RESPONSE TO

# THE CITY OF PITTSBURGH

## SMART STREETLIGHTS REQUEST FOR INFORMATION (2017-0001)

Submitted To:
City of Pittsburgh
Office of Management and Budget
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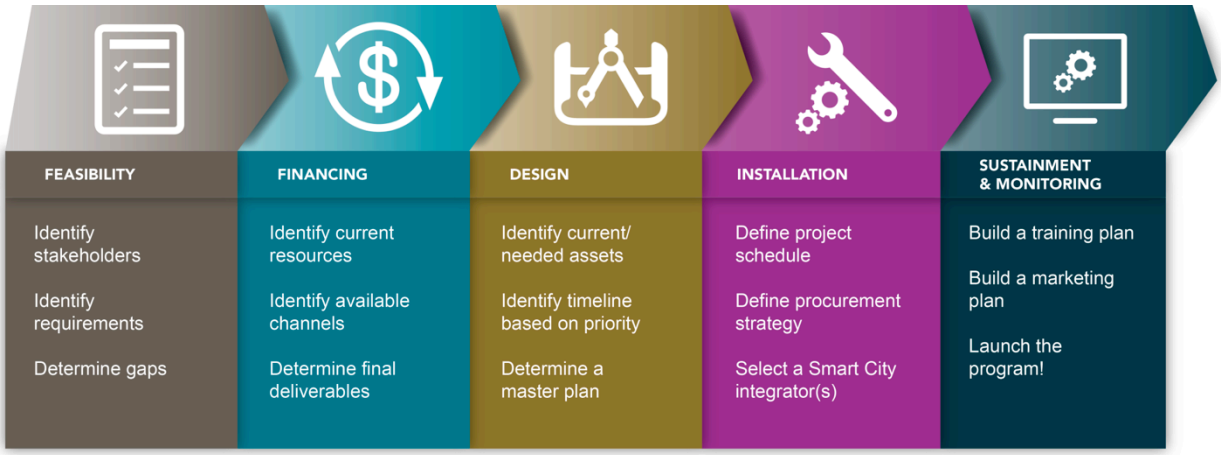
# 1 - INTRODUCTION

The vision of a Smart City is commonly shared at an aspirational level by all parties who hope to play a part in improving the public good. We all understand the potential impact that modernized infrastructure and the data that it generates can have on equity, productivity, sustainability, and delight within a city. It is typically at the next step of implementation where perspectives skew on how to achieve these outcomes.

In this RFI response, we do not have a specific product to sell to you. Rather Leidos and our smart city consortium are proposing an approach that starts with collaboratively developing goals that we can work with Pittsburgh-area stakeholders to outline. Ultimately, this approach ends with a Smart City Program, but this is a bespoke program that targets outcomes based on these goals and how people want to access them. This Smart City Program is also of a scale that the name implies: region-wide coverage implemented and refreshed over a 10-30 year period. It is sustained throughout using a revenue-positive business model that brings together commercial partners from multiple industries to build a diversified Public-Private Partnership (P3) at the City of Pittsburgh's direction. It also leverages our access to financial markets to minimize up-front costs to the City.

# 2 - PROGRAM OVERVIEW

Leidos has a proven track-record of working with the government to solve its most complex challenges. As we note above, our proposed Smart City Program is not a pre-defined solution, but rather a specific lifecycle approach to translating goals into outcomes.




## FIGURE 1 – SMART CITY LIFECYCLE ACTIONS

This lifecycle includes many actions, including those outlined in **Figure 1** above, which we consolidate into four Key Program Activities:

- 2.1 PROGRAM DEFINITION
- 2.2 PROGRAM DELIVERY
- 2.3 TECHNICAL DESIGN
- 2.4 BUSINESS MODEL AND OPERATIONAL CONSIDERATIONS

The lifecycle culminates in the delivery of a modernized infrastructure system to Pittsburgh, with curated datasets flowing into WPRDC and/or other open data repositories, and an ongoing set of applications that address the public needs defined during the process. This lifecycle is agile and iterates on itself throughout the 10-30 year program period to deliver solutions that are always timely to the City's needs – even if certain needs in the future do not yet exist today.

This can be understood in more detail by diving into each of the four Key Program Activities.

## 2.1 PROGRAM DEFINITION

Our Program Definition phase begins by leveraging the ongoing effort of identifying and bringing stakeholder representatives together with the purpose of understanding, developing, and prioritizing the many opportunities and challenges that are present in Pittsburgh. In order to develop specific Smart City Program requirements, we augment your current process with individual stakeholder interviews that converge into an all-hands discovery workshop. This creates an open environment for all parties to share and understand the comprehensive set of requirements that then go into defining the Smart City Program. As an output of this effort, user personas, use cases, and a set of prioritized Projects are then developed by our team for the City's review during the next Business Model Design phase.

As a part of the discovery process during the Program Definition phase, we will also share challenges and opportunities from other clients around the world, as well as best practices on how different data sets can be translated into public value. Based on the goals outlined by the City, here are examples of outcomes that can be built into a Pittsburgh Smart City Program:

### Physical/Digital Access & Equity

Access starts with connectivity, but physical mobility and internet access are a means to an end. The other component of access involves understanding the specific needs of underserved populations and how they access resources. Once this is understood, specific community infrastructure, online portals, and tools can be developed that directly address community needs.


CivicConnect CivicAR Technology

### Improving People Flow

As Pittsburgh evolves and people's behavior patterns change with their demographics, continued support for the expansion of multimodal transportation and intelligent transportation systems becomes critical to optimize the increasing flow of people into the city.

### A Safer and Healthier City

Transportation safety initiatives like Vision Zero, as well as air quality health initiatives have been proven to deliver significant public value. The challenge with these programs lie in the fact that the public benefits do not have a direct financial ROI. The funding challenge often associated with these programs can be solved by converging them into a broader Smart City Program to reduce and offset costs.

### Exceptional City Services

Mobile augmented reality (AR) for the public sector, like that provided by CivicConnect, adds a layer of rich data and information to any public asset or location, ensuring simple, accurate, safe and efficient delivery of public services. City workers can simply point their devices at any public asset, and immediately retrieve information pertaining to that specific asset or point of interest.

### Constituent Engagement

Another immediate, high value public benefit is to use mobile AR technologies to engage residents and visitors in context, that is, while they are experiencing something relevant or in proximity to a City asset or service.

### Business Growth

Local small businesses often do not have the capability to effectively advertise in order to grow their enterprises. Local contextual digital advertising can blend digital and physical channels together and connect SMEs with new customers.

## 2.2 PROGRAM DELIVERY

A consequence of the large-scale and long-term nature of our proposed Smart City Program is that the complexity that inevitably results cannot all be described and planned for in advance. It is inadvisable to plan Program components 20 years into the future without knowing what the key challenges and opportunity for Pittsburgh will be at that time. We have found that a planning horizon of 18 months works well and so we recommend breaking the 10-30 year Smart City Program into 18 month Project Cycles, as detailed in **Figure 2** below. The first Project Cycle is for the infrastructure modernization implementation determined in the Program Definition and Business Model phases. It consists of 9 months to refine requirements and design the resulting infrastructure system, and 9 months to build and deliver the Project.

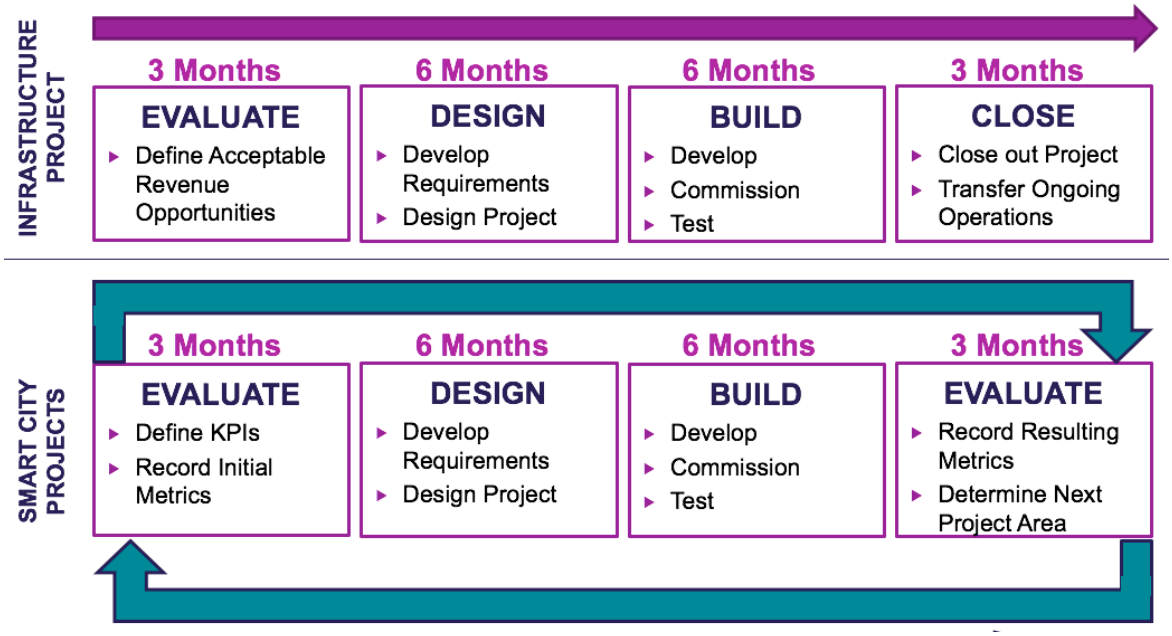



**FIGURE 2 – SMART CITY PROGRAM AGILE DEPLOYMENT PLAN**

For the remainder of the Smart City Program duration, the 18-month Project Cycles that follow are for implementing the specific initiatives that address the Pittsburgh stakeholders key challenges and opportunities that were outlined in the Program Definition phase. These ongoing project cycles then take a hybrid approach of (1) iterative implementation of citywide applications, and (2) a neighborhood-by-neighborhood application implementation depending on the application requirements and the pervasiveness of the outcome that it is looking to provide.

Each ongoing Cycle consists of 9 months to define Project requirements and goals, as well as 6 months to build and deliver the Project. The remaining 3 months in the cycle are used to measure the success of the Project and to evaluate changes to the overall Smart City Program requirements as the City continues to evolve.

This agile long-term approach provides the needed internal checkpoints and resulting flexibility that form the underpinning of a sustainable Smart City Program. Along with the Business Model Design, the agile Deployment Plan is also what empowers the City to move between Projects that generate economic value and those that add other forms of public value by making the city more safe, productive, delightful, and pleasurable to interact with.

## 2.3 TECHNICAL DESIGN

**Figure 3** below embodies the premise that a smart city technical architecture begins with what the purpose is for driving any underlying technology and not the actual technology itself.

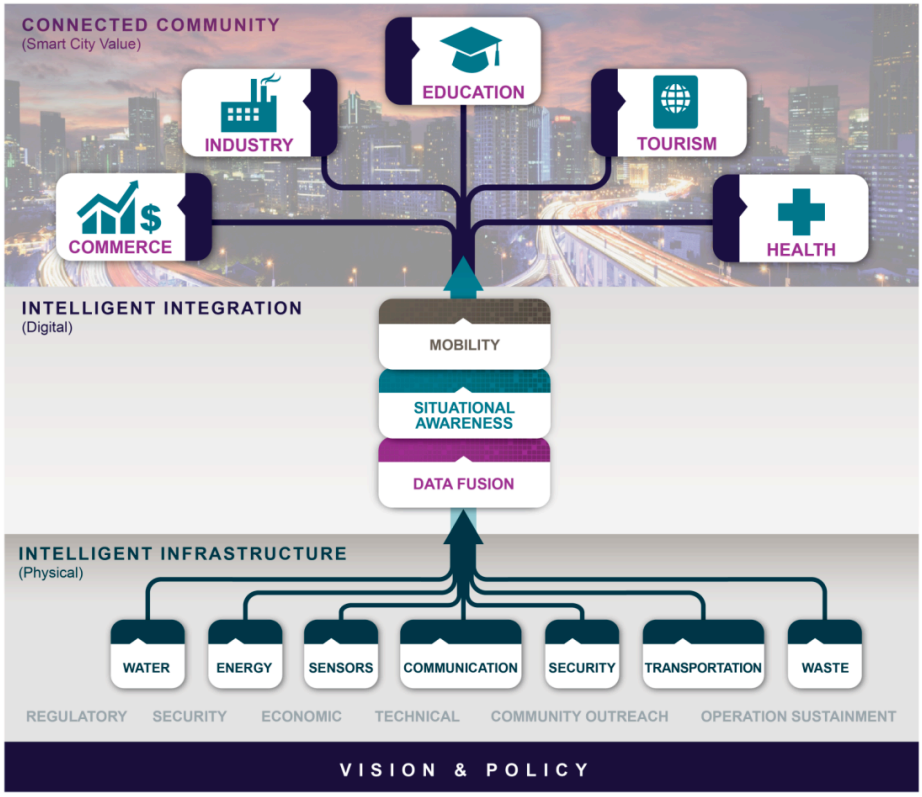



**FIGURE 3 – LEIDOS SMART CITY PARADIGM**

We believe that a technical design begins with the vision and policy outlined in the Program Definition phase. The next layer of architecture is then the Infrastructure Modernization that acts as the 'economic engine' for the Smart City Program. Data integration is the third layer and is often where smart city projects can fail. If data is not thoughtfully gathered at the sensor level and immediately curated upon ingestion, data repositories can fall victim to a data deluge where every piece of information is collected, but the value becomes lost within the dataset. Intelligent data integration instead focuses on fusing and presenting data in ways where the public, City employees, and researchers can derive their own insights, and also access applications that provide value. These applications create a connected community that drives the *engagement* and *access* that should be outcomes of a successfully architected Technical Design.

There is also an operational perspective to a Smart City Program technical design. This Concept-of-Operations (ConOps) describes how the system should be used, by whom, and for what purposes. We recommend the following ruleset to guide the design of the ConOps component of the Technical Design:

### Access to Assets is Closed

Operational access to the City's infrastructure needs to remain closed for security purposes. Special programs can be created to facilitate public access to non-critical infrastructure, in order to assist the public in gathering data they may need.

### Access to the Network is Allowed

A great deal of synergy can be derived from sharing network access and centralizing the storage of data. The more trusted parties that share the Smart City network, the more value can be created together.

### Access to (Non-Sensitive) Data is Open

All non-sensitive data should be open and accessible with tools to assist the public in creating their own personal value from the data. This newly derived value should also have a mechanism to be shared with the broader community.

### Data Collection

Edge intelligence should be used to gather only the data that may be useful in creating public value. This keeps the Smart City system efficient and protects public privacy.

Once we have the Program Definition, initial Business Case, and ConOps in place, we then can complete the System Architecture of the Technical Design. It is here that all of the technology associated with the Smart City Program comes into play. Leidos and our teammates have developed a flexible reference architecture that contains the superset of all potential technology components:

### Sensors and Controllers

There are hundreds of commercial-off-the-shelf (COTS) sensors and controllers available. We focus on system integration and combining sensors and controllers for different functional areas together into common hybrid devices. This drives down the cost of these edge systems and also enables them to be deployed in a broader set of environments. Our reference architecture includes over 60 different sensors and controllers, including those that the City is currently utilizing in pilots.

### Network
Hybrid networks combining various wireless and fiber technologies are a standard. Disparate existing networks often have complex current ownership. We have flexible business approaches and use software-defined technology architectures to accommodate working with existing assets and managing the multi-tenant usage of new assets.

### Data Curation and Insights
The Process of translating data into insights requires an extensible cloud IoT structure, like the Amazon Web Services Pragma Architecture, that enable control of both data ingestion and the data sources themselves. It also requires a Con-Ops centered around data curation rules and practices.

### Analytics and Applications
A public-facing ecosystem of open data tools, such as Geospatial Information Systems (GIS) and Business Intelligence (BI) applications, can promote entrepreneurialism and help enhance the ability of the public to derive value from smart city data. A complimentary set of more advanced tools that are augmented by machine learning can help the City solve the very complex problems that arise at a regional level.

### Access and User Experience
The methods that public and City employees access applications is important in maximizing value creation. User experiences that focus on bridging the physical-digital divide with mobile augmented reality technology can optimize how various applications are used to interact with the real world.

All of the components together can be thought of as a toolkit in this sense. Based on the previous program activities, we can select the components that fit the City's specific requirements - the right tools for the job. **Figure 4** below provides a high-level outline of these components.

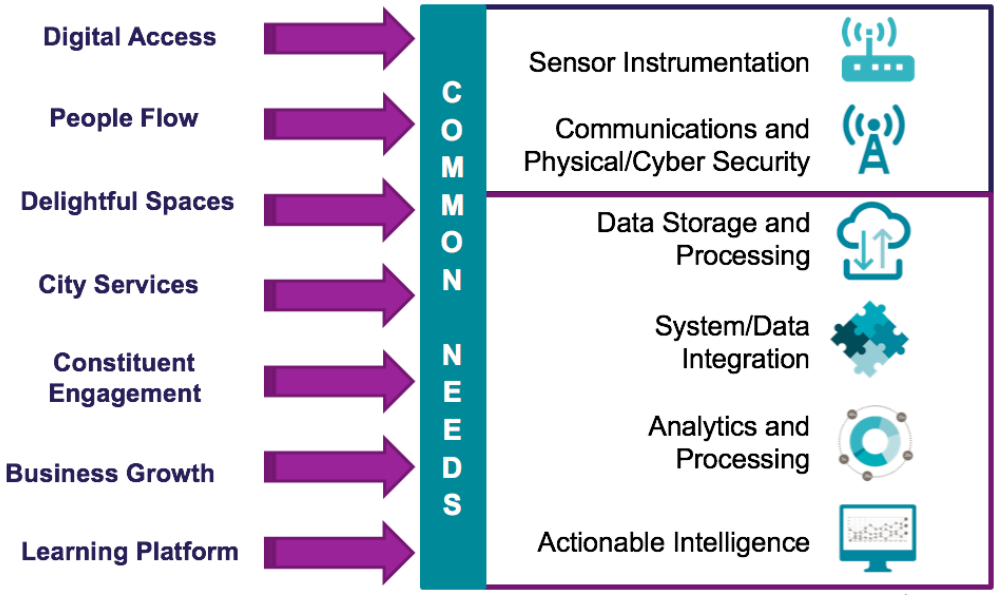



**FIGURE 4 – REQUIREMENTS-BASED SYSTEM ARCHITECTURE**

The list of assets owned by the City, Duquesne Light Company, and other area stakeholders offer many possibilities for the development of a successful Business Model and Technical Design. The following examples of asset usage illustrate what a Technical Design can incorporate in Pittsburgh. These choices are ultimately guided by the requirements set forth in the Program Design.

*Street Lighting*

LED street lighting retrofit projects are often one of the first smart city initiatives that are undertaken, because of their fast return-on-investment. Due to the ideal height and power connectivity of these asset, new hybrid functionality that integrate sensor sets and wireless networking are now prevalent as well.

*Smart Spines and Traffic Signal Infrastructure*

The transportation assets along corridors and at a traffic intersection hold significant value due to their data and energy connectivity, which forms another important nexus. Projects that capture this value, while also modernizing existing infrastructure, are often important initiatives. Leidos specializes in V2I infrastructure in this space, enabling the paradigm shift towards connected autonomous electric vehicles.

*Electric Avenue, EV Fleets, and Charging Infrastructure*

Mobility is a rare and critical value for infrastructure. City vehicles can act as mobile labs that also provide the City workforce with functionality enhancements for increased productivity and safety. A key to enabling city and commercial EV fleets is a supporting EV charging infrastructure. Opportunities exist to augment EV charging systems with increased functionality to offset the infrastructure costs. Doing so requires understanding the value of these assets and how they function in an environment with increasing EV, CAV, and multimodal penetration.

*Shadow Conduit*

Conduit will always be a valuable resource, even as backhaul moves into the wireless domain. (see 'Network' in the section above)

*Utility Smart Grid Infrastructure*

Leidos has worked with Duquesne Light Company on much of DLC's ongoing grid modernization efforts. As the utility grid becomes increasingly sophisticated in the face of emerging challenges and opportunities associated with distributed energy resources (DERs), there is an opportunity to leverage this investment and the data that the smart grid generates to create additional public value in a Smart City Program.

## 2.4 BUSINESS MODEL DESIGN AND OPERATIONAL CONSIDERATIONS

One of the most immediate challenges that cities face when exploring a citywide Smart City Program is developing a sustainable funding model that does not rely on passing new bonds. The crux of this challenge is that most smart city applications provide 'soft' benefits to the city – benefits that do not provide hard cash income in return. The City of Pittsburgh's goals will certainly improve the public good. Many of these goals will do so in indirect and unquantifiable ways. These often are the most important impacts, however, without a direct means of generating a return-on-investment, a sustainable business model cannot be developed.

Building large scale sustainable business models is where Leidos has spent much of our focus in developing solutions for the smart city space. Leidos and our teammates have developed Public-Private Partnership (P3) models that finance the creation of large-scale energy initiatives and we apply this same approach to our Smart City Program. **Figure 5** below describes this process further.


**FIGURE 5 - P3 BUSINESS MODEL APPROACH**

At a high level, this Business Model consists of these fundamental actions:

### Making Markets

Leidos and our team have relationships in many commercial industries. By understanding the challenges that these industries are facing, we have designed new ways to develop value out of many of the City's existing assets. We work with cities to monetize these assets through Purchase Agreements with our commercial clients, and then act as a market maker by facilitating and managing these transactions on the City's behalf.

### Infrastructure Modernization

These Purchase Agreements often require new functionality out of existing infrastructure. Some of this functionality can be generated quickly by bridging the digital-physical nexus (ex. by implementing technologies that assign digital information to physical infrastructure assets), but the remainder requires modernization of the infrastructure assets themselves. Leidos works with our financial market teammates to fully finance these upgrades with little or no cost to the City.

### Recurring Revenue for the Smart City Projects

Once City infrastructure has been modernized and begins delivering value to our commercial clients, the recurring revenues defined in the Purchase Agreements begin flowing back into the Smart City Program. This revenue from our commercial partnerships fund the implementation of the remaining Projects (often the 'soft-benefit' initiatives) outlined in the Program Definition phase. Since the duration of the Program and Purchase Agreements is often for a term of 10-30 years, we recommend taking an agile approach to the execution of these Projects in 18-month delivery and reevaluation cycles as detailed next during Program Delivery planning.

This P3 business model approach provides immediate value to the City, the public, and our commercial partners, while also generating a return-on-investment for the City and the financiers of the Program. Perhaps most importantly, it creates a method to sustainably fund an at-scale Smart City Program that focuses on the public good, while also providing value to our team's P3 clients.

## 3 - SMART CITY PROGRAM EVALUATION AND STAGE OF DEVELOPMENT

When evaluating potential options for future smart city efforts, it is important to appreciate that a sustainable P3 Smart City Program of this size has not been done before. Leidos and our teammates have developed and proven out the approach aspects outlined in this response in developing complex solutions for the government and commercial clients. The P3 business model also spreads the risk associated with a program of this type across all parties. With this inherent complexity, an initiative of this type is not the right program for every city.

We are looking for the right city partners to work with. Based on the perspectives and the prior activities of the City of Pittsburgh, we believe that this type of program would fit well with what you are looking to accomplish.

The following criteria are how we judge the suitability for a program of this nature and may be useful in your discussion on ways to proceed:

- Right-of-way and asset concession availability
- Population density in target deployment areas
- Regional stakeholder participation
- Leadership/Stakeholder support
- Available city resources (personnel, funding)
- Procurement Innovation
- Other simultaneous major projects

If the information that Leidos and our teammates have detailed in this response may be useful to explore in further detail, we can facilitate this for the City in several ways. We work with city customers and regional stakeholders in a discovery phase that determines appropriate follow-up steps to identify and gather stakeholder inputs, analyze this data, and explore how an inclusive business model can be crafted that enables this type of a Smart City Program to be undertaken.

We believe that this inclusion is an important component in making smart city programs a success, due to their cross-boundary scope. In this discovery process, we also suggest engaging with researchers and universities to analyze data and identify value creation opportunities. We can provide resources such as high-performance supercomputing for data analysis and two-way digital communications vehicles for anthropological analysis of public participants. We also bring a technical staff of over 8,000 individuals with post-graduate degrees to collaborate with. This type of an engagement is a pragmatic first step to provide the City with the public value research, business model, and programmatic approach to launch a sustainable city-scale Smart City Program that benefits the whole of the city of Pittsburgh.

For questions or for more information, please contact Brandon Freeman at 619-309-5593 or Brandon.P.Freeman@Leidos.com.

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## CORPORATE OVERVIEWS

Leidos is a global science and technology solutions leader working to solve the world's toughest challenges in the defense, intelligence, homeland security, civil, and health markets. The company's 33,000 employees support vital missions for government and commercial customers.

CivicConnect provides a suite of augmented reality-based mobile applications--CivicAR®--that empower cities to improve efficiency and sustainability while enabling citizens, visitors and workers to more easily explore and navigate their city. These applications are built on the CivicConnect Platform, a cloud-based data management platform, purpose-built for the public sector, that enables the rapid deployment of applications while providing the data and analytics needed to make smart decisions.