ACTION RESEARCH AGENDA

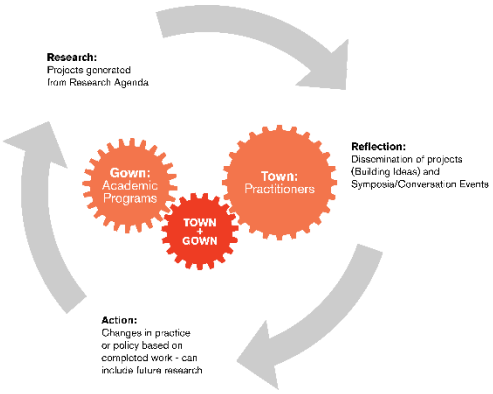
2022-2023

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.

Director: Terri Matthews
matthewte@ddc.nyc.gov
212 313 3546 (Office)
917 417 4637 (Cell)

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 focuses on supporting applied research and innovative policy design to close construction material loops on a city-wide basis. The URR working group has developed a Closing Loops City Program Initiative (CLCPI) that outlines changes to City agency construction practices and policies that would leverage the City's capital program to support the market and close CDW material loops by increasing overall direct re-use of recovered construction and demolition waste (CDW) materials generated on City capital projects without interim processing as available materials on City capital projects and increasing intentional redirection of recovered CDW generated on City capital projects away from landfills to interim processing facilities as feedstock for manufacturing facilities producing new construction materials. The CLCPI was introduced at the 10/13/21 *Pushing the Urban Resource Recovery and Re-use Envelope: Closing Loops City Program Initiative (URR.8) or You Can't Have Zero Waste without CDW* event.

Life Cycle Cost Analysis of Closing Material Loops under the CLCPI

The Closing Loops City Program Initiative (CLCPI) focuses on expanding the recovery and re-use of a number of CDW and other materials in a direct manner on City capital projects 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 first and, if time permits, intentional indirect re-use of any material covered by 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.

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. At the local level, consideration of local siting of interim processing and manufacturing facilities is necessary for reductions in transportation needs to reduce GHG emissions.

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, identify existing data sources, and develop an actionable methodology for an estimation tool that the City could use to support policy development.

Ahead of the Wind Turbine Re-use Curve

New York State has been siting wind turbines across the state and most recently has approved sites closer to the New York City area, as part of its renewable energy strategy. Wind turbine blades have a useful life and they have been decommissioned on existing sites and will eventually be decommissioned on sites near NYC. Decommissioning blades often occurs before the end of useful life due to material and other technology advances to increase efficiency and generate more power.

These decommissioned blades need to go somewhere. Either they are recovered and re-used in other applications, or they are landfilled. There has been much technical research on re-uses of decommissioned blades to avoid having them go to landfills, which includes using entire blades or parts of blades in various public space and/or art installations and as elements in

construction projects. Queens University Belfast has also done work, using GIS-based analyses. to optimize this type of re-use and minimize additional GHG emissions from transporting them.

This project will assess the state of thinking in New York about the future re-use of decommissioned wind turbine blades to keep them out of landfills, develop a plan to support future re-use of decommissioned wind turbine blades as wind farms are increasingly developed, and develop a geographical-based model to minimize GHG emissions for the re-use plan.

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 "green" economic development opportunities would be particularly helpful.

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.

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.

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 SCDA working group has expanded these initial analyses by using city-wide data from the Capital Project Dashboard and using granular DDC project data to generate additional insights, as the foundation for a more comprehensive analysis using granular project data from all construction agencies to derive actionable results. This work will also support work on initial observations made at the 11/14/19 *Culture+Data for Better Project Delivery* symposium event.

Assessing Benefits of Proactive State of Good Repair Management for Public Buildings against the Costs of Deferred Maintenance

All public owners experience impediments in planning for, and achieving, state-of-good-repair (SOGR) investments. Unlike new construction, which is generally all eligible for capital finance, to the extent that some SOGR investments are not eligible for capital finance, they compete with other expense budget needs (i.e., running the programs within assets) and tend to be deferred until such time they are capital eligible, which increases the total cost of eventual capital repair and replacement projects not to mention programs continuing to operate in assets requiring SOGR work. At the same time, the mismatch between long-lived capital assets and changes in the demand for the services they were designed for argue against rigid application of planning, budgeting and execution rules that do not reflect such dynamics. Evolving technology also argues against rigid application of such rules, since upgrades before the end of useful life permit the replacement to take advantage of the latest technology.

For some time, 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. In the context of this country's long history of financing and building (often over-building) public works, however, 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 focus on buildings and 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 SOGR management program within constraints of finite capital resources and available technologies that are well suited for asset condition assessment. The project will also develop a cost benefit model to assess the benefits of improved state of good repair management programs against the costs of deferred maintenance under current practice.

Comparative Public Construction Efficiency

New York City public building construction takes place in New York City's unique construction market and is subject to a complex set of state and local laws, which makes public building construction costs much higher than public construction costs in otherwise comparable U.S. cities. There have been recent studies highlighting the New York City public construction "premium". Understanding of the particular factors that tend to drive higher costs for New York City public building construction relative to public construction elsewhere, a foundational comparative analysis is a first important step to developing a holistic plan to address what is likely to be a myriad of drivers from different sources. Public buildings are where essential public services are delivered—from health services to fire houses to libraries. Since public building construction depends on being able to fund projects, which is limited by available and scarce resources, understanding—and addressing—cost drivers in this way will enable a city to maximize existing resources and assure equity in capital project distribution.

This research project would involve first identifying a set of up to 10 U.S. cities that are comparable to New York City along a variety of metrics, including size, density, age and population. An economic market analysis of construction costs for these cities would help to "normalize" the various construction costs, since New York City's construction market is an outlier. Interviews with New York City construction experts as well as experts in construction economics and those in the case study cities will provide a basis for the market analysis leading to a set of initial major differences among the case study cities to serve as a reference point for the second analysis.

From the economic market analysis, the research project would involve diving deeply into the mechanics of public construction in the case study cities, using New York City's mechanics as the baseline for comparison. It will likely be necessary in this phase of the project to focus on public building typologies that all case study cities build. This analysis will involve primary research, including public websites and interviews, into each city's construction processes to

identify differences among the case study cities, focusing on their connection with cost drivers from the economic market analysis.

Note: This project could be done with a focus on public infrastructure as opposed to public buildings.

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 methods of construction.

Systemic Drivers of Construction Cost Increase and Schedule Delay

The ability to build and rehabilitate all public projects—from buildings that that include affordable housing subsidized by the public to 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 and schedule delay on public projects.

Resilient People, Places and Projects (RP3). Following symposium events focusing on place-based resiliency, the RP3 working group developed a research project to apply the City's Neighborhood Activation Study methodology (https://criminaljustice.cityofnewyork.us/reports/neighborhood-activation-study/), lifecycle cost benefit analysis and the Envision framework holistically to clusters of capital projects in pre-selected neighborhoods to identify potential project synergies to create increased infrastructural resiliency (and community resiliency) and assess whether such project synergies can be done for less or the same amount of investment. This research project will also focus on ways to make existing community-based processes more effective in translating community

knowledge during the City's capital project planning and design phases. The RP3 working group's efforts to date have generated important insights and possible solutions, and efforts are underway with the academic partner to identify 3rd party grant opportunities to fund continuation of the research project.

Community-Based Planning and Design

The NYC Charter provides institutional roles for community boards, which are the smallest neighborhood-level actors in the City's land use planning and capital budget processes. The Community Boards perform what Jane Jacobs referred to the "locality coordination" function, through the City-wide planning and budget processes, in part, by collecting and interpreting all types of complaints and suggestions from community members and transmitting that knowledge, often prioritized based on local knowledge, to directly coterminous and more broadly coterminous operating agencies. Before NYC implemented its 311 system during the Bloomberg Administration, Community Boards were the official pre-311 app that imparted local knowledge and navigated the bureaucracy at operating agencies and the central budget and planning offices on behalf of its community members.

Community boards still provide neighborhood-level information up to the larger actors within city government agencies and the central planning and budget offices to inform policies and actions taken by these actors in ways that have the potential to correct for bias in the City's 311 data, which can translate into biased outcomes in agency operations and city-wide planning and budgeting decisions that are based on 311 data, leaving vulnerable and underserved neighborhoods with underestimated and unaddressed capital needs and inequitable service results.

This research project would begin 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 plan with a menu of options 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 "under the roadway" and the idea of multi-utility tunnels—or utilidors—for some time. The Utilidor working group has focused on life cycle cost benefit analysis modeling of implementing

utilidors, modeling to identify opportunities for innovative subsurface design, and changes to current practice based on knowledge gained from the 4/28/21 *Under the Ground: Planning, Management and Utilization of the Subsurface for a Smart, Sustainable and Resilient City* symposium event. Aging subsurface infrastructure is a hazard and presents opportunities to increase infrastructural and community resilience. The subsurface is a limited, non-renewable resource that has the potential to solve connected subsurface and surface issues. Prior projects for the working group include life cycle cost benefit analyses and a geospatial tool to identify opportunities for innovative subsurface infrastructure designs.

Subsurface Uses to Solve Surface Problems and Create Green Space Opportunities

Research into cities where utilidors exist has 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.

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. The SONYC project was a National Science Foundation-funded project at NYU/Tandon that developed technological solutions, including sensors that can be mounted to different urban features, for constant systematic monitoring of noise pollution at city scale and the accurate description of various sources of noise. The SONYC working group collaborated with the NSF team to identify City capital projects suitable for sensoring 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 City agencies with real time testing and validating of various mitigation actions on construction projects. The NSF grant has ended, and the SONYC working group members are exploring ways to build on that project.

The following research projects have been identified:

- 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 method- ologies 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.

Systematic Planning for Public Buildings and Services

The planning of public building facilities related to programs/service delivery is often done by line agencies or departments in isolation from each other, making it difficult for system-wide planning to make optimal use of public building assets. Theories on program performance and/or fiscal benefits from service delivery centralization or decentralization vary over time and with facts. But integrated systematic planning that focuses on both the service and the facility where it is delivered across the entire enterprise could yield improvements in service performance, optimization of related facilities and avoided costs.

Structures are no longer static items with fixed life spans. For large institutional systems, such as New York City, the rapid change in technology has presented an opportunity for them to view their public building inventory more flexibly as combinations of systems with respective different useful lives that can be manipulated to meet anticipated and unanticipated needs. 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 "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 may be implementable in New York City. Environmental sustainability and increased resiliency goals have increased interest in designing for sustainability/resiliency

over time as well as in adaptive reuse of existing assets. Further, recent trends in work standards, such as job sharing, telecommuting and flexible co-location of staffs from various offices across an organization also create tools for institutions to consider when dealing with future system needs. Leveraging unused building density capacity present in the current zoning code also presents additional opportunities.

This project would begin with a literature survey to identify methodologies for integrated systematic public building planning and their resulting opportunities, for increased sustainability and resiliency and long-term cost savings. A comparative analysis of practices at large comparable cities would be helpful. The methodologies and opportunities would be mapped against New York City capital planning processes to identify areas requiring change and generate a list of necessary and desirable policy and practice changes.

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.*

<u>Creating a Culture of Innovation in Public Construction Agencies</u>

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.

<u>Labor and Finance Issues for High Performance Buildings and Infrastructure</u>

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/ll97/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_Climate_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.

Comprehensive Habitat Restoration Plan Site Reconnaissance

Under the authorization of Congress in 1999, the US Army Corps of Engineers and The Port Authority of New York and New Jersey facilitated the development of the Comprehensive Restoration Plan (CRP). It was created collaboratively by scientists, professionals, government agencies, nonprofit organizations, academic institutions, and environmental advocates with the assistance of the Hudson River Foundation. The plan is a blueprint to protect those habitats that still exist and restore habitats that have been lost. The Comprehensive Restoration Plan provides shared vision and priorities for the federal, state, and local agencies, university and non-profit partners engaged in habitat conservation and restoration. Its implementation is supported by *The Waters We Share*, a collaborative effort developed by the New York-New Jersey Harbor & Estuary Program, The Port Authority of New York & New Jersey and the US Army Corps of Engineers - New York District that helps ensure progress toward the Plan's goals. This collaborative work includes the on-going sharing of knowledge and tracking of progress undertaken by HEP's Restoration Work Group.

Following a draft version in 2009, the final CRP was released in 2016. The NY-NJ Harbor & Estuary Program has been tracking progress towards the CRP goals since 2009, has tracked individual restoration projects though the Restoration Activity Map. Through a process developed by the Restoration Work Group, the NY-NJ Harbor & Estuary Program has also added a handful of new restoration opportunities as well as taken a few sites off the list due to a completion of restoration or acquisition opportunities.

The NY-NJ Harbor & Estuary Program has not yet tracked the loss of opportunities, largely due to development of these once undeveloped or natural areas. This is important not only to evaluate habitat loss and development threat in our region, but also to update the CRP restoration sites to accurately represent the remaining opportunities for restoration practitioners and land managers going forward. This research project would focus on tracking the loss of opportunities, using mapping resources including ariel imagery, tax maps, land use maps, etc. See also: https://www.hudsonriver.org/article/hrecrp.

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.

Holistic Assessments of the Impacts of the City's Routine Capital Projects on Neighborhoods

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. While aging infrastructure is an unacknowledged hazard that impedes efforts to increase infrastructural and community resiliency, understanding the benefits of state of good repair projects is less accessible to most when compared to large new projects with more obvious social and economic benefits.

There is an intuitive sense that some types of public projects are beneficial to neighborhoods and others, perhaps, less so. The City's "fair share" location requirements aim to make sure that certain neighborhoods do not have a disproportionate share of City facilities that burdened

them. Quantitatively based assessments of various routine project types would enable the City to achieve equitable distribution and chose among various possible locations for regular programmatic investments to maximize resulting social and economic benefits in neighborhoods. This research project would expand prior work within Town+Gown done with Columbia/SIPA and NYU/Tandon-Management of Technology on hedonic place-in-place regression, which is a quantitative-based analysis, of routine capital projects to evaluate their impact. These projects suggested it is likely that some routine investments have a positive impact on the economic vitality and property values of areas nearby completed projects.

Equitable distribution of routine capital investment is important in its own right because aging infrastructure and buildings are themselves hazards that negatively impact a community by reducing resiliency. Knowing the project types that demonstrate quantifiable benefits across a range of metrics would further goals of economic justice through enabling strategic allocation of capital investments, when possible, in neighborhoods needing more investment to increase community resiliency.

The focus on property values required by hedonic regression, however, bumps up against the current economic justice focus, so that evaluation of capital improvements must also address negative implications of increased property values as the measure of positive impact and bring in other measures for a complete evaluation. A fundamental goal of these capital projects is to maintain and enhance the local quality of life, and metrics that more directly capture societal impacts are necessary to balance the property value proxy for beneficial impact. For example, a survey by the Center for Active Design found that maintenance of public spaces contributed to respondents' sense of civic trust. Other studies may have looked at the impact of infrastructure condition on crime, absenteeism, academic performance, and public health. Researchers in the UK have gone the furthest in evaluating the specific monetary value that residents place on well-maintained versus poorly maintained infrastructure, based on carefully constructed surveys. Transport for London has encoded these valuations into its Valuing Urban Realm Toolkit.

The data sets for this project would include publicly available data on capital projects and property values, neighborhood demographics, along with other societal and community impact data. The challenge will be for the student team to consider how all available data and evaluation techniques can be brought together to evaluate the impact of capital investments in order to provide a methodology for capital project planning to look across neighborhoods to increase positive impacts (and minimize negative impacts through more thoughtful design with community input) equitably.

The ultimate goal of this project is to provide a comprehensive methodology to enable the city to holistically evaluate routine capital investment neighborhood impacts as a basis for capital

project planning. A suggested approach might include identifying and assessing all types of analyses and data that could be used in a mixed methods approach, with as much quantitative rigor as is possible, that would holistically and fully capture the impacts of routine capital on the communities they are located and applying this mixed methods approach on a selected case study projects to demonstrate its feasibility in prioritizing projects based on impact and allocating them equitably (subject to technical infrastructural and building conditions) in practice during the capital project planning process.

Expanding Hedonic Regression to Assess Economic Impacts of the City's Routine Capital Projects

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.

Section 3, Federal Pre-emption and the City

Section 3 of the Housing and Urban Development Act of 1968, as recently amended, 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 City's Minority and Women-owned Business Enterprises (M/WBE) Program, a version of which NYCHA recently adopted, and the State's Locally-Based Enterprise (LBE) Certification Program permit agencies to target some of Section 3's audience.

This research project would assess the legal authority for the three types of programs and evaluate the hierarchy among them, specifically addressing the circumstances under which and the extent to which Section 3 pre-empts the local and state programs. This research project would also focus on recent case law related to Section 3 violations and analyze the recent Section 3 amendments with respect to the hierarchy and Section 3 violation case law.

Ability of Federal Public Housing Authorities to Engage in Concessions for Placemaking and Revenue Generation

NYCHA has developed various enterprise-wide plans with respect to its open green spaces, for placemaking and climate resiliency purposes. Various public policy analyses of these plans have pointed to the New York City Department of Parks and Recreation's concessions as a tool for activating and helping maintain public spaces. The concession tool has its origins in local franchise and concession laws—and the City's green market program is likely based on this local authority—but NYCHA is not a city agency. Analysis of NYCHA's ability to use concessions to activate and connect these spaces to the surrounding neighborhoods and utilize this funding for the care of those spaces, depends on analysis of federal public housing law.

This research project would analyze federal laws pertaining to NYCHA to determine NYCHA's ability to engage in concessions, like City agencies are able to do, in order for NYCHA to activate

its open spaces and generate revenue for NYCHA to support various open space activities. This project would also involve collaborating with NYCHA to develop a feasible program model to implement the research findings.

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 suspectable 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.

Developing a Post Occupancy Evaluation Tool from a User-Centered Perspective

Design and construction standards for City agencies with active capital projects facilitate and expedite project delivery. They inform decision making and ensure consistency in design and construction of public buildings that NYC Department of Design and Construction (DDC) manages for 28 City agencies, which are DDC's "sponsor agencies". Design standards provide guidance to DDC teams in Public Buildings division and their consultants and are applicable to new construction and renovation projects. Design standards will often codify best practices, methods and technical requirements. They are intended to provide clear instructions and serve as living documents, which can be updated to suit changing needs.

Design is also an iterative process using Design Standards, best practices, design guidance and can include "lessons learned" on completed projects, which is a circular process where a feedback loop from one past project to a new one is incorporated. This design research project would be to develop a Post Occupancy Evaluation tool from a user-centered perspective focusing on a particular building typology, such as New York City libraries. The City's public buildings are designed to provide services to the public and respond to community needs. The branch libraries are embedded in every neighborhood and are often the cornerstone of the community, a place to gather and connect with neighbors, as well as provide access to books, tapes, and programming for all ages. Note: Other building typologies would be available for a project, such as court facilities or health facilities.

Communities are always evolving in terms of needs and demographics, and DDC is continually upgrading library facilities to provide new services, such as more computer access, improved access for persons with disabilities, upgraded mechanical systems, improvements to environmental considerations. In addition, such items as indoor air quality, adequate lighting and noise mitigation are important to the user experience, as are intuitive wayfinding and an overall welcoming and inspiring experience.

A library renovation may take a few years to design and build and this design research project aims at analyzing the public library functions, space layout and architectural considerations to conduct a post-occupancy evaluation with the goal of providing a feedback loop to improve the design criteria for the next set of new libraries and renovations. The deliverables from this studio project include:

A. Develop a post-occupancy evaluation (POE) tool from the point of view of the community users – using an equity and engagement lens.

- Does the design respond to the original design intent? Interview the original architect
- Visit two or three libraries and observe the user experience
- Are there areas that could be improved? The goal is to gain knowledge so that the next design builds off the feedback of past projects.
- Are there areas that should be included in every library (best practices)
- Should different input have been gathered up front?

B. Develop a community engagement survey as if one was starting a new renovation project.

- Using the input from the POE, develop a user questionnaire for the initial community engagement for the diverse user group that is NYC.
- Consider the various ages and abilities and using an equity lens, what questions and considerations should be asked of the community before design even begins?

C. Based on knowledge gained through observation on site and interviews (librarians and user members of the public), design the public areas for a typical small branch library focusing on how the design respond to user's needs—what are the questions to ask in a POE for teens—how the design uses knowledge gains from their library visits, observations and interviews?

<u>Design and Construction Specification Practice</u>

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.

<u>Designing for Roadway Safety</u>

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.