Town+Gown

Building Ideas

7

Volume 7

Building Ideas Volume 7

Systemic Action Research in the Built Environment

Academic Year 2015-2016

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About Town+Gown

Town+Gown is a systemic action research platform linking academics and practitioners to increase applied built environment research across disciplines and sectors. As new and previously unresolved built environment issues become apparent, so too the unmet need for applied research to increase common understanding. Town+Gown scales long-standing structural hurdles—low levels of investment, low levels of public sponsorship, especially at the local government level, inadequate linkages between research and application and fragmentation in both industry and academia—that have made increasing applied research difficult. The city's inter-related physical and governance setting serves as a laboratory for applied research in the built environment, which is a complex and dynamic social system with "wicked problem" characteristics that are further complicated by issues of geographical and temporal scale. Thus, built environment research requires active attention to context and multiple modes of inquiry, research methodologies and types of academic-practitioner collaborations, all operating within a "interacting open system" and "over an extended—virtually an unbounded—period of time."[1] Systemic action research, a form of cooperative inquiry involving both practitioner and academic as equal partners in knowledge creation, addresses the continual need to integrate research within the broader context and provides a "learning architecture"

1 Horst W. J. Rittel and Melvin M. Webber, "Dilemmas in a General Theory of Planning", Policy Sciences, 4 (1973), pp. 155-169.

in which system stakeholders can bring about changes in practice and policy based on research results.[2]

The Town+Gown Research Agenda is one mechanism to engage academics and practitioners on applied research and encompasses a non-linear process, with multiple perspectives, research methodologies and types of academic-practitioner collaborations. The purpose of generating research results, within a broad, open and cyclical process, is to increase the common knowledge base and support systemic change over time. At the end of each academic year, Town+Gown abstracts the results of all completed projects in this annual review, *Building Ideas*, which is disseminated within the Town+Gown community, setting the stage for reflection among participants and future action based on research. Following the release of *Building Ideas*, the annual symposia series provides a space for Town+Gown members to explore the topics raised by completed projects so that they may collectively use research results to inform future changes in policy and practice. The action research methodology facilitates change through "the use of small working groups around participants' practice—what action learning practitioners call 'action learning sets'—with repeated cycles of action-reflection."[3]

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[2] Danny Burns, *Systemic Action Research: A Strategy for Whole System Change* (Bristol: 2007), p. 1.
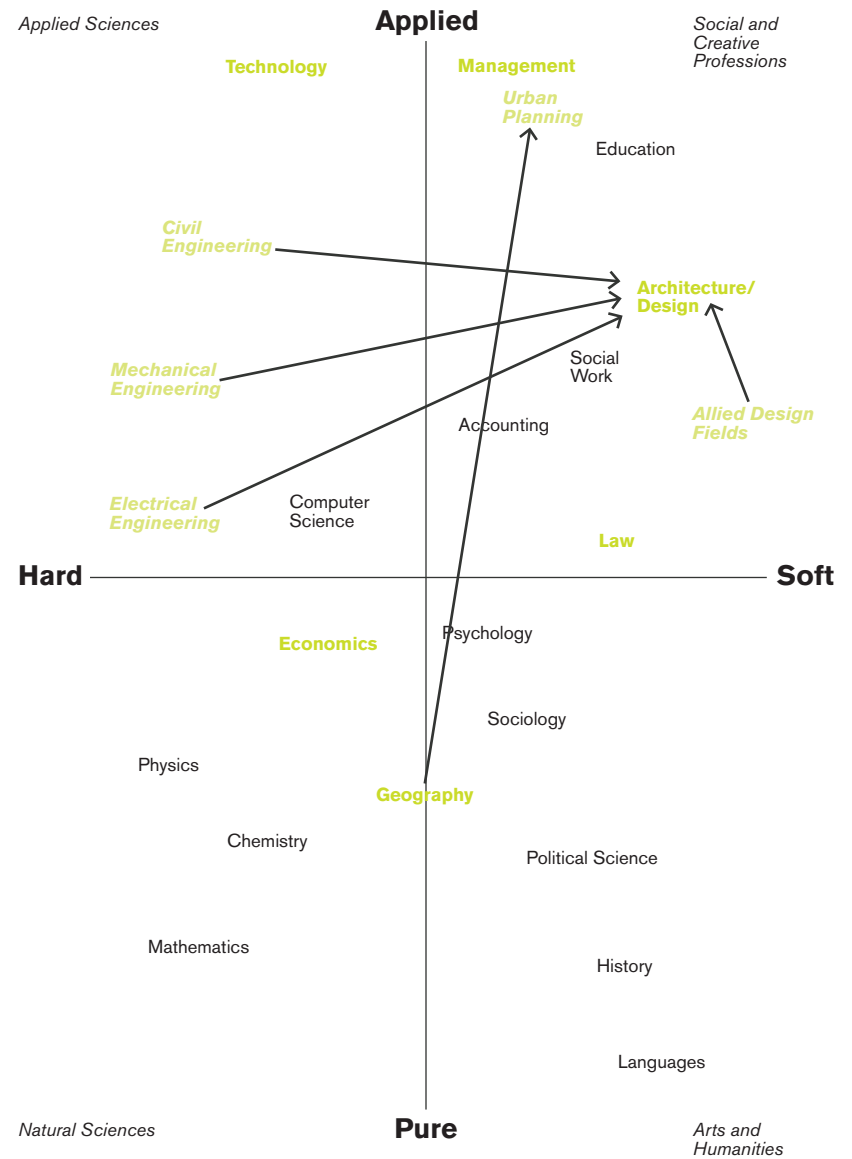[3] Sonia Ospina, Waad El Hadidy and Amparo Hofmann-Pinilla, "Cooperative Inquiry for Learning and Connectedness," Action Learning: Research and Practice, July 2008, 5:2 (Taylor & Francis), pp. 131-147; online reprint, Rider 6-A, https://upcommons.upc.edu/bitstream/handle/2099/5810/l8_pap_Hofmann-Pinilla.pdf, accessed 04-11-17 @ 12:28 p.m.

At the end of its seventh year of operation, Town+Gown has hosted or captured a total of 121 completed projects with 32 practitioner partners and 37 academic programs and departments,

GOWN
Academic Programs

**TOWN+ GOWN**

TOWN
Practitioners
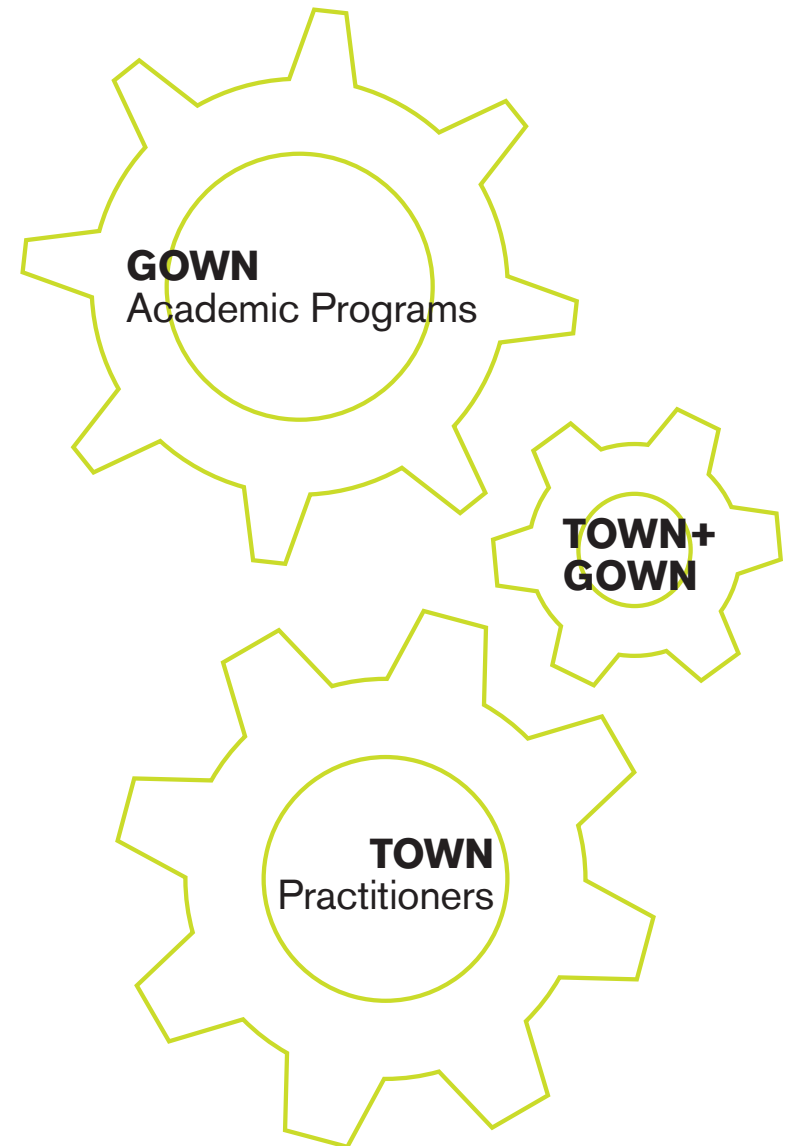
and has hosted five series of symposium events, consisting of 19 separate events, using completed research projects as the foundation for open-ended conversations among Town+Gown members. This Volume 7 of Building Ideas represents the capstone of Town+Gown's 2015-2016 academic year. See the Town + Gown website at http://www1.nyc.gov/site/ddc/about/town-gown.page.

This Volume 7 is organized along the lines of the six disciplines—Management, Geography, Economics, Law, Technology and Design—that Town+Gown uses to explore the recognized inter-disciplinary Built Environment field. Symposium events are recorded in a separate section.

Applied Sciences

Applied

Social and Creative Professions

Technology

Management

Urban Planning

Education

Civil Engineering

Architecture/Design

Mechanical Engineering

Social Work

Allied Design Fields

Accounting

Electrical Engineering

Computer Science

Law

Hard

Soft

Psychology

Economics

Sociology

Physics

Geography

Chemistry

Political Science

Mathematics

History

Languages

Natural Sciences

Pure

Arts and Humanities

Biglan Disciplinary Model from Paul Chynoweth, The Built Environment Interdiscipline: A Theoretical Model for Decision Makers in Research and Teaching, Proceedings of the CIB Working Commission (W098) Building Education and Research Conference, Kowloon Sangri-La Hotel, Hong Kong, April 10-13, 2006, Rider 9-A, http://usir.salford.ac.uk/12453/2/Interdiscipline(SS-2009).pdf, accessed 04-11-17 @ 12:08 p.m.

Index of Abbreviations
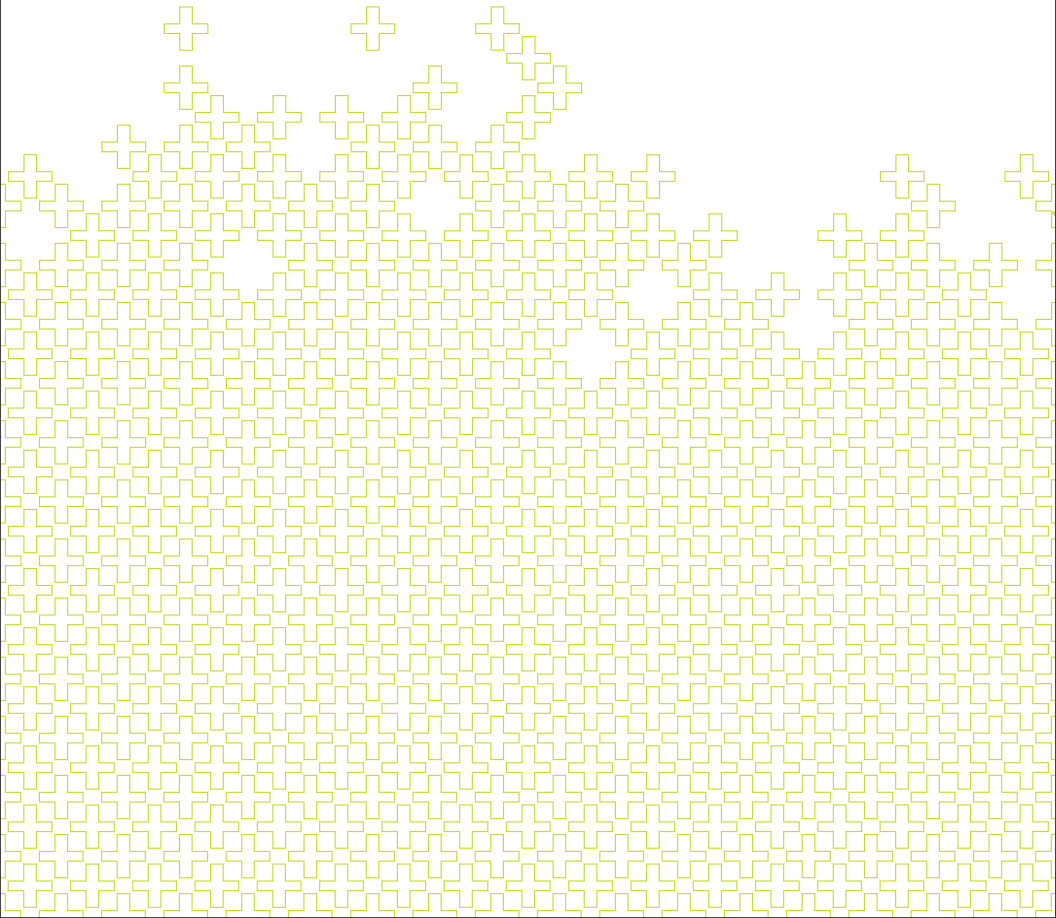
Gown

BLS/Clinic—Brooklyn Law School/Corporate and Real Estate Clinic

BLS/Fellowship—Brooklyn Law School/Post-graduate Fellowship Program

Columbia/SIPA—Columbia University/School of International and Public Affairs

CUNY/CCNY-Grove—City University of New York/City College of New York-Grove School of Engineering

CUNY/Hunter-Planning—City University of New York/Hunter College-Urban Policy and Planning

Fordham/Gabelli—Fordham University/Gabelli School of Business

New School/Milano—The New School/Milano School of International Affairs, Management, and Urban Policy

NYSID—New York School of Interior Design

Pratt/Architecture—Pratt Institute/School of Architecture

Pratt/Design-Communications—Pratt Institute/School of Design-Communications Design

Pratt/GI Fellowship—Pratt Institute/ Graduate Center for Planning and the Environment-Green Infrastructure Fellowship Program

Town

Brooklyn CB 16—Brooklyn Community Board 16

NYC DDC—New York City Department of Design and Construction

NYC DEP—New York City Department of Environmental Protection

NYC Law—New York City Law Department

NYPD—New York Police Department

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Dissemination: Abstracts of Completed Projects

Town+Gown disseminates research results in *Building Ideas*, as one way to foster ongoing discussions. Many completed projects have served as the focus of collaborative symposia and other events that bring academics and practitioners together to focus on the results of research with an eye to future research and potential action. Since Town+Gown functions as a clearing house for applied research in the Built Environment, the abstracts contained in *Building Ideas* volumes serve as resources for practitioners and academics, reducing the need to re-invent the research wheel each time a project focusing on recurring systemic issues arises. *Building Ideas* presents the work of academic programs to a wider audience of built environment practitioners and showcases the work of academic researchers outside the academic sphere.

MAN-AGE-MENT

The projects that follow under Management primarily focus on the built environment from the perspectives of its archetypal participants—owner, designer, constructor and financier. A critical objective for participants is to align their various interests in budget, schedule, safety and quality to make individual projects successful, in a context where information asymmetries continually change. Practitioners adapt to changes "on the ground" and changes in materials, building methods and information technology by using an evolving menu of service delivery methodologies and various management theories, techniques and tools, not dissimilar to those found in other industries or sectors. Research projects involving public projects also include separate analytical issues related to the public planning, budgeting and financing processes.

ESTIMATE/BID DIFFERENTIAL EXPLORATIONS.2

Objective: This research project sought to continue explorations begun in academic year 2014-2015, abstracted in Building Ideas, Vol. 6, with respect to estimate/bid differentials using administrative public works construction data and combining infrastructure and public building projects in a single data analytic exercise. As with the projects from 2014-2015, this project also sought to continue demonstrating that such administrative data are amenable to standard business data analytic techniques.

Methodology: The standard business data analytic methodology started with data cleaning and data visualization of the submitted data (internal data); creation of variables from the internal data; identification and use of external data thought to impact the dependent variable(s) studied, such as inflation rates, oil prices and interest rates; application of data analytic techniques to identify statistically significant correlations; and, predictive modeling. The data cleaning exercise also aimed at identifying projects that corresponded to whole distinct projects as opposed to components of projects contracted on a requirements contract or job order contract

Town	Gown	Researcher(s)
NYC DDC	Fordham/Gabelli	David Cai, Yichen Wang, Sam Xia and Karen Zhang

basis. Infrastructure project data are reported on a project type basis and a geographical basis, while public building project data are reported on an operational unit basis, which was assumed to correspond to project type. This project did not focus on geographical aspects of public building projects. The team created variables consisting of a Difference% variable to measure the difference between the cost estimate, developed during design and the bid price as a percentage of the design cost estimate, and a Contract Duration variable to measure the estimated project duration at the time of award that could be assumed to be the project horizon known to the designers and contractors at time the estimates and bid prices were calculated before construction commenced.
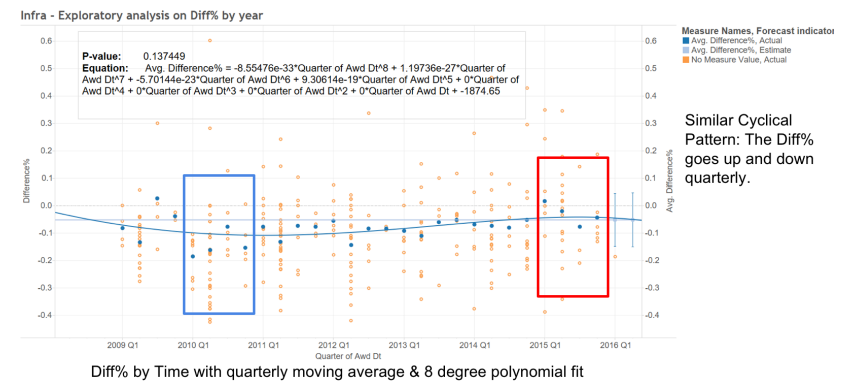
Findings: As with the prior research projects, the actual findings discussed below were less important than the fact that administrative public works construction data are amenable to business data analytic techniques and the concepts that emerged giving rise to ideas for future research. The internal data visualization exercise revealed, among other findings, increasing variance among bid prices as design-phase estimate amounts increased for both infrastructure and public buildings projects. Scatter plot analyses of the Difference% and contract prices revealed larger over- and under-estimate variance at smaller contract prices, which were assumed to be smaller projects, for both infrastructure and public building projects. With external data, the team performed correlation analysis, revealing that for public building projects, inflation rate and oil price were strongly correlated with number of bidders, while for infrastructure projects they were not strongly

correlated. Exploratory analysis revealed that for both public building and infrastructure projects, there is a cyclical pattern of the Difference% variable on a quarterly basis. Statistical correlation analysis revealed that, for public building and infrastructure projects, the Difference% was correlated with oil prices and inflation rates, while for public building projects there was an additional correlation with the city unemployment rate. Linear regression analysis revealed that oil prices had the highest statistical significance for public buildings projects. The team conducted several predictive modeling exercises for the internal data aimed at predicting tested project variables for 3 classes of Difference% (underestimates greater than 10%, under- and over-estimates less than 10% and overestimates greater than 10%). For public building projects, random forest algorithm-based supervised machine learning predictions were at the 61% accuracy level, while neural network-based supervised learning predictions were at the 48% accuracy level. For infrastructure projects, neural network-based supervised machine learning predictions were at the 72% accuracy level. The team added external data to the neural network-based predictive modeling exercises, improving the accuracy levels to 50% for public building projects and to 83% for infrastructure projects. A decision tree-based predictive modeling exercise for public buildings revealed that the project amount was the most important internal predictive variable, while GDP was the most important external predictive variable.

Next Steps: As this research project expanded the research begun the prior year with respect to the estimate/bid differential, demonstrating

that standard data analytic techniques applied to administrative public works construction data can shed light on the spread between estimates and bids, this project concluded with no next steps. Having demonstrated the use of standard data analytic techniques to administrative data from one city construction agency, a next step would be to apply such techniques to such data from all city construction agencies to identify root causes of such spreads, with under- and over-estimates greater than 10% being of special interest.

Infrastructure
Exploratory analysis on Diff% by year

Infra - Exploratory analysis on Diff% by year

P-value: 0.137449
Equation: Avg. Difference% = -8.55476e-33*Quarter of Awd Dt^8 + 1.19736e-27*Quarter of Awd Dt^7 + -5.70144e-23*Quarter of Awd Dt^6 + 9.30614e-19*Quarter of Awd Dt^5 + 0*Quarter of Awd Dt^4 + 0*Quarter of Awd Dt^3 + 0*Quarter of Awd Dt^2 + 0*Quarter of Awd Dt + -1874.65

Measure Names, Forecast indicator
■ Avg. Difference%, Actual
■ Avg. Difference%, Estimate
■ No Measure Value, Actual

Similar Cyclical Pattern: The Diff% goes up and down quarterly.

Diff% by Time with quarterly moving average & 8 degree polynomial fit

EXPLORING FACTORS RELATED TO CHANGE ORDERS

Objective: This research project sought to expand on explorations using administrative public works construction data begun in academic year 2014-2015, abstracted in Building Ideas, Vol. 6, by focusing on change orders and combining infrastructure and public building projects in a single data analytic exercise. Change orders occur during the build or construction phase of a project when the project owner agrees with the contractor under the terms of the contract that the contractor must perform extra work, which on city public works projects consists of work necessary to complete the project work as defined in the contract's original scope or non-material changes to the contract's original scope. Change orders are amendments to the contract for the project to accommodate changes during construction, which can include unforeseen conditions and design errors and omissions. As with the projects from 2014-2015, this project also sought to continue demonstrating that such administrative data are amenable to standard business data analytic techniques.

Methodology: The standard business data analytic methodology started with data cleaning and data visualization of the submitted data base (internal data); identification of external data thought to impact the dependent variable(s) studied, such as inflation rates, oil prices and interest rates; creation of variables from the internal data; application of data analytic techniques to identify statistically significant correlations; and, predictive modeling. The data cleaning exercise also aimed at identifying projects that corresponded to whole distinct projects as opposed to components of projects contracted on a requirements contract or job order contract basis. Since the nature of the construction process is one of continual change after execution of the contract containing the contractor's price, that price becomes a baseline against which to measure change, and the team created two variables to measure the total amount of change orders as a proportion of the original contract amount for a project (Ratio Type II) and as a proportion of the original contract amount plus all change orders (Ratio Type III). Picking up from the thread of prior estimate/bid differential projects, the team also created variables comparing "all in" project costs with the designer's estimate (Agency Estimate Differ) and with the contractor's estimate contained in its bid package (Nego Differ).

Findings: As with the prior research projects, the actual findings discussed below were less important than the fact that administrative public works construction data are amenable to business data analytic techniques and the concepts that emerged giving rise to ideas for future research. The initial data visualization exercise revealed trends in change order activity over time and change order activity associated with project

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and contract types, and the team focused its descriptive analyses across several dimensions including the difference between estimates and bids; negotiation time; ratios of change order amounts to "all in" project costs; reasons for change orders; and, project types. Ratio Types II and III were the target variables for correlation analysis with respect to internal project-related data variables and external economic variables, revealing that the highest positively correlated pairs for Ratio Types II and III consisted of project duration and producer price index (PPI), followed by project duration and city unemployment rate. Total change order amounts were positively correlated with PPI, and Ratio Type III was negatively correlated with interest rates. Logistic regression analysis, with backward selection, of Ratio Type III identified five independent variables consisting of oil prices, PPI, GDP per capita, project duration and operational unit. Neural network analysis for Ratio Type III revealed that project duration was the most important independent variable, with 71% accuracy. Decision tree analysis for Ratio Type III revealed that operational unit was the most important independent variable, with 66% accuracy. And, naïve Bayes analysis for Ratio Type III did not list factor importance among the internal variables consisting of project amount, operational unit and project type and external economic variables, but model accuracy was at 69%.

Next Steps: As this research project expanded the research begun the prior year to focus on change orders, demonstrating that standard data analytic techniques applied to administrative public works construction data can shed light on the

change orders, this project concluded with no next steps. Having demonstrated the use of standard data analytic techniques to administrative data from one city construction agency, a next step would be to apply such techniques to such data from all city construction agencies to identify root causes of change orders, with root causes of change orders greater than the "rule of thumb" 10% variance from original contract amount being of special interest.

Neural Network: Ratio II

▸ Input:
  ➢ 4 internal variables: Project amount, division, unit, project type
  ➢ 9 external variables
▸ Conclusion:
  ➢ 71% accuracy – good model
  ➢ The project duration is the most important factor
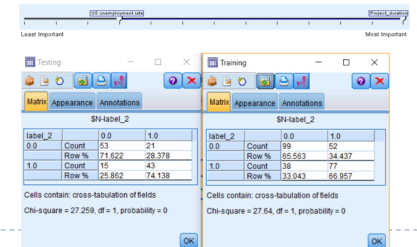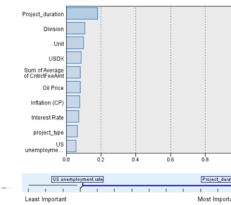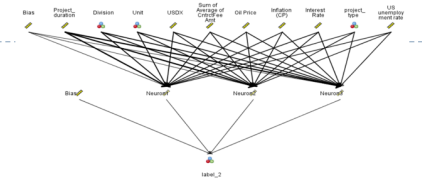
EXPLORATION OF CONSTRUCTION CLAIMS

Objective: This project sought to apply standard data analytic techniques to construction claims data for all city agencies kept by the New York City Comptroller's office, informed by the risk management methodology used in the healthcare industry, in order to explore root causes of such claims with the ultimate goal of providing a basis to develop changes in project management practices and policies aimed at minimizing or avoiding such root causes in the future. The healthcare industry's risk management methodology identifies "sentinel" events, which are unanticipated events resulting in death or serious injury not related to illness, that form the basis of a feedback mechanism performed by an interdisciplinary team to identify high-risk or high-vulnerability root causes of these events in order to analyze them and revise practices and policies to reduce the risk of such events happening in the future.

Methodology: While the Comptroller's Office dataset was being compiled, the research team conducted domain research of healthcare risk management theory and practice as well as risk management practices in construction and aviation industries. The standard business data analytic methodology started with data cleaning and data visualization of the submitted data (internal data); identification of external data thought to impact the dependent variable(s) studied, such as inflation rates, oil prices and interest rates; creation of variables from the internal data; application of data analytic techniques to identify statistically significant correlations; and, predictive modeling.

Findings: When the team received construction claims data for the period 2006-2015, the researchers were able to conduct initial data cleaning and visualization, with some descriptive analysis of the large dataset. They found that construction claims by agency were within similar ranges, with no agency as a positive or negative outlier, and that the trends over the period were similar, with 2015 showing some outliers and a higher number of claims than previous years. The ability to perform meaningful correlation analyses and predictive modeling, however, was hampered by the lack of sufficient numeric data points in the dataset.

Next Steps: The lack of sufficient numeric data points in the dataset impeded the full application of standard data analytic techniques to this administrative dataset, so next steps included obtaining a more complete dataset in the future to continue the exploration of this type of administrative data.

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Researcher(s)
Ryan Gregg, Zhongtian Jiang, Zhenyang Wang, Huanhuan Xu and Yuxi Zhan

FINANCIAL CAPACITY EXPLORATIONS.2

Objective: This research project sought to continue explorations begun in academic year 2014-2015, abstracted in Building Ideas, Vol. 6, with respect to financial capacity of construction vendors using administrative public works construction data. As with the projects from 2014-2015, this project also sought to continue demonstrating that such administrative data are amenable to standard business data analytic techniques.

Methodology: The standard business data analytic methodology started with data cleaning and data visualization of the submitted data (internal data); identification of external data thought to impact the dependent variable(s) studied, such as inflation rates, oil prices and interest rates; creation of variables from the internal data; application of data analytic techniques to identify statistically significant correlations; and, predictive modeling. Based on domain research, the research team used different measures of vendor financial capacity—Net Income, Average Net Accounts Receivable (Net AR) and Average Working Capital (Working Capital)—as well different external data than the prior project team used, though they used the same vendor and project datasets for their analyses. The team

created variables to measure the difference in project duration from projected and actual (Duration Diff) as well as the difference in project cost between projected and actual (Cost Diff).

Findings: As with the prior research project, the actual findings discussed below were less important than the fact that administrative public works construction data are amenable to business data analytic techniques and the concepts that emerged giving rise to ideas for future research. The researchers found Net AR and Working Capital were negatively correlated with US Dollar Index, inflation rate, consumer price index and interest rates; and, were positively correlated with oil prices, GDP/capita and producer price index. Using the Duration Diff as a target variable, breaking the data into three categories of less than projected, on time and more than projected, the team set Net AR and Working Capital and external economic indicators as independent variables to predict the target variables, in a logistic regression classifier exercise using cross-entropy loss method. This exercise ranked predictive variables, with Working Capital, Net AR and Net Income as the top predictive variables, followed by the city unemployment rate, producer price index, inflation, oil prices, the US unemployment rate, interest rates and GDP, with 75% testing set accuracy and 47% accuracy after oversampling. A neural network exercise, using Duration Diff as a target variable, revealed that Net AR followed by Working Capital and the US Dollar Index had the greatest predictive value, with 78% accuracy for the training dataset and overall model accuracy of 58%. K-means cluster analysis revealed, using the

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three categories of Duration Diff, the importance of external economic indicators. A linear regression exercise to predict that target Duration Diff variables revealed that external economic indicators overwhelmed all financial capacity indicators except Working Capital, with low R-square values. A logistic regression analysis by project type (public buildings, infrastructure and job order contracts) and a neural network analysis by project type, however, did reveal the importance of all financial capacity indicators, but the small size of the testing data made a predictive model infeasible. Linear regression analysis of Cost Diff also revealed that external economic indicators overwhelmed all financial capacity indicators, with low R-square values. The team continued regression analysis to tease out the different roles of external factors for three groups of project amounts (less than $4 million, between $4 million and $20 million, and greater than $20 million), with projects of less than $4 million and projects between $4 million and $20 million having 58% prediction accuracy and 57% prediction accuracy, respectively. Net Income, Working Capital and Net AR were the most important predictors of Duration Diff for the three project amount groups. A neural network analysis of the three project amount groups revealed that Net AR and Net Income were the most important predictors for projects less than $4 million (81% accuracy); all three financial capacity measures were important predictors for projects between $4 million and $20 million (88% accuracy); and, Working Capital and Net AR were the most important predictors for projects greater than $20 million (85% accuracy). Among the external economic indicators, the city unemployment rate was the top predictor for projects less than $4

million, inflation rate was the top predictor for projects between $4 million and $20 million, and oil price was the top predictor for projects greater than $20 million. Finally, a linear regression analysis of the three project amount groups also revealed that external economic indicators overwhelmed all financial capacity indicators, with low R-square values.

Next Steps: The researchers suggested that future research could improve use of linear regression analysis. Having demonstrated the use of standard data analytic techniques to administrative data from one city construction agency, a next step would be to apply such techniques to such data from all city construction agencies to continue to explore the city's construction vendor market.

Predictor importance for 3 contract amount groups
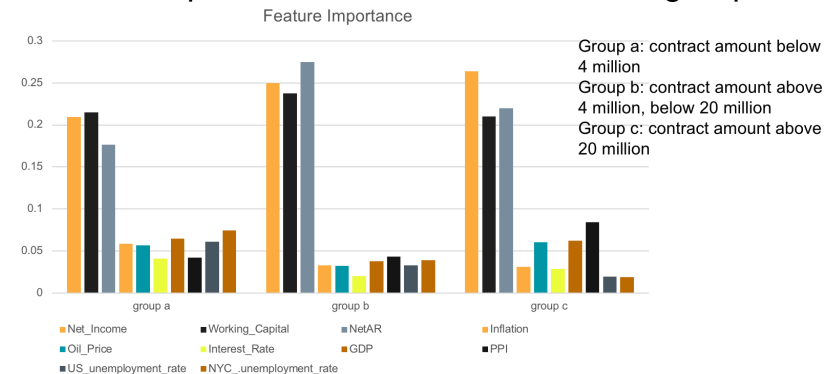
STOPPING TRASH WHERE IT STARTS

Objective: This research project was the first of a related set of research projects intended to to contribute to NYC DEP's "Stopping Trash Where It Starts" initiative to reduce street litter or trash before it enters the City's municipal separate storm sewer system and the related surrounding waterways ("potentially floatable trash). The most common elements of potentially floatable trash include cigarette butts, plastic bags, glass and plastic bottles and takeout containers. The municipal separate storm sewer system consists of conveyances or systems of conveyances, such as catch basins, gutters and storm drains, through which storm water runoff flows without being processed in any of the city's waste water treatment facilities before directly ending in surrounding waterways. The researchers sought to design a survey instrument and protocol for identifying potentially floatable trash origins and composition and conducting a preliminary test of the survey instrument and protocol for use in subsequent projects.

Methodology: The team conducted an extensive literature survey on current research on urban street litter and potentially floatable trash, which was used to develop hypotheses to be tested in subsequent research projects using the survey instrument and the survey protocol. The team also reviewed current city and state litter-related policies in order to understand the regulatory environment and neighborhood-specific conditions that impact street litter. The literature survey also evaluated the manner of collecting data via surveys—the who, when and where contexts—in order to inform the survey instrument and protocol aimed at being suitable for use by "citizen scientists", while ensuring the data collected would be valid and reliable. Across the country, all levels of government require local governments to conduct some form litter assessment or document baseline measurements of litter, based on multiple methodologies, and the team reviewed these assessments, measurements and methodologies to assess how they categorized litter sources and types, how they measure litter and floatable trash quantities and types, and the survey methodologies they used. The review informed the team in designing the survey instrument to conform to the format, structure and content areas of other surveys they identified, while reflecting the city's goals and unique urban environment. The team pre-tested the survey instrument they designed in order to test the survey's feasibility and ease of use, especially in light of the expressed desire to use "citizen scientists" to conduct future surveys, and collected preliminary data on litter and community characteristics to support the following research projects.

Findings: The team concluded that the city would require its own survey methodology and protocol, finding, in particular, that a survey effort would need to be conducted on a city block level

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Felipe Cortes, Jennifer Kim, Shruti Pandey, Robert Piccone, Sonya Rubin and João Villela de Fa

in order to analyze variation in the quantity of street litter. The team found that there was no one standard measurement tool or methodology that municipalities use and that they frequently develop their own surveys to meet their goals. They found considerable variation in the choice of survey location, with the majority of studies analyzing and measuring floatable trash either within waterbodies or on shorelines; and, those studies that were land-based focused on non-metropolitan roadways. Categorization of street litter was found to be based on subjective perceptions, some based on context, often relying on some level of expertise. The team also identified best practices in "citizen scientist"-conducted surveys, which includes training before going into the field. The protocol for categorizing street litter by "citizen scientists" in a city effort would need to categorize street litter by defining the source of trash. They also concluded it would be necessary to research nearby land uses, which affect street litter type and quantity headed toward the surrounding water as well as demographic factors, such as high concentrations of children, which also affect street litter. Since visual assessment of street litter was found to be a cost-effective tool to track baseline conditions and evaluate changes over time, the studies identified various metrics to use in the survey, though, like categorization of street litter, visual assessments are based on subjective perceptions. Across all studies, however, plastics, food and beverage items and cigarette butts were identified as major components of potential floatable trash, and the team used that insight in developing the categories in the survey instrument. The initial survey instrument designed by the team to measure variables in the policy model included one set

of questions focused on determining block level characteristics and activity and another set focused on measuring type, source and quantity of street litter. The variables in the initial survey instrument were based on variable used in prior studies, but results from the pre-test conducted by the team were expected to provide feedback to the next set of researchers to refine the final survey instrument and eliminate questions that did not yield policy relevant data.

Next Steps: The work of the team was expected to support and inform subsequent planned research projects.
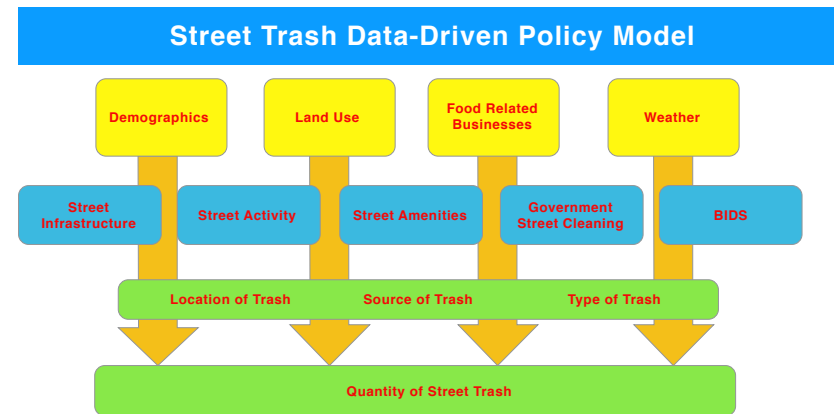
Analytic Street Litter Policy Model

INCENTIVIZING GREEN BUILDING AND INFRASTRUCTURE

Objective: The city's approach to promoting building and infrastructure performance to mitigate greenhouse gases and reduce energy use has primarily been through legislation mandating "green" performance for public and private buildings, while providing some incentives for building owners. NYC DDC, which is responsible for integrating green building and energy use reduction into city capital projects, tasked the researchers with assessing the optimal mix of regulation and incentives (both regulatory and financial) to assure a "green" future for the city, taking into account the many demands for public funds as well as the need for collaboration between public and private sector actors.

Methodology: The researchers began with a literature review to gain an overview of green building policies and practices from NYC DDC's earliest influence up to the city's 2015 release of OneNYC, followed by a review of the legal framework consisting of local, state and federal laws. They conducted a case study analysis using a database of 10,000 energy-related programs across the country and conducted interviews of city agency staff and experts across public, private and

non-profit sectors. The researchers selected case study incentive programs for proposal identification and further analyzed them on the basis of their level of innovation, their reach and scope, their applicability to the city based on demographic composition and various jurisdictional aspects, and the specific category of green technology that they addressed. They created four building and infrastructure categories, consisting of energy consumption, energy generation, building envelope and green infrastructure, each of which was further broken into sub-categories. The two criteria to evaluate the resulting proposals consisted of (1) maximizing cost efficiency, based on varied measures of output/dollar due to the many types of technology, and (2) ease of implementation by the city, measured on a scale with the highest implementation ease not requiring additional city resource to the lowest requiring additional city resources. The researchers created an evaluative framework, which identified specific public and private actors responsible for proposal implementation, beneficiaries of the proposal, the technologies to be used, and the type and amount of financing needed for implementation. For the first three categories and their subcategories, the researchers applied up to five incentive models, which included an array of city rebates, loans and grants; an array of state rebates, loans and grants; joint city-private utility financing; creation, via a city-private utility partnership, of a database to match customers with utilities for existing rebates, loans and grants; and, leveraging the building code provisions to create additional incentives, which generated 32 proposals. For the fourth category, green infrastructure, the researchers applied a truncated set of incentive models, which consisted

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Meg Davidson, Chelsea O'Shea, Ilya Perepelitsa and Rosa Ramirez

of city rebates, loans and grants and leveraging the city's building code to create additional incentives, which generated an additional four proposals.

Findings: The case study analysis revealed that while public actors are market creators and local government actors often function as intermediate supporters, utilities often dominate market technology in both mature and newly emerging industries. Application of the evaluation model for the 32 proposals revealed that either the database proposal or the proposal for building code changes was the most cost efficient and easy-to-implement proposal, while application of the model for the last four proposals revealed that a permeable pavement rebate proposal was most cost efficient and easy-to-implement proposal, followed by the proposal for building code changes. The researchers concluded with an assessment of technologies and markets measured by the most effective actor. For relatively new technologies, the researchers suggested the state was the best actor, with the city providing regulatory incentives to deepen state action; for mature technologies with full utility market saturation, the researchers suggested the city was the best actor to provide informational services; and for mature technologies with less utility saturation, the city was the best actor to provide financial, building code and zoning code incentives.

Next Steps: The evaluated recommendations themselves provided a foundation for city consideration of next steps.

	NYC	NY State	Utilities (status quo)	Database	Building Code
Maximize cost efficiency					
Rebate	$250 - $1,500	$10,000 - $500,000	$800 - $7,500	0	0
Grant	$25,000	$1,850 - $15,000		0	0
Ease of implementation	Low	High	High	Medium	Medium

Solar Energy Proposals – analysis

GEO- GRA- PHY

Geography includes several related fields, commonly placed under the rubric of Planning, such as urban planning, regional planning and placemaking, as well as land use practices, which are also covered under Law.

HEALTHY BROWNSVILLE

Objective: This planning studio, the third in a series of studios for Brooklyn CB 16, sought to provide Brooklyn CB 16 with a menu of strategies leveraging existing neighborhood assets to improve the community-wide health outcomes within the community district.

Methodology: The work from the two earlier studio projects—Brownsville Works (2012) and At Home in Brownsville (2014), provided the basis for a community needs assessment refined to focus on public health issues. The methodology, set within an urban planning framework, used core concepts from epidemiology to establish the project scope and theoretical health framework. The researchers used data and analytical research findings, interpolating broader geographical data down to the community board level, to identify the most pressing public health needs and social determinants of public health. Community outreach, which included structured stakeholder interviews and resident questionnaires, helped the researchers understand the neighborhood's views of public health needs. Interviews with city agencies and non-profit organizations helped the researchers understand priorities and recent projects in the neighborhood. With this foundation
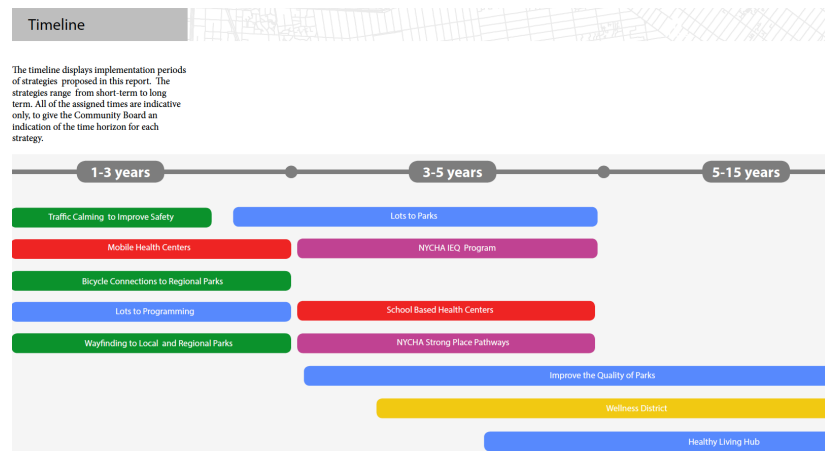
and after researching efforts by other municipalities and community-based organizations to make neighborhoods healthier, the researchers used spatial analysis to develop physical environment interventions to address identified public health needs.

The research identified several strategic assumptions on which to base their proposed physical environment interventions—access to quality parks improves mental health outcomes, reduces crime, increases physical activity and thus reduces chronic disease, as do access to quality food and good indoor environmental quality, and increases social cohesion and thus improves public health outcomes; access to cultural programming also improves mental health outcomes, reduces crime and increases social cohesion; housing stability improves mental health outcomes; and, access to quality primary care improves public health outcomes.

Findings: The researchers identified strategies built around Brownsville's existing assets, which include public housing developments, an accessible street network and transit system, a public and private school network, many vacant lots available for activation and development, and public and private organizations providing quality health services. Their proposed strategies consisted of a strong place pathway program with physical interventions to create a more welcoming atmosphere in public space within public housing developments and an indoor air quality program with window improvements and indoor air quality testing within public housing developments; wayfinding tools to local and

Town	Gown	Researcher(s)
Brooklyn CB 16*	CUNY/Hunter-Planning	Dylan Dekay Bemis, Eileen Botti, Rebecca Chau, Jeremiah Cox, Racquel Forrester, Felix Gottdiener, Brian Hamlin, Elena Lunyova, Gregory Roussine, Yetunde Soetan and Daniel Townsend

regional parks and bicycle connections to regional parks; a traffic calming initiative to improve roadway safety; expansion of school-based health centers; development of mobile health clinics as a bridge to primary care health facilities; activating vacant lots for temporary or permanent parks and cultural programming via temporary placemaking events; improving the quality of existing parks; and, creation of a healthy living hub by re-purposing the vacant LIRR Substation #2 building.

Next Steps: The researchers identified all steps and resources necessary to implement the proposed strategies for consideration by Brooklyn CB 16.

Timeline

The timeline displays implementation periods of strategies proposed in this report. The strategies range from short-term to long term. All of the assigned times are indicative only, to give the Community Board an indication of the time horizon for each strategy.

1-3 years	3-5 years	5-15 years
Traffic Calming to Improve Safety	Lots to Parks	
Mobile Health Centers	NYCHA IEQ Program	
Bicycle Connections to Regional Parks		
Lots to Programming	School Based Health Centers	
Wayfinding to Local and Regional Parks	NYCHA Strong Place Pathways	
	Improve the Quality of Parks	
	Wellness District	
	Healthy Living Hub	

ECONOMICS

Projects that follow under Economics make it possible to see government acting in and on the built environment in the different roles it often plays simultaneously. Public capital programs are, in essence, work orders for facilities relating to "social" or "public" goods and to "mixed goods" that correct for negative and positive externalities. Yet, at the same time government participates in the built environment as an owner, it also operates in its other roles—economic catalyst and policy maker, regulator and financier—increasing the complexity of built environment systems and affecting the effectiveness and efficiency of public and private capital programs and projects.

REPLACING NATURAL AGGREGATES WITH RECYCLED AGGREGATES FOR CONCRETE MAKING IN NYC- AN ENVIRONMENTAL IMPACT ASSESSMENT STUDY

Objective: In the course of an internship project with CUNY/CCNY faculty, Meryl Lagouin performed a partial comparative life cycle assessment (LCA) to compare the environmental impacts of two concrete product systems—concrete with coarse natural aggregate and concrete with coarse recycled aggregate — focusing specifically on the effects of cement content, transportation distances and landfill avoidance in New York City. Since, among the mostly inert construction and demolition waste (CDW) materials generated by the construction sector, concrete is a significant component, use of recycled concrete aggregate (RCA) as a replacement for natural (virgin) aggregate (NA) in concrete for new uses can increase reduction of this component of CDW in landfills, with

associated transportation effects, and preserve natural resources associated with concrete production.

Methodology: This partial comparative LCA focused on the New York City area and considered two categories of processes—the extraction and production of raw materials and the transportation of the raw materials to concrete plants—and excluded processes assumed to be the same for both product systems, such as producing concrete in a ready-mix plant and service and demolition phases. The researcher used private aggregated data sources for lifecycle elements of the concrete production function and used data collected from DSNY with respect to transfer stations located within the city limits that DSNY regulates, which recycle CDW, to calculate the average distance between job sites and landfills and associated transportation effects, including avoided transportation due to recycling RCA. Among the LCA assumptions was an assumed 8% additional cement for recycled cement production; an assumption that infrastructure itself was the only parameter responsible for the beneficial environmental impact (i.e., if x% of CDW is recycled in RCA usable for new concrete, then only x% of the beneficial impacts of landfill avoidance would be allocated to the recycled concrete in the LCA); an assumption that landfilling CDW was a negative environmental impact; and, an assumption that the collected recycled products go to the nearest transfer station within the city. The results of interim data processing permitted a further assumption that 43% of transfer stations located within the city are turned into RCA, which was combined with an additional assumption that

Town
See note below*

Gown
CUNY/CCNY-Grove

Researcher(s)
Meryl Lagouin

only CDW that can be turned into RCA is sent to transfer stations, which, in turn, led to landfill avoidance metrics. The researcher used SimaPro software and ecoinvent life cycle inventory datasets to model elements of the LCA in order to transform market and production system activities for the two waste scenarios.

Findings: The LCA tool permits quantification of all material flows with their associated potential environmental impacts and characterization the effects of the different processes. The comparative LCA noted the predominance of cement production as a negative environmental impact in the concrete production function, and found that, in absolute terms, the production of RCA and NA had similar environmental impacts. When transportation and landfill avoidance were added to the LCA model, however, a lower negative environmental impact for concrete production resulted, and, regardless of landfilling, the use of RCA in new concrete has a lower negative environmental impact than the use of NA for concrete production.

Next Steps: These comparative findings suggested that, with additional research, it is possible to reduce the overall negative environmental impacts of concrete production by increasing the use of RCA in new concrete within a geographic area. Project-specific LCA studies need to be performed to determine the types of construction projects for which the use of recycled CDW in concrete (or other applications) would have the highest environmental benefit. In addition, consequential LCA studies need to be conducted to investigate recycling consequences other than

avoided landfilling for the environmental burden of construction.
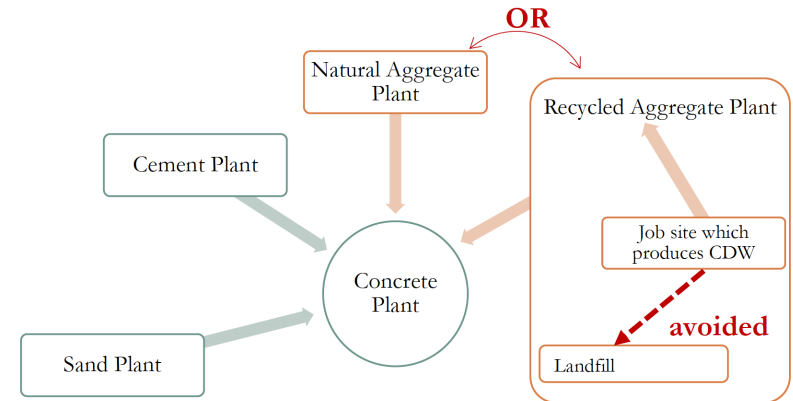
INNOVATIVE FINANCIAL MECHANISMS TO PROMOTE PRIVATE INVESTMENT IN GREEN INFRASTRUCTURE

Objective: In 2010, NYC DEP began implementing a citywide Green Infrastructure Program to manage stormwater runoff that would otherwise discharge into the combined sewer system and contribute to combined sewer overflows (CSOs), and over the next 20 years, NYC DEP is planning for $2.4 billion in public and private funding for targeted green infrastructure installations to manage one inch of stormwater runoff from 10% of impervious surfaces in combined sewer areas of the city. NYC DEP anticipates a portion of that investment will come from the private sector for the construction of green stormwater infrastructure on private properties, so that incentivizing private investment is critical. Green stormwater infrastructure projects using innovative technologies to stop rainwater from entering the sewers by capture or by increased absorption into the groundwater table are thought to have the potential to be financed and constructed using the public-private partnership (P3) methodology, which includes

Town
NYC DEP

Gown
Columbia/SIPA

Researcher(s)
Yilmaz Bozkurt, Sai Siddharth Janapareddy, Sizhou Liu, Val Monrose and Haruka Teramae

private capital market financing. Formal P3s involve a performance-based contract between public and private entities to establish financing, construction, operations and maintenance of public infrastructure, in which the private sector shares some level of risk. While formal P3s require state authorization, many local governments have successfully used informal partnership arrangements.

Methodology: The researchers began with a comprehensive literature review to assess the economic and social benefits of green storm-water infrastructure and assess value-generating technologies that could be integrated with such infrastructure. Through stakeholder analysis, case study analysis and interviews with experts, including those expert in P3s, the researchers identified and collected information on technology, private sector partners, and various financing models. The researchers then identified multiple financing strategies and technologies independently, examining stakeholders involved and their incentives within each research area, and combining the results to identify points where stakeholder incentives converge and diverge.

Findings: The researchers found that local governments tend to use formal P3 arrangements when public capital needs exceed available public funds and when private sector expertise exhibits advantages over public owner expertise, creating a balance between access to private capital markets and financing options and market-driven pricing and operation and maintenance responsibilities that are sensitive to customer demands. Geographically distributed infrastructure projects, such as green

stormwater infrastructure projects, however, are not only difficult to measure and monetize but also difficult for private entities to capture for financing purposes, making it difficult for the private sector to finance such infrastructure because of an inability to make a profit or market-rate return. From that analysis, the researchers created an incentive matrix that captured the relationship between green stormwater infrastructure types and incentives as a basis to focus on policies that could make private investment more attractive in light of private actor incentives. Analysis of financing models and mechanisms, supported by case studies, revealed several types of government finance models including stormwater user fee-based debt, tax increment-based debt, general municipal debt and debt supported by revolving funds. End-user incentive-based finance models, also supported by case studies, included property assessed clean energy financing, tax rebate programs and carbon offset market programs. The researchers expanded the definition of P3s to include partnerships with grant-making institutions and with non-governmental entities, such as corporations with social responsibility programs and not-for profit organization and community groups, to expand financing opportunities.

Next Steps: The researchers concluded with a menu of options available to NYC DEP in its attempts to encourage public-private partnerships to help solve the city's stormwater management needs. The menu was prioritized first, for immediately actionable financing strategies, followed by actions that would increase availability of financing strategies over time and strategies to maximize the impact of existing public financing and physical infrastructure capacity to reduce CSOs. These recommendations included participation in California's carbon offset market, leveraging corporate social responsibility programs; enhancing the city's concession finance model to include stormwater fees; adding green—or social impact—bonds as part of its overall financing program; leveraging existing federal grant programs for green stormwater infrastructure projects; partnering with the city's business improvement districts, working in conjunction with large property owners building or renovating large developments to create "eco districts"; and, investigating value-generating technologies, such as water cooled air-conditioning systems, hydroelectricity generated from water distribution system, and mussel farms as supplemental water treatment plants.

DEP's Current Technologies	Incentive Analysis							
	Economic Benefits				Social Benefits			
	Reducing Treatment Impact	Reducing Energy Demand	Increasing Energy Efficieny	Decreasing CO2 Emissions	Reducing Flooding Damage	Improving Quality of Life	Increasing Air Quality	Increasing Property Values
Bioswales	✔	✔	✔	✔	✔	✔	✔	✔
Stormwater Greenstreets	✔	✔	✔	✔	✔	✔	✔	✔
Rain Gardens	✔	✔	✔	✔	✔	✔	✔	✔
Permeable Pavings	✔	✔			✔	✔		✔
Green Roofs	✔	✔	✔	✔	✔	✔	✔	✔
Blue Roofs	✔	✔	✔		✔	✔		✔
Subsurface Detention Systems	✔	✔			✔	✔		✔
Cisterns and Rain Barrels	✔	✔			✔	✔		✔

LAW

Projects under Law focus on the impact of law on built environment activities from the perspective of the archetypal participants—owner, designer, constructor and financier. Statutes and regulations, contractual forms and provisions, and related case law all affect the relationships among built environment participants, their expectations and their 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 and provide a foundation for policy and practice change.

MULTIPLE EXPLORATIONS IN BUILD PHASE RISK ALLOCATION IN CONSTRUCTIONS CONTRACTS

Objective: Avallone conducted several legal research and analysis projects in connection with ongoing projects in Town+Gown that all share a focus on the build phase, the construction contract that facilitates the build phase, and the statutory framework that construction projects—public and private—work within. Town+Gown has been working for several years on two research questions: *How Can Public Owners Better Match Risk Shifting/Mitigation Strategies to Risk?*, which aims at a comparative contract analysis of risk allocation provisions to support financial analyses of risk shifting provisions, and *Why Does It Cost So Much to Build in New York?*, which focuses on both public and private projects. In addition, completed projects under the research question *Future Workforce Needs and Development—What Are the Conditions for Construction Business Formation and Success?* supported Town+Gown's management of the Opportunity Academy program, which included creating course materials that contain contextual and specific information for the city's public works processes such as the capital

planning, budgeting and finance processes, the regular payment processes, the change order payment process, and construction management processes.

Methodology: Avallone performed standard legal analyses of case law, statutes and construction provisions in the course of her work. She reviewed and documented project delivery systems for construction, including integrated project delivery and lean construction principles. She analyzed and documented contract provisions related to means and methods provisions and to the requirements the public construction contract imposes on contractors during the build phase. She also analyzed and documented case law related to various contract terms such as unforeseen changes in condition, insurance, and surety and performance bonds.

Findings: As these projects join other projects to provide the foundational basis for the broader research questions, there were no specific findings.

Next Steps: Work on the broader research questions continues.

Town	Gown	Researcher(s)
NYC DDC	BLS/Fellowship	Devon Avallone

Capital Project Processes: Build

PARADE OF TRADES
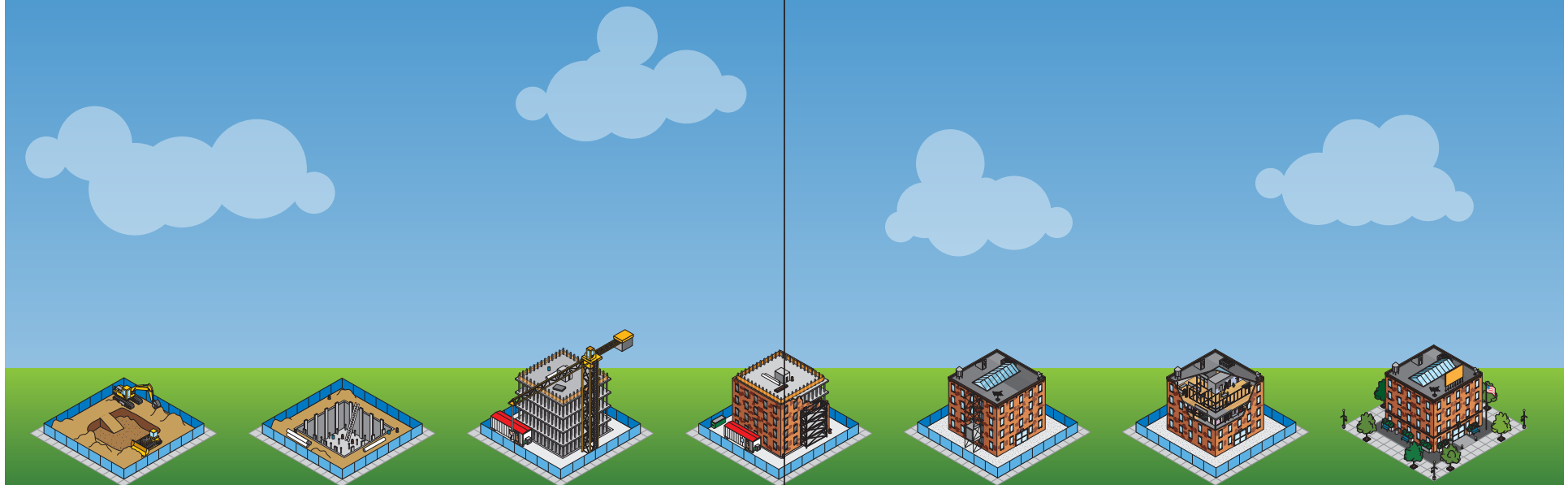
SITE CLEARANCE AND EXCAVATION

FOUNDATION

STEEL ERECTION

SHELL/SKIN

ROOF

INTERIOR FLOORING

SITE WORK

NEW YORK STATE GENERAL MUNICIPAL LAW, SECTIONS 101 AND 103
NEW YORK STATE FINANCE LAW, SECIONS 135 AND 163

NEW YORK STATE LABOR LAW: SECTIONS 220 AND 240

NEW YORK STATE REAL PROPERTY TAX LAWS

NEW YORK BUILDING CODES

NEW YORK CITY ZONING CODE

NEW YORK STATE LOCAL FINANCE LAW, SECTION 11

NEW YORK STATE INSURANCE LAW, SECTION 2504

FEDERAL, STATE AND LOCAL ENVIRONMENTAL IMPACT ANALYTICS REQUIREMENTS

NEW YORK CITY UNIFORM LAND USE REVIEW PHASE

INVESTIGATIONS INTO THE NATURE OF THE PUBLIC AND THE PRIVATE OWNER: LEGAL ANALYSIS OF PRIVATE OWNER BUSINESS MODELS

Objective: This research project focused on the relation of construction owner business models to related project typologies. To say there are there are public owners and private owners is simply the beginning of any analysis in the built environment. While public and private owners share concerns, there are critical differences between them. For government to regulate the industry efficiently and effectively, it is necessary to develop understanding of variations within the archetype of the private sector owner of construction—what they are functionally (owner-developers, build-to-own-and-operate-owners, owners as financing vehicles) and what their respective business forms and operating models are. This project represented the initial effort to develop a sense of private owner business models using the New York City market as the case study.

Methodology: Review of academic literature analyzing the "business model", which includes what businesses do and how they generate revenues from their activities, revealed that it is possible to analyze types of business models and types of assets involved to generate a matrix of business models within an industry in order to evaluate the relative financial performance of business models, which has been shown to be a better predictor of financial performance than the use of industry classifications. The literature also revealed that business model analysis can also evaluate the relative effectiveness of various business models. Young began with an examination of the local construction industry, creating a matrix that aligned business models with project typologies. He then conducted standard legal analysis and documentation of the statutory environment for these business models, reviewing state statutes governing business organization as well as public financing models for some project types.

Findings: Since this project was intended to provide foundational legal analysis and documentation for the broader research topic, there were no findings.

Next Steps: It is expected that the next research project would consist of developing a survey instrument, based on this completed work and stakeholder interviews to be conducted, to be fielded within the local construction and real estate development industry.

Town
NYC DDC

Gown
BLS/Clinic

Researcher(s)
Joseph Young

LEGAL ANALYSIS FOR OPTIMIZING OPERATIONAL FLEXIBILITY AT JUVENILE JUSTICE FACILITIES THROUGH DESIGN

Objective: This project responded to proposed "Raise the Age" legislation to explore regulatory impediments to the use of flexible design to optimize operational flexibility at juvenile justice facilities. Town+Gown has several research questions investigating the application of "long life, loose fit, low technology" principles to public building design, at a time when building information modeling and pre-fabricated modular construction technologies have developed to the point of being able to promote flexible building design to accommodate changes in use during the long life of buildings, while reducing construction costs. This research project was intended to support a planned architecture studio-based design research project focusing on designing juvenile detention spaces that would be able to shift easily between both types of juvenile detention modes—secure and non-secure—to increase operational flexibility at facilities to accommodate future fluctuation in the mix of secure and non-secure bed demand.

Town	Gown	Researcher(s)
NYC DDC	BLS/Fellowship	Jessica Downes

An earlier action research set that focused on using flexible design for co-located human service programs at underutilized educational facilities included a similar exploration of regulatory impediments.

Methodology: Downes performed standard legal analyses and documentation of statutes governing juvenile justice facilities, which included state and local regulations as well as the state governance structure for criminal justice, which includes one for adults and another for juveniles, with connections between the two as the age of the detainee changes over time. Downes supplemented her legal analysis by conducting an historical review of juvenile justice theory and practice in New York, interviewing professionals involved in juvenile justice practice, and researching state and local budgeting practices with respect to juvenile justice facilities.

Findings: Legal analysis of the statutory environment for juvenile justice facilities revealed a more complex regulatory environment for public detention buildings serving juveniles than that for public education facilities and facilities for social service provision. Downes concluded that increased regulatory complexity was, in part, due to the fact that the laws that govern the facilities were part of the broader, and also complex, criminal justice regulatory field. This regulatory complexity was further complicated by evolving legislative and policy changes in the area of juvenile justice that had started during this project.

Next Steps: The planned studio-based design research project did not occur so that Downes'

research would need to be updated to reflect changes to support a studio-based design research project in the future.

DESI-GN

The projects under Design can focus on any aspect raised by this complex disciplinary field. Both public and private construction projects become part of the visible built environment, and this aspect of Design includes both Architecture and Engineering. Within or surrounding built objects, several other design disciplines also operate and contribute significantly to the overall success of any built environment object. Interior design, lighting design, landscape design, service design, communications (or visual) design, digital design and product design comprise a suite of integrated design services that interface with Architecture and Engineering and are included under Design as well.

WAIT… PILOT PROGRAM

Objective: For the Wait… Pilot Program, a student-led team from Pratt Institute's School of Design/Communications, working with another student-led sustainability team from Pratt/ GI Fellowship, sought to identify communications design principles for DEP to utilize to encourage public engagement and to illustrate to a broad audience that individual actions, such as voluntarily reducing the volume of water used during heavy rain events, can have a positive impact on the city's waterbodies. As part of its ongoing effort to improve water quality in the city's waterways, NYC DEP developed a pilot program to encourage residents in the Newtown Creek sewer-shed to wait to use water during heavy rain events (Wait… Pilot Program). When there is heavy rain and heavy household water usage, the city's sewers can reach capacity, which can lead to combined sewer overflows (CSOs) and impact water quality. The Wait… Pilot Program encourages participants to wait to do laundry, wash dishes, shower, and flush the toilet during these rain events to help free up capacity in the combined sewer system.

Inspired by the energy industry's campaigns to encourage reduced energy consumption during peak demand periods, the Wait… Pilot Program is intended to leverage the actions of individual water users within the Newtown Creek sewer-shed to help increase capacity in the combined sewer system and reduce the concentration of wastewater in CSOs.

Methodology: Using the Newtown Creek sewer-shed pilot as the case study for a waterbody stewardship campaign, the team developed a communications campaign with printed material and text messages that would be suitable for NYC DEP to use as it scaled up the initiative across the city's sewer-sheds, and that would also generate survey data to permit evaluation of the success of this informal partnership model. The students engaged in a three-phase research effort to create a communications campaign that connects communities to their waterbodies, harnesses community action, and offers qualitative measures of success.

In addition to conducting a literature survey with respect to individual behavior and ethnography, the team conducted one-on-one interviews of residents to understand perceptions and knowledge of water issues. Working from the interview results, sub-teams designed interventions to engage larger audiences and draw them into increased levels of individual participation, including prototyping the interventions, developing a blueprint of touchpoints and developing a plan for public engagement that included a focus on specific spaces and locations. The final phase involved developing an awareness campaign highlighting specific water issues raised in the first two phases, with options for campaign launching, digital and other communications assets and a roadmap for evaluation. The teams conducted demographic, mapping, and stakeholder

Town	Gown	Researcher(s)
NYC DEP	Pratt/Design-Communications	Melissa Berman and Corwin Green in conjunction with Pratt/GI Fellows Miguel Dias, Maria Gonzelez and Lekhana Chidinanda

analyses focusing on the Flushing Bay/Flushing Creek sewer-shed.

Findings: Utilizing a behavioral model for persuasive design, the team adopted an approach to promote sustainable behavior with community-based social marketing and designing for behavior change intervention. The demographic and mapping analyses highlighted, among other things, that perception of water usage and the cost of water is not experienced in the same way across the city's 11 sewer-sheds. The Flushing Bay/Flushing Creek sewer-shed stakeholder analyses revealed a complex environment of business, educational, environmental, and recreational stakeholder groups at the local level, providing a methodology for future analyses of other sewer-sheds and comparison of local communications resources.The team developed three survey instruments to be administered over a campaign's lifespan to determine the change in local awareness of CSO events and to evaluate a campaign's success, using qualitative metrics of access to water, empathy with respect to interacting with water, and awareness of municipal education efforts, along with standard quantitative demographic metrics.

Next Steps: The team recommended that the city utilize the project deliverables on a sewer-shed-by-sewer-shed basis, in the context of the city's long-term control plan program.

CHANGE THE STORY BROWNSVILLE: A COMMUNICATION STRATEGY TO BUILD TRUST

Objective: One element of the "Community Connections Pavilion" pod design in Pratt/ Architecture's The People's Precinct at the 73— Design of the Community project abstracted in Building Ideas, Vol. 6, was an electronic "bulletin board" to be a communications resource shared by the community and NYPD to support "People's Precinct" programming objectives. This follow up communications design project for NYPD was intended to focus on the potential content for the bulletin board and to detail the background community and NYPD infrastructures necessary to support the bulletin board content, and the relationship between the two infrastructures.

Methodology: The team conducted a multiple method research project that, at its core, identified the relationship between police and the community as a significant challenge and explored ways to enable existing communication channels in

Brownsville to increase trust between the police and the community. The researchers' methods included a walking tour to document the physical conditions in the neighborhood; a series of interviews with service providers and agencies to identify community organizations; a participatory design process with community residents utilizing concept cards and narrative prompts to test emerging ideas and gain deeper insight; and, additional research to dig deeper and validate earlier findings.

Findings: Taken as a whole, the researchers' insights reflected differing perceptions of the current state of police community interactions, 90 percent of which take place outside the precinct building, but also reflected a shared interest in building trust over time with face-to-face interactions. The researchers mapped current communications channels amid differing perceptions of safety within the neighborhood. The researchers observed that the police and the community approached developing better relationships of trust, which is complicated and dependent on time and perceptions, from opposing directions, with the police starting from an approach of providing public safety and the community starting from an approach of developing personal relationships. The researchers concluded that a solution to achieve the stated desire to build trust required a "counter narrative" to the dominant narrative of negative police community relations. The counter narrative would include key values of Brownsville residents, such as community ownership and sense of belonging, understanding public safety "on the ground" in their neighborhood, knowledge of physical and social neighborhood

Town	Gown	Researcher(s)
NYPD	SVA/Impact	Katie Buckel, Paula DiMarco, Nisha Haji, Mariana Fernandez Magnou, Peter Martin, Charlene Sequeira, Larissa Sasson Vaz and Valérie Yobé

assets where people want to go and engage, and community art to imagine what is possible.

Their proposed communications strategy for the digital bulletin board included the creation of a new community newsletter that would leverage existing communication channels and change the current narrative to provide a holistic view of Brownsville and would overlap with the digital bulletin board. In the social infrastructure behind the proposed strategy, the community would be responsible for the newsletter, creating positive and constructive content about the community, in the context of an agreed-upon set of guidelines and a protocol between the community and the police, with articulated roles, to create the content, since it would migrate to the bulletin board inside the precinct building.

Next Steps: Since the proposed protocol specifically envisioned a position of community content coordinator and administrator to interface between the community and the precinct, engaging with a local creative agency, and the purchase of a digital bulletin board, the researchers indicated a need to identify funding models for start-up operations and long-term operations as pre-condition for implementation.

COMMUNICATION SYSTEM MAP
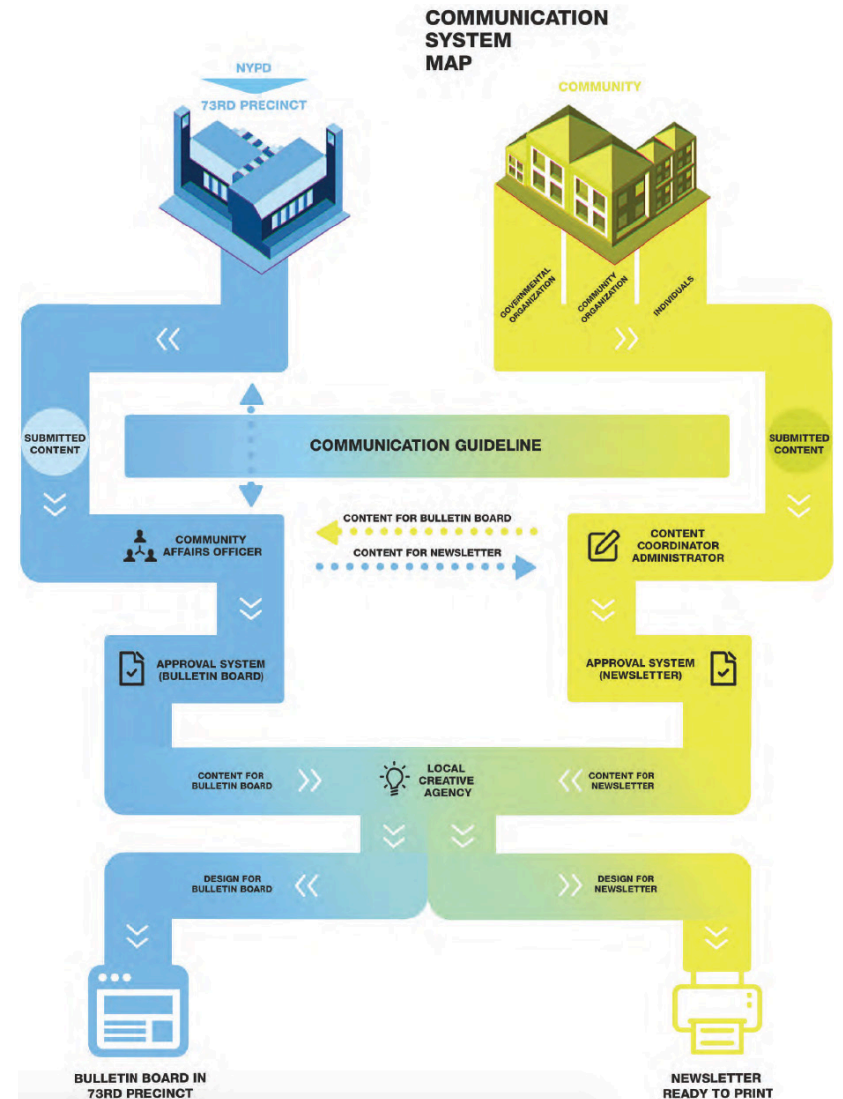
SOAK UP NEW YORK

Objective: The objective of this research project was to use multi-disciplinary strategic design methodologies to support NYC DEP's green infrastructure initiatives. By utilizing a human-centered, holistic, and empathetic design approach, applying "design thinking" methodologies to the problems and issues of the public's interactions with the city's green infrastructure installations, this exercise aimed at transforming individual behaviors in desirable and sustainable ways while creating meaningful experiences and interactions within the broad system of the environment in which people are participants rather than users of communications tools.

Methodology: The researchers organized themselves into groups to tackle four individual challenges, uniting the look and feel of the components through an overarching brand governance designed by the team. For each of the challenges—brand development, community action, on-site opportunities and off-site opportunities—the researchers conducted a similar approach consisting of collecting relevant baseline information, conducting specific research, engaging with various stakeholders, conducting a needs assessment, developing design solutions,

Town	Gown	Researcher(s)
NYC DEP	Pratt/Design-Communication	Alexis Baran, Melissa Berman, Corwin Green, Leonor Kerke, Andrea Laszlo, Abbey Roam, Craig Roberts, Ryan Schoenherr, Gizen Serifoglu and Katie Wylie

and providing potential impact assessments of the design solutions.

Findings: The researchers developed a campaign called "Soak Up New York", consisting of a high-level brand strategy, with digital, video and print deliverables, that collectively showed how a united effort across multiple touchpoints can educate and excite New Yorkers about the benefits of the city's green infrastructure installations, in particular the city's bioswale installations. The brand development strategy team concluded that NYC DEP's existing brand contained room for expansion into a contemporary, unified and engaging look and feel, and the researchers developed a "kit of parts" brand, based on research of other brands in the "water issues" space, that could serve as a foundation on which to build out a range of print and digital deliverables with a custom logo and color palette, typography and layout choices. The logo design was intended to be understandable by all viewers while being sufficiently abstract to able to communicate a certain level of sophistication. A proposed illustration style for plants and photography style would unite disparate imagery and, along with the logo, color palette, typography and layout choices, formed the basis of various proposed campaign launch concepts to engage and educate the public about bioswales, which were presented as sponges. The community strategy team conducted research about bioswales in neighborhoods, finding collective confusion surrounding green infrastructure. The team created an educational video, using short-form and long-form interviews asking the question "Why should New Yorkers care about Green Infrastructure?", which provided an informational

narrative and access to visual evidence of related phenomena, reinforcing action as well as memory and raising awareness of collective power within the ecosystem and within communities. The on-site intervention strategy team developed signage for bioswale installations, after conducting field observations of bioswale sites, observing six types of "users". The proposed signage was intended engage users and inform them about the funtions of a bioswale, providing links to the informational website containing in-depth information about NYC DEP and its green infrastructure program, distinguishing it from other installations involving plant materials, as well as providing information to discourage littering at bioswale installations. Field obervations revealed misunderstandings about bioswale functions in the overall environment, which includes combined sewage overflows ("CSOs") during rainfalls. Research on how people learn about issues from knowledgeable people they trust, led the off-site intervention strategy team develop a friendly, "neighborly" and interactive website (www.soakupnyc.com) to provide a central source of information showing the effects of water usage on CSOs during rainfalls to encourage individuals personally to reduce water use during rainfalls and help NYC DEP in its overall efforts to reduce CSOs. This website used a story format to provide information and social media, community boards and guerilla marketing techniques to drive people to the website.

Next Steps: This research-based communications design strategy provided NYC DEP with a coordinated set of options to consider as it moves forward with its green infrastructure program.

Bioswale-Specific Tagline

Still Included in Brand Language

Hey New York!
I'm a sponge!

73 PRECINCT OFFICERS' LOUNGE AND GYM REIMAGINED

Objective: NYPD's efforts to implement the "People's Precinct" model, which involved a series of design projects abstracted in Building Ideas, Vol.6, included a companion effort to improve the officer-oriented spaces, using the 73 Precinct building as the case study. Two research teams in this eight-week summer experiential learning seminar were tasked with developing interior design options for the officers' lounge and gym space at the 73 Precinct.

Methodology: Following a user-centered design research methodology similar to that used in the NYSID design project for the vestibule in 2014-2015, the research team conducted four structured design meetings with the officers and other staff at the 73 Precinct to create designs to reimage their officers' lounge and exercise spaces.

Findings: The designs for the officers' lounge and exercise space reflected physical space limitations while addressing the needs expressed by officers during the design process. The designs also reflected general operational needs at city facilities for durable and easy-to-clean materials.
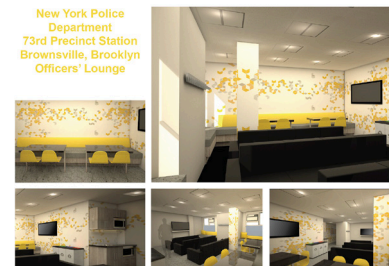
The officers' lounge design, included a wall covering system that provided an overall sense of relaxation and openness by reflecting available natural light from the windows. The design aligned the space and systems to accommodate a kitchen and dining and seating furniture to promote better flow based on the way the officers use the current space. The gym design improved the lighting system and also used a wall covering that added color and provided sound-proofing. The current space focuses exclusively on weights and exercise machines, so the design also created a space for exercise videos/classes, which officers who do not use the currently space indicated would encourage them to use the gym. The design also included the same emphasis on durability and maintenance in a basement, which added complexity to the selection of materials.

Next Steps: The proposed interior design changes for the 73 Precinct were the subject of discussions in connection with ongoing operations and maintenance efforts and, by the end of academic year 2015-2016, had not been implemented.

New York Police Department 73rd Precinct Station Brownsville, Brooklyn Officers' Lounge

73rd Precinct Gym Reimagined

Town	Gown	Researcher(s)
NYPD	NYSID	Tom Elka, Mateo Baca Fernández, Marie Nguyen, Anette Severino, Sylvia Sirabella and Juliana Tiseo

Reflection: Proceedings from Symposium Events

The systemic action research methodology provides structure for stakeholders to use research results to help bring about changes in practice and policy within a complex and dynamic social system. In the built environment, where complex issues are embedded, it is necessary to conduct research explicitly within its context. The action research methodology facilitates change through repeated cycles of research and reflection aimed at eventual action, which the action learning methodology calls 'action learning sets'.

Since 2011-2012, Town+Gown has been using the symposium format as a space for reflection, where practitioner and academic participants, in an open-ended conversation focusing on particular completed project results, can move toward appropriate action. There no particular agenda other than what is suggested by the completed project or projects, and these events are simply research-based conversations within a broader context aimed at action.

The following summaries of symposium events held during 2015-2016 evidence the state of reflection on the completed projects that were subjects of the events.

MEANS AND METHODS: SWORD OR SHIELD?

In conjunction with Brooklyn Law School and Associated General Contractors of New York State

Date. June 15, 2016

Purpose. This event, structured with NYC Law as a continuing legal education ("CLE") event to provide city attorneys who attended with the option of obtaining CLE credit, explored the legal issue of "means and methods" in construction contracts that was the subject of a completed 2013-2014 research project abstracted in Building Ideas, Vol. 5, that aimed at unpacking and analyzing various relationships on construction projects by subjecting "means and methods" contractual provisions to legal analysis in the context of historical practice, risk shift conventions, and regulation, in order to provide a foundation for future research projects related to risk analysis and management. The researcher concluded his work by preparing a survey instrument for distribution across the industry to explore further issues related to "means and methods" in view of the continued use of the undefined term and interview results that suggested that there is a need to define the term in light of dramatic inconsistencies of understanding of the term. This event was intended to provide additional information to refine the survey instrument to be fielded in a subsequent research project.

In the construction contract between owner and contractor, with the architect sometimes having a role, the term "means and methods", a term of art, most often not defined in the contract, is used in practice by parties to advance and protect their respective interests. Researchers and practitioners have noted the adversarial nature of participants "on the ground", which is the result of risk shifting contract provisions, regulations and case law interpretations. The researcher concluded that the sophistication of contracting has intentionally evolved, shaped by rational actors in the industry and the courts, and the continued use of the undefined term "means and methods" functions as a risk shifting device from which the owner appears to benefit the most. Whether "means and methods" provisions work as a shield or a sword appears to depend on the facts of the particular harm that resulted, so that analysis of case law revealed little conceptual explanation of the term. The increasing sophistication of contract forms and provisions linked with insurance products, in an environment of evolving building technologies and project service delivery methods, and significant variance among state laws governing construction, further hindered the ability to pin down a working definition of the term.

Conversation. The conversation illustrated the many ways in which reality meets theory. The particulars of means and methods in a contract depend on the type of work being done—horizontal building structures and vertical infrastructure differ from each other in significant ways and have different recurring issues. Any future work on means and methods may have to be bifurcated to address these basic differences.

The design phase involves the ideation and description of materials in space, followed by the construction phase, which involves bringing and installing materials to create the designed space. There can be a certain amount of flexibility in the choice of materials and manner of material installation, which can lead to potential savings that can go entirely to the contractor or can be shared by the owner and contractor, bounded by safety concerns during and after construction and the visible aesthetics. Designers are expected to prescribe what is intended, but means and methods are about the details of execution, where the realities of field conditions meet design intent. Pre-construction activities, such as constructability reviews and value engineering exercises during the latter part of the design phase can help reduce uncertainty in the field, but not all owners engage in such activities or engage in them on all projects. The quality of design documents that contractors bid on is a key factor—a linchpin—and the means and methods function cannot correct for poor design documents. Design documents form the basis of the estimates contractors perform as the basis of their bids, and it is important to understand that designers and owners have a significantly longer timeframe to accomplish the design phase, which is typically at least six months to a year, than contractors have to estimate the job and prepare bids, which is typically three-to-four weeks. While the technological evolution in design from hand-drawing to building information models promises to solve many problems in design and construction, the potential loss of the "thinking" and "understanding" that preceded the hand-drawing of design documents that become the basis of

shop drawings during the construction phase may be part of the problem with current design documents.

Construction is a process of ongoing revelation, but the bid process—and the construction process that follows an award where the price bid becomes the hard cost/price—typically does not permit the answering of questions and revision of the project design or the contract work as the revelation proceeds. Contractual means and methods can work as a hard safety valve, at best, within previously established contractual risk allocations, when nuance may be required. Rigid risk allocation, especially when risk is assigned to parties not best placed to control the risk, creates the potential for problems during the construction phase. What is best for the project should be the objective of all project participants, and leadership in running the project, consistent with contract terms, at the owner level is key to project success. While the formal contract documents set the tone, leadership and creation of trust among all parties are critical.

Thoughts about future research included: comparing the spread between awarded price and all-in cost over a 30-40 year period to analyze the impact of computer technology in design documents; exploring the "best and final offer" procurement tool as a way to get at both design document quality and the means and methods component of bids; exploring ways to obtain professional observations for safety purposes without drawing them into a liability vortex; and exploring methods of design delegation for shop drawings of complex components during the construction phase.

THE POLICY OF DESIGN AND EQUITY

In collaboration with AIANY/Center for Architecture and the AIANY/Public Architecture Committee, as part of Archtober, Architecture and Design Month

Date. October 28, 2015

Purpose. This event explored the meaning of design equity and the role of architects in advancing it. It began with a general discussion of the term and the role of architects and then focused on the series of completed design research projects for the "Peoples' Precincts" with NYPD and a hedonic regression project to create a model to evaluate the economic impact of city capital projects on their surrounding neighborhoods, all completed in 2014-2015 and abstracted Building Ideas, Vol. 6, as case studies to explore these concepts further.

The question of the modern role of equity in distribution finds a tension between the modern articulation of efficiency and just or fair distribution. To address that tension, it is necessary to go outside economic theory to societal judgments about what is fair and equitable. There are limitations to the redistributive function regardless of the criteria used, such as the size of the resources available for distribution. Under current theory, government is the appropriate actor to correct for market failures in the efficient production—or allocation of resources for the production—of the politically desired levels of pure social goods and services as well as correcting for negative and positive externalities with respect to mixed social goods and services. State and local governments have varying abilities to intervene in the economy to correct for market failures. State and local government capital programs and budgets provide a catalogue of physical manifestations of pure and mixed social goods. Government is a project owner and client of construction services that implement its capital program, and 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. Government also performs an active management role in the economy when it changes levels of capital spending. In addition, state and local government regulation of the construction industry, as an economic component and as a major facilitator of its public projects, provides additional opportunities for government to increase the efficiencies.

Public space is a public good that provides the "stage" for the civic experience and provides the spaces for the provision of public goods and services. Much of the city's public realm is constructed and reconstructed via the city capital program, financed by city bonds and managed by city agencies contracting with private architects, engineers and construction companies. The city's diverse capital program rehabilitates, maintains, and expands public infrastructure and public building stock of a large and complex built urban

center. While the capital budget is large, the city's capital needs are larger, requiring choices that balance a variety of competing needs.

Conversation. The conversation at this event was captured in a video (https://www.youtube.com/watch?v=PnavSLhGYHg). Among the issues discussed was the limited role of the architect vis à vis equity due to the budget allocated by the owner and the goals of the owner's program, which may or may not include an explicit design focus on the end-user. The history of government as a public owner was raised in the context of public housing regulation enacted during the Reagan administration, which constrained what design was permitted to do for federally-funded projects. The role that finance plays in equity considerations was also raised as a general constraint. And, improvements to the quantification of social equity metrics, currently at levels less sophisticated than economic benefits metrics, which could serve as a proxy for social equity metrics, was not viewed as a pre-condition to using them in the decision-making process for capital investment.