



TOWN + GOWN

ACTION RESEARCH AGENDA

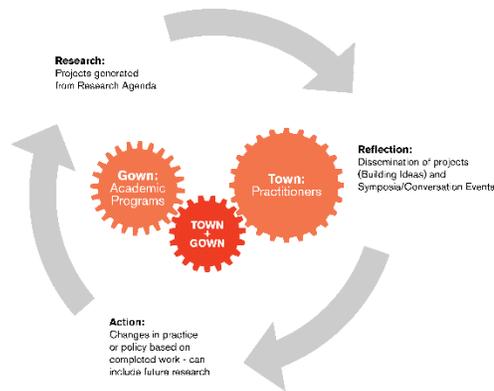
2021-2022

Town+Gown:NYC, is a city-wide university-community partnership program, resident at the New York City Department of Design and Construction (DDC), brings academics and practitioners together to create knowledge in the built environment, using several models of university-community partnership. Situated on the practitioner side of the academic-practitioner divide and *within* a local government, Town+Gown facilitates partnerships across the academic-practitioner divide, which involve negotiating differing expectations, motivations, understanding and language to produce work of benefit to both sides.

The purpose of increasing evidence-based analysis, information transfer, and understanding of the built environment, using, in many instances, New York City's built environment as a laboratory is to provide evidence-based research to support changes in practices and policies based on research results. Town+Gown works with academic institutions' service (experiential) learning programs to facilitate partnerships between academics and practitioners on applied built environment research projects through the collaborative inquiry model of systemic action research. Town+Gown is experienced with all modes of service (experiential) learning and has created projects with formal experiential learning programs (such as studios, workshops, capstones and clinics), informal or *ad hoc* experiential learning engagements, graduate and undergraduate classes or components of these classes, and graduation requirements such as master's theses and doctoral dissertations

The built environment's inter-related physical and governance setting is a complex and dynamic social system, further complicated by issues of geographical and temporal scale. And, built environment research requires active attention to context and multiple modes of inquiry, research methodologies and types of academic-practitioner collaborations, operating within an interactive and open action research platform across academic years through action research sets.

This Research Agenda is a tool to develop projects with Town+Gown providing initial links between practitioners as equal partners in knowledge creation with academics and support to these projects until completion, bridging the academic/practitioner divide that can make such projects challenging. For applied built environment research to be useful to government practitioners, it needs to reflect their operational, jurisdictional and political constraints, which are not perfectly evident to researchers who are not directly involved in the day-to-day details of urban management, local and regional governance and the public policy decision-making process.



After projects are completed, Town+Gown disseminates the results through its annual review document, *Building Ideas*, which provides long-lasting exposure of completed student-led research. Town+Gown also reflects on results through its annual series of symposium events, aiming at future research and action. Town+Gown serves as a clearinghouse for completed projects and provides researchers with additional contextual materials to support their research.

All practitioners and academics are welcome to participate in Town+Gown. To explore working within Town+Gown, please see the research questions that follow, with the first section containing specific research ideas, with no specific Built Environment discipline marker, for the Town+Gown working groups, and the second section containing more general research ideas along the lines of the Built Environment disciplines. If none of these work for your programs, we can develop your project ideas that work for your students.

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Town+Gown Working Group-Focused Research Questions

Introduction. Town+Gown first piloted knowledge co-creation sessions in 2018 to engage in “real time” co-creation of knowledge to identify what we know and what we don’t know on a particular topic and what need to know to make changes in practice and policy based on research. After years of conducting research, disseminating research results in *Building Ideas* and holding symposium events to reflect on results and move them toward action, Town+Gown needed a mechanism to accelerate the action research cycle and move Town+Gown’s work to the “thought leader” stage and toward a more systemic form of decision-making.

These co-creation sessions led to the creation of Town+Gown’s working groups where Town+Gown could provide an architecture for intentional, targeted intentional research projects focused on the identified research gap and increase academic synthesis and translation of the results to serve as useful applied research resources for policy makers. The research needs of the working group, which can involve several Built Environment disciplines, are reflected below.

Urban Resource Recovery (URR). Initially created as the Construction+Demolition Waste working group, the URR Working Group is focused on supporting applied research and innovative policy design to close construction material loops on a city-wide basis. The URR has developed a Closing Loops City Program Initiative (CLCPI) that aims at revising City agency construction practices and policies in order to leverage the City's capital program to support the market to close CDW material loops, pursuant to and consistent with New York State Department of Environmental Conservation (NYS DEC) beneficial use designation (BUD) regulations and the process to request case specific BUDs where none exist, in the context of NYS DEC Enforcement Discretion Letter, dated February 12, 2021, by (1) increasing overall direct re-use of recovered CDW materials generated on City capital projects without interim processing as available materials on City capital projects or private construction projects¹ (Direct Re-use) and (2) by intentionally redirecting recovered CDW generated on City capital projects away from landfills to transfer locations for Direct Re-use (either by the City or private users) or to interim processing facilities² for use as feedstock for manufacturing facilities producing new construction materials (Intentional Indirect Re-use). Direct Re-use and Intentional Indirect Reuse will (1) conserve embodied carbon by recovering and re-using CDW elements, (2) eliminate Greenhouse Gas (GHG) emissions from no-longer-needed virgin materials extraction and production, (3) support the private development of resource recovery facilities and manufacturing facilities for construction materials using recovered resources, which is necessary for the circular economy, and (4) generate City capital budget savings over time. The CLCPI will also support the City's furtherance of the United Nations Sustainable Development Goals 3 (3.9) and 8 (8.3 and 8.4) (CLCIP's SDG Goals). While the CLCPI is a City initiative that leverages its capital projects, the policies, practices and tools it develops would be replicable by private owners on their construction projects and private adoption of CLCPI policies, practices and tools over time would expand the reach and impact of the CLCPI.

Circular Economy for Recovered Urban Resources

In the area of recoverable urban resources, market analysis depends directly on each material—its properties and potential reuse options, demand and supply for these reuse options, and the private market conditions necessary for manufacturing development, which include interim processing facilities and high-value “upcycling” manufacturing facilities for new products.

¹ It is currently anticipated that the Virtual CDW Matching Website for these materials will give City agencies a right of first refusal before making them available to private construction owners and contractors.

² The CLCPI references to “interim processing” facilities mean those interim processing facilities and transfer facilities that are intermediary facilities processing CLCPI Recoverable Materials for reuse in new construction materials. There are two ownership models for these intermediary facilities—municipal ownership and private ownership—the CLCPI will support both, which need to comply with 6 NYCRR § 361-5 and Part 362.

The goals of this research project would be to develop an overall methodology that could be applied to each resource to develop actionable plans for implementation at the state and local government levels, which both need to be addressed due to the regulatory environment and the scale of the market.

How to Estimate Construction+Demolition Waste (CDW)

At the present time, neither the state nor local governments have data on the amounts of CDW generated from new construction and major renovations of buildings and infrastructure to support policy development. Initial research has revealed studies pointing to ways to estimate CDW within a market area.

The goals of this research project would be to survey and document such research and develop an actionable methodology for an estimation tool that the City could use to support policy development.

Specification Practice to Support Re-Use of Recovered CDW Materials

City agencies have multiple and independent specifications for construction materials and for handling CDW waste generated by their infrastructure projects. There are no city-wide specifications for public buildings because material specifications on public buildings are produced by consultant designers for each building, and NYC DOB only controls the procedures for testing concrete. NYS DEC's beneficial use designation (BUD) regulations, however, permit re-use of certain CDW elements, and the State's GreenNY program is developing template specifications (see <https://ogs.ny.gov/greenny/executive-order-4-tentatively-approved-specifications>), which City agencies can use on their projects. While specification tends to be siloed in each agency, within an environment of engineering conservatism, the development of the City's Climate Resiliency Design Guidelines is an example of agencies developing performance specifications in a collaborative manner.

This research project would survey best practices at large construction enterprises, including public entities, for construction specification development and management over time as conditions change, and recommend an optimum approach for the City to take for specification development to support the CLCP.

Opportunities for Upstate New York's Economy from Construction Activities

Technological developments in the construction industry, such as building information modeling (BIM) and off-site prefabricated construction, which are related phenomena, and interim processing of construction+demolition waste and other urban recovered resources and manufacturing of high value “up cycled” materials have the potential to revive the New York State economy, especially in upstate New York where economic conditions have not been particularly good.

The goals of this research project would be first, to survey existing construction-related businesses in New York State and then through research, including interviews with industry, identify potential opportunities presented by BIM-enabled pre-fabricated construction and interim processing and high value manufacturing across the state based on land values, workforce characteristics, presence of academic institutions with engineering departments, and location to transportation, including transportation by water.

Life Cycle Cost Analysis of Closing Material Loops under the CLCPI

The Closing Loops City Program Initiative (CLCPI) discussed above focuses on expanding the recovery and re-use of a number of CDW and other materials either in a direct manner or an intentional indirect manner. Among the reasons it is difficult for local governments to develop public policies for CDW recovery and re-use is the need to analyze each specific CDW material separately as part of the lifecycle from material generation, physical properties for use and re-use, actual use, recycling and eventual re-use in different applications or new materials. The CLCPI will focus on the following materials:

- Non-renewable building CDW
- Concrete and recycled concrete aggregate
- All excavated soils
- Nearshore dredged materials
- Grit from DEP’s wastewater resource recovery facilities (WRRFs)
- CDW glass
- Wood pallets
- Decommissioned wind turbine blades
- Rubber crumb

This research project would develop a life cycle cost benefit analysis of direct re-use and/or intentional indirect re-use of any material covered by the CLCPI.

Leveraging LEED and ENVISION to Increase CDW Recovery and Re-Use on City Capital Projects

LEED is a national certification system that the City's local law mandates certain City public building construction projects follow and achieve a minimum LEED rating of Certified or Silver and, in many cases, use energy and water more efficiently than current City codes require. City construction contract specifications reflect the LEED requirements for CDW management performance requirements, with diversion requirements, but LEED construction materials standard do not explicitly include construction materials made from recovered CDW. Thus, LEED, as implemented on City projects, does not focus on closing material loops. In contrast to public building construction projects that must comply with LEED, City infrastructure construction agencies have an option to use the Envision rating system, which is a framework applied to infrastructure projects, to apply for an Envision rating for their infrastructure projects. While both LEED and Envision focus on the impact of built environment structures on the environment, the Envision framework is less prescriptive in the use of methodologies to measure the impact of using recycled CDW on new construction projects than LEED because Envision seeks to optimize the sustainability of an infrastructure project during the planning and preliminary design phases, and quantify the relative sustainability of the project.

This research project would explore how the City could leverage the requirements of both rating systems to increase recovery and re-use of CDW from City capital projects under the URR Working Group's Closing Loops City Program Initiative.

Ahead of the Curve—Wind Turbine Blades

New York State has begun increasing authorization of wind turbine farms across the state, with more installations in and near downstate New York, which includes New York City, in the pipeline of projects to increase the production of renewable energy. Decommissioned wind turbine blades at the end of their useful lives still have structural integrity for a number of uses, and often the blades are decommissioned before the end of life due to switching out earlier with blades with new design and material technology. This means for downstate New York, we are ahead of the curve for when the feedstock from decommissioned blades, either in whole or in part, can be recovered and re-used without interim processing as construction materials and divert them from landfills, many of which face their own capacity issues. There has been significant materials research on the properties of these blade with realistic re-use potential. There has also been research on logistical issues between wind farms and sites for re-use with the constraint that re-use should not increase the overall reduction in GHG emissions from wind farms and blade re-use.

This project will apply the geospatial analysis methodology developed by Queen’s University Belfast for Ireland and design research done by the ReWind Network to connect the predicted flow of decommissioned wind turbine blades from existing and planned windfarms in New York State with potential re-use of these blades in construction projects at locations across New York State where transportation logistics and GHG emissions issues become part of the re-use analysis.

Communications Design to Expand the Reach of Virtual CDW “Market” Maker

The City has several small virtual public access marketplaces for donated materials, one of which could serve as a test platform for some CDW materials in the CLCP initiative that could later be expanded for the entire initiative.

This research project would create a communications design strategy and collateral to support the expansion of one city virtual marketplace to include some CDW materials and enhance the marketplace’s ability to find good homes for these materials while the CLCP initiative gets underway.

Systemic Construction Data Analytics. Town+Gown has been working with data analytic students on a series of data analytics projects using DDC project data (see <https://vimeo.com/215532183/1ff5f29c70>). The actual findings were less important than the fact that administrative data are amenable to data analytic techniques to produce insight for construction process management. The Systemic Construction Data Analytics working group has expanded its systemic data analyses using city-wide data from the Capital Project Dashboard, generating initial system-wide insights, from which the working group can add more granular construction agency project data to derive actionable insights.

Systemic Drivers of Construction Cost Increase and Schedule Delay

The ability to build and rehabilitate all public projects—from buildings that include affordable housing subsidized by the public and infrastructure—to meet demand within a resource envelope depends on the ability to control construction costs.

This research project would focus on identifying the drivers of construction costs, with a focus on construction cost increases, and schedule delay, and identify those drivers within local government's control, including the adoption of technology. The research would include a literature survey and other research techniques, including interviews, possibly with analysis of available data, to further develop actionable plans/initiatives to control construction costs on public projects.

Increasing Capital Project Planning and Delivery Efficiency

The ability to build and rehabilitate all public projects—from buildings that include affordable housing subsidized by the public and infrastructure—to meet demand within a resource envelope depends on the ability to increase efficiency of capital projects through a variety of systemic improvements in the capital planning and budgeting processes and a variety of project management tools on individual projects. There is a relationship between the capital project system and individual project management capacity in the area of efficiency.

This research project would first define what efficiency means in public construction, where laws advance a number of public purposes that often conflict with each other and then focus on identifying system root causes of inefficiency in public construction programs and sources of inefficiency at the project level to identify state-wide improvements that affect state projects as well as local government projects and local government improvements.

Building Information Modeling (BIM) and Off-site Prefabricated Construction

BIM-enabled off-site prefabricated construction offers the potential to reduce or control construction costs for all types of projects—whether it is used for the entire project or elements of the project.

This research project would focus on developing a methodology to estimate potential savings from using BIM-enabled off-site construction on public projects as compared to the current “stick” method of construction.

Assessing the Costs of Deferred Maintenance and Benefits of Proactive State of Good Repair Management

All public owners experience impediments in planning for, and achieving, state-of-good-repair investments. At the same time, the mismatch between long-lived capital assets and changes in the demand for the related services that inspired them in the first place might argue against rigid application of planning, budgeting and execution rules that do not reflect such dynamics. Evolving technology may also argue against rigid application of such rules, since replacing near or at the time of actual failure permits the replacement to take advantage of the latest technology. For some time now, there have been reports of a “crisis” in infrastructure. The American Society of Civil Engineers (ASCE) annually releases a report on the state of American infrastructure, often reported in the press as a “crisis” that implies an acute episode, but in the context of this country’s long history of financing and building (often over-building) public works, this represents a chronic civic condition. The causes of any single moment of crisis are not particularly new nor are they unique to any particular jurisdiction. New York City’s Charter “state of good repair” provisions were enacted around the time of the first ASCE report and responded to the reality of years after the fiscal crisis when infrastructure maintenance was at its nadir; they require assessment of facility and infrastructure assessment in a limited way and compliance with them has not led to a state of good repair for all the City’s capital assets.

This research project would include a literature survey of capital asset condition assessment theory and practice and recent technology for asset evaluation to identify the elements that should be in a large enterprise public owner’s state-of-good-repair management program within constraints of finite capital resources and available technologies that are well suited for asset condition assessment. The project will also include a cost benefit model to assess the costs of deferred maintenance and the benefits of improved state of good repair management programs.

Resilient People, Places and Projects (RP3). Following two symposium events focusing on resiliency, the RP3 working group has developed a research project to apply the Neighborhood Activation Study methodology, Envision framework and the City's Resiliency Design Guidelines holistically to a group of capital projects in the Financial Plan "out years" of the Financial Plan period for two case study Community Districts that include all elements of resiliency—coastal flooding, inland flooding and urban heat island effect— to identify potential project synergies and run those projects through a life cycle cost benefit model to assess whether it is possible for such project synergies to create additional resiliency value for less or the same amount of investment. Latter phases of this research project will focus on ways to make the existing process more effective in translating community knowledge during capital project planning and design phases.

Community-Based Planning and Design

The NYC City Charter provides institutional roles for community boards, which are the actors with the smallest neighborhood-level jurisdiction in the City's land use planning and capital budget processes. The Charter intends the community boards to provide neighborhood-level information up to inform policies and actions taken by the larger actors within city government governmental processes.

This research project would work with the theory of a partnered platform (see Sherry Arnstein, "A Ladder of Citizen Participation," *Journal of American Institute of Planners*, Vol. 35 (1969), Issue 4, pp 216-224) and subsequent theoretical work, to identify institutional process points during the capital planning-to-design-to-construction-to-maintenance process and develop a menu of options within a plan to increase the ability of community boards to transmit community knowledge relevant to capital projects in the planning stage and during the design stage *in a meaningful way to City agencies* during the various processes to help increase capital projects' overall effectiveness in increasing infrastructural and community resilience.

Toward a "Smarter" City: Utilidors (Utilidor). Town+Gown has been focusing on issues “under the roadway” and in particular on the idea of multi-utility tunnels—or utilidors—which had gained some interest during the rebuilding of Lower Manhattan after 9/11. The work of the Utilidor working group has expanded its purview from “under the roadway” to “under the surface”, which is a limited, non-renewable resource, and is developing an innovative policy for implementing utilidors as part of the City’s standard roadway reconstruction program to solve subsurface—and surface—issues. The Utilidor has a life cycle cost benefit analysis (LCCBA) model for this initiative. Increasing subsurface planning and use to solve subsurface and surface problems also advances Sustainability Development Goals 6 and 11.

Additional Life Cycle Analyses (LCAs) for Utilidor Implementation

Our LCCBA model is an excellent first step, but review and subsequent research suggest additional LCA for specific pieces of this puzzle need to be done to make the model as accurate as possible.

This research project would develop LCA model for all or some of the sub-areas below:

- Private utility franchises were not priced to capture the negative externalities created by the current practice—students would review the City’s franchise agreement fees and develop an LCA model to quantify the negative externalities from current practice for future policy development
- Utilidors make the application of integrated computer technology (ICT) for remote asset condition assessment for proactive maintenance and remote commodity (e.g., water) quality assessment possible—the students would review is area remote ICT-facilitated monitoring technology and develop and LCA model to assess the relative costs and benefits of ICT application to subsurface infrastructure
- The working group has refined the LCCBA to focus on direct costs only, leaving the indirect costs to be refined further—the students would review an earlier LCA project analyzing trenchless technology for roadway reconstruction projects that established a methodology for quantifying indirect benefits and develop a methodology for quantifying the indirect benefits of utilidor implementation.

Prioritizing Application of Modern Infrastructure Design for Subsurface Utility Infrastructure

From different accounts, the City's roads are cut up for excavation between 300 and 550 times per day, mostly to permit public and private utilities to access their subsurface transmission infrastructure for repair and expansion. It is a widely known fact that utility companies do not know exactly where their subsurface infrastructure is located. It is becoming known that the direct burial of transmission infrastructure is inefficient on a long-term direct cost basis and, when indirect social costs and negative externalities are added, the efficiency calculus gets worse. Finally, direct burial and the costs of access contribute to the poor state of good repair condition of these subsurface transmission facilities, which periodically fail in dramatic fashion. There are designed infrastructure solutions to the costs and externalities of direct burial running from pre-case concrete pavement elements that permit lifting for access to multi-utility tunnels (utilidors). For the City to move forward in implementing designed infrastructure solutions, it is necessary to get a sense of how to prioritize change on the ground.

This data visualization project will use multiple data sets associated with subsurface utility construction work to identify the areas where these projects are directly related to types of roadway segments that are important for urban mobility, such as intersections, where subsurface infrastructure failures should not occur and where modern infrastructure designs permitting easier access to the subsurface should be applied first. Among the data sets will be excavation permits, 311 construction noise complaints, roadway condition assessments, and crash data due to a connection between construction sites and crashes.

Subsurface Uses to Solve Surface Problems and Create Green Space Opportunities

Research into cities where utilidors exist revealed other subsurface uses beyond utilidors.

This research project would perform a survey of urban subsurface uses elsewhere that solve for surface congestion as well as create the opportunity for increasing urban green space and connect them to elements of the City's capital program and private sector projects.

Making the Invisible Visible

A significant impediment to understanding the subsurface for planning and use policy is the largely unseen nature of the subsurface. Unless streets are opened for construction projects, subsurface infrastructure is completely hidden.

This research project would create a communications design strategy and collateral to make the invisible subsurface visible to more people, first, for general understanding, and then to support policy development.

Designing the Utilidor

The issue of the design of utilidors within the City's environment has emerged as an issue to assess on a preliminary basis.

This research project would involve designing and costing a case study utilidor for a roadway reconstruction project that had been designed and constructed under current practice.

Risk Management for Utilidors

While lifecycle cost analysis of utilidors tend to show the benefits of utilidors exceeds the cost, utilidors changes the risk profile as compared to standard practice. The operations and maintenance of utilidors is also an issue that is different than current practice. Risk management as well as operations and maintenance responsibilities would be the subject of utilidor operations agreement to be negotiated among the utilidor users and the City, as manager of the public right of way (PROW) and franchisor of subsurface PROW use.

This research project would involve review of utilidor risks, risk management techniques, operation and maintenance issues and recommend optimum allocation of responsibilities and risk management techniques for utilidor construction and lifecycle operations and maintenance.

Planning for Subsurface Use

The City's planning functions performed by the City's Department of Planning currently focus only on the surface despite authorization that does not limit its functions to the surface with the potential for planning for subsurface use.

This research project would survey other cities that formally plan for subsurface use, review the City's existing planning processes and interview City experts to develop a methodology for the Department of City Planning to focus its functions under the surface.

Lifecycle Road Management the Chicago Way

After the 1992 Great Flood, Chicago instituted a comprehensive damage prevention lifecycle program, that takes a holistic damage prevention life cycle approach.

This project would assess the differences between the Chicago DOT approach and the City's street rules for street openings and excavations and develop a gap analysis. If this project is done by law students, this project would include specific revisions to City's laws and rules to accomplish a New York City version of the Chicago approach. If this project is done by students in other disciplines, this project would include a cost benefit analysis of implementing the Chicago approach as compared to the current City approach.

Locational Analysis for Utilidors

The literature reveals that prior to life cycle analyses on particular projects, location-based analysis of potential utilidor project sites should be done.

This research project would use DDC roadway reconstruction projects authorized in the most recent capital budget as the case study sites to perform a comparative location-based analysis following the methodology from the literature, which involves assessing sites for utility density (using surface density as a proxy and assuming all utilities), roadway cut permits for a selected period for those locations (assuming a percentage representing actual work), surface development level (using zoning code designations as a proxy) and population densities, known geological and hydrological conditions, traffic density, location of surrounding structures/natural barriers, among others.

Sounds of New York City (SONYC): Construction Noise. This National Science Foundation-funded project at NYU/Tandon is developing technological solutions, including sensors that can be mounted to different urban features, for the systematic, constant monitoring of noise pollution at city scale and the accurate description of various sources of noise. The SONYC working group is working with the NSF team to identify City capital projects suitable for sensing in order for the system to identify multiple specific construction noises over time and space so that the resulting data produced from the system could assist the City with testing and validating in real time various existing and new mitigation actions on specific public and private construction projects.

The NSF-funded project will be ending, but the data collected by its sensors and the experience and work done by the researchers are available to other researchers. The following research projects have been identified:

- How can we effectively automate the identification of activities of interest (e.g., jackhammering) across different acoustic contexts (e.g. location, time of day, time of year)?
- What effects does the introduction of sensors that can monitor noise 24-7 have on the way different stakeholders interact?
- How to design a methodology to evaluate the impacts of different noise mitigation techniques in construction?
- This research project would develop a communications strategy and collateral for the SONYC system and the data it has been collected for stakeholders interested in monitoring and/or evaluating the data.

Built Environment Discipline-Focused Research Questions

Introduction. Town+Gown’s earlier Research Agendas were organized along the lines of the six disciplines—Management, Geography, Economics, Law, Technology and Design—that Town+Gown:NYC has modified from the recognized inter-disciplinary Built Environment field. If you are interested in any of these research project ideas, Town+Gown will connect you to the appropriate City agencies to turn the ideas into suitable experiential learning projects.

The general research project ideas by Built Environment discipline, as modified within Town+Gown, are below:

Management. The research projects below primarily focus on construction projects from the perspectives of the archetypal participants—owner, designer and constructor . A critical objective for participants is to align their various interests in budget, schedule, safety and quality to make a project successful, all in an environment where information asymmetries change during the project. Participants adapt to “on the ground” changes in materials, building methods and information technology by using an evolving menu of service delivery methodologies as well as various management theories, techniques and tools, similar to those found in other industries or sectors. To the extent the research projects below involve public capital projects, separate analytical issues related to the public capital planning and budget processes may arise.

Enterprise Risk Management in Public Capital Planning, Budgeting and Implementation

The capital programs of large institutional owners—in both public and private sectors—serve as a setting to apply “enterprise risk management” or eRM, a strategic framework for owners to improve decision-making at all levels within the entity. eRM has been conceived as a multi-disciplinary approach by which an organization assesses—quantitatively where possible—controls, exploits, finances, and monitors risks from all sources for the purpose, in the private sector, of increasing its short- and long-term value. As applied in the public sector, eRM can expand and integrate traditional risk management approaches across sub-units within the public owner entity, leading to decisions that take into account all risks facing the organization and, most important, the inter-relation among those risks. While not eliminating risk, modern risk management theory and tools can help an entity or enterprise acknowledge, evaluate and plan for the likelihood of malfunctions and mistakes.

This research project would explore how a large institutional owner move from focusing on insurance, surety and traditional contractual risk allocation to an enterprise-wide approach to managing risk. It would include lessons from private sector application of large program governance techniques and individual project governance techniques and develop a methodology for large institutional owners, including public owners, to implement such practices. For public owners, this project would identify opportunities embedded into long-established, and to some extent legislatively mandated, capital planning and budget processes to assist with reforming systemic practices in order to apply innovative risk management.

Companion research project under Law.

Optimizing Alignment of Risk Shifting/Mitigation Strategies to Risk

Owners—in both private and public sectors—bear the ultimate responsibility for a capital project—from program definition to payment to commissioning and long-term operation and

maintenance—and are concerned with budget, schedule, safety and quality, in a milieu that is the poster child for asymmetric information. Thus, a critical objective for participants is to align their interests in budget, schedule, safety and quality to increase the chances that a project will meet stated goals. Risk management methodologies, most often used by private sector enterprises to assess and manage risks across entire corporate operations, can be useful tools to help owners, in particular, identify opportunities to make their capital programs more efficient, beginning in the capital planning process, including the project development process, and ending with the project commissioning process. Risk management tools can reduce the risk of harm to life and property as well as manage financial risk.

This research project would identify strategies public owners can use to better manage risk in construction, from planning to design and construction to post-construction operation and maintenance. In addition to identifying areas in long-established, and to some extent legislatively mandated, capital planning and budget processes, this project will look at the public construction contract, to identify areas for reforming systemic practices that better align risk shifting/mitigation strategies to actual risk. *Companion research project under Law.*

Pro-active and Intentional Infrastructure and Building State of Good Repair Maintenance

The task of maintaining public infrastructure and buildings is technically difficult and subject to competing forces including the political benefits that accrue to new and expansion capital projects and the tendency to defer maintenance activities paid from the expense budget until the deferrals accumulate into a capital project paid from the capital budget.

This research project would investigate protocols and/or integrated computer technology (ICT) can be applied to inspection and evaluation of existing asset condition on a regular inspection cycle, to proactively estimate when repairs will be needed to prevent failures. This project would also develop a life cycle cost analysis of implementing protocols and/or ICT and identify opportunities in long-established, and to some extent legislatively mandated, planning and budget processes, to reform practices related to operation and maintenance of infrastructure and public buildings.

Creating a Culture of Innovation in Public Construction Agencies

Construction is known to be an inherently conservative industry, as compared to other industries, where innovations in private construction slowly filter into public construction, if ever.

This research project would focus on issues of knowledge transfer in the public sector as a baseline and then within hierarchical and siloed public construction agencies as they relate to creating a culture of innovation within public construction agencies.

Labor and Finance Issues for High Performance Buildings and Infrastructure

For some time now, the City has been designing and constructing “high performance” assets, which require a level of skills for operations not found among City employees in civil service titles that were created when asset operations were not computer-based. High performance assets are a means for the City to realize several environmental sustainability and resiliency goals. In addition, third-party financing of “high performance” assets as components of existing facilities often include third party workers to operate and maintain these assets during the financing period before the assets revert back to the city.

This research project would review civil service law and labor law as the foundation to assess the level of alignment between civil service titles and the types of work necessary to operate and maintain “high performance” assets, as well as assess issues with respect to the existing workforce under third party financing, operations and maintenance vehicles.

Cross-Systems Benefits for Sustainability and Resiliency Projects

The City’s OneNYC sustainability strategy (<http://onenyc.cityofnewyork.us/>) built upon earlier sustainability initiatives and encompasses

- a plan for green infrastructure that responded to a federal EPA requirement (<https://www1.nyc.gov/site/dep/water/green-infrastructure.page>),
- a recent local law to reduce greenhouse gas emissions from private and public buildings in the City (<https://www1.nyc.gov/site/sustainablebuildings/l197/local-law-97.page#:~:text=Local%20Law%2097%20is%20one,reducing%20emissions%20in%20the%20nation.&text=Under%20this%20groundbreaking%20law%2C%20most,coming%20into%20effect%20in%202030>),
- Citywide resiliency design guidelines (https://www1.nyc.gov/assets/orr/pdf/NYC_Climat_e_Resiliency_Design_Guidelines_v4-0.pdf),
- a Citywide Zero Waste program, and various sustainability laws that apply to the City’s buildings (<https://www1.nyc.gov/site/ddc/about/sustainable-design-local-law-86.page>) and
- a third edition of the City’s street design manual with sustainability elements (<https://www.nycstreetdesign.info/>).

All these citywide and agency-specific plans produce cross-systems benefits. This research project would examine the City's and agency's sustainability and resiliency programs and develop a methodology to assess cross-system benefits generally and a methodology to evaluate cross-system benefits of capital projects. In addition, the research project could identify opportunities to increase efficiencies and gaps among the various programs and on capital projects.

Geography. The research questions that follow focus on issues when the owner of construction is a governmental entity with formal municipal planning powers.

Managing the Inevitable Mismatch between Static Capital Assets and Demographic Trends

Across the spectrum of public uses, there is always the potential for a mismatch over time between long-lived fixed capital assets and the demographic changes in populations that they were intended to serve as well as general changes in demand for such services. This mismatch occurs under the practice of over-building public assets to assure they last “forever” in the face of historically insufficient maintenance after construction completion and is further complicated in a highly built urban environment with little available land as a general matter and even less for public projects. Under such circumstances, currently or projected underutilized public assets of many kinds might be considered as resources for future planned and/or unanticipated demand.

The research project would identify and assess demographic forecasting techniques that would be useful for place-based assets in the context of the time it takes for public owners to change policies or strategies and identify opportunities in long-established, and to some extent legislatively mandated, planning and budget processes, to reform practices related to solve for the inevitable mismatch in order to optimize utilization of the City’s existing capital assets.
Companion research project under Design.

Planning and Asset Systems Obduracy

The urban built environment is composed of long-lived physical assets with a tendency to become obdurate, to remain behind, sometimes with adverse impacts, when the conditions and theories that supported their creation have been eliminated or discredited. Built objects that form parts of systems become the subject of thinking about their nature in the larger civic project. While an urban space is a work in progress, thinking about urban space continually changes, yet the products of past theories and efforts remain in physical space, creating obstacles for current and future theories and plans.

This research project would analyze the evolution of building and infrastructure technology and planning theory to shed light on why objects remain in place when the animating needs and rationale disappear and are no longer operational. It will also assess the degree to which planning tools can help predict obsolescence of assets within various areas of the City based on the type of construction, the use, and the time during which the area was developed, as well as demographic and investment/ reinvestment/disinvestment trends.

Economics. Economics makes it possible to see government acting in and on the built environment in the different roles it plays, often simultaneously. For example, it permits analysis of public owners when they act in their role of economic catalyst, economic policy maker, as regulator and as financier. The City builds, through its capital program, a significant portion of its public realm. The public works or capital programs of all levels of government are, in essence, work orders for facilities relating to “social” or “public” goods and to “mixed goods” that correct for negative and positive externalities, and while engaging in such activities, the City acts in its role of economic policy maker. In its role of regulator, the City directs and regulates private capital participation in the public realm and regulates the safety of the construction process and the products of construction of both public and private owners. Moreover, the practices of large public owners within a regional construction market have impacts on such market. The City also acts in the role of financier when it funds, by the issuance of its own debt, the construction of such social goods, or when it provides subsidies in numerous forms to other entities to enable them to construct such social goods by reducing their overall cost, which, to some extent, may be impacted by regulation.

Modelling Impacts of Environmental-Based Regulations of Buildings

Since PlaNYC, the City has continually enacted game-changing regulations, often, but not always, related to climate change, that target buildings—public and private—as a source of greenhouse gas emissions. Construction costs in New York are the highest in the nation and these types of regulations increase the cost of construction and building operations/maintenance. For private buildings, the increase in costs translates into higher costs for property owners and renters, while for public buildings, the increase translates into less available funds for additional building projects within a given capital budget allocation. The City Charter fiscal impact statement requirement for legislation does not capture these types of interplays.

This research project would develop a life cycle cost model to assess the costs and benefits of environmental-based regulations on public buildings and on private buildings, as separate categories due to the differences in ownership and funding.

Assessing Economic Impacts of the City’s Routine Capital Projects

The City’s diverse capital program rehabilitates, maintains, and expands the public infrastructure of a large and complex built urban center. Routine capital projects such as street reconstruction projects and new and rehabilitated public building projects are an essential part meeting demand for city services and of keeping the City’s infrastructure and building portfolio

in a state of good repair. It is likely that these routine activities have an impact on the economic vitality of business districts and property values of residential districts.

This research project would expand prior work within Town+Gown on hedonic regression of routine capital projects to evaluate their impact. An expansion of hedonic regression to encompass more building types and roadway reconstruction work across the city would also support equity considerations in capital project decision-making.

Modelling the Local Construction Market

Attempts at predicting economic behavior in construction are often unreliable in general and nowhere is more unreliable than in New York City. Year after year, in every report of construction costs in major American cities, New York City tops them all, and commercial report services for components of construction costs, which are disaggregated by region and are used by a diverse group, including economists and job estimators, always make a disclaimer for the New York City region because they are estimated top down from aggregated data. The idiosyncratic nature of the New York City market argues for a New York City-centric accounting of construction economic behavior to guide economists and planners, including budget officials.

This research project would assess the feasibility of creating a New York City-based construction model, including identifying locally-generated components of construction that can function as market indicators within the New York City area and create a “market basket” of cost indicators to use for capital planning and budgeting efforts.

Law. Research project ideas under Law can focus on the impact of the law on built environment activities from the perspective of the archetypal participants—owner, designer and constructor. Statutes and regulations, related case law, and contractual forms and provisions, which are the products of industry standard practice, governing law and past experience, all affect the relationships among the participants, their expectations and behaviors. Deconstructing the law in the context of its impact “on the ground” can provide powerful explanatory insight for the other disciplines analyzing built environment issues. Many project ideas, however, develop as a result of projects under the other disciplines.

Public Construction Contract Provisions Increasing Alignment between Principal and Agent to Facilitate Successful Projects

The public construction contract is akin to a contract of adhesion, with the contract made part of the bid and not subject to negotiation and provisions that tend to shift risk to the contractor, including risk the owner can better manage. This type of contract does not facilitate an optimum working environment on public projects or successful projects measured by increases in cost over original price and schedule delay. A contract that aligns the owner’s interests in budget, schedule, safety and quality with the interests of its agents—the architect and the contractor—and places risk on the party most able to control it is more likely to foster a good working relationship and successful projects.

This research project would identify a menu of changes in the public construction contract that would increase alignment and appropriate risk responsibility to increase chances of successful projects. *Companion research projects under Management.*

Section 3, Federal Pre-emption and the City

Section 3 of the Housing and Urban Development Act of 1968, as amended on November 1, 2020, directs public housing authorities, like NYCHA, and other public entities receiving federal housing and community development assistance funding, to make new hires or subcontracting opportunities flowing from government contracts go to public housing residents, low- and very low-income persons, and Section 3 business concerns. At the same time, the State’s Locally-Based Enterprise (LBE) Certification Program and the City’s Minority and Women-owned Business Enterprises (M/WBE) Program permit agencies to target some of Section 3’s audience.

This research project would assess the legal authority for the three programs and evaluate the hierarchy among them, specifically addressing the circumstances under which and the extent to which Section 3 pre-empt the State and City programs.

Technology/Data Science. Town+Gown has not yet discovered a way for the students in the technology discipline to work on research projects where technology, as technology, intersects with construction and the built environment, but Town+Gown has done many data science investigations over the years, so data science investigations are located under the Technology discipline.

Data Analytics: NYC Fleet Telematics Data

The City has some of the highest asthma rates in the country, with children needing to breathe in more air per pound than adults, which makes them more susceptible to medical conditions due to air pollution. Ending unnecessarily idling in the city would be the equivalent of taking 18,000 cars off the road each day. Motor vehicles contribute 11% of local fine particulate matter and 28% of nitrogen oxide emissions – pollutants that can exacerbate cardiovascular and respiratory disease. While the City has numerous laws in place to limit idling and, in 2020, launched a new anti-idling campaign, idling continues to be an issue that must be addressed.

This research project would analyze idling data from the telematics systems in City government-owned vehicles and contracted privately-owned school buses to review the types of vehicles that idle, the duration of idling, the location of idling, fuel consumption due to idling, and other areas that can be analyzed with the data provided. The project would analyze each of these indicators and determine the economic and environmental impact of idling of City vehicles and school buses, including measuring nitrogen oxides (NOx), volatile organic compounds (VOCs), particulate matter (PM), carbon monoxide (CO) and carbon dioxide (CO₂) that are released into the atmosphere. The goal of this project would be to provide insights into why vehicles are idling, where changes in training and policy could address idling, technologies that would reduce the impact of idling where the vehicle type needs to idle for operational purposes, and how transitioning to an all-electric fleet would reduce the environmental impact of idling.

For examples of the ways in which technology, *as technology*, and construction intersect, see above under:

Systemic Construction Data Analytics. Building Information Modeling (BIM) and Off-site Prefabricated Construction

Toward a "Smarter" City: Utilidors (Utilidor). Additional Life Cycle Analyses (LCAs) for Utilidor Implementation and Prioritizing Application of Modern Infrastructure Design for Subsurface Utility Infrastructure

Sounds of New York City (SONYC): Construction Noise. See various project ideas.

Management. Creating a Culture of Innovation in Public Construction Agencies

Design. The Design category includes architecture, engineering, interior design and communications design, and projects listed below reflect the amalgamated nature of *Design* as a Built Environment discipline in Town+Gown.

Managing the Inevitable Mismatch between Static Capital Assets and Demographic Trends

Across the spectrum of public uses, there is always the potential for a mismatch over time between long-lived fixed capital assets and the demographic changes in populations that they were intended to serve as well as general changes in demand for such services. This mismatch occurs under the practice of over-building public assets to assure they last “forever” in the face of historically insufficient maintenance after construction completion and is further complicated in a highly built urban environment with little available land as a general matter and even less for public projects. Under such circumstances, currently or projected underutilized public assets of many kinds might be considered as resources for future planned and/or unanticipated demand.

The research project would identify and assess design strategies, beginning with the “long life, loose fit, low technology” design principles, that anticipate and facilitate future uses or permit multiple compatible uses within structures that become underutilized due to demographic change in order to optimize utilization of the City’s existing capital assets? *Companion research project under Planning.*

Design and Construction Specification Practice

Large institutional owners often have a combination of design, materials and construction standard specifications to assist in managing costs, quality and safety. There is the risk, however, in the bureaucratic environment of large institutional owners that standards, once implemented, may not change quickly enough to take advantage of innovative design and construction techniques and new materials. The bureaucratic tendency is compounded in an industry that has historically been slow to adopt innovative methods and materials, and failure to update standards increases the risk that static standards may, at some point, fail to contain costs and/or maintain a certain quality.

This research project would survey best practices at large construction enterprises, including public entities, for construction specification development and management over time as conditions change; interview City agencies to document current City agency practice; and, recommend an optimum approach for the City to take for specification development.

Designing for Roadway Safety

The City's roadway design specifications likely reflect, as a vestigial effect, earlier focuses on automobile efficiency so that efforts at reducing crashes rely on enforcement activities and incremental designs on the baseline design specifications.

This research project would involve reviewing the City's roadway design specifications, review roadway design specifications of jurisdictions elsewhere with lower incidence of crashes, and propose changes to roadway design specifications that focus on roadway safety.

Communications Design for Section 3

Section 3 of the Housing and Urban Development Act of 1968, as amended on November 1, 2020, directs public housing authorities, like NYCHA, and other public entities receiving federal housing and community development assistance funding, to make new hires or subcontracting opportunities flowing from government contracts go to public housing residents, low- and very low-income persons, and Section 3 business concerns. At the same time, the State's Locally-Based Enterprise (LBE) Certification Program and the City's Minority and Women-owned Business Enterprises (M/WBE) Program permit agencies to target some of Section 3's audience.

This research project would develop a communications strategy and collateral for the Section 3 program operated at a public housing authority, such as NYCHA, aimed at the Section 3 audience, to support Section 3 compliance.