



***Approximating Integrated Project Delivery in Design-Bid-Build Environment:
Innovations in Design and Construction***

Town+Gown in collaboration with AIANY/Public Architecture Committee,
Michael Plottel and Anna Torriani, Co-Chairs,
AIANY/Center for Architecture and MethodLean
@536 LaGuardia Place, New York
November 17, 2016, 8:30 a.m. to Noon

- 8:30—8:40 a.m.** **Introduction and Welcome**
Michael Plottel and Anna Torriani, Co-Chairs of Public Architecture Committee
- 8:40—8:55 a.m.** **Construction Contracts and Transaction Cost Economics**
W. Bentley MacLeod, Professor, Public Affairs and Political Science, Columbia/School of International and Public Affairs
- 9:00—9:55 a.m.** **Innovations to Approximate Integrated Project Delivery in a Design-Bid-Build World**
Safiy Abdur-Rahman, BIM Manager, Real Estate Development & Facilities, NYU Langone Medical Center
Joan Blumenfeld, Firmwide Design Director for Interiors, Principal, Perkins+Will
David Burney, Associate Professor, Graduate Center for Planning, Pratt/School of Architecture
Frank Darconte, NYU/Tandon School of Engineering
Philip Heller, Director, Capital Construction Unit, New York Police Department
Dale Peterson, AIA, Project Executive, New York City Department of Design and Construction
David Resnick, Vice President, Design and Construction, NYU Langone Medical Center

Moderator: W. Bentley MacLeod, Professor, Public Affairs and Political Science, Columbia/School of International and Public Affairs
- 10:00—10:55 a.m.** **Lean Theory and Techniques in Practice**
Joseph Hogan, CDT, Vice President - Building Services, AGC NYS, LLC
Sam Spata, AIA, Owner + Principal - MethodLean and co-chair LeanNY

Moderator: Michael Plottel, AIA
- 11:00—11:55 a.m.** **Building Information Modeling in Action**
Safiy Abdur-Rahman, BIM Manager, Real Estate Development & Facilities, NYU Langone Medical Center
Lennart Andersson, Professor, Pratt Institute/School of Architecture
Adis Sehic, Professor Civil Engineering (Construction), NYU/Tandon School of Engineering

Moderator: Fletcher Griffis, Professor of Civil Engineering (Construction), NYU/Tandon School of Engineering
- 11:55 a.m.—Noon** **Brief Concluding Remarks**
Michael Plottel and Anna Torriani, Co-Chairs of Public Architecture Committee

Origins of Exploration. Town+Gown began exploring design and construction innovation within the design-bid-build environment at its event **Service Delivery Not Procurement** in April 2013 (See Attachment 1). This broad-stroke public policy exploration used a systems analysis approach to identify the several related sources of constraints and challenges that public owners face when attempting to innovate the delivery of public projects within public sector parameters of cost, schedule, safety and quality. The exploration focused on the potential for innovation at the project level in a design-bid-build environment, which could eventually translate up to changes in overall policies and practices supported at the enterprise-wide level. But the potential for innovation at the project level requires awareness of systemic issues that can obscure impediments to innovation at the project level.

First, the tendency across a public owner entity to use the words “procurement”, “contracting” and “service delivery methodology” interchangeably can obscure identification of systemic impediments to innovation. New York State laws authorizing how *contracting* for public works must occur conflate contracting, which is a procurement term, with the single service delivery methodology it authorizes—traditional design-bid-build service delivery methodology.¹ Thus, it is common for proposed reforms or innovations to be expressed as reforms to procurement or contracting, instead of focusing on aspects of the service delivery methodology at the project level that are bound up in the laws. In addition, dissonances—or disconnects—between enterprise-wide management systems and policies (e.g., public capital planning and budgeting) and project-specific management systems and activities also can obscure systemic impediments to innovation, if not actually discourage them.

State of Statutory Environment. The State has expanded service delivery options to include design-build for only certain State agencies responsible for horizontal infrastructure. Efforts to expand design-build to more public owners, including local governments, and to expand service delivery options to include those thought more suitable for vertical structures—construction-manager-at-

¹ This service delivery methodology is not expressed as a service delivery methodology anywhere in the law—it is simply what the law permits—and it mandates the separation of the designer from the constructor, depriving the designer of construction-related information during the design phase, almost certainly guaranteeing, as a functional matter, a certain level of change orders to deal the delayed revelation of construction-related information.

risk or construction-manager-as-constructor—will continue. Even with expanded service delivery methodology flexibility, however, it is likely that public owners will continue to use the traditional design-bid-build methodology for a significant portion of their capital programs.² Thus, continuing to focus on project management innovations on projects using the design-bid-build service delivery methodology, in particular those that approximate the benefits of integrated project delivery, remains relevant. The innovations that are the subject of today’s conversations have occurred within a broader context of some enterprise-wide initiatives at the City over the past 10 years and one targeted State law reform in 2008 that bear repeating to serve as a foundation for the conversation.

Past City-wide Innovations within Design-Bid-Build

Environment. City agencies involved in the City’s capital program embarked on a cooperative working group venture at the end of 2003 to prioritize excellence in construction design. Leveraging major features of the General Services Administration’s methodology to address impediments to design and construction excellence, the working group identified impediments in City processes and developed solutions, which became the City’s Design+Construction Initiative. In 2004, the Mayor tasked the New York Department of Design and Construction (DDC) to lead the implementation of this initiative. As one example, the absence in the City’s Procurement Policy Board (PPB) rules of express authorization for agencies to make evaluations based on subjective design criteria was an impediment to design excellence. Since the City Charter permits an evaluation of proposers *not* based primarily on price, the City was able to make necessary changes to the PPB rules to expressly authorize quality-based selection models.

In 2008, the City announced a suite of related strategic initiatives that were intended to increase the number of bidders on City construction projects based on analyses that began in 2006, to study and address the drivers of cost increases. One pilot initiative consisted of adding a contractual provision in 25 percent of construction

² A study hypothesized the future of service delivery methodology use over the next 30 years and noted that “[t]he vast majority of public infrastructure projects (75%) will continue to use design-bid-build (and Construction Management at Risk)”, “while [t]he use of design-build will continue to expand (to 10% of all projects and approximately 5% of all expenditures).” John B. Miller, “Life Cycle Delivery of Public Infrastructure: Precedents and Opportunities for the Commonwealth” (Boston: Pioneer Institute December 2008), No. 44, p. 10.

contracts greater than \$1 million over a three-year test period that allows contractors to collect damages for certain delays that they can prove resulted from the City's actions. The underlying theory for this initiative was that provisions that do not allow compensation to contractors for construction delays due to the City's actions increase the initial bid prices to cover this risk and also blunt incentives to prevent delays. This innovation was made permanent before the three-year test period concluded.

Another initiative created a fund to support professional preliminary project scoping and cost estimating for projects during the capital planning phase, before budget adoption. The fund provides expense budget resources³ for professional scope development and cost estimating exercises on proposed projects with unclear scopes, new or unusual technical challenges, or complex regulatory issues. These analyses enable funding agencies and the Mayor's Office of Management and Budget (OMB) to identify realistic costs and options *before* budget adoption to reduce the likelihood and magnitude of schedule delays and change order cost increases during construction that are due to initially inadequate project scopes and budgeted amounts. Management techniques, applied during the design phase after budget adoption, are still available to align project costs and scope. Value engineering is perhaps the best known technique,⁴ and OMB uses value engineering reviews to provide an opportunity for all stakeholders to get a "reality check" on a project's functionality, cost and schedule for projects that meet certain criteria.⁵

³ State finance laws prohibit applying capital funds to projects during the planning phase before budget adoption. Allocating expense funds to a central account available to agencies before budget adoption solved a structural problem that impeded earlier scoping to support budget estimates.

⁴ Other design management methodologies that help bridge the mandated divide between designer and constructor in a design-bid-build environment *earlier in the design phase* than when value engineering is typically used include: Functional Analysis System Technique/Functional Analysis Conceptual Design; Target Cost Modeling and Target Value Design; Multi-disciplinary Design Optimization; and Total Quality Management. Techniques to align scope, schedule and authorized funding *during the earliest part of the design phase* are available for public capital projects that are managed by the funding agency—they are especially critical for those projects funded by public agencies but managed by a separate design and construction management agency.

⁵ The criteria include projects that: are valued at \$30 million; involve complexity, new technology; are repetitive or prototype projects or reflect standards; are of high visibility; are subject to constrained schedules; or involve processes or operational procedures in need of improvement or streamlining.

Also as part of the 2008 initiatives, the City announced a task force to evaluate the City's bonding requirements, which earlier investigations had suggested inhibited the ability of contractors, especially small construction firms and Minority and Women's Business Enterprise (MWBE) firms, to bid on City construction projects. Elements of the City's performance bond form did not comply with the requirements of the federal Small Business Administration's Surety Bond Guarantee Program that assists small construction businesses obtain bonding required by municipal contracts. The City, in October 2009, announced a reform of its bonding policy on projects valued up to \$5 million that permits small construction businesses to participate in the Surety Bond Guarantee Program. The revised bond form and ability to participate in the federal program eliminated one impediment to small firms bidding as prime contractors or subcontractors on City projects.

The City has been able to take advantage of targeted State law reforms from 2008, which include an ability to avoid the mandatory prime contracting requirement, known as the Wicks Law,⁶ if it enters into a project labor agreement⁷ for an individual project or project type. The City has also been able to take advantage of general authorization for public owners to pre-qualify bidders for particular public works in order to focus on those contracting firms with the experience, skills and compliance track records that would ensure such projects, typically complex projects, come in on-time and on-budget.

In December 2013, the City posted its NYC Capital Projects Dashboard at <http://www.nyc.gov/html/ops/capital/html/home/home.sh> [tm](http://www.nyc.gov/html/ops/capital/html/home/home.sh), which provides the public with a snapshot view of the City's public building, infrastructure and information technology (IT) projects with budgets of \$25 million or more. This centralized reporting of capital projects permits

⁶ In New York, multiple prime contracts are required for projects above threshold amount. Public owners must break up construction drawings and specifications and separately bid contracts for general construction, HVAC, electrical and plumbing. These contracts have direct contract privity with the public owner, not with the general contractor as is the case for most private projects and the majority of public projects outside New York.

⁷ Project labor agreements are a version of what is known as "pre-hire agreements" entered into by a public owner, construction unions and contractor firms before the procurement of any construction services for a public project. A project labor agreement functions as "a comprehensive labor relations agreement — the 'job site constitution' — that governs over various area craft agreements, setting uniform terms and conditions, for a particular project." Kotler, F. [2009]. *Project Labor Agreements in New York State: In the Public Interest*. Ithaca, NY: Cornell University, School of Industrial and Labor Relations — Extension Division, Construction Industry Program, p. 2.

comparison of projects across agencies, using standardized metrics, and facilitates project management transparency and accountability. While it tracks project information over time to inform citywide policy on the budgeting and management of capital projects, it also permits data analyses of a large database to inform policy as well.

Today's Conversations. Public projects executed in a statutory environment mandating the design-bid-build service delivery methodology are executed by contracting with firms that are selected on the basis of lowest initial price alone (See Attachment 2). The construction contracts that are made part of the contractor's bid are non-negotiable and contain provisions that reflects a statutory environment based on economic and law principles of perfect information and price as the single operative variable and not a long-term mutually dependent relationship with *ex post* revelation of information. Nonetheless, the several piloted design and construction management innovations to be discussed today were

accomplished within the statutory design-bid-build/lowest initial cost statutory and contract environment and attempted to approximate the benefits of integrated project delivery. Aimed at assisting in the delivering of high-quality public building projects within public sector budget and schedule parameters, they are now suitable for academic review and evaluation. These innovations included co-location of designer/contractor/owner team during the design phase; the use of pre-construction design-assist (with pre-qualification); the use of lean construction techniques including the "last planner" scheduling technique; and application of building information modeling. Ongoing academic and applied research related to increasing project delivery efficiency and effectiveness within the design-bid-build framework provide additional bases to pilot and test innovations on active projects to optimize project delivery performance and provide options for contracts that reflect *ex post* realities of construction.



Service Delivery Not Procurement

A Town+Gown Symposium Event

New York Public Library Branch @ 455 Fifth Avenue

April 18, 2013 (8:30 a.m. to 10:30 a.m.)

Words Matter. Words can sometimes obscure the reality they are meant to signify. In the built environment and, in particular, public capital construction, words like *procurement* and *contracting* can obscure relations to other large system processes and, in particular, to the underlying functions they facilitate. In large organizations, by obscuring the project service delivery function, words with roots in the larger enterprise system can create conceptual impediments that inhibit management innovation. The tendency of referring to project delivery as *procurement* and/or *contracting*, as those at public owners are accustomed to do, can obscure thinking of ways to improve service delivery. It is as if the words themselves inhibit innovative thinking.

The management discipline, within the built environment multi-disciplinary field,⁸ covers two related areas. The first is management of an actual project and is often referred to as project management. In large owner organizations, especially public owners, the second is management of the enterprise of which the individual projects are component parts and which projects serve the broader objectives and activities of the larger organization. Terms related to management of the enterprise with a significant capital program include program management or governance, portfolio management and enterprise risk management. These larger enterprise-wide systems consist of capital planning, finance and budgeting, related management

and control systems, such as procurement and audit, and legal analysis and documentation standards.

At this symposium event we will begin to explore the structural dissonance between enterprise-wide management systems and line agency component systems that can create impediments to innovation. We will explore this dissonance through the lens of the potential for innovation at the lowest unit level—the construction project and the project delivery function—and how it can translate into innovation at the higher enterprise-wide system processes.

Sources of the Dissonance. An enterprise's operating systems and controls can, over time, lose the direct connection to the imperatives that animated them. The measures of the larger system, often publicly reported at public owner entities, develop a life of their own, obscuring their underlying animating purposes, sometimes at odds with the imperatives of the actual activities and results.⁹

After the City began to operate under a less strict fiscal monitoring environment, budget analysts identified a structural disconnect between the work of line agencies and the enterprise-wide budget planning and implementation processes.¹⁰ This disconnect, expressed in the context of the expense budget, arises from differences in planning functions and budgeting functions.

⁸ Paul Chynoweth, *The Built Environment Interdiscipline: A Theoretical Model for Decision Makers in Research and Teaching (Proceeding of the CIB Working Commission Building Education and Research Conference 2006)*, <http://www.lawlectures.co.uk/bear2006/chynoweth.pdf>, pp.1-5.

⁹ Processes generate documents and measures, which are important to analyze in this context but which analysis is beyond the scope of this précis document.

¹⁰ See New York State Financial Control Board, *Financial Planning in the Nineties: Building on New York's Pioneering Efforts in the Seventies*, June 1992—for the difference between planning and budgeting, see pp. 15-18; for related operational elements, see pp. 24-28.

“The terms ‘financial plan’ and ‘budget’ . . . are often used interchangeably. In fact, they are different products with different purposes even though they are developed at essentially the same time and are often presented together [but are] . . . the result of separate sets of decisions and analytical investigations”¹¹

This disconnect, still to be resolved on the expense side of the budget, is exacerbated on the capital budget side by the temporal realities of capital programs as well as the several, but inextricably related, roles the enterprise government plays in the built environment, often simultaneously, as it performs the related functions.¹² (See Tabs 2, 3 and 4)

The City’s budget process has a four-to-five year horizon, depending on the time of year, consisting of the current year (adopted budget) and estimates for up to the following four fiscal years (financial plan period). This horizon, which is considered the gold standard in public budgeting, is not long enough to account for the temporal realities of construction, and a focus on the budget alone—including the capital budget component—will distort analysis. Making matters worse, the time from design to construction completion for an individual project, even excluding the time for related capital planning phase, can span across executive administrations and legislatures, “further attenuating the connection between the decision to invest and the budget consequences of such decision.”¹³ The investment decision methodology, the analytical tool for analyzing capital projects, which accounts for related

debt service costs¹⁴ and post-completion life cycle operation and maintenance expenses, would far outstrip any budget horizon.¹⁵ This temporal reality establishes an illusion, during the planning and construction phases, especially at the line agency level, that capital projects are without cost or impact on their agency operating budgets, which illusion the budget convention of reporting debt service on an aggregate enterprise-wide basis aids and abets. These divides and dissonances impede the ability of both enterprise-wide oversight entities and line agencies to understand and plan for the impact of capital decisions on annual operating budgets.

A Few Words on Town+Gown Projects. From the beginning of Town+Gown, the research questions raised by and developed with the agencies touched upon various aspects of the dissonance. Completed Town+Gown projects, all of them excellent, explored some of these questions came up to the systemic breach, and were unable to reach the other side. Projects looking at life cycle costing models for planning purposes ran into limitations with lifecycle cost data limitations, including their absence. Projects looking at the ability of capital planning and/or budgeting processes to inform and manage individual project and *vice versa* ran straight into the complex system and dissonance between planning and budgeting, complicated by the impact of schedule and budget overruns, which appear as change orders, during the construction/contract administration phase that cycles through the annual capital budget process. Town+Gown’s first project involving a Ph.D. dissertation using completed project data (the “BIM Ph.D. Project”), was able to extrapolate from estimates of avoided costs on discrete projects and suggests enterprise-wide potential from the use of BIM city-wide, across construction agencies, but the potential for system-wide transformation remains just that at the moment.

¹¹ *Ibid.*, p. 15.

¹² Government acts simultaneously as a public owner of facilities and infrastructure to implement its provision of services, a financier of both operations and maintenance and expansion or major renovation, and a regulator of the process (land use and zoning), the participants (licensure of trades and businesses) and the products (building codes). Government also acts as an economic catalyst, whether passively as the result of its ongoing investment in public works or more actively as the result of targeting various types of subsidies to lower the cost of construction of certain types of projects. See Danny Myers, *Construction Economics: A New Approach* (London: Spon Press 2004), pp. 15, 39-40, 60, 70-71, 147-159, 184-86, 191.

¹³ Terri Matthews, *Blueprint for Modernizing Built Environment Law: A View from the Budget*, 6 Albany Government Law Review (forthcoming April 2013). “The weak connection between capital program decisions at the agency level and their impact on the operating budget is made more tenuous by the length of time from the planning of a project, scoping a project, awarding the contracts, constructing and commissioning the project and, finally, debt service payments.”

¹⁴ *Idem* Debt service costs and operation and maintenance costs accruing from capital planning/budgeting decisions appear much later in the expense budget. Debt service becomes a non-discretionary cost that can crowd out other expense budget needs when revenues are tight. Expense budget-funded operations and maintenance cost, in practice, are often deferred until they become larger and thus eligible for debt finance (e.g., “capital” eligible). See *When Does Design Begin and End?*, précis document for March 14, 2014 Town+Gown symposium event, pp. 2-3.

¹⁵ *Idem* The investment decision methodology can also include other costs and benefits, such as negative and positive externalities exposed by the sustainability agenda, which would exceed the budget horizon as well.

Operative State Law. Complicating matters, the City enterprise is subject to various laws from higher levels of government. While the City has its own Charter chapter for procurement and an extensive set of rules,¹⁶ State law effectively pre-empts local law to such an extent that New York State law defines and constrains the public construction process for the City as one of the State's many subordinate municipal governments. The essential elements of New York's public construction procurement statutory ensemble were established by the end of the first half of the last century, and despite "tinkering on the margins, [this ensemble] remains essentially the same reflection of theory and practice, today as when it was enacted."¹⁷ While the statute itself does not explicitly use the functional service delivery term "design-bid-build", various provisions under the rubric of contracting for public works (see Tab 5), result in the design-bid-build methodology as the single authorized service delivery for the vast majority of the State's public owner entities, several decades after alternative delivery service methodologies developed to meet changing project needs.¹⁸

Two defining elements of the design-bid-build methodology, which remains appropriate for some projects, consist of a temporal and legal separation of the designer and the constructor entities¹⁹ and the requirement that the lowest initial cost determines who the constructor entities can be. The temporal separation of designer from constructor reduces the opportunities to avoid changes and related costs during the construction phase (see Tab 6, pp. 4-5). The mandated use of a single delivery methodology, with such separation, further reduces opportunities to avoid costs arising from the mismatch from the service delivery methodology and projects needs and project team capacities.²⁰ The requirement that selection of

constructor entities be based on the lowest initial cost may have been an effective criteria when buildings were simpler, aligning more closely with the concept of commodity pricing, and when it was realistic to expect that final plans and specifications were indeed final, which is often no longer the case.²¹ Moreover, the lowest initial cost requirement may tend, in a public and political budget environment where what is required to be measured tends to drive attention, to become an impediment for the owner to maintain (assuming it had one) a focus on the total life cycle costs of the project, especially on more complex projects for which incrementally increased initial costs can reduce life cycle costs as compared to the lowest initial cost version.

It is now axiomatic that there is no single optimal project delivery methodology for all types of construction projects. In an environment that prohibits an owner from matching the service delivery methodology with specific project circumstances,²² the mismatch between service delivery and project needs will reduce the chances a project team will be able to remain within parameters established by inter-related "project performance goals of budget, schedule, quality and safety."²³ This mismatch will thus generate costs that could have been avoided with a more appropriate match of service delivery methodology, project needs and

¹⁶ See Charter Chapter 13 and Rules of the Procurement Policy Board.

¹⁷ Matthews, *op. cit.*

¹⁸ *Idem*

¹⁹ The constructor is a term that contains, and obscures, a highly complex set of contractual arrangements that creates a corresponding highly complex set of management issues within the constructor actor and among the three archetypal participants. See Patrick Bajari & Steven Tadelis, "Incentive versus Transaction Costs: A Theory of Procurement Contracts," 32 *Rand Journal of Economics* 387 (2001), pp. 389-90; see also Iris D. Tommelein, David R. Riley & Greg A. Howell, "Parade Game: Impact of Work Flow Variability on Trade Performance," 125 *Journal of Construction Engineering and Management* 304 (1999), pp. 304-05.

²⁰ Matthews, *op. cit.*

²¹ New York City Bar Association, Construction Law Committee, *21st Century Construction, 20th Century Construction Law*, February 2008 (<http://www.nycbar.org/pdf/report/ConstructionLaw.pdf>) (hereafter referred to as "2008 Report"), endnote 4.

²² For example, the extent of scope definition, the need for schedule speed as well as certainty, the need for flexibility to make changes to the project during construction, the capacity of the owner to participate in the process, and general market conditions. Matthews, *op. cit.*, citing New York City Bar Association, Construction Law Committee, *20th Century Construction, 21st Century Construction Law: Update*, March 2011 (<http://www.nycbar.org/pdf/report/uploads/20072050-21stCentConstruction20thCentConstructionLawUpdated.pdf>) (hereafter referred to as "2011 Update"), p. 9, and quoting C. William Ibbs, Young Hoon Kwak, Tzeyu and A. Murat Odabasi, "Project Delivery Systems and Project Change: Quantitative Analysis," *Journal of Construction Engineering and Management* (Reston: American Society of Civil Engineers, July/August 2003), p. 382.

²³ See 2011 Update, p. 9; and for analysis that captured "the interactions among changes, disruptions, productivity losses," demonstrating the capacity of techniques to manage change, whether owner- or contractor-directed, and related costs, see also, William Ibbs; Long D. Nguyen; and Seulkee Lee, Quantified Impacts of Project Change, *Journal of Professional Issues in Engineering Education and Practice*, American Society of [Civil] Engineers, January 2007, p. 46. See also Love, Peter E. D., Irani, Zahir and Edwards, David J., "A Rework Reduction Model for Construction Projects," *IBEE Transactions on Engineering Management*, Vol., 51, No. 4, November 2004, pp. 435-37.

owner capacity. On some projects, an owner's concomitant inhibition from using modern project management techniques (see Tab 13) will exacerbate the forces driving a project outside its initial estimated budget, schedule and quality parameters.²⁴

MIT Framework and Innovation in the Field. When things appear to go wrong at various levels, yet the response has often been to attempt to change the law, with little result.²⁵ In the absence of momentum to modernize New York's public construction procurement laws,²⁶ the locus of innovation can be at the project level. A different approach, using the MIT Framework (see Tabs 7-11), which the Model Code for Public Infrastructure Procurement (MCPIP) expresses in the familiar procurement law vernacular (see Tab 12), may instead work better.

The MIT Framework integrates all necessary aspects of project delivery, regardless of artificial distinctions that may be present in any applicable law. It specifically brings, into the conventional view of project delivery, the related debt financing of the project and the project's post-completion operation and maintenance activities. Viewing all functional elements in this integrated way can permit the line agencies and oversight agencies to acknowledge artificial divides imposed by the various laws and implementing processes as artificial. To the extent they are at odds with project delivery on the ground, the dissonances can provide opportunities for owners, aided by modern technology and management tools and theories, to push the boundaries of the law²⁷ and reform practices for the benefit of delivering the project efficiently and effectively.

Working through state statutory requirements, practitioners can use modern project management tools and techniques to approximate, as much as possible, the benefits from modern methodologies. For example, an owner's expanding use of building information modeling (BIM) technology from the design phase into the

construction phase can help approximate some of the benefits that accrue to the design-build methodology from earlier collaboration between designer and constructor (see Tab 6).

Once an owner fully expands BIM across a project's life cycle, from project planning to life cycle operations and maintenance, as other industries have done much earlier, it is possible for the owner and project team to use the shared information platform to apply elements of industrial production and related management techniques, such as total quality management (see Tab 13), to discrete projects. The construction industry has adapted total quality management as "lean construction" and it permits project teams to increase the efficiency of producing capital projects and reduce waste, by identifying areas amenable to industrial production management techniques.²⁸

The aggregated project data from the BIM models can then feed back into the enterprise-wide processes, informing and linking to future capital planning and expense budgeting processes more effectively—giving the existing sets of processes established under local and state laws renewed purpose and utility.²⁹ For example, change order types and costs can inform enterprise-wide contingency policy and practice, while operation and maintenance expenses from discrete projects can be traced to the agencies responsible for initiating and using the projects, reducing negative operational impacts from the temporal realities of construction.

The expanded use of BIM across the project life cycle and the application of lean construction principles and techniques during construction not only permits an owner to avoid the costs associated with segmented data flows but also permits the project team to reduce information asymmetries that traditionally have been responsible for certain types of contract provisions and allocations of risk. Assessing the impact of innovative service delivery practices that change the arrangements of archetypal project participants—owner, designer, constructor and financier—expressed in the various

²⁴ Matthews, *op. cit.*

²⁵ See 2008 Report, Footnote 14, for the saga of New York City's experience with the Wicks Law.

²⁶ See Update 2011, p. 10, as well as Matthews *op. cit.*, for discussion of how regulation can distort economic relationships as well as create "groups invested in preserving the earlier-distortion-that-becomes-the-status-quo."

²⁷ But, of course, consistent with law.

²⁸ Matthews, *op. cit.*, citing Glenn Ballard and Greg Howell, "What Kind of Production Function is Construction" (1998) and the American Institution of Aeronautics and Astronautics, "Current State of the Art on Multidisciplinary Design Optimization" 36 (1991).

²⁹ Financial Control Board, *op. cit.*

contracts, to perform the project tasks, from “defining and designing the project” to “operating and maintaining the assets in order to deliver the product/service”³⁰ more effectively makes it then possible to consider revisiting conventional relationships and related provisions in the contracts, not merely in the context of implementing laws but also in the context of maximizing “the economic efficiency of various options to deliver capital projects, which economics views as asset- and relationship-specific investments, at two points in time—before the deal is struck, or *ex ante*, and after the deal is struck, or *ex post*.”³¹

Questions for Discussion.

- On the divide between planning and budgeting:
 - In Fiscal Year 2008, the City implemented its Capital Scope Development Program, bridging the structural divide between capital and expense funds for projects prior to inclusion in a capital budget. What other similar opportunities are there to bridge gaps between planning and budgeting, between capital and expense funding?
 - The BIM Ph.D. Project suggested the expanded use of BIM on City projects would generate system-wide areas for cost

avoidance (financial plan savings in the outyears). How can we explore the magnitude for long-term recurring savings from expanding the application of BIM in the capital program? from the application of BIM’s close relative, integrated project delivery principles? from expanding the application of lean construction principles?

- What technical issues might arise from expanding the application of BIM across the City’s capital program? expanding it to the planning phase? expanding it from the design phase to the construction phase?
- As the City increases its use of BIM, generating data and the potential for data that can, over time, reduce information asymmetries in construction under what conditions could the City explore reforming its standard construction contract to reflect practice enabled by BIM? What types of research (and on what topics) would be helpful to assist the exploration?

³⁰ Matthews, *op. cit.*, citing Jean-Etienne de Bettignies and Thomas W. Ross, “The Economics of Public-Private Partnerships”, 30 *Canadian Public Policy* 135, (2004), p. 140.

³¹ Matthews, *op. cit.* Viewed from the lens of recent transaction cost economic theory combined with relational contracting theory, the tendency in construction, especially public construction, for contracts to assume they are complete because they have anticipated all future events and have negotiated price accordingly becomes noticeably untenable (though, in some instances, the public procurement statute requires that position), because empirical observations on the ground reveal project participants actual projects, distinct from what the drafters wrote:

“... (1) negotiate these issues *ex ante* based on *ex ante* information and related information asymmetries; and (2) work within an incomplete contractual framework to negotiate within the *ex post* environment, where a totality of change—on the ground, within the external environment, and between the parties themselves, exacerbated by changing related information asymmetries—requires functional *ex post* negotiation to reflect such modifications.”

See, e.g., Oliver E. Williamson, *The Theory of the Firm as Governance Structure: From Choice to Contract*, 16 *Journal of Economic Perspectives* 171 (2002), p. 174, and Ian R. Macneil, *Contracts: Adjustment of Long-Term Economic Relations Under Classical, Neoclassical, and Relational Contract Law*, 72 *Northwestern University Law Review*, 854 (1978); see also Bajari and Tadelis, *op. cit.* and Ibbs, Nguyen and Lee, *op. cit.*

McKinney’s Chart of Design-Bid-Build

<p>Mandatory Separation of Designer and Constructor +</p>	<p>Mandated Award to Proposer with Lowest Initial Price</p>
<p>= Mandated Public Design-Bid-Build Methodology</p>	
<p>Public owner must prepare separate <i>specifications</i> for three articulated subdivisions of work, <i>which specifications shall be drawn as to permit bidding</i> (GML § 101 (1) and (2); SFL § 135) <i>See also Ed. Law §§7302, 7202, 7209(4), 7210</i>³²</p>	<p>Public owners must award contracts for public work to lowest responsible bidder (GML § 103 (1); SFL § 135)³³</p>
<p>Designer's job is to create "final and complete" drawings and specifications, in absence of information from constructor, that owner puts out to public bid by constructors—mechanics of law mandates separation of designer (architect/engineer) from constructor (a cast of prime- and sub-contractors and trades) at earliest stages of design when changes to design are less costly, relative to changes during construction phase.³⁴</p> <p>Increasing technological complexity of built things tests reality of legal requirement of “final and complete”</p>	<p>Mandatory focus of law on price alone assumes built item is a commodity, which, in many instances, it is not; it also implies that constructor does not exercise skill or judgment like project participants licensed under Education Law</p>
<p>Project team cannot avoid certain costs during construction that are directly related to separation of designer and constructor and inevitable later revelation of information on the site during construction, which, if able to have been revealed during design phase, could have been avoided</p>	<p>Mandatory focus on initial construction price instead of life cycle costs/best value <i>exacerbates</i> public sector’s tendency not to focus on operation and maintenance costs in annual expense budget and also to engage in deferred maintenance, leading to higher capital costs in long-term</p>

³² Robert J. MacPherson et al., *New York Construction Law*, in STATE PUBLIC CONSTRUCTION LAW SOURCE BOOK 8 (Michael K. Love & Douglas L. Patin eds., 2002).

³³ New York State also mandates multiple prime contracting, a construction innovation at one time, which requires a strong owner to use it effectively. Each multiple prime contractor has contract privity with the owner and not with each other or with the general contractor. To the extent an owner is not institutionally equipped to manage multiple prime contracts and/or a project is not suitable for multiple prime contracts, this mandated feature of New York construction law creates additional avoidable costs, which are not covered by the analysis of this article.

³⁴ 2011 Update, pp. 6-10.