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PROCURING DIGITAL INFRASTRUCTURE:

HOW SYSTEM APPROACHES CAN PRODUCE PUBLIC VALUE

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About the Authors

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About Data-Smart City Solutions

Data-Smart City Solutions is working to catalyze adoption of data projects on the local government level by serving as a central resource for cities interested in this emerging field. We highlight best practices, top innovators, and promising case studies while also connecting leading industry, academic, and government officials. Our research focus is the intersection of government and data, ranging from open data and predictive analytics to civic engagement technology. We seek to promote the combination of integrated, cross-agency data with community data to better discover and preemptively address civic problems. Our website, datasmart.hks.harvard.edu, and our broader work are housed at the Bloomberg Center for Cities at Harvard University.

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Executive Summary

Technological breakthroughs, substantial federal funding, necessity, and public officials more accustomed to data and digital processes combine to present a multi-generational opportunity to transform the delivery of public services. The most powerful transformations and contributions to public value arise when officials utilize digital infrastructure to conceptualize, buy, and build at the system level. These system solutions range from how regions build area workforces to how they manage urban mobility to how they facilitate competing uses along their curbs and sidewalks.

These advancements require complex relationships with the private sector that carry risks as well. Of course, public private partnerships (P3s) are not new; indeed, our university engaged in a public-private agreement in 1640, when Harvard College partnered with the Massachusetts Bay Colony over the revenue from operating the public Boston-Charlestown ferry.[1] Rather these digital public, private, nonprofit networks present new issues, putting additional pressure on government to structure and manage the relationships correctly.

The first step in these digital breakthroughs involves approaching an important public matter at the system level, and not at the agency or problem level.[2] When innovating with a new digital process officials can benefit by combining best practices from two other related disciplines – cross sector collaboration[3] and the development of physical infrastructure P3s.[4]

This paper therefore looks at how digital infrastructure can best be procured and utilized to produce new benefits by producing collaborative or network approaches through the application of P3 principles that produce more resident engagement and equity. Digital infrastructure can mean many things, yet in this paper we define it as the opportunity to modernize asset management, augmented by federal funding, which will often involve hybrid physical-digital systems. The differentiating characteristics of a digital P3, whether standing on its own or part of the design, construction, or management of physical infrastructure must be clearly defined, particularly given the dramatic increases in federal funding for smart, connected, and digital projects.[5] These characteristics include intangibility, scalability, interoperability, and multitenancy, all of which require modified procurement approaches.

While there are clear advantages to digital P3s, such as access to technical expertise, increased speed and efficiency, and the potential for real-time updates and improvements, this paper will also highlight concerns that must be addressed. Those concerns include scoping, data privacy, security, and ownership and procurement challenges that include scoring bids to capture life-cycle savings or benefits in terms of livability or equity.

With a goal to facilitate these contracts more broadly, with more imagination, and with more community involvement, we propose the following criteria to be addressed in procurement: defining the scope and criteria for contractor selection; dealing with intellectual property, addressing data ownership and privacy; correcting for imbalanced expertise; ensuring incentive congruence; streamlining the digital engagement process; and considering the increased complexity of off ramps. We conclude this discussion by suggesting the application of progressive P3s to adapt to the range and promise of digital solutions and offering nascent models for P3s of the future.

Introduction

Cities and state officials are facing rising levels of complexity in dealing with public responsibilities. Whether driven by the need to adapt to climate challenges, promote environmental and social equity, adapt to and incorporate technological breakthroughs, or respond to long neglected and deteriorating infrastructure, public officials may seek to connect with non-governmental partners to deliver in a timelier and more cost-effective manner. Even with the federal funds from the Infrastructure Investment and Jobs Act and the American Rescue Plan Act, cities often rely on blended financing and, of course, always rely on private contractors to deliver major projects like bridges, airports, and public transportation networks.[6] In order to build for future needs, and not simply to replace aging existing structures, these P3 investments need to include the digital components that can in fact transform the country's infrastructure inventory.[7]

This paper focuses on how to develop workable contracting structures to help government agencies deliver complex digital infrastructure and systems. We use the phrase P3s to describe generally longer-term contractual arrangements between public agencies and private or nonprofit entities that evolve from the agency using its purchasing power or authority to pursue a better-delivered public service. Indeed, these are not partnerships in a traditional sense but rather multi-party procurements where government sets the conditions as described in *Governing by Network*.[8] The best of such network arrangements address the new values, terms and conditions, and service level agreements (SLAs) that should be addressed when dealing with digital products. Addressing these subjects thrusts public officials into relatively new areas, including security, privacy regulations, data ownership, "customer" ownership, intellectual property, and interoperability, among others.

The costs of developing technology that supports infrastructure construction, maintenance and use often requires a scale and expertise which exceeds that of most city and state agencies. Software as a service (SaaS)-based technology provides a path for the public sector to tap into private sector expertise, innovation, and efficiency to improve the delivery of public services. P3s present complexity enough when the product or service has easily described physical characteristics, such as a road, bridge, or water treatment system. When the acquisition involves complex technology, such as sensors embedded in a bridge or a strictly digital product, the terms of the relationship become more difficult. And when the digital acquisition serves as a platform for a system approach, such as one that helps a city mange the permitting and allowable action on a curb or sidewalk, the difficulty dramatically increases. In this paper, we highlight how to obtain the benefits of P3s while handling the complex challenges of the digital networked realm.

Traditional P3 structures serve as a foundation, albeit an incomplete one, for this discussion. P3s encompass a wide range of contracting modalities, each unique in its allocations of rights, responsibilities, and risk between the public and private partners.

One common P3 model, Design, Build, Finance, Operate and Maintain (DBFOM), places comprehensive responsibility for the delivery of infrastructure assets and services on the private partner for a specified period. This model transfers substantial risks associated with project delivery and asset performance to the private partner. The government agency specifies the project output requirements, and the private partners respond with a proposal that meets those requirements over the term of the P3 contract. In such a model the "general contractor," on the project accepts much of the responsibility and risk for enforcing the city's policies and for proper structuring of the relationships with the other (subcontractor) vendors.

A DBFOM model, or even a design/build approach, will produce benefits in many digital situations, especially those where the private actor possesses much more experience in the operation of digital assets. Even in those situations governments face complex responsibilities in ensuring that public dollars produce public value in the separate categories of designing, building, operating, and maintaining. Government needs to reconsider how it procures private participation in each of these categories as well as when it should procure for a combination of strategies. Each variation of a procurement model has its strengths and weaknesses, and the best model depends on the specific circumstances of the project. We look to characteristics which distinguish digital from physical acquisitions in order to provide guidance about what modifications will be needed in order to adapt lessons from more commonly utilized P3 processes.

Given the current gap between the research and the interest expressed by city leaders, this paper raises issues distinctly applicable to procuring in the digital realms when it involves multiple parties and a myriad of interconnected functions and goals.

In 2023 the United States Department of Transportation (USDoT) made a broad set of Strengthening Mobility and Revolutionizing Transportation (SMART) grants designed to build data and technology capacities and expertise in state, local, and tribal governments. Thanks to funding from the Knight Foundation, and in conjunction with the Open Mobility Foundation, we were able to help a number of cities successfully pursue "digital platforms and/or services" as part of this DoT program. This work brought into focus the potential cumulative impact of several issues addressed over the last several years at the Data-Smart City Solutions project.

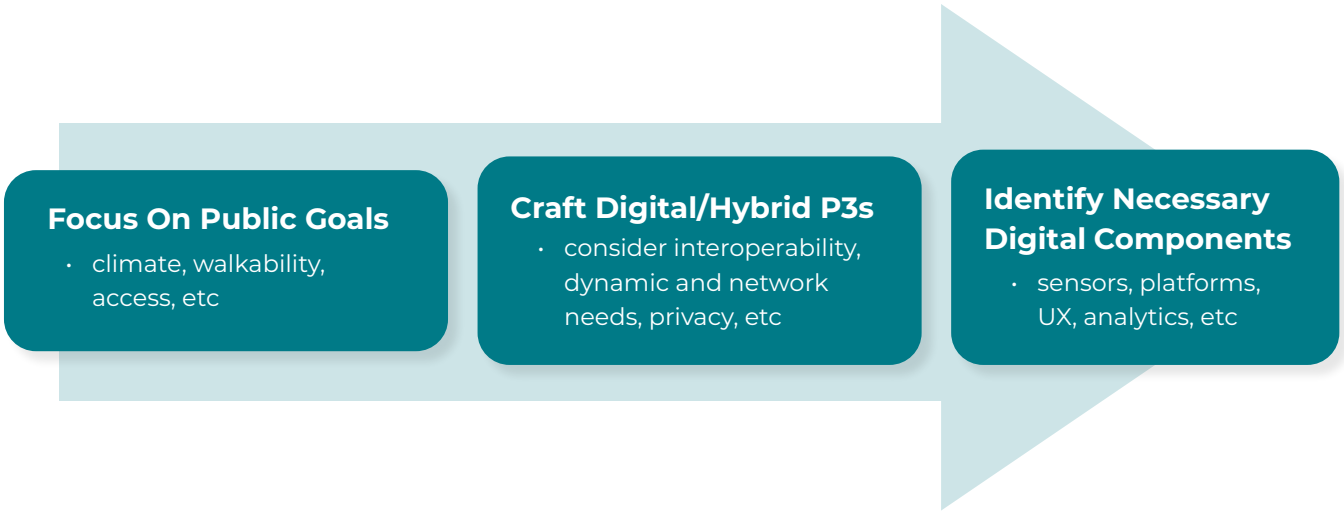
In 2019 we convened a group of national experts at our Mobility and the Connected City conference in Cambridge, MA to focus on the why and the what of connected urban mobility. We discussed how officials should concentrate on better management of public assets associated with mobility, not as a technocratic matter, but rather to create public value in neighborhood quality of life, sustainability, access, and safety – and do this in conjunction with and for community engagement. The goal of equity crosscuts all those issues. This work helped bring into focus several themes critical for cities looking to procure the partnerships necessary to improve urban mobility and livability. Following this convening, in 2020 we addressed mobility and the connected city, in *Prioritizing Public Value in the Changing Mobility Landscape*[9] and *Effectively Managing Connected Mobility Marketplaces*.[10]

Since 2020, and through the structural and social upheavals of the COVID-19 pandemic, we have examined the role of digital infrastructure in accomplishing those goals. In an earlier paper, *Implementing Digital Infrastructure Responses to Equity, Sustainability, and Safety*[11], we argued that constructing physical infrastructure without incorporating digital capabilities would cause local and state governments to miss a generational opportunity, one possible due to pandemic-era federal grants.

Technological breakthroughs allow government to produce improved or even transformative public services. Yet these advancements require relationships with the private sector that carry risks and opportunities which put added pressure on government to structure the relationships correctly. The paper referenced in the Executive Summary, *Tapping Private Financing and Delivery to Modernize America's Federal Water Resources*, was written in 2017 and emphasized the key role of well-crafted P3s in closing the deficit in roads, bridges, docks, and clean wastewater systems. The issues raised in that paper are even more relevant to the ever more complex ones raised when government structures multi-party technology P3s that couple digital and physical assets.

Digital infrastructure can, of course, mean many things. In this paper we look at a definition related to the opportunity to modernize asset management presented by federal funding, which will often involve hybrid systems consisting of physical and digital components. We refer to digital infrastructure as: hardware (like Internet of Things (IoT) sensors and cameras), data, software, platforms for analysis and collaboration, advanced data capabilities (to both manage and protect data), and the way these assist in managing public assets, scheduling maintenance, monitoring safety, and improving sustainability and accessibility. Here we particularly focus on system design thinking which requires data platforms, interoperability, and data sharing rules of substantial complexity and mammoth opportunity.[12]

This paper focuses not on how to procure stand-alone technology but rather how to procure the technology that supports or is part of a system which will deliver better outcomes.



The Mobility Value Creation Process

A useful first step in adapting and innovating a new digital process via a public-private partnership is a better understanding of the characteristics of technology partnerships that differentiate them from the issues associated with the use of P3s to deliver civil works infrastructure, such as roads, bridges, and water systems, which we and others have documented.

Characteristics differentiating digital P3s from civil works infrastructure must be clearly defined, particularly given the dramatic increases in smart, connected, and digital projects related to infrastructure.[13] To us, these characteristics include intangibility, scalability, interoperability, and multitenancy, which require modified procurement and contracting approaches when compared to public civil works infrastructure of the past.

While there are imminent advantages to well-structured digital P3s, such as access to cutting-edge technologies and technical expertise, faster deployment, the potential for real-time life-cycle updates and life-cycle savings, this paper will also highlight associated concerns. Those concerns include scoping, data privacy, security, and intellectual property ownership, as well as the difficulty of designing procurement processes and contracting structures that optimize risk allocation.

With a goal to facilitate these digital P3 contracting modalities in order to accomplish broader goals with more flexibility and community involvement, we propose carefully defining in the initial procurement the conditions controlling intellectual property, data ownership security, and privacy; correcting for imbalanced expertise; ensuring incentive congruence; streamlining the digital engagement process; and considering the increased complexity of off-ramps. We conclude this discussion by suggesting the application of contracting structures, including progressive P3, to adapt to the range and promise of digital solutions. This review also offers nascent models for P3s of the future.

Differentiating Characteristics

The characteristics of digital infrastructure differ in many ways from traditional services. First, their **intangibility**, making them difficult to describe and inspect, and making contracting more difficult to conceptualize.[14]

Second, technological products possess much greater **scalability**. With physical products, increased demand requires substantial expense in terms of increasing the supply of a product. The extra supply may also take additional time to deliver. According to Joni Salminen of the University of Vaasa, digital services are characterized by “unlimited seats,” meaning that the services scale according to true demand. “For example, when ten customers begin to use the product today and one hundred tomorrow, the increase does not require additional action from the service provider – in a scalable service system, there is no need to plan productive capacity once the system has been configured.”[15]

Yet scalability brings focus on another characteristic, **interoperability**. Scale may come simply from more users, or it may result from the ability of the technology to incorporate other providers in a way that increases demand and value across the network. Of course, interoperability depends on government standards, requirements, and protocols that facilitate data sharing and interaction. Government must insist, in the early stages of the procurement process, that the digital solution be interoperable with point solutions and even with a specific vendor's competitors.

A final set of characteristics derives from the fact that, increasingly, digital infrastructure presents itself to a city as SaaS, a cloud-based offering which facilitates **multitenancy**, where users share information, applications, and ease of customization. And cloud-based services benefit more easily from continuous modernization. Yet multitenancy produces risks as well. By acquiring and using data from multiple sources, the need to track data ownership and determine accountability for failure escalates sharply. Multitenancy requires addressing systems instead of just a particular service, which brings with it both great problem-solving potential and complexity.

Configuring Digital Procurements

These characteristics produce opportunities and conceptual challenges at each level in the procurement cycle. Complexity begins at the first instance when the government sets out to describe that it wishes to purchase and then cascades through specification writing, preparation of scoring criteria, evaluating responses, and finally writing the SLAs associated with an award.

P3 Advantages

Digital P3s, as we use the phrase here, present a resident-centered system solution that has the capacity to enact the transformative advantages associated with smart cities. We reference back to our definition of a smart city and look for the attributes of that definition to be gained in a digital acquisition:

1. Uses digital tools to operate more inclusively, equitably and better.
2. Helps employees work smarter.
3. User designs put residents in the center, giving them more choice.
4. Enhances the way it listens to and involves the public.

5. Uses digital platforms to improve the way it builds and maintains.

6. Acts in real time, increasing speed and flexibility.

7. Supports systems, resulting in sustainability and resiliency.[16]

The more audacious digital innovation, the more it stretches to accomplish these seven criteria, and the more complex the procurement and contracting. As noted by researchers from Pegaso University in Naples, Italy, these new technologies, if structured correctly, allow the system to detect, manage, and transform data into useful information in real time and enable the shift from interpersonal to human-machine relationships.[17] Built-in analytics yield powerful insights about performance, which allow officials and other stakeholders to adjust midcourse.

Digital tools produce not just more efficiency, but more resident or client focus. A superior design will incorporate more engagement in the planning process,[18] synthesize diverse programs into a single resident-facing entry point,[19] and collect ongoing data that allows preemptive interventions.[20]

Local officials can develop some technology themselves, but the costs and talent barriers create limitations. When structured appropriately, digital P3s have the potential to allow a city to tap into the private sector's expertise, innovation, and scale to improve the delivery of public services and remain up to date with changing technology while reducing the risks associated with research and development. By partnering with the private sector, local governments may access specific expertise and cutting-edge technology. Innovation in the private sector, like carbon-capture roadways,[21] solar paved highways,[22] and artificial intelligence that monitors pipeline safety,[23] are available for public projects through private contracts, which in turn need to be combined with other investments that further the systems approach.

Well-structured P3s offer the advantage of optimizing risk allocation, by assigning project risks to the party best positioned to manage such risk. This results in significant project delivery and performance risk being borne by the private partner. According to a report on international infrastructure P3s, risks can be categorized as "construction, financing, operations and maintenance] political risks, administrative licenses, and other risks (such as the price of the need to make *ex post* changes to the PPP service contract)."[24] These conventional P3 risks apply in the digital space along with a newer set of concerns that need attention.

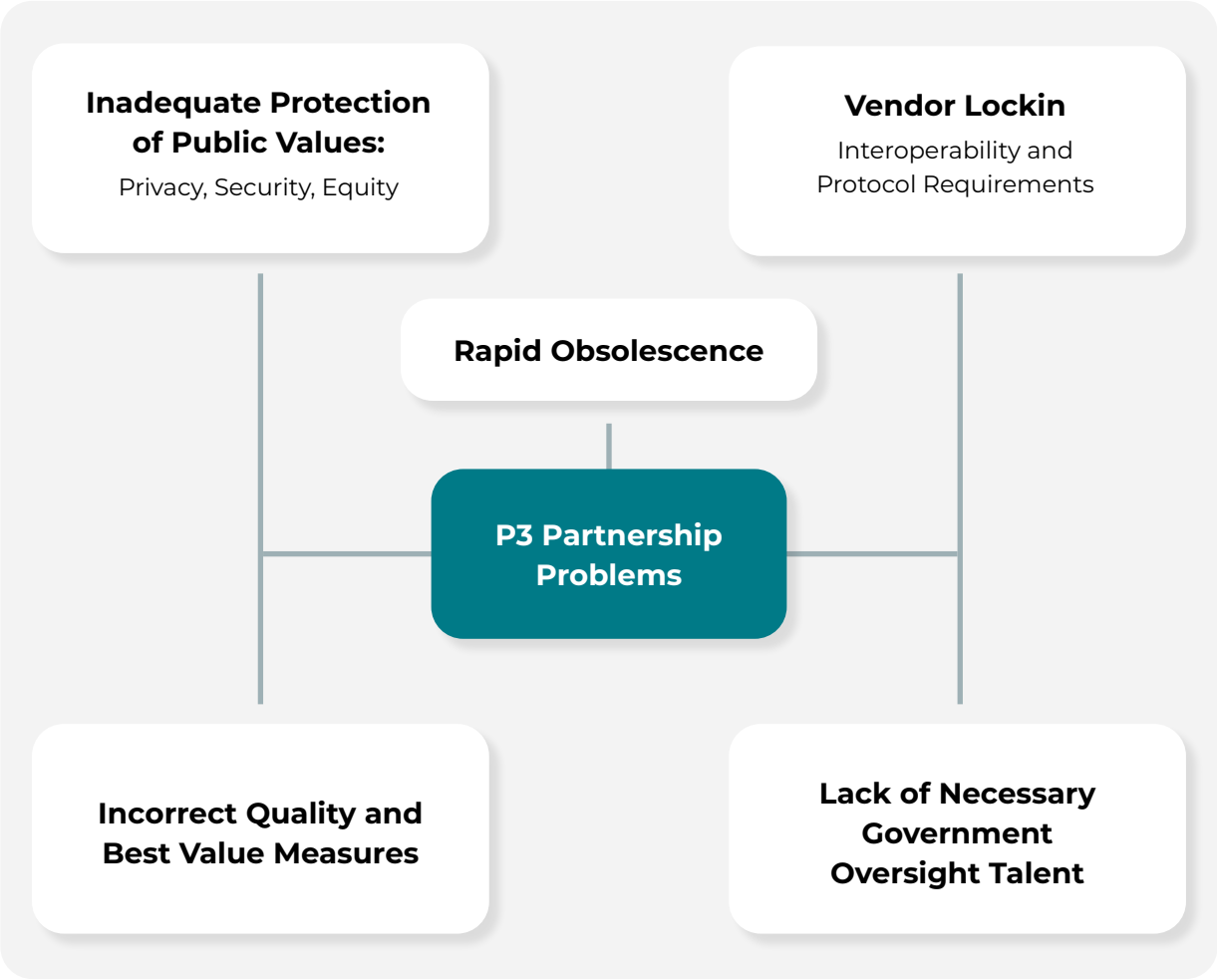
Concerns in Digital P3s

Whether the procurement is for a platform itself or for the inclusion of digital components in a traditional purchase, moving into a new digital mode presents even more challenges to the

standard public and private relationships. We view success as all parties working together to produce more public value for dollar spent than government alone, while ensuring that the relationships respect privacy and produce equitable results. The structure of the relationship between local government and its vendors determines the success or failure of a particular project or undertaking.

Failure can take many forms: overpaying for services of inferior quality or items that don't work as intended, deploying technology that's obsolete by the time it's installed, unfunded maintenance or poor response times, or other defaults. Ultimately, failure could mean wasting the taxpayer's money, losing their trust, or providing insufficient benefit. Digital P3 issues that require attention can be summarized in the figure below.

Digital P3 Issues



In particular we focus on those digital platform P3s that allow value to be produced across agencies, governmental units, or sectors. The breadth of these agreements, and the fact that so few of them follow a standard model, puts even more stress on defining the scope and SLAs.

Digital P3 Contractual Principles

The move to digital P3s should be guided by the best aspects of traditional P3 contract modalities, but with reforms tailored to the characteristics and potential associated with technology. As opportunity grows, so does complexity. The following principles are keys to successful digital P3s.

1. Use System Thinking and Imagination in the Problem Definition and Criteria

A digital P3 should be solution oriented. It is not the purchase of a commodity, but the purchase of a performance output. One of the fundamental differences between P3 contracts and traditional administrative contracting, is that the former is output-based, with a focus on meeting prescribed outcomes and service levels, while the latter has been based on prescribed inputs.

During the COVID-19 pandemic, many cities needed to help residents secure emergency rental assistance and issued emergency contracts to vendors to this end. However, cities needed a more imaginative and comprehensive solution. Residents also needed other programs including short-term COVID benefits, Medicaid, and the Supplemental Nutritional Assistance Program. On the other hand, government needed a more comprehensive, novel, outsourced front end that would allow residents to secure all the benefits for which they were qualified. As we have seen, many cities were able to meet this challenge during the pandemic, although these tools were typically enacted as one-off tactical solutions. Ideally, this system should be easier for the recipients and the government, with more accountability.[25] This difference illustrates that digital P3s should be designed around resident-centric solutions that incentivize private sector innovation around the needs of the public "customer" and create new opportunities for transformative, user-centric change.

Furthermore, this example illustrates how even the process of writing criteria upon which the bids will be formulated often needs cross-agency participation and criteria greater than just one program. Digital P3s, because of their capacity to stretch across stakeholders and sectors, must incorporate a broader set of criteria. For example, many digital solutions are two-sided, providing better processes internally (to the government administrator) and externally (to the public seeking a service). The internal and external user experience and ease of use for each stakeholder must be considered.

A digital platform can enhance collaboration across sectors and government verticals. For example, a platform could bring together disparate data and multiple parties involved with workforce or mobility, which improves the collaborative nature of the work by having everyone work with the same data, review how different initiatives make progress, and map out proposed changes for comment. Evaluations should be connected not simply to the performance of the *software*, but to the performance of the *system* in terms of the accomplishments, such as better paying jobs for the users or faster commutes.

This potential for multi-sided benefits means that in most cases, the criteria of 'lowest cost' and 'best value' differ. A more upfront costly proposal that produces a cascading or more equitable benefit, or the one-time inclusion of vibration sensors in a bridge, will produce life cycle savings even if it's more expensive upfront. Scoring responses is difficult given that lowest bid can often equal the worst bid. Defining best value will not be easily measured, and certainly not just in terms of cost.

System approaches require rule setting for interoperability purposes since multiple technologies will be utilized. Systems also require the use of protocols that govern information exchange nationally. An efficient system will utilize the innovation of national technology companies, and will benefit residents who visit, drive, walk, bike and work in more than one city. National protocols, such as those now promoted by the Open Mobility Foundations with its curb management specifications serve to scale innovation, helping make innovations available to small and large cities alike. National protocols, such as those now promoted by the Open Mobility Foundation with its curb management specifications serve to scale innovation, helping make innovations available to small and large cities alike. *For example, the Foundation's Mobility Data Specification standardizes communication and data-sharing between cities and private mobility providers to facilitate a repeatable experience for residents, and vendors, across local jurisdictions.*

TIP: Start with a definition of the public good sought and the required services, outputs, and performance standards. This should be a cross-agency process with an emphasis on values and clarity of outcomes.

2. Address Trade-offs Concerning Intellectual Property

The government needs to provide incentives for a private partner to invest in research and development of technological solutions. Of course, one way for the vendor to do that is by spreading the cost of its product across customers, which means it needs to retain control of its intellectual property. At the same time, the government needs to have control over access to that software, including what application programming interfaces (APIs) should be facilitated and the terms of interoperability.

The line between open and proprietary is a difficult and blurry one, made more complex by the potentially sensitive information collected by governments and the transparency regulations applicable to public services. Legal advice and guidance will be crucial as local leaders navigate this new realm of ownership. The issue needs to account for enhancements authorized and paid for by government during the contract term.

TIP: Use federal civilian contracting and federal acquisition regulations as guidelines. In these regulations, vendors usually retain ownership of technical data and commercial software, but the government receives a license to use them during the contract.[26]

3. Incorporate Rules Concerning Data Security and Privacy

Data privacy is one of the biggest concerns in a digital world. In a situation where data are mixed or merged, with some derived from governmental sources and relationships and others from private parties, government needs to control the rules on data privacy and commercialization. One of the most well-known examples of digital P3 privacy controversy emanated from the Sidewalk Labs Quayside proposal in Toronto. There, an ambitious plan for a real estate P3 infused with digital infrastructure failed. With substantial data interactions, access to personal information occurred regardless of whether a resident was on a public or private right of way, blurring the lines and rules between public and private.

Bennat Berger, in an article about the Quayside failure and the future of smart cities, insightfully emphasized the importance of trust and transparency when he stated that the private partner, "[m]ust adopt a near-nonprofit perspective that prioritizes social gain over profits to avoid accusations of corporate greed and involve advocacy groups in their decision-making processes. Residents must understand how their data will be used, who has access to it, and what they can do to maintain their privacy in a space where data collection is a necessity."[27]

If a public agency gives a vendor the right to provide a solution that entails access to data, then the city should set the privacy boundaries, regardless of whether access to the public's data comes from the product itself or from easements on public property. This is the case with LinkNYC, which provides free street level connectivity in return for data and advertising rights. According to Michael Bennon, managing director of the Stanford Global Projects Center, "the public partner needs to set clear guardrails up front, as well as know what is feasible within these systems and incentivize private partners to be flexible in terms of data issues and terms."[28] We go even further, advocating that ownership and use of data needs to be clearly articulated and legally codified in the P3 agreement (or alternatively, subject to more generalized regulations, as is the case in the European Union).

Although security liability issues are less controversial, they are no less difficult than privacy, as data breaches happen regularly in multiple industries and many popular apps. According to Jill Jamieson, leading P3 expert and advisor on this paper, "The issue is who is legally liable for each layer of data security and what, if any, limitations exist on exposure. This allocation of responsibility is a major source of contention in the negotiation of these contracts,

as most financing institutions and technology providers are unwilling to assume unlimited liability in the case of breaches." A breach could occur through a private but connected device. Things like connected vehicles – which can communicate directly to city traffic sensors – should meet local and national security standards.

The privacy issues raise a range of questions. The rules can not be easily set out in advance and in fact require the preferred parties and the government to negotiate the range of approaches. As Jascha Franklin-Hodge spelled out in his article *Bikes, Scooters, and Personal Data: Protecting Privacy While Managing Micromobility,* not all data is equal; aggregated data is the safest, but often anonymized personally identifiable information (PII) data can be reidentified.[29] Developing rules related to collection, use and archiving will evolve during the negotiations and implementation of a project.

TIP: Make sure that a city official or a separate consulting expert oversees data privacy and the rules and audits for employees and external partners. Ensure that anonymous data cannot be easily reidentified and clearly understand the revenues and risks involved with authorized commercialization. Look to other best practice examples in setting city-wide standards.

4. Utilize Consultants to Compensate for Asymmetric Expertise

Private partners will generally understand more about their product, its capacities, and risks than the city official with whom they are negotiating. According to research published in the Rand Journal of Economics, "the long-term relationship inherent in a public-private partnership may create particular scope for information asymmetries to develop between the public sector and the private entity," which means that "the private-sector entity may become better informed than the public authority about additional costs that may arise in the operation stage when changes in circumstances occur."[30]

And ordinary boilerplate provisions from procurement officials may miss the point of a newly tailored technology solution and restrict innovation while inadvertently accepting risks. While serving as mayor of Indianapolis, an author of this paper, Stephen Goldsmith, experienced this first-hand. Goldsmith's administration bid out one of the country's first, big-city full information technology (IT) outsourcing. His team faced challenges concerning SLAs in defining where scope ended, and whether a change order would occur. Faced with these challenges, the administration sought out one of the few law firms in the country with applicable experience.

Since then, availability of digital technologies has exponentially increased. Yet this commercialization also creates complexity in evaluating technical and business risks. City officials cannot easily evaluate the chances that a start up with an innovative solution will stay in business during the length of a contract. As is standard with infrastructure P3, public agencies should consider what steps should be taken at the outset to provide protections on a change in ownership or even a failure of the vendor and ensure that the appropriate terms and conditions are codified in the P3 agreement.

> **TIP:** Revise or prepare standard contract language for digital P3s and engage knowledgeable outside advisors or counsel for expertise.

5. Ensure and Incentive Congruence

There are several funding models for P3, including budget-based performance payments, monetization models, and revenue-sharing models. In a revenue-sharing model, the public and private sectors agree to share the revenue generated by the project based on predefined criteria. This incentivizes the private sector to maximize the revenue generated by the project. In a performance-based payment model, the private sector receives payments based on achieving performance milestones, which may involve meeting certain quality or safety standards, completing the project on time, or achieving specific environmental or social outcomes.

Digital P3s often involve significant upfront costs and, when coupled with life cycle operations and maintenance costs, present an interesting challenge for government budgets. Upfront design-build costs are often accounted for as a capital expense, with little to no consideration of life-cycle operations and maintenance costs, which is contemplated within an agency's operating budget. This disconnect, between the design and installation of a system and its life-cycle operations and maintenance needs, often leads to a focus on first-cost savings over total life-cycle system costs, resulting in both inadequate systems and persistent budget shortfalls for future upgrades and major maintenance and repair. Full life-cycle system cost should include criteria for modernization and preventative maintenance.

The sponsoring government agency can decide whether a project is a Design, Build; Design, Build, Operate; Design, Build, Finance, Operate, Maintain; or Design, Build, Operate, Maintain. Yet regardless, with the amount of infrastructure funding now available, officials should adopt procedures and criteria that encourage digital components that will produce long term cost savings in a project and enhancements in usability of the asset, even if there are slightly higher upfront costs.

In digital P3s, there are often opportunities to reduce costs by allowing the private provider to monetize information from the service. These monetization opportunities may present privacy questions, even when the specific users' information is anonymized.

> **TIP:** Enhance value engineering responsibilities to include true life cycle costing evaluations and realistic programmatic savings determinations in all agencies. Also, evaluate costs and benefits of revenue sources including data.

6. Streamline Processes

As technology advances rapidly, public agencies need to accelerate the procurement process. However, digital P3s have a broad scope that includes stakeholders from different departments, which can complicate this goal. Innovative digital P3s should be driven by the program officials and supported by procurement experts, not the other way around.

First, digital tools, such as online applications and comprehensive cloud-based data maps,[31] can make the entire process more transparent and efficient. Governments should set tight timelines and determine whether they can utilize a contract from another jurisdiction or from a cooperative purchasing group. Senior program managers should control the procurement process. Only lawyers experienced with technology contracts should participate, since lawyers inexperienced with such subject matter slow down the process considerably over terms and conditions.

Second, meetings with vendors, requests for information (RFI) or other pre-request for approval (RFP) invitations, and procurement meetings with potential bidders that are commercially confidential are crucial to better contracting processes, especially as governments move toward partnerships for innovative technologies and novel digital tools. These invitations can help stimulate innovative proposals and better identify and allocate risks.

Third, government entities should consider progressive contracting approaches that will allow solutions to be developed collaboratively between the public and private sector, allowing the public agency to make fully informed decisions before committing to a long-term agreement. This process also allows for greater public input, as well as enhanced transparency into system life-cycle costs. In contrast to traditional P3 models, which typically involve a fixed payment structure, progressive P3s aim to align financial incentives and increase certainty around scope and performance as the project progresses. The main characteristic of a progressive P3 is its ability to adapt to changing circumstances over the course of the project.

According to Bennon, "pre-development agreements are not new, but the ways in which they're being used now is novel. Essentially the government will select a preferred proponent or private partner very early in the development process and will be governed by an agreement with the private partner which will define pre-development activities and can also include other things including grant applications and community consultation."

Pitch Pilots: Long Beach, CA

The government of Long Beach is a leader in reforming procurement. Long Beach's Smart Cities Program Manager Ryan Kurtzman oversees the innovation procurement program, Pitch Long Beach![32] which directly invites proposals from vendors. These vendors pitch pilot programs "to explore new and emerging tech in the city."[33] This unique P3 model means that the city can access innovative technologies on a pilot basis, provide cutting-edge tech solutions to residents, and open the procurement process for short-term P3s on a more inclusive basis.

Long Beach's What Works Cities team initiated forecasting exercises to predict when and how vendors needed to be engaged. In addition, it established a Procurement University to train city employees, which reduced the average time to issue and award RFPs from 8 months to 3.5 months. External stakeholders, such as community-based organizations (CBOs), have also been included in the procurement process. Laura Merryfield, a fellow at the Harvard Kennedy School's Government Performance Lab, was brought on to expand the focus on inclusive procurement, collecting feedback from vendors and ensuring that they are not encountering any barriers.

Pitch Long Beach! provides an opportunity for local startups and entrepreneurs to work with the city to pilot new technologies and solutions that can improve city services and operations. The program is open to businesses working in various sectors, including transportation, energy, and public safety. Pitch Long Beach! follows a three-step process that begins with an open call for proposals. Interested startups and entrepreneurs can submit their ideas and solutions to the city's Innovation Team for review. The top proposals are then selected and invited to pitch their ideas in front of a panel of judges made up of city officials, industry experts, and community leaders. The last step is the implementation phase, where the city works with the winning startups to develop a pilot project to test and refine the proposed solution. This phase is typically funded through a grant or other financial support provided by the city.

These expedited processes can also be facilitated at the state level. The State of Nevada Commission on Educational Technology[34] makes recommendations on hardware and software procurement for schools. The Commission itself is comprised of public-private representatives to better understand the educational needs of the students, purchasing power of the state, and relevant products or services from the private sector.

TIP: The city executive should ensure that there's a program management team on significant digital acquisitions. The team should include representatives from all departments that might benefit and meet at regular intervals from the start with legal and procurement officials who are not in control but are advisors.

7. Build in Off Ramps

As with most public contracts, many P3 arrangements set forth the terms and conditions under which the government may terminate or withdraw from the arrangements. These moments can of course occur anytime upon a material default, but they also can and should be allowed under standard termination for convenience options as well with clear terms. Yet replacing a major piece of a technology stack, or even the platform itself, can be challenging and needs special attention. However, digital P3s also need to have provisions dealing with data and customer access if the digital agreement puts a company or companies between the government and resident users. The original contract should anticipate situations by addressing transitions for those connected to a platform by APIs and interoperability arrangements. The sudden disappearance of an app, particularly without a transition to another digital tool, confuses residents and leaves them concerned about their personal data. The same issue can occur internally, when public sector employees potentially lose access to a tool that managed services or resident information, putting them back to square one and again damaging their trust in digital systems.

TIP: Encourage vendors to align as teams that provide broader digital services, but explicitly plan on contractual transitions that may occur if technology becomes obsolete or important new approaches are developed.

8. Visualize Benefits, Collaborate and Plan for Equity

In our previous paper, *The Responsive City Cycle*, we detail how digital tools can involve the public in the acquisition and use of digital tools, which we recommend reading in conjunction with this report.[35] In addition to the loop of civic engagement, different tools can

assist with equity planning. For example, geographic information systems (GIS) tools should be used to map existing and planned infrastructure to expose inequities and plan investments. Augmented reality should be utilized to show the community variations of what is planned. And sentiment mining and polling will help with construction mitigation. Due to the power of a digital P3, using newer technologies to involve the public is particularly important.[36]

TIP: Use digital tools to plan for equitable services/ distribution and to acquire digital P3s.

Embarking on a Digital Future

What is the Progressive Delivery Model?

As technology advances rapidly, public agencies need to accelerate the procurement process. The value that a digital system can produce demands new approaches to procurement.

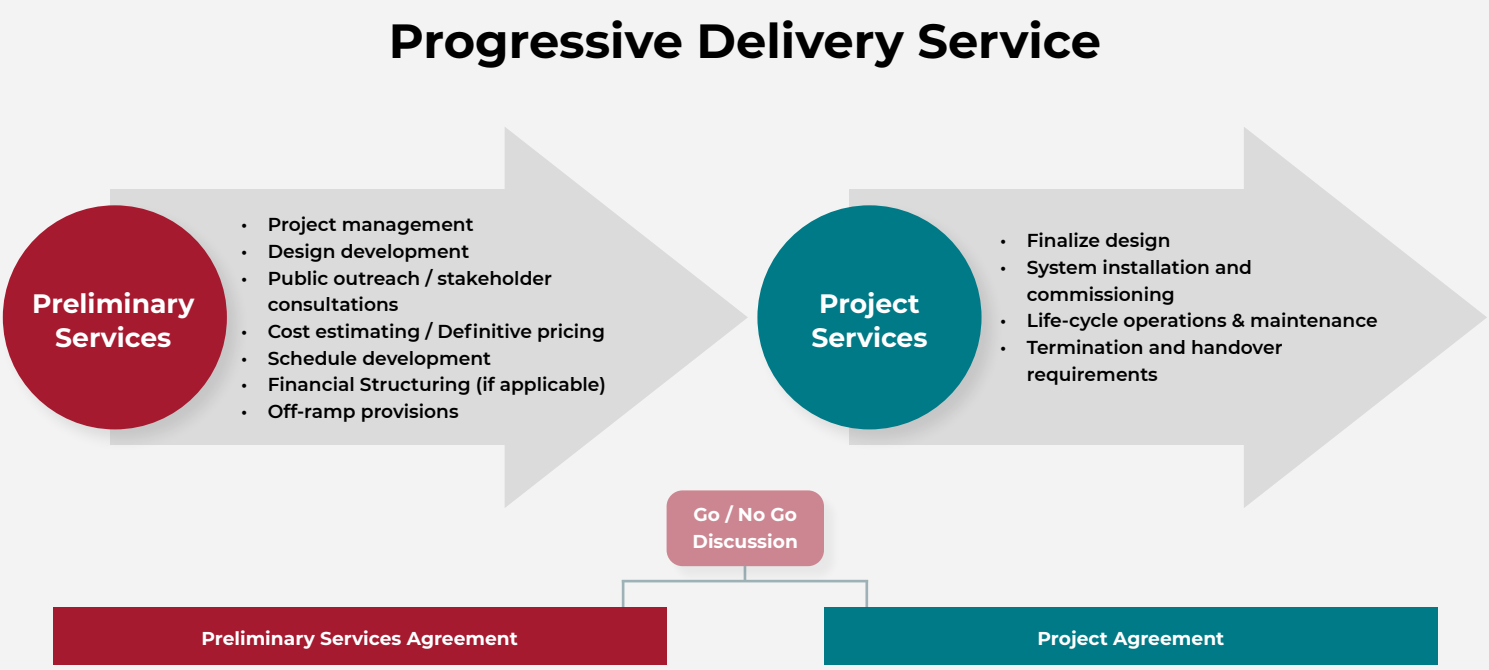
Digital infrastructure produces the most benefit when it powers a system approach to a solution, and as such the solution will evolve among the government and multiple vendors. Traditional procurement relies on a clear scope at the beginning of the process and incorporates too little of the creativity of the private sector. Yet the public entity must control the process to ensure the right outcome and protection of privacy, security, and equity. Cities can accomplish these goals by adopting a progressive delivery model sometimes used in the construction of complex physical infrastructure. This process also allows for greater public input, as well as enhanced transparency into system life-cycle costs.

We asked P3 expert Jill Jamieson, who collaborated with us on an earlier infrastructure paper and acted as an advisor on this one, to tell us about her progressive contracting experience and ideas for digital P3s. Her thoughts are below.

> Progressive contracting is an umbrella term used to describe contracting models that engage a contractor to work collaboratively with the project owner during the design phase, prior to fixing the final price and schedule for delivering the infrastructure or digital system.
>
> Following a competitive procurement process, a contractor is engaged to deliver work under two separate agreements. The first agreement, commonly referred to as the Preliminary Services Agreement or Pre-Development Agreement, involves the progressive, collaborative, and iterative development of key project parameters, such as project scope, design, open-book cost estimation, risk identification, etc. At a specified design level (typically the 60 percent level), the contractor will typically submit a binding proposal for the

second phase (project delivery phase) with a fully defined scope, schedule, and price, thereby allowing the project owner to make a fully informed decision about whether to proceed to the project implementation based on either a Fixed Price or Guaranteed Maximum Price.

If the project owner accepts the contractor's proposal, the contractor delivers and completes the project in accordance with the agreed scope, schedule, and price, which are codified in a Project Agreement. Nevertheless, the public agency retains the right to off-ramp at any point during the Preliminary Services Period, at which time it can either abandon the project altogether or terminate the relationship with the original contractor and use

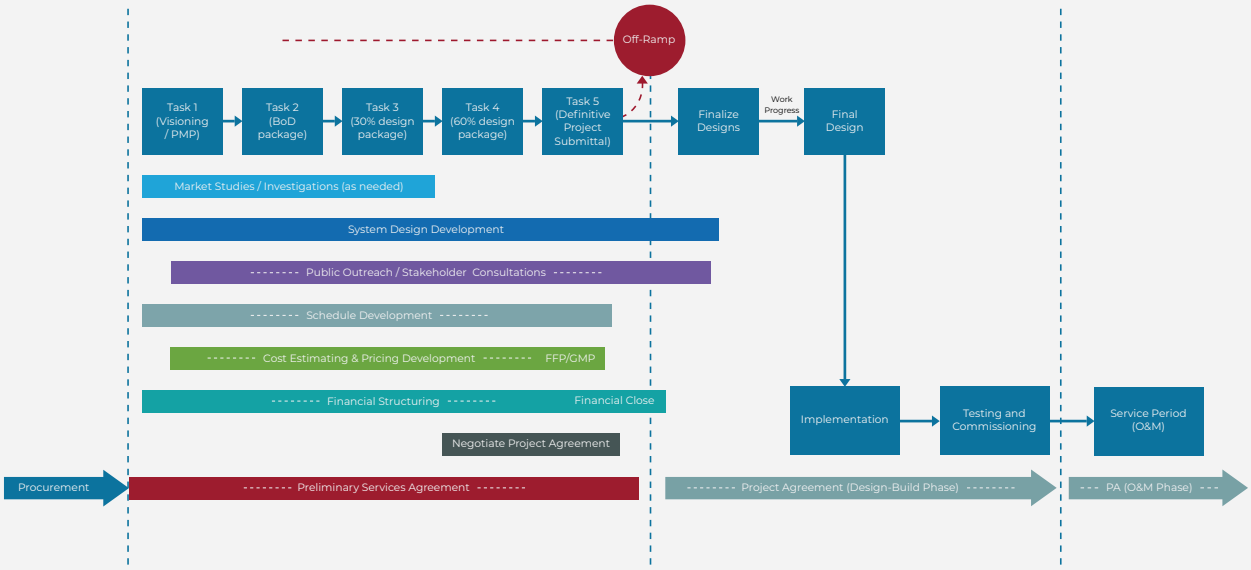


the designs and other work products prepared during the preliminary services phase in a subsequent procurement for project implementation.

Payment terms during the preliminary services period vary significantly, ranging preliminary services costs being carried at-risk by the contractor until project implementation to payments being made on either a service agreement or milestone basis.

Progressive contracting structures are best suited for projects that are not well defined or that require extensive owner/public input, making fixed price procurements challenging. Likewise progressive contracting is particularly useful when project risks are not well defined or understood. The progressive

approach is particularly valuable when there is a need or desire for extensive public input during design processes or where it is important for project owners/stakeholders to retain input and control over project outcomes. The collaborative nature of progressive contracting, including the iterative build-up of project scope, schedule, and cost estimates, allows significant opportunities for project owner input and control throughout. The progressive approach also aligns well with projects that involve systems engineering for emerging technology, where iterative design and testing is required prior to project implementation.



The procurement will depend of course on the digital infrastructure necessary. We consider here that part of the infrastructure that helps power a system, or is part of a system, where multiple parties, stakeholders, and vendors are involved.

In short, the progressive contracting approach offers a less cumbersome and costly procurement process, allowing public agencies to focus more on project development and less on complex procurements based on imperfect information. That said, progressive contracting is not suitable for all projects, particularly those where scope and risk are well understood. Moreover, government agencies must be prepared to scrutinize and oversee their contractor during the preliminary services phase to avoid the risk of capture or questionable pricing outside of a competitive environment.

The move toward digital P3s might seem daunting, yet the more formidable the task the greater the potential benefits. Maximum benefits require a new way of structuring partnerships and procuring system-wide solutions. Digital infrastructure is indispensable and requires rethinking the foundations of the public/private relationship. This is a moment to reexamine, correct, and create a new model that will influence the very shape of the future city.

Endnotes

[1] (2003). This month in Harvard history. The Harvard Gazette. news.harvard.edu/gazette/story/2003/10/this-month-in-harvard-history-38-2/

[2] Jamieson, J., Goldsmith, S. (2017). Tapping Private Financing and Delivery to Modernize America's Federal Water Resources, *Ash Center for Democratic Governance and Innovation*.

[3] Coleman, K., Goldsmith, S. (2022). Collaborative Cities: *Mapping Solutions to Wicked Problems*, Esri Press.

[4] Fernandez, S., Rendell, E., & Goldsmith, S. (2014). Government Outsourcing: A Practical Guide for State and Local Governments. *School of Public and Environmental Affairs at Indiana University*.

[5] Buckberg, E., Mudge, R., & Sheffield, H. (2018). Rising Tide of Next Generation U.S. P3s —and How to Sustain It, *The Brattle Group*. brattle.com/wp-content/uploads/2021/05/13441_rising_tide_of_next_generation_us_p3s_-_and_how_to_sustain_it.pdf

[6] Rodriguez Marin, F.J., Sarad, N.J. & Donovan, L.P. (2023) Infrastructure Investment and Jobs Act: Selected Changes Impacting Public-Private Partnerships, *The National Law Review*. natlawreview.com/article/infrastructure-investment-and-jobs-act-selected-changes-impacting-public-private

[7] Webster, K. (2022). IIJA funding opens door for more infrastructure P3s, panelists say, *The Bond Buyer*. cdfa.net/cdfa/cdfaweb.nsf/pages/46911/$file/IIJA%20Funding%20Opens%20Door%20for%20More%20Infrastructure%20P3s.pdf

[8] Goldsmith, S., Eggers, W. D. (2004). *Governing by Network: The New Shape of the Public Sector*. Brookings Institution Press. http://www.jstor.org/stable/10.7864/j.ctt12879qp

[9] https://ash.harvard.edu/files/ash/files/ash_mobility_goldsmith_gardner_final_.pdf

[10] https://ash.harvard.edu/files/ash/files/020520_hvd_ash_effectively_managed_connected_mobility_marketplaces_report.pdf

[11] Gardner, B., Goldsmith, S. (2022) Implementing Digital Infrastructure Responses to Equity, Sustainability, and Safety, *Data-Smart City Solutions*. https://datasmart.hks.harvard.edu/implementing-digital-infrastructure

[12] (2022). Digital Infrastructure Strategic Framework, *City of Toronto*. https://www.toronto.ca/wp-content/uploads/2022/03/9728-DISFAcc2.pdf

[13] Buckberg, E., Mudge, R., & Sheffield, H. (2018). Rising Tide of Next Generation U.S. P3s —and How to Sustain It, *The Brattle Group*. brattle.com/wp-content/uploads/2021/05/13441_rising_tide_of_next_generation_us_p3s_-_and_how_to_sustain_it.pdf

[14] Sampson, R. C. (2007). R&D Alliances and Firm Performance: The Impact of Technological Diversity and Alliance Organization on Innovation. *The Academy of Management Journal*, 50(2), 364–386. http://www.jstor.org/stable/20159859

[15] Salminen, J. (2014). Digital Services – How Are They Different? *In Proceedings of International Conference on Business, Information, and Cultural Creative Industry (ICBIC14)*, Taipei, Taiwan, 6–8 August

[16] Goldsmith, S. (2021). As the Chorus of Dumb City Advocates Increases, How Do We Define the Truly Smart City?, *Data-Smart City Solutions*. datasmart.ash.harvard.edu/chorus-dumb-city-advocates-increases-how-do-we-define-truly-smart-city

[17] (2021). *Journal of Service Science and Management*, Volume 14, Number 2. ISSN Online: 1940-9907 https://www.scirp.org/(S(351jmbntvnsjt1aadkozje))/journal/home.aspx?issueid=15204#108795

[18] Gardner, B., Goldsmith, S. (2022). The Responsive City Cycle, *Data-Smart City Solutions*. datasmart.ash.harvard.edu/responsive-city-cycle

[19] Ammouri, L. Personal interview. February 22, 2023.

[20] Perricos, C. and Kapur, V. (2021) *Anticipatory government, Deloitte Insights*. deloitte.com/us/en/insights/industry/public-sector/government-trends/2020/predictive-analytics-in-government.html

[21] Steff, B. (2021) On the road again: New solutions for old problems, *Purdue University News*. purdue.edu/newsroom/releases/2021/Q2/on-the-road-again-new-solutions-for-old-problems.html

[22] The Ray Today (2020) *The Ray*. theray.org/technology/the-ray-today/

[23] Michael M., & Overend M. (2022) Closed cavity façade, an innovative energy saving façade. *Building Services Engineering Research and Technology*. doi:10.1177/01436244221080030

Endnotes

[24] Joaquim, M. S., & Renneboog, L. (2016). Anatomy of public-private partnerships: their creation, financing and renegotiations. *International Journal of Managing Projects in Business*, 9(1), 94-122. https://doi.org/10.1108/IJMPB-03-2015-0023

[25] Gardner, B. (2021). Benephilly Case Study, *Data-Smart City Solutions*. datasmart.ash.harvard.edu/benephilly-case-study

[26] Cassidy, S., Hastings, A., Plitsch J. (2017). What Every Company Should Know about IP Rights When Selling to the US Government, *Landslide*, Vol. 9, No. 6, July/August 2017, by the American Bar Association. americanbar.org/groups/intellectual_property_law/publications/landslide/2016-17/july-august/what-every-company-should-know-about-ip-rights-when-selling-us-government/

[27] Berger, B. (2020). Sidewalk Labs' Failure and the Future of Smart Cities, *Triple Pundit*. triplepundit.com/story/2020/sidewalk-labs-failure-smart-cities/120616

[28] Bennon, M. Personal interview. February 17, 2022.

[29] Franklin-Hodge, J. (2018). Bikes, Scooters, and Personal Data: Protecting Privacy While Managing Micromobility, *Medium*. medium.com/@jfh/bikes-scooters-and-personal-data-protecting-privacy-while-managing-micromobility-3ee5651bdf32

[30] Hoppe, E. I., & Schmitz, P. W. (2013). Public-private partnerships versus traditional procurement: Innovation incentives and information gathering. *The RAND Journal of Economics*, 44(1), 56–74. https://www.jstor.org/stable/43186407

[31] Leger, M. (2022) GIS Enables Collaborative Infrastructure Investments in Normal, Illinois, *Data-Smart City Solutions*. datasmart.ash.harvard.edu/gis-enables-collaborative-infrastructure-investments-normal-illinois

[32] (2022). Pitch Long Beach!, *Smart City Long Beach*. longbeach.gov/smartcity/pilot-programs/pitch-long-beach/

[33] Gardner, B. (2022). Long Beach Leads the Way on Inclusive Procurement, *Data-Smart City Solutions*. datasmart.ash.harvard.edu/long-beach-leads-way-inclusive-procurement

[34] Commission on Educational Technology, *State of Nevada Department of Education*. doe.nv.gov/Boards_Commissions_Councils/Commission_on_EdTech/

[35] Gardner, B., Goldsmith, S. (2022). The Responsive City Cycle, Data-Smart City Solutions. datasmart.ash.harvard.edu/responsive-city-cycle

[36] Goldsmith, S. (Host). 2023, February 22. The Pre-Decisional Opportunity in Community Engagement. Episode 36, *The Data-Smart City Pod*. datasmart.ash.harvard.edu/pre-decisional-opportunity-community-engagement

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