Issues in Systemic Construction Data Analyses: Top-Down, Bottom-Up and Middle Out
DYCD@2 Lafayette Street, Room 1827
November 9, 2018, 8:30-Noon

Agenda

8:45 a.m. - 9:00 a.m. What is Systemic Data Analysis and Why Do We Need It?

- Nicole Marwell, University of Chicago

9:00 a.m. - 10:15 a.m. Issues in Systemic Construction Data Analysis

- DEP Floatables Project: Patricia Culligan, Columbia/School of Engineering
- RAID - Model Creation from One Agency Dataset: Fletcher Griffis and Frank Darconte, NYU/School of Engineering
- Translating Agency-Collected Data Up and Across Agencies to Inform Policy Development: David Nadler, NYIT/School of Engineering
- Planned NYU Student Data Collection Project: Debra Laefer, NYU/CUSP
- Expanding Fordham/School of Business Student-Led Construction Data Analytic Projects: Terri Matthews, Director, Town+Gown

10:15 a.m. - 10:50 a.m. Co-creating Knowledge and Change - Simultaneous Working Group Table Sessions

- Would Agencies Like to Do Systemic Construction Data Analysis and What Are the Impediments?
- Role of Citizen Science in Systemic Construction Data Analysis

10:50 a.m. - 11:00 a.m. Break

11:00 a.m. - 11:30 a.m. Reconvening: Reporting Back and Closing Remarks

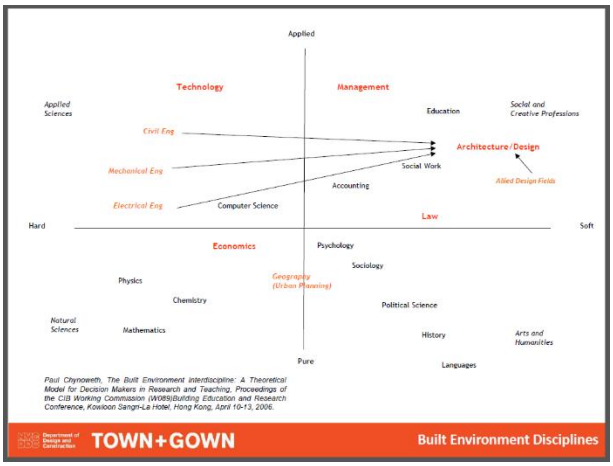
Systemic Action Research in the Built Environment. Town+Gown has supported numerous applied research projects within the built environment disciplines. These projects, as abstracted in Appendix A, focus on some aspect of the city's construction process, which has a significant impact on the city's physical urban built environment.

Town+Gown aims at increasing evidence-based analysis, information transfer, and understanding of the built environment, using, in many instances, New York City's built environment as a laboratory for practitioners working in the City's physical spaces, and academics in the built environment disciplines, with the ultimate objective of providing evidence-based research to support making changes in practices and policies.

Town+Gown helps to resolve structural hurdles that can make increasing applied built environment research difficult. The city's inter-related physical and governance setting 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, operating within an interactive and open action research platform across academic years through action research sets.

For applied built environment research to be useful to government practitioners, it needs to reflect their operational, jurisdictional and political constraints, all of which are not perfectly evident to researchers who are not directly involved in the day-to-day details of urban management, local and regional governance and the public policy decision-making process.

The questions in this research agenda are organized around built environment disciplines. The ***built environment*** is a recognized multi-disciplinary field, and Town+Gown has modified its core disciplines to make them more suitable for a New York City-based program. Town+Gown added Geography to the built environment disciplines. In Town+Gown, the projects under Design can focus on any aspect raised by this complex disciplinary field. Town+Gown modified Design to include both Architecture and Engineering as well as a suite of integrated design services that interface with Architecture and Engineering, including interior design, lighting design, landscape design, service design, communications (or visual) design, digital design and product design.



All aspects of the built environment are well suited to quantitative analysis. This is fortuitous for public built environment (PBE) systems because the efficiency and effectiveness

paradigm is a key value and measure[1] from project initiation, where planning, budget and finance functions predominate; during project delivery, where procurement and construction contract functions predominate; until the end of useful life that follows a series of state of good repair (SOGR) maintenance activities, where budget and finance functions again play a role. In all PBE systems, finance issues—the capital budget and debt financings for construction[2] and, primarily, the expense budget for post-construction SOGR[3]—have a direct impact on system performance. PBE systems at the local government level[4] reflect the police powers of local governments, [5] as they have expanded over time to include economically-related areas, and mandates from the state level of government.[6]

Built Environment/Construction Efficiency. This efficiency paradigm is associated with the needs of the infrastructure and the construction activities necessary to effect them. Construction activities are notoriously inefficient due to a number of factors, so that a focus on ways to make the construction and renovation/rehabilitation processes more efficient has a direct impact on the finance issues associated with PBE systems. For built environment artifacts, technological construction innovation and innovations in design and construction can help increase efficiency. This conceptual paradigm focusing on the needs of infrastructure *as infrastructure* is grounded in the reality that debt is not free, and non-discretionary debt service payments operate in within revenue constraints to crowd out discretionary expense-funded program service. Increasing public capital planning/budget process efficiencies and design/construction process efficiencies can create future "savings" for expense budget and/or permits more capital projects to come to start line. But it is critical to ***start*** with a focus on the physical assets (the 'stuff"), and not with the policy of the stuff.[7] Planning exercises that do not explicitly acknowledge and focus on physical and finance limitations of the "stuff"

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[1] For qualitative aspects of public works construction, please see precis for October 28, 2015 symposium event entitled *The Policy of Design and Equity* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/10-28-15%20precis%20document.pdf.

[2] Construction activities consist of new construction, major rehabilitation of existing facilities and capital-eligible renovations that fall short of major rehabilitation, which are associated with "state of good repair" or "SOGR".

[3] Maintenance includes activities associated with "state of good repair" or "SOGR".

[4] This analytical paradigm applies to all levels of government; when authorities have been created to finance and operate systems, these authorities are city controlled.

[5] These PBE systems include: local roads and bridges (local tax supported with federal (See recent CBO report on grant replacement for federal transportation grant program) and state grants); water resource facilities, waste water treatment facilities (In New York City, these are local government responsibilities; elsewhere they can be regional responsibilities) and related transmission facilities (NYC Water Authority/Board with federal and state grants); and, facilities where local services, such as police, fire, sanitation, cultural (New York City owns a number of cultural facilities, such as the Metropolitan Museum of Art, the Natural History Museum, which are operated by private entities; unlike other cities, however, New York City does not own or operate the public libraries, which are three separate privately owned systems with long standing public funding agreements) and social services, are delivered (local tax supported with federal and state funding and grants).

[6] 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.

[7] For example: residential rental assets vs. multifaceted housing policies; roads and bridges and transit infrastructure vs. transportation policy; water resource systems, waste water treatment facilities, distribution networks vs. environmental policy; energy generation and transmission facilities vs. energy policy; residential housing assets at all income levels vs. homeless and affordable housing policy.

tend to create unrealistic expectations within the larger political system that cannot be met until the baseline finance and infrastructure issues are addressed.

Risk Management. The enterprise risk management paradigm requires attention to a complex set of laws and regulations at all levels of government that control creation and management of PBE systems. While regulatory complexity alone creates inefficiencies, the governing laws from all levels of government serve various public purposes that do not explicitly include efficiency and, in fact. are often at odds with efficiency. They are rarely updated to reflect current reality and they often work together to increase inefficiency.

Public Finance qua Public Finance. The spatial incidence of PBE systems and the revenues to support them impact their efficiency and performance. Legal jurisdictional issues are directly related to spatial incidence of revenues and the authorization to build systems. Constitutional home rule provisions and the municipal corporation law "Dillon's rule" identify the authorized actor(s) for various PBE systems, which may be at odds with the efficient actor. Finance law also determines what level of government is the authorized actor and can help with the efficiency perspective. Constitutional debt limits and the resulting creation of authorities and development of public-private financing vehicles can all highlight areas of inefficiency. State public finance laws and federal tax laws also provide additional contexts for identifying inefficiencies in delivery of projects and post-construction state of good repair activities.

Roles of Government in the Built Environment. Complicating analysis along the three conceptual paradigms is the environment in which a PBE system operates and the fact that "government" performs several roles, often simultaneously and often at cross purposes, in the built environment. For some PBE systems, all three levels of government play these roles as well.

As an owner of construction and client of construction-related services (design and constructor), the interests of the government owner in budget, schedule, quality and safety are similar to and shared with those of all owners of construction, including private owners. Issues that arise from the owner role are of an enterprise management nature, with specific construction project management issues as part of the larger enterprise perspective. Public owners that are units of government with debt issuing authority to finance their project also perform the role of financier (which is performed by construction lending institutions for private project), which along with the public budgeting function, is also an enterprise management issue.

Government owners that are units of government act in the role of economic policy maker and regulator. Public owners with large capital spends can function as market makers and economic catalysts.[8] The public spend is thought to have countercyclical power within the economy, providing public works for the

[8] This is different than the use of specific economic development projects, which are a form of economic catalyst as well.

construction industry going in the downside of the economic cycle when private construction tapers down. The recent sustained focus on minority and women owned business enterprises within the construction sector is another manifestation of the economic policy maker role.

Government owners that are units of government at various levels regulate built environment artifacts and market participants under the police powers (e.g., various safety codes, licensing schemes and public procurement). The multiplicity of several layers of regulation that often apply to all projects creates regulatory complexity and related inefficiencies, and the institutional frameworks at all levels are rarely reviewed and revised to reflect current conditions and needs and/or reduce inefficiency.

Government owners that are units of government also own and operate PBE systems that are "social" or "public" goods or "mixed goods" intended to correct for negative and positive externalities also provide subsidies and other incentives (which have budget and efficiency implications) to lower the cost to users of the PBE system to achieve social policy objectives, which necessarily change over time.

Knowledge Co-Creation Sessions to Begin the Move from Segmented to Systemic Analysis in Town+Gown. At this symposium event, Town+Gown is piloting a new format aimed at "real time" co-creation of knowledge to identify what we know, what we don't know and need/want to know to make changes in practice and policy based on research so that Town+Gown can accelerate the action research cycle by:

- Moving Town+Gown research projects to the "thought leader" stage and toward a more systemic form of decision-making, using Town+Gown projects and related symposium events as a point of departure
- Increasing academic synthesis and translation of current work in various areas as research resources

By identifying research gaps that the Gown community knows are important to the city, Town+Gown can work with Gown to focus future targeted research to address those gaps, which constitutes "action" within Town+Gown's action research paradigm. It is also possible, however, that this knowledge co-creation can identify insights to support "action" without additional research.

As noted in Appendix A, Town+Gown projects focusing on the city's capital program/built environment have tended to be of a mixed nature, with capital planning and budgeting and construction process policy-based analyses being of a necessarily systemic nature and with data-analysis within construction being of a focused agency-specific nature due to available data at the time. This event represents T+G's initial attempt to develop pathways to bridge the two via systemic data analysis.

The idea behind this symposium event is to use the first-level within-one-agency managerial data analytics of built environment issues that are presented as a point of departure to discuss how city agencies involved in particular issues, using multiple agency data sets, could integrate and expand data analytics with broader policy analyses to look at the "wicked problem" in the larger system in which all construction agencies operate.

We need to collectively through the following issue in order to move from the agency-specific analyses to a system analysis:

- the right questions to study
- the various (and appropriate) analytic methods (which can get at the short-comings of pure data analytics vs. classical statistical analysis)
- data sources
- data challenges

A collaboratively designed methodology would need to go beyond choosing specific analytic or statistical techniques, and would require those with real domain knowledge to think about how the different pieces of the system relate to one another, and how the agencies could collectively pool their data together in a way that could paint a portrait of the system, thereby allowing system-level questions to be developed. First, it's about asking the right questions, and then it involves engage in a diagnostic process to identify data gaps and places where data collection, production and organization could be shifted in relatively low-cost ways to create the data sets and system to enable us to answer (or at least better inform) the questions that really matter (the wicked problems).

Soon after this symposium event concludes, Town+Gown will synthesize the work from the working groups as an addendum to the event precis and make it available to those who participated, post it to the Town+Gown website Archives, and create follow-up events, all with a view to developing future targeted identified research projects.

Working Group/Table Session Protocol. Those attending this symposium event will break into the following groups:

- Would Agencies Like to Do Systemic Construction Data Analysis and What Are the Impediments?
- Role of Citizen Science in Systemic Construction Data Analysis

Using the presentations as a taking off point of departure, in each working group:

- Practitioners and Academics share knowledge of what they are doing/would like to do/where known data is (*what we know)*
- Practitioners share knowledge of impediments (city-wide process/organizational issues and regulatory issues) (*what we need to know*)
- Identification of targeted research ideas in the presence of participating academics for future research projects/events in T+G to support practitioners and for researchers to use back at their schools to show areas that need work
- Also, identification of insights to support "action" without additional research
- All keeping in mind:
    - Role of city/city agencies as owner
    - Role of city/city agencies as regulator within its jurisdiction of its own buildings/infrastructure, privately-owned buildings, industry participants, and markets
    - Role of designers (architects and engineers) and builders
    - Role of communities
    - Data gaps

With the materials made available at each table, each working group will explore ideas in the topic area in some capturable form and present them at the end of the session, with

suggestions for next steps for Town+Gown and the working groups.

Each working group can use whatever process they feel will work for it, but should consider assigning members to the following roles:

- sticky note maker + placer on white paper (familiar to those who have been through VE/VA engagements)
- picture taker
- summarizer and/or presenter to reconvened group

Appendix A

Completed Town+Gown Projects

2016-2017 and 2017-2018

Volumes 8+9 of *Building Ideas* not yet released.

ASSESSING THE ECONOMIC IMPACT OF PUBLIC CAPITAL PROJECTS ON SURROUNDING NEIGHBORHOODS (Columbia-SIPA)

LEGAL INVESTIGATIONS INTO IMPROVING PUBLIC CAPITAL PROJECT PLANNING, BUDGETING AND SCHEDULING FOR CERTAIN PROJECTS TYPES INITIATED BY ELECTED OFFICIALS (Brooklyn Law School)

BEST VALUE ALIGNMENT PROCESS FOR PUBLIC WORKS CONSTRUCTION IN NEW YORK STATE (NYU-Tandon)

IMPROVING NYC INFRASTRUCTURE; PUBLIC-PRIVATE PARTNERSHIPS AS A CHANCE FOR MORE EFFICIENT PROJECT DELIVERY (Columbia-SIPA)

INSIGHTS INTO CONSTRUCTION PROJECT DATA (Fordham-Gabelli)

CONSTRUCTION CLAIMS: CORRECLATION AND PREDICTIVE MODEL (Fordham-Gabelli)

2015-2016

For abstracts of these projects, please see Volume 7 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/T+G+BI_V7.pdf:

ESTIMATE/BID DIFFERENTIAL Explorations.2 (Fordham-Gabelli)

EXPLORING FACTORS RELATED TO CHANGE ORDERS (Fordham-Gabelli)

EXPLORATION OF CONSTRUCTION CLAIMS (Fordham-Gabelli)

FINANCIAL CAPACITY EXPLORATIONS.2 (Fordham-Gabelli)

STOPPING TRASH WHERE IT STARTS (Columbia-SIPA)

MULTIPLE EXPLORATIONS IN BUILD PHASE RISK ALLOCATION IN CONSTRUCTION CONTRACTS (Brooklyn Law School)

2014-2015

For abstracts of these projects, please see Volume 6 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/T+G+BI_V6.pdf

EXPLORING FACTORS RELATED TO SPREAD BETWEEN ESTIMATES AND BIDS: INFRASTRUCTURE (Fordham-Gabelli)

EXPLORING FACTORS RELATED TO SPREAD BETWEEN ESTIMATE AND BIDS PUBLIC BUILDINGS (Fordham-Gabelli)

EXPLORING VENDOR FINANCIAL DATA (Fordham-Gabelli)

PREDICTING THE EFFECT OF NEW YORK CITY CAPITAL PROJECTS ON NEARBY PROPERTY SALES PRICES (Columbia/SIPA)

WHY DOES IT COST SO MUCH TO BUILD IN NEW YORK—PRIVATE PROJECTS? (Brooklyn Law School)

2013-2014

For abstracts of these projects, please see Volume 5 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/building-ideas-5.pdf

DATA DRIVEN INFLUENCE: PUTTING DOLLARS TO WORK AT THE COMMUNITY BOARD LEVEL (New School-Milano and Parsons)

LIFE CYCLE COST ANALYSIS AND GREEN INFRASTRUCTURE IN NEW YORK CITY (Columbia-SIPA)

IMPROVING CAPITAL PROJECT MANAGEMENT IN NEW YORK CITY (Fordham-Gabelli)

ADVANCED STATISTICAL INVESTIGATIONS INTO GOVERNMENTAL PROCESS-GENERATED DATA: PREDICTING CHANGE ORDERS (Columbia-Statistics)

NEW YORK CITY'S PARKS AND RECREATION DEPARTMENT: TREES AND SIDEWALKS PROGRAM (Columbia-SIPA)

IMPACTS OF URBAN LAND USE: A COMPARATIVE ANALYSIS OF ENVIRONMENTAL IMPACT STATEMENTS (NYU-CUSP)

2012-2013

For abstracts of these projects, please see Volume 4 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/building-ideas-4.pdf

THE MULIT-PURPOSE UTILITY CORRIDOR HYPOTHETHICAL: TELECOMM, GAS AND ELECTRIC UTILITY ANALYSIS (Brooklyn Law School)

PERMIT DENSITY: AGGREGATE ROAD CUSTS FROM MULTIPLE OVERLAPPING CONTRACTORS (2008-2012) (Columbia/GSAAP)

WHY DOES IT COST SO MUCH TO BUILD IN NEW YORK—PRIVATE CONSTRUCTION? (Brooklyn Law School and CUNY-Hunter)

CONSTRUCTION FOR A LIVABLE CITY: A PRELIMINARY COST-BENEFIT APPRAISAL (New School-Milano)

TOWARD A SUSTAINABLE NYCDOT CAPITAL PROJECT APPRAISAL PROCESS: POSSIBLE CHALLENGENS IN ADOPTING EPA-RECOMMENDED LIFE-CYCLE ASSESSMENT (Manhattan College)

CASE STUDY INVESTIGATIONS INTO LIFE CYCLE COST BENEFIT ANALYSIS OF GREEN INFRASTRUCTURE ELEMENTS ON ROADWAY RECONSTRUCTION PROJECTS (SUNY-Buffalo)

ROADMAP FOR PERVIOUS PAVEMENT IN NEW YORK CITY: A STRATEGIC PLANN FOR THE NEW YORK CITY DEPARTMENT OF TRANSPORTATION (Columbia-Earth Institute)

FINDING FUNDING IN WATER: OLD AND NEW URBAN PARKS AS GREEN STORMWATER INFRASTRUCTURE (Harvard-Kennedy)

2011-2012

For abstracts of these projects, please see Volume 3 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/building-ideas-3.pdf

PROJECT SPECIFIC, DRIVEN BASED CONTINGENCY ESTIMATING MODEL IN CONSTRUCTION (NYU-Poly (now Tandon))

BALANCING COST AND QUALITY FOR NEW YORK CITY INFRASTRUCTURE PROJECTS (Columbia-SIPA)

LABOR SUPPLY AND DEMAND MIS-MATCHING IN THE CONSTRUCTION SECTOR: ISSUES AND SOLUTIONS (New School-Milano)

FROM SMITH TO WILLIAMSON: THE RELATIONSHIP OF ECONOMIC THEORY AND LEGAL THEORY OVER TIME (Brooklyn Law School)

2010-2011

For abstracts of these projects, please see Volume 2 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/building-ideas-2.pdf

TRANSITIONING INTO LIFECYCLE COST ANALYSIS (NYU-Wagner)

INCREASING PROJECT PLANNING AND SCHEDULING CERTAINTY FOR CRITICAL CONSTRUCTION PROJECTS (Columbia-SIPA)

DECONSTRUCTING THE ARTICULATED ENSEMBLE; ANALYTICS AND NEW YORK CITY'S CAPITAL BUDGET (New School-Milano)

UTILIZING THE PRO FORMA INVESTMENT MODEL IN A SENSITIVITY ANALYSIS TO MOVE TOWARD A FULL COST ACCOUNTING OF PROPOSED BUILT ENVIRONMENT REGULATION (Brooklyn Law School)

WHAT IS THE CURRENT PATTERN OF CONSTRUCTION PARTICIPANT LICENSURE? (Brooklyn Law School)

WHAT TYPES OF CONSTRUCTION CONTRACT PROVISIONS WOULD INCREASE ALIGNMENT BETWEEN PRINCIPAL AND AGENCT? (Brooklyn Law School)

WHAT ARE STATUTORY CONSEQUENCES OF BEING A "PUBLIC WORKS"? (Brooklyn Law School)

2009-2010

For abstracts of these projects, please see Volume 1 of *Building Ideas* at https://www1.nyc.gov/assets/ddc/downloads/town-and-gown/building-ideas-1.pdf

NYC CAPITAL BUDGETING: THE IMPACT ON THE OPERATING/EXPENSE BUDGETS (Columbia-SIPA)

PLANNING FOR THE OPTIMUM UTILIZATION OF NEW YORK CITY SCHOOLS (Columbia-GSAAP)

HOW CAN PUBLIC OWNERS BETTER MATCH RISK SHIFTING/MITIGATION STRATEGIES TO RISKS? (Brooklyn Law School)