintaining roadway life expectancy between resurfacings in the context of limited resources. Among the study's recommendations was a proposal to implement a pilot program for utility tunnels in various locations with concentrations of underground utilities, which would allow utility lines to be installed, upgraded and repaired without road disruption and also permit utilities to install remote sensor equipment to monitor flow for system monitoring to identify potential breaks requiring emergency repair and predict state of good repair needs for effective and efficient state of good repair capital programs. This recommendation was expected to reduce the need

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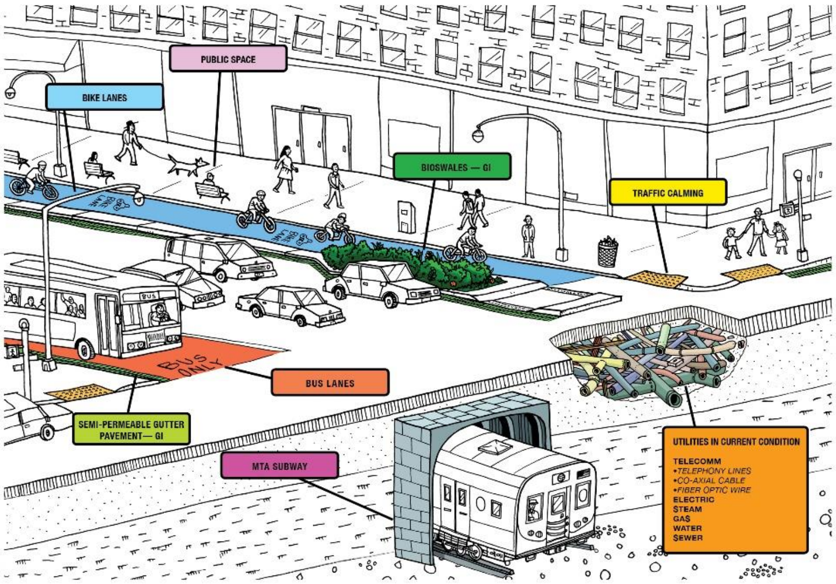
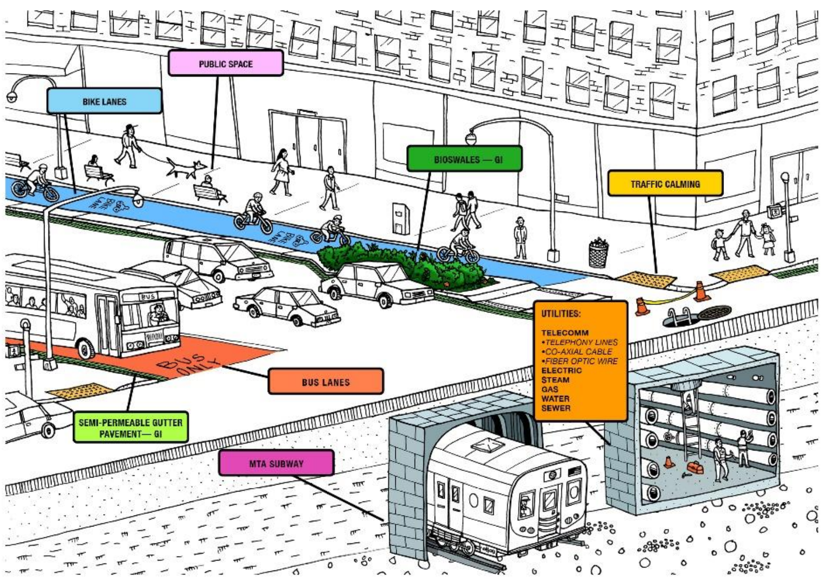
[1] Julian Canto-Perello and Jorge Curiel-Esparza, "Assessing Governance Issues of Urban Utility Tunnels," *Tunneling and Underground Space Technology,* Vol. 33 (2013), pp. 82-87 https://riunet.upv.es accessed 12/08/19 @ 10:12 p.m., p. 1.

[2] Lewis Makana, *Development of a Decision Support System for Sustainable and Resilience Evaluation of Urban Underground Space Physical Infrastructure,* Ph.D. Dissertation, October 2014, p. 104. https://etheses.bham.ac.uk/id/eprint/6262/1/Makana15PhD.pdf accessed 12-05-19 @ 6:20 p.m.

[3] In this précis, the terms utility and utilities will encompass both private and public utilities.

for street cuts, to achieve design life, extend the time between resurfacing and improve street conditions.[4]





David Akey, NYC DDC, Creative Services

[4] M-25. Other recommendations included using reusable, removable pre-cast pavement in select areas to pave the road to provide a durable driving surface that is removable for access to buried utilities to reduce reliance on the ability of the utility company to adequate restore the road and thus maximize the design life of the reconstructed street, maximize the time between resurfacing needs, thus improving street conditions (IR-44), and establishing city-wide standard lane assignments for telephone and cable TV where possible, with the ultimate intent of having the private utility assignments under the sidewalks where applicable to put this infrastructure outside the roadway, thus reducing interference of future roadway infrastructure projects and ensuring their design life (M-14).

In 2010-2011, Town+Gown began work with an experiential learning project to explore how the City might incorporate long-term life cycle cost and full cost/benefit analyses for projects adhering to NYC DOT's sustainable street design guidelines. This project identified significant data gaps to populate the model. The 'the spaghetti subsurface problem' kept rearing its head during all discussions with the student team. At a symposium event in 2012, the participants began to explore where data or proxies might be to populate the model and, the conversation quickly and decidedly became a collectively-experienced introduction to the 'the spaghetti subsurface problem' under New York City streets. An important takeaway from the conversation was that state regulatory practices governing the portion of approved rates attributable to private utility capital programs contributed to the spaghetti subsurface situation and the dysfunctional data environment.

The second phase of this work, in 2012-2013, involved extensive legal policy research, in the experiential learning component, that focused on the nature of the regulatory environment in which the private utilities operate. Systemic elements consisting of multiple commodities and provider entities individually operating within the same constrained physical subterranean spaces and multiple regulation at all levels of government for the commodity providers either create or exacerbate the conditions for what is known as "recursive collective action" under the City's roadways. After that second event, a city budget expert suggested that the impediment to implementing this modern approach was a finance problem.

At our May 30, 2019 event, *Construction+Finance in 2019: Innovative Delivery and Finance,* there was a presentation of the federal Revenue Procedure 82-26 (formerly Revenue Ruling 63-20) "63-20" financing option for utilidors, which have public and private use aspects.[5] This spring semester, a team of Columbia/SIPA students will conduct a life cycle cost benefit analysis of implementing utilidors in the City as part of the City's routine roadway reconstruction program.

This event kicks off Town+Gown's Spring 2020 Symposium event series and focuses on what lies beneath urban infrastructure—the urban subsurface. This event seeks to reintroduce the topic of underground utilities, conditions, data, and management to a broader audience so that interdisciplinary research can emerge, with facilitated collaboration on multi-level, multi-faceted workable solutions. The various stakeholders, organizers, and presenters involved in this work understand the multi-faceted environment event sometimes find their work siloed and not integrated among the many urban subsurface actors.

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[5] Pacifica Law Group, *Fifty Years of 63-20 Financing: Revisiting an Alternate Development Tool for Washington State Agencies and Municipalities*, p. 1. mrsc.org/getmedia/530A597A-4D81-41AE-9279-3523D1BE0BAC/m58-63_20.aspx accessed 01/22/20 @ 2:26 p.m.

The underground environment includes utility infrastructure from the pavement down to the different soils and the hydro-elements underground and encompass everything under the public roadway and below the first floor of buildings.[6] The complex and multifaceted nature of the subsurface requires involvement of many different professions. Understanding and managing the subsurface and gathering and managing subsurface data requires coordination between many different entities—private and public, academic and professional.

For urban planners and policymakers, timely and accurate subsurface data lays the crucial foundation for actionable plans. Especially for environmentally vulnerable cities like New York, the subsurface represents an important but hidden asset and opportunity. What lies beneath infrastructure touches on everything that planners and policymakers deal with on the surface—finance and budgeting, construction, communities, and environmental consideration. Urban planners typically consider structures and everything else above ground within their purview, planning for growth, and now, for environmental sustainability and resiliency. While the surface remains important, planning, managing and utilizing the *subsurface*, which is a finite resource in a dense urban environment, are necessary and complementary.

From the Sustainable Urban Subsurface Systems Workshop. On June 24, 2019, a subsurface-oriented event organized by New York University's Center for Urban Science and Progress featured 23 presentations on urban subsurface research and management.[7] Throughout the event, presenters discussed important issues directly related to the interactions between private and public entities regarding subsurface projects and highlighted the benefits of interdisciplinary collaboration, particularly in how available and shared subsurface data affects the operation of current data systems. Interdisciplinary collaboration is necessary for all subsurface issues. Below are summaries of the workshop's themes and presentations and big picture takeaways.

The first six presentations focused on *New York City in Context* and included a brief history of underground infrastructure and GIS in New York City, the benefits of underground infrastructure data interoperability, reducing risk to emergency responders with updated subsurface utility data, resilient coastal design, 3D underground proof of concept and interagency data coordination, and the value of historic geotechnical information. Superstorm Sandy exposed the far-reaching vulnerabilities that New York City infrastructure faces in light of climate change, which has required a renewed understanding New York City's subsurface,

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[6] Alan Leidner, *Benefits of Underground Infrastructure Data Interoperability* presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

[7] See https://www.youtube.com/playlist?list=PLXpf--miAIDM51tgpUYn20NG1gYTpjjRK

particularly making resiliency a focal point for future academic and professional pursuits. Several presenters identified historic GIS, interagency, and intra-agency coordination—between private and public entities—as the most important foundations for creating replicable and viable future systems.[8]

Coastal flooding and aging infrastructure emerged as primary vulnerabilities for entities managing New York City's infrastructure systems. Resolving the problems of aging infrastructure involves determining risk, which combines probability and impact, and must include resiliency approaches.[9] Differentiated from sustainability, resiliency refers how humans survive the effects of the natural environment, and resilience efforts in coastal regions require people to think about how urban environments' current designs and actions will affect the future of these built environments.[10]

The next five presentations focused on *Data Collection and Management* and included getting to a common language for subsurface data, finding a common ground with model harmonization and integration for underground data, the British Geological Survey's National Borehold Repository, and how Flanders tackled the burden of sharing information about its underground assets, and recommended policy change for all urban projects. The presenters highlighted a widespread lack of coordination both within government and between government and private entities and a need to change the culture of data-sharing by not only illuminating its positives, but also its potential to enact positive change. Since the subsurface involves a number of different entities, a variety of measures and analytics must be employed in order to fully capture the multi-faceted area.

Presenter identified several obstacles that complicate the processes of managing and researching the urban subsurface. Cumbersome, sometimes time-prohibitive, processes of requesting data from different governmental agencies stymy coordination and data-sharing both within the public realm and between the public and private realms. The format of data affects the availability and digestion of information. Incompatible data formats—for example, one agency or entity sharing its information through Adobe PDFs and another using Microsoft Office Suite—muddy meaningful knowledge transfer.[11]

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[8] Wendy Dorf, *A Brief History of Underground Infrastructure and GIS in NYC* presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

[9] Michael Brady, *Reducing Risk to Emergency Responders with Updated Subsurface Utility Data*" presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

[10] Spiro N. Pollalis, "The Envision® Rating System for Sustainable Infrastructure Projects" presentation at Town+Gown: NYC symposium event, *CD+W.4. Envision and Impact Analyses*, October 23, 2019; not yet posted to website.

[11] Allen Cadden, *DIGGS: Getting to a Common Language for Subsurface Data* presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

Since no single entity deals with the underground environment, information comes from a variety of different environments and formats, the DIGGS (Data Interchange for Geotechnical and Geoenvironmental Specialists) solution, which includes the DIGGS data schema and an XML standard developed to ensure interoperability of geotechnical data and facilitate broader data-sharing and integration, was developed to become an industry-standard protocol for transmitting and storing geotechnical and geoenvironmental information serving a wide range of public-sector institution and private-sector industry organizations. [12] Through an industry standard solution, there is now a common language for subsurface data to help prevent miscommunication or gaps in knowledge shared. If subsurface information on which utility plans are based on is inaccurate, the resulting projects run the probable risk of missing important factors that would not only fail to have the desired effect, but also add avoidable complexity in the subsurface area.

Six presentations provided *Domain Perspectives* and examined whether a city can combat sea-level rise on its own, based on recent experience in coastal region resilience activities, applied geospatial technologies in archaeology and urban planning, the contractor's perspective on ground improvement in urban areas, the potential of smart civil infrastructure in St. Louis, and subsurface utility engineering and the application of ASCE 38-02. Interdependent adaptation remains an important issue among governmental entities within a region, with methods undertaken by one entity affecting possible methods available to nearby governmental entities.[13] While certain protective features may protect one entity, they may affect or add pressure to the protective features of other entities. Shoreline protection for urban areas primarily take on two forms: accommodation (like wetlands) and containment (for example, hard walls).[14] As sea level rise emerges as a contributing factor to changing lives in current urban areas near coastlines, subsurface data becomes necessary for both sustainable projects and resiliency projects, and data identification and control become the linchpins of laying the literal groundwork for multi-entity subsurface management. Since climate change highlights the vulnerability of current transportation systems crossing jurisdictional boundaries, data coordination among those government entities is key for vulnerable transportation systems.

The last six presentations focused on *Emerging Technology and Emerging Needs* and included heat exchange and heat storage in urban subsurface infrastructure, subsurface infrastructure informatics with geo-sensing, augmented reality and the Internet of things, innovative urban

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[12] *Idem*

[13] Roger Wang, *Can a City Combat Sea-Level Rise Alone?* presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

[14] *Idem*

wastewater systems on and off the grid, geophysical tools to help unearth opportunities and challenges in the urban underground, microplastic pollution in urban areas, and monitoring urban environments through environmental DNA analysis. As projections for climate change and its potentially devastating effects on the natural environment and the built environment, the subsurface can provide insight and information for stakeholders.[15]

More on Utilidors. Modern urban life depends on utility commodities, consisting of clean water, sewage and waste disposal, electricity, gas and telecommunications, which are essential to human life and require infrastructure to produce and deliver them. These commodities are now expected to be produced and delivered within an environmentally—and financially—sustainable envelope and be resilient to natural and man-made disasters. As cities expand and adapt to demographic changes and the resulting changes in demand on utility infrastructure, utilities and policymakers must explicitly consider the subsurface for optimal solutions to meet new demand, while maintaining and/or improving the infrastructure and the environment.[16] In many urban areas, public and private utilities bury their utility infrastructure in the dirt under public roadways, with little to no coordinated planning or placement, exposing each utility's infrastructure to natural elements under the ground and to risks imposed by other utilities' infrastructure. Utilidor infrastructure is a planned and designed underground structure that supports "continuous improvement of sustainable and resource efficient urban planning and development."[17]

The historic practice of burying utility infrastructure under the ground " has meant that the large cities have their underground sections occupied by numerous pipes, many of them out of use, which cross it with no coordination and not programmed, and this in spite of the efforts of rationalization and planning made by public administrations, and by the private companies themselves who supply these services to the inhabitants."[18] "The transfer from the surface toward underground burial [of urban utility infrastructure] was historically made without real planning: the principal goal was to rapidly solve a problem on the ground by moving it underground in the best technical and financial conditions [leading to a common urban phenomenon where] all urban underground space beneath the pavement is densely filled with

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[15] Eugenia Naro-Maciel, *Monitoring Urban Environments Through Environmental DNA Analysis* presentation at the Sustainable Urban Subsurface Systems Workshop. Brooklyn, New York, June 24, 2019.

[16] Wout Broere, "Urban Problems – Underground Solutions," *Advances in Underground Space Development,* Shou, Cai and Sterling, eds. (Singapore: The Society for Rock Mechanics and Engineering Geology, Research Publishing), 2013, p. 1528.

[17] *Ibid.*, p. 1529

[18] José Garcia and José Berrade, "Service Tunnels as an Element for the Regeneration of Historic Centres: The Case of Pamplona," *Selected Proceedings from the 13th International Congress of Project Engineering* (Badajoz, July 2009), p. 119.

urban utilities [with a] mess of cables and pipelines [that] has been ironically termed 'the spaghetti subsurface problem'."[19]

This historical practice has created a subsurface chaotic situation completely at odds with formal public planning efforts that have focused, since the early 20th century, above the ground in cities. "The effectiveness of infrastructure projects ... depends on their integrated character and their polyvalence, i.e., they must serve for something beyond a specific function [, which] is why it is necessary to arrange and rationalize the use of the underground section of large cities ... to [correct] the current anarchical and non programmed location of service pipelines, which, very often, are set up one against the other in the same street to serve the same citizen, offering him/her first water, then light and last gas [, all of which contributes] to the belief in the convenience of using spaces or common service tunnels through which the pipes or conduits of the different services can run."[20]

Corrosion of subsurface utility infrastructure due to subsurface conditions and the interaction of the infrastructure in a spaghetti-like environment, and damage to infrastructure elements during excavations by contractors are "[t]he main problems causing interruption to service associated with an urban utility."[21] "Damage to utility infrastructure is mainly due to the natural aging of the structural materials [,especially] since utility structures remain in service exceptionally long, and to changes in the operating condition. The principal failure hazard to such structures arises from a lack of routine inspections [,and] utility tunnels increase reliability of services as compared to conventional trenching practice."[22] The utilidor's facilitation of "[i]nspection and preventive maintenance of utilities ... permitting early identification and reducing of potential ... failures, increas[es] the utility [infrastructure's] economic life and reduc[es the] probability of rupture to pipe-type facilities, [thus] minimizing maintenance and operating costs for some or all utilities, as compared to conventional practice. Maintenance work can be developed under all climatic conditions with these subsurface facilities [, and d]amage to pipes and cables by others is minimal since blind digging is eliminated. Utility tunnel practice eliminates or reduces to a minimum, corrosion problems, which usually appear in buried pipelines."[23]

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[19] Julian Canto-Perello and Jorge Curiel-Esparza, "Assessing Governance Issues of Urban Utility Tunnels," *Tunneling and Underground Space Technology,* Vol. 33 (2013), pp. 82-87 https://riunet.upv.es accessed 12/08/19 @ 10:12 p.m., p. 1.

[20] *Idem*

[21] *Idem*

[22] *Ibid., p. 3.*

[23] *Idem*

"The [United Nation's] definition of sustainable development ... [which] is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' [Although s]tudies carried out by the United Nations on sustainable development have been focused on the global economy, ... they could also be applied to utility networks."[24] Sustainability requires proper infrastructure planning and "efforts to achieve sustainability must include innovation to all types of infrastructure including [those hidden] underground."[25] A sustainable city is also a "smart" city that requires an explicit focus on its utility infrastructure. "The vision of 'Smart Cities' is the urban center of the future, made safe, secure environmentally green, and efficient because all structures—whether for power, water, transportation, etc.—are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking and decision-making algorithms."[26] A smart city "monitors and integrates conditions of all its critical infrastructures, including roads, ... communications, water, power ..., [so that it] can better optimize its resources, plan its preventive maintenance activities, and monitoring security aspects, while maximizing services to its citizens."[27] Realizing the promise for information and computer technology to increase and optimize efficiency and effectiveness in delivery of public and private utility commodities—and, the public services dependent on such commodities—requires a focus on the actual infrastructure, much of which is located under the roadway, leading to utilidor implementation.

Analyzing cities' "capacity to act" with respect to local government energy planning policies and program implementation reveals the existence of broad climate change action goals, but extremely limited capacity to act in this space.[28] Utilidor implementation, which has significant positive environmental sustainability impacts, and is a *sine qua non* element of a smart city, is not only technically more within a city's capacity to act and its span of control than broad sustainability initiatives but also represents an efficient back door to achieve elements of their broader environmental sustainability initiatives. Under law, cities hold the roadways in trust for the public and grant access for use of subsurface space to private utilities under concessions,

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[24] *Ibid.,* p. 1

[25] *Idem*

[26] Robert E. Hall, Brookhaven National Laboratory, Upton, New York (under U.S. Department of Energy, Contract No. DE-AC02-98CH10886), *The Vision of a Smart City*, presented at the 2nd International Life Extension Technology Workshop, Paris, France, September 28, 2000, P. 1. https://webcache.googleusercontent.com/search?q=cache:7a0JqM8FeP8J:https://www.osti.gov/servlets/purl/773961+&cd=1&hl=en&ct=clnk&gl=us&client=firefox-b-1-d 11/03/19 @ 7:12 p.m.

[27] *Idem*

[28] Stephen Hammer, "Capacity to Act: the Critical Determinant of Local Energy Planning and Program Implementation," Working Paper, Columbia University Center for Energy, Marine Transportation and Public Policy. Presented at the World Bank's 5th Urban Research Symposium (Cities and Climate Change), Marseilles, France, June 28-30, 2009, pp. 6-10.

franchises and licenses, which are authorized by law. Cities wanting to engage in more rational planning and use of subsurface space under their roadways can, with the utilities, revise existing concessions franchises and licenses to support utilidor implementation without changes in superior law. At issue is financing, with its mixed public and private uses by public and private utilities, and concomitant risk allocation issues. A city's capacity to act, with respect to deciding to implement utilidors and having private utilities participate in some way, is not in question.

The benefits of utilidors accrue to the utilities, but externalities from utilidors also accrue as benefits to others, and a brief description of them helps to identify the stakeholders and their interests. Benefits accrue to the general travelling public and to property owners, both abuttors and others, due to reductions in future noise and future disruption of bypassing traffic.[29] There are overall improvements to environmental sustainability benefitting all, specifically due to the reduction in street cuts for utility infrastructure repair and maintenance and the increase in the useful life of the surface roadway and utility infrastructure, with the attendant reduction in waste of natural resources.

More on 63-20 Financing for Utilidors. Central to the 63-20 financing option is the creation of a "nonprofit corporation [that] issues bonds to finance the development of a facility 'on behalf' of a state or municipal entity," the proceeds of which bonds "are applied to pay for the acquisition, construction and equipping of the facility."[30] "The bonds are repaid from net revenues of the facility and, if the governmental entity is the lessee of the facility, from lease payments sized to cover debt service on the bonds."[31] When the bonds are "retired without consideration," the financed asset "must transfer to the governmental entity."[32]

Advantages of the 63-20 financing option accrue for a public-private asset, which may require bonds attributable to utilidor components used by private utilities to be taxable. While "the governmental entity must have a beneficial interest in the nonprofit corporation during the term of the bonds," the nonprofit governance structure can accommodate representation of the several public and private utilities locating their distribution infrastructure in the utilidor within the context of existing fundamental organic laws and documents granting rights of access to the subsurface space.[33] The 63-20 option can approximate public-private financing in the absence of specific statutory authority.[34] Advantages of the 63-20 option "may make sense

[29] Canto-Perello, *op. cit.,* pp. 4-5.
[30] Pacifica, *op. cit.,* p. 1.
[31] *Ibid.,* p. 2.
[32] *Idem*
[33] *Idem*
[34] See pp. 3-4.

when a private approach to developing a governmental facility is likely to provide significant benefits compared to a traditional public approach."[35] These benefits include construction-related procurement considerations of schedule and cost in addition to "specialized development skills, knowledge or approaches."[36]

As with all construction projects, the nonprofit organization will need to determine risk allocation and risk mitigation,[37] but governance for utilidor planning and implementation would be more complex and difficult than a standard public or standard private capital project. The short list of governance issues includes risk analysis related to safety considerations for those who would work in the utilidors and for the utilidor itself as well as legal, financial and threat-type security considerations.[38]

Design principles for the utilidor should accommodate safe employee access and working conditions, and the utilidor design "should be finely tuned to future demands in space requirements to avoid becoming outdated too early."[39] Utilidors require planning and construction for "future growth and needs," so that it is important not "to reduce economic expense to lowest possible level" and repeat the financing protocols that created the current spaghetti subsurface problem.[40] It is, however, the "need to provide this expansion space along with the necessary access space [that] produces the main disadvantage of the utility tunnel, [which] is [its] high initial cost."[41]

Since one important reason for implementing utilidors "is to avoid interference with urban transportation networks, both vehicular and pedestrian ... to minimize interference and disruption, as many utilities as possible must coexist in the same facility," the nonprofit organization would need to be capable of contending with the "many governmental authorities and private companies [that would be] involved. The organizational structure must be flexible enough, so that the inability to rather rigidly control the placement of all utilities in a narrow corridor does not cause administrative breakdown."[42] Since "cooperation and agreement of all participants is critical to success of the [utilidor, e]xplicit agreements as to the rights and obligations of all concerned will be necessary, [especially] including criteria influencing a dispute resolution strategy," which may be dictated and/or constrained by financing terms, and

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[35] *Ibid.,* p. 2.
[36] *Idem* See also pp. 2-3 for flexible procurement opportunities under "public work" analysis.
[37] *Ibid.,* p. 4.
[38] Canto-Perello, *op. cit*., p. 2.
[39] *Ibid.,* p. 3.
[40] *Idem*
[41] *Ibid.,* p. 6.
[42] *Idem*

should include "guarantees of impartial treatment" for all participating utilities.[43] In addition, the management organization would need to contend with liability issues for the design and construction of the utilidors *and their operation*, which would be based on insurance products available to all utilities for their construction projects and for their operations under current conditions.[44]

The functions of the managing organization throughout the life of the utilidor would cover all planning activities for the utilidors; construction-related permitting, easements and coordination with regulatory authorities; determination and coordination of criteria for installation and operation of all utilidor utility systems; the operation and maintenance of utilidor systems including drainage, lighting, ventilation, fire detection and gas detection; all security and access control procedures; and, management of expenses and collection of rates.[45]

There must be appropriate levels of security in terms of what is being protected—physical property and facility operation—consisting of guarded entrances; limited and easily secured and protected access points, including ventilation openings and entrances to laterals leading to buildings; and a wall between the utilidor and any subsurface transportation system.[46] Security measures can vary with different threat levels, with practices in Madrid and Barcelona serving as good examples; and, countermeasures can include in-tunnel protective lighting; intrusion detection systems; alarm systems and surveillance cameras operating in tandem to alert local police; automatic fast acting shutoff device to protect the utilidor and its utilities; and annual inspection and checks of security measures and procedures.[47]

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[43] *Ibid.,* p. 5.
[44] *Ibid.,* p. 4.
[45] *Ibid.,* p. 5.
[46] *Idem*
[47] *Ibid.,* p. 6.