BEYOND THE LINE

Smart C.A.T.S.
Kansas State University
Acknowledgements

Smart C.A.T.S. (Community, Access, Technology, Synergy)

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INTRODUCTION
Following the lead of the Mayor’s Office of Technology and Innovation within the City of New York, 76 11th Avenue will be at the center of data collection and sharing aimed at improving the space for nearby users and residents as well as connecting it to the larger city framework. The site, which is located on the western edge of the Manhattan borough in the West Chelsea neighborhood, gives it a prominent location near the High Line, major thoroughfares that move people - not just cars - and against the Hudson River water edge.

The West Chelsea neighborhood around the site is described by the New York City Planning Department as:

A dynamic, mixed-use neighborhood along the Hudson River in Manhattan. The neighborhood is one of the city’s most prominent cultural destinations, a growing office district, and is equally a vibrant residential community. It is a neighborhood where historic lofts meet cutting-edge architecture, where street-level galleries meet an elevated park and where a daytime population of office workers, shoppers, and tourists meets a nighttime culture of restaurants and bars.

While there will be two buildings on the site, one standing 26 stories and the other 18, the site will feature many Smart City elements. Each element aims to connect the site to people moving about the area and to the city network from an infrastructure standpoint. The points of

Figure 1: Site Layout This view of the Smart Cities site, looking east over the Hudson River, shows its potential (Google Earth, 2017)
connection will blend in with the neighborhood, from the green spaces high and low to the art that Chelsea is known for. Sensors along the water lines; LinkNYC connection points and other Wi-Fi routers on human-scale light posts; green spaces that help manage stormwater - each element of this Smart City plan plays to the larger picture and moves beyond just the site.

To help structure this Smart City plan, the students at Kansas State University followed the framework provided by Matt Bucchin, AICP, Rob Kerns, AICP, and Ellen Forthofer in the Informational Webinar for the inaugural Smart City Design Competition. The plan and document address the site through four perspectives: Hidden Smart City, Exterior Smart City, Interior Smart City, and Smart New York City. Within these perspectives, the themes showcased in the webinar are identified: smart infrastructure, smart energy, smart mobility, smart building, smart governance, sustainability, equity, and placemaking. Some of the themes were customized by the Kansas State students to ensure the site addresses elements of the One New York: The Plan for a Strong and Just City comprehensive plan and other components that were deemed necessary.

Considering the themes and framework in which this Smart City plan is created, the goal of the proposed site and elements is simple: connect the lives of all in New York City, one Smart City element at a time.

Importance of Smart City Site + NYC

New York City created and adopted the One NYC comprehensive plan in 2015, setting the direction for the city as it drives towards its 400th anniversary in the next decade. The plan envisions the city through four lenses: growth, sustainability, resiliency and equity. To align itself with the comprehensive plan, the 76 11th Avenue site targets each one of these areas through several initiatives. For example, sustainability is addressed through LEED certification, which addresses topics such as energy efficiency and ecosystem restoration. As for resiliency, the ground level features permeable surfaces to manage stormwater and sensors throughout the water system to connect with other parts of the infrastructure network and adjust for supply during surges. Equity is
at the forefront of every user of the space as the ground level is a public space that users of the High Line or the larger Chelsea neighborhood can seek refuge from day-to-day life. As for growth, the site is connected to multi-modal transportation, providing a sustainable network of transportation choices for higher levels of population.

The entire site strives to exhibit what the One NYC plan stands for: empowering citizens and limiting their disconnect from the wider New York City and regional network. Once a New York City resident or visitor from afar steps on the 76 11th Avenue site, they will see and experience the wonder of what the city can offer, from Wi-Fi connectivity to activated art to sustainable green spaces amidst a high-rise development. The best part is, like a good comprehensive plan, the work will be done for them. All they have to do is go about their daily lives and the Smart City will take care of the rest.

**HIDDEN SMART CITY**

**Themes: Smart Infrastructure, Smart Energy, Sustainability**

While a city can be smart, it is vital the hidden aspects of the city be proactive in measuring data and usage. Therefore, connecting what is out of sight of the user will make the experience a positive one for all users of the site. The site will become the center of the Hidden Smart City for the Chelsea neighborhood and bring the district in line with the rest of the Manhattan borough and New York City.

As the center for the Hidden Smart City, the information gathered will enable everyone - residents, public works, local government, and outside researchers - to incorporate efficient delivery of services throughout the city. Examples of such infrastructure include sensors, cloud computing, efficient lighting and green infrastructure elements. All these pieces will be a part of the “Array of Things” framework, similarly instituted in Chicago. An infrastructure network that is connected throughout will enable current actions to be monitored and future uses to become more efficient and serve a better population. The overriding purpose of the Hidden Smart City is to collect data at as many points as possible and connect different aspects of infrastructure, from traffic management to water service, to the same network.

The biggest component of the Hidden Smart City is sensors stationed throughout the water and stormwater collection system. Sensors will monitor water service, delivery and management as well as quality. The sensors will actively collect data about the amount of water being used at all hours of the day, where it is going and coming from, and if it is being used efficiently. Over time, this data will become richer, showing the pitfalls of efficiency in water use in the city and help correct them to ensure little waste of water and lower costs to the residents and government.

Another aspect of the sensor-driven water lines will be the ability to manage flooding. With recent events demonstrating New York City’s susceptibility to flooding during heavy storms, resiliency for such measures is critical. The sensors in the water lines at the site will help prevent backlogs in the water collecting process because the sensors will engage with the rest of the network in real-time and determine where stormwater should be diverted to limit the impact. With this design, communication within the system will automatically shift water management to facilities that are not at full capacity.

Central to the Hidden Smart City is a smart grid that adjusts where it provides resources based on actual supply and demand. For example, the sensors in water lines would aggregate data over time to help determine future demand on different days and times, getting smarter as more information is collected. These types of artificial intelligence systems can be applied to the power grid and traffic lights to help efficiently deliver power and energy throughout and around the site.

The Hidden Smart City will extend beyond the infrastructure system within the site to the streets through Intelligent Traffic Management. Currently, most transportation planners rely on road tubes or hand-counts to measure traffic flow on any given streets. Around this site, we plan on placing Bluetooth sensors and other data collection modules on the street lights and lighting structures to gather data as it relates to traffic speed, congestion and vehicle counts. As with any technological investment, the Bluetooth sensors require an upfront cost. However, the initial investment will be less costly than conducting standard traffic counts. The Bluetooth sensors will also provide rich, anonymous data that is applicable to other potential uses. Meanwhile, the modules will measure noise levels, temperature, and other key data indicators similar to what is being collected in Chicago through its Array of Things program.

The Hidden Smart City infrastructure can also be visible to users of the site - but their effects will be hidden and appreciated. These visible elements include permeable surfaces for the walkways and bike lanes, rain gardens, increasing the canopy of trees along 11th Street, and retention basins. Another feature will be a Pollinator Pathway, a visionary idea created by Sarah Bergmann which connects existing green spaces, such as the High Line, around the site (Bergmann, n.d.). Each of these surface points will collect stormwater runoff, nourish the soil of gardens, enhance the air quality around the site, and help minimize heat island effect. In addition to collecting greywater from the building, each of these sustainable measures will feed into the sensor-powered water system and attempt to be net-zero in water use at the site.

**EXTERIOR SMART CITY**

**Themes: Smart Mobility, Equity/Inclusivity, Placemaking**

Smart City technologies inform New Yorkers’ interactions with 76 11th Avenue before even entering the building. The ways in which people arrive at the site and move around the site are heavily influenced by smart mobility and access technologies.

Distinctly positioned between the High Line and the Hudson River Greenway, the 76 11th Avenue site is a hub for multi-modal transportation. Entry from the north on 18th street emphasizes pedestrian, bike, and public transit access. The 17th street entry accommodates cars only and a connector from the High Line to the 2nd floor of the building provides easy access to the bottom two publicly available retail and open space in the building. 18th street
Beyond the High Line - Kansas State University

would be an ideal road to upgrade using the “Complete Streets” model. This model provides safe access “for everyone... including pedestrians, bicyclists, motorists and transit riders of all ages” to the site (Complete Streets, 2017). Following the Complete Streets model, 18th street would have separated bike lanes moving both directions, as well as space for vehicles and public transit modes. Adjacent to the bike lanes, automatic counters will be installed. This will provide real-time, smart data on the number of bicyclists using the bike lanes near the site.

Wi-Fi enabled street lamps and trash cans around the site interact with “responsive street furniture” surrounding the site. The street furniture senses the needs of pedestrians and accommodate by allowing extra time to walk across the street or by reading the name of the street aloud to accommodate the blind (AM, 2015). All street sidewalks and crossings surrounding the site includes sensors to determine appropriate signaling for pedestrians. The streetscape will also include smart stormwater runoff systems to effectively guide water runoff to management areas with less demand as determined in real-time.

One mechanism for minimizing conflicts among transit modes is to separate motorists from cyclists and pedestrians (Retting et al, 2003). For this reason, vehicle access to the site is limited to only 17th street. Vehicles enter from 17th street and park vehicles in an automated underground parking garage. This garage, modeled after “The Lift at Juniper Street” in Philadelphia, Pennsylvania, provides increased parking density and space efficiencies while also decreasing vehicular carbon emissions up to 83% in the garage. This automated parking technology allows for decreased square-footage per parking space due to lack of necessary parking lanes and ramps. In addition, electric and HVAC costs decrease within the garage because cars are moved to available parking spots without the need for people to enter the garage at any time (Lift, 2012). In order to support transit alternatives with positive environmental impacts, charging stations for electric vehicles, car sharing, and bike parking options are integrated into the underground parking garage.

Those seeking a car share experience utilize an online reservation system to retrieve the shared-use vehicle from the automated garage. One distinction is that shared-use vehicles are parked on the garage level closest to the entrance to ensure a quicker retrieval for car-sharers. The one vehicular exception on 17th street related to this site are the pick-up locations for taxis and ride-hailing options like Uber and Lyft. In addition, automated bike parking is available in the underground garage area. Access to this parking resides on the 18th street entrance. Publicly accessible showers are available for bike commuters on the lower levels of the building. Separate from vehicular access to the parking garage, the 18th street access point for bicyclists continue to minimize conflict with cars while providing secure, indoor bike parking away from the outdoor elements.

At present, four CitiBike bikeshare stations are located within a 0.25 mile radius or five minute walk of our site. Rather than introduce another bike

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Figure 4: Site Plan This view of the site shows the various Smart City elements around the design site (Regan Tokos, 2017)
share station at the site, the number of available bikes and empty bike docks per station are shown on "Transit Screens" throughout the site. A multitude of transit modes radiate from this site, however, it is critical for information on these mode options to be readily available and easily accessible. Transit Screens, strategically positioned throughout the site, inform site users of arrival times for nearby bus lines, distance to and availability of nearest bike share stations, access to car-sharing services housed within the building, and portals to mobility platforms such as CityMapper and Moovit. The transit screens serve as a Smart Hub for New Yorkers to connect to transit options at the site and beyond.

For those that elect to walk about the site, 76 11th Avenue will be the first location in the West Chelsea neighborhood to feature LinkNYC stations. The “first-of-its-kind communications network” will enable pedestrians to access free, superfast Wi-Fi, ability to make phone calls and charge devices and use a tablet that to utilize city services, maps and directions. Currently, the nearest LinkNYC stations are situated in Central Manhattan, showing a potential location to expand the service to the West Chelsea area. Our site will encourage pedestrian activity, through a public plaza and direct access to the High Line, which demonstrates demand for LinkNYC stations is expected to increase at the site.

76 11th Avenue acts as a built green space link between the High Line and the Hudson River Greenway. The two buildings on the site include residential, office and retail space. Between the buildings, however, is public green space serving the environmental purpose of storm water filtration and open space for residents, commuters, and workers. In addition, the space below the High Line will be transformed into a public space inspired by the "Underpass Park" designed for downtown Toronto (“2016 ASLA Professional Awards,” n.d.). With public art from Chelsea artists, smart sensors managing the park lighting, and vegetation to soften the hard edges of the cityscape, the Below the High Line park contributes to the greenspace grandeur of the entire 76 11th Avenue site.

INTERIOR SMART CITY
Themes: Smart Energy, Smart Building, Placemaking
It is vital that the themes presented on 76 11th Avenue are consistent throughout all of the its components to ensure that the occupants enjoy the characteristics that drew them into the site. The Interior Smart City contains the technologies and innovations that provide a pleasurable experience to those who visit it while connecting them to the surrounding neighborhood.

One of the greatest innovations implemented on 76 11th Avenue is its energy generation and conservation. It is connected to a smart grid, therefore only consuming outsourced energy that is in demand; this prevents a continuous flow of energy from entering the site and becoming wasted when it is not in use. However, not all of 76 11th Avenue’s energy is acquired from off-site sources. The site’s 112 photovoltaic panels is estimated to generate nearly three-fourths of its energy usage. These panels can be found nested among the vegetation on the green roofs, atop the bus shelters, and in other inconspicuous locations on-site. Some of the panels provide energy to charge electric vehicles, which are given parking priority on the first floor of the underground parking garage. Additionally, many of the building’s windows are comprised of transparent solar panels, serving direct and indirect needs of the site.

The project team for 76 11th Avenue achieved LEED platinum certification for the building, primarily for cost savings and its environmental benefits. Per requirement and credit achievement, significant energy conservation efforts were made. The outdoor lighting is solar-powered and lit by efficient CFL bulbs. These lights also contain motion sensors to shut off whenever lighting is not necessary; some areas do need to be lit at all hours, including at night, and the lighting motion sensor in those areas switch to dimmed lighting when there is no movement. The indoor lighting is controlled by demand response technologies, only lighting up rooms when they are occupied to ensure lights are not left on when the rooms are empty.

The unique, forward-thinking design of the building constructed on 76 11th Avenue stands out among the buildings of the Chelsea Neighborhood, both historic and modern. Its aesthetic appeal draws attention, but the design has practical benefits as well. The angled slopes of the structure allow for natural ventilation, reducing the environmental and economic impacts of the building’s cooling processes and providing continuous fresh air to the occupants. Fresh air enters the building’s inlets through its low angles, which face west toward the cool Hudson River. Then the air rises and exits through the outlets on the top tier on the east side of the building that faces and rises over the High Line.

Some site locations and seasonal patterns require HVAC systems nonetheless, particularly the apartments on the top floors, which receive hot air that rises due to the natural ventilation. These systems are monitored by meters and through a commissioning process. Hourly and annual consumption rates are provided by the meters, which are used during commissioning to identify areas in need of conservation improvements throughout the building’s life cycle.

Similarly, potable water consumption is monitored by building meters to collect data and to determine where to reduce use over time. Metering also helps to identify locations that could benefit from grey water reuse. This, in turn, further reduces potable water consumption and utilizes water that could otherwise cause stream overflow, runoff, and pollution. Water fixtures and lavatories use WaterSense fixtures, which further minimize water consumption.

The Interior Smart City innovations of 76 11th Avenue reflect the other innovation categories stated above. On-site smart energy consumption mirrors the Hidden Smart City infrastructure and energy system efforts; smart building technologies echo those presented in the Exterior Smart City by their visibility.

Smart building technology is used by the building operators and owners for management and anonymous data collection purposes. However, the building occupants benefit from these technologies as well. Efforts were made by the project team to connect the LinkNYC technology in the form of free Wi-Fi, connecting occupants and residents to the surrounding...
area while they are occupying 76 11th Avenue. The network connects to user tech, such as personal computers and stereos, and to building utilities, such as the demand response and HVAC systems. This allows for wireless connectivity, reducing installation and repair maintenance and providing aesthetic appeal to the interior spaces.

The Interior Smart City does not rely simply on technology, however. Exterior connections between 76 11th Avenue is followed by connections created within the site. Spatial and human interaction is encouraged by the progressive design of the site. The open layouts of the green spaces, building centers, and many of the retail centers foster relationship-building between the occupants. Some interior spaces open up to other floors of the building as well, bridging the two floors of public space to the residential floors above. Similarly, shared open space between the green roofs, balconies, and vegetated courtyard on the ground level cultivate a relationship between the areas, removing any implied barriers within the site. The High Line opens up to a patio on the second level of the building, intertwining the two spaces to promote inclusivity and welcome visitors to the site.

The spatial and structural design connects people to the outdoor spaces while they are indoors, and vice versa. Large windows in the public spaces provide expansive views of the flora and fauna outdoors while simultaneously providing insight to the design and connections of the indoor public spaces.

Design features intertwine 76 11th Avenue to the cultural significance of the Chelsea Neighborhood as an art district. Original works of art from Chelsea residents permeate the entirety of the site. From the artistically structured bicycle racks to the extraordinary design of the building and its sculpted furnishings inside, the site would not fit into the Chelsea Neighborhood as well as it does without it. Murals cover the walls of the building, inside and out, throughout areas on all of the site’s levels.

An avant-garde percolating wall is erected beneath the High Line as a wall along the path that connects the vegetated courtyard to the site’s eastern side green space. This wall is an artistic, energy-efficient approach to stormwater management; thin, slow-drip pipes carry runoff from the sloped rooftops and the High Line between two blue-tinted panes of glass. The water flows into a drain basin for storage; from there it is pumped to different facilities, such as washing machines, lavatories, and watering hoses, to be used in place of potable water.

Two important aspects of smart cities is connectivity and reflectivity. The Hidden and Exterior Smart City components that draw people to 76 11th Avenue are reflected within the Interior Smart City, connecting the site as a whole and promoting inclusivity and sustainability.

**SMART NEW YORK CITY**

**Themes: Smart Mobility, Smart Governance**

Connecting the site to the wider network of New York City was discussed in Hidden Smart City and Exterior Smart City. However, it is important to stress the site will be the center of encouraging strong public-private partnerships and transparent data. The City government already provides the NYC Open Data portal. Therefore, for 76 11th Avenue, all the information gathered from this site will be accessible to outside groups and developers through this portal. To avoid privacy issues regarding the data collected, the type of information will not be tied to a specific person or identity.

The City of New York already implements several Smart City projects that can be connected to aspects of this site. For example, New York City’s Department of Environmental Protection has instituted an advanced Automated Meter Reading (AMR) system. The AMR uses a low-powered radio transmitter that sends readings to rooftop transmitters and directs that information to a central office. This site will also use this AMR system to help feed the city-wide network, which
has resulted in financial savings to the City and residents while also addressing water leaks at a household level. The AMR system is one way in which this site will utilize current projects from the City of New York while also implementing new practices to provide further and data information.

The site’s ability to connect to the wider network of infrastructure in New York City will help public works officials address problems. While residents and visitors to New York City are able to use the New York City 311 app to report complaints, the site will empower those app users even further by having Wi-Fi nodes around the site to make sure users are connected beyond cellular usage.

Transparent data is a vital piece to the site being within the Smart New York City framework. The goal is to have New York City residents and non-governmental agencies with access to the same type of data as the government departments. Data collected from sensors and nodes will be accessible to the public at no cost and in an easy-to-understand format. The access to the data will enable improvements to be made at a faster pace and create important buy-in to the connected network from the public and private sectors.

To connect the site to one of its major features, the High Line, 76 11th Avenue will be the launching point of one-of-a-kind app aimed at supporting the users of the site. “the line” is a new mobile app made to provide High Line users with an organized, easy-to-use information center that can be accessed at their fingertips. The app allows users to discover where nearby busses, businesses, and bike and car share programs are located. The app also gives information on when busses will arrive at stops near the High Line. To know how to get to the public transportation stops, the app provides information on access points where people can enter and exit the High Line. The app will also let the user know how far away one is from a LinkNYC station as well as bus stops or bike share stations. To measure how long it will take to get there, “the line” allows users know the length of time it will take one to walk to the next location or mode of transportation.

**FUNDING**
Funding for the site will rely on private businesses, nonprofit organizations and the City of New York to implement aspects of this Smart City plan to the site. Currently, the City of New York steers many Smart City projects throughout the city through the Mayor’s Office of Technology and Innovation. This site will become a prioritized area for the City, demonstrating its ability to collect valuable data and implement innovative ideas in a pilot-project way.

As for private partners, technological companies such as Microsoft and Alphabet/Google can be utilized to create the network for the Internet of Things (IoT). Microsoft is a premier sponsor of the Smart Cities NYC ’17 conference in May, demonstrating the company’s desire to be at the forefront of the Smart City movement and within New York City. Meanwhile, Alphabet and its subsidiary Sidewalk Labs already operate in the city, giving the site a local partner to implement aspects of the project. A partner like Alphabet/Google can also deliver projects that do not strain existing infrastructure but still provide Smart City elements, such as the recently launched Parking feature on Google Maps. This system works by combining “crowdsourced data and relatively simple machine learning algorithms to classify parking difficulty.” (Hwang, 2017) Also, to help provide connectivity service for the proposed elements, companies such as AT&T or Verizon can enable more people to use the features of the site.

Potential nongovernmental groups are the ones who stress the use of innovative technology for public benefit. In Chicago, its Array of Things initiative has partnered with the National Science Foundation, University of Illinois at Chicago, Argonne National Laboratory, and many others to collaborate on leading technologies to implement in the area. These partners can provide researchers and developers as resources around the site. Ultimately, the goal is to align as many leading collaborators around this site to provide the time and resources to gather data and implement its findings.

**CONCLUSION**
The site, located at 76 11th Avenue, will be a public gallery of why cities and its residents should embrace Smart City technology. From access to multi-modal transportation to LinkNYC connectivity stationed around the site, all those that take part in the site will benefit from the technology. This plan identifies Smart City elements that can be applied from a framework of Hidden Smart City, Exterior Smart City, Interior Smart City, and Smart New York City. The site also falls in line with the One NYC comprehensive plan, addressing themes of growth, equity, sustainability and resiliency. Ultimately, the site will connect the lives of all in New York City, one Smart City element at a time.
REFERENCES


