

Stafford Smart Town Center: Strategic Roadmap Vision, Strategy and Operations Report

Prepared by:



CONVERGING MISSION,
INNOVATION, AND TECHNOLOGY

**1676 International Drive
Suite 1100
McLean, Virginia 22102**



Table of Contents

1	INTRODUCTION	5
1.1	Executive Summary	5
1.2	County Overview	5
1.3	Stafford Smart Town Center Vision	8
1.4	Stafford Smart Town Center Value	11
2	GOALS, OBJECTIVES, AND MEASURES OF SUCCESS	15
2.1.	Goal One: Create an Attractive, Livable and Vibrant Place	15
2.1.1	Objective 1.1: Design a Multi-Use Location with Broad Appeal.....	16
2.1.2	Objective 1.2: Attract and Retain New Residents.....	16
2.1.3	Objective 1.3: Enhance Public Safety through Environmental Design	16
2.1.4	Objective 1.4: Connect Local Buildings with Safe Bike and Walking Paths.....	17
2.1.5	Objective 1.5: Plan for Future Needs of Citizens	17
2.1.6	Objective 1.6: Leverage the Strengths Already in Place	17
2.1.7	Measuring Success.....	18
2.2	Goal Two: Create New Commerce	18
2.2.1	Objective 2.1: Attract New Retail and High-Quality Food Establishments	18
2.2.2	Objective 2.2: Attract High-Tech Businesses.....	18
2.2.3	Objective 2.3: Attract Hotel and Lodging Businesses	19
2.2.4	Objective 2.4: Attract Medical and Health Businesses	19
2.2.5	Objective 2.5: Expand the Sports Complex	19
2.2.6	Objective 2.6: Community College, Training Center and Meeting Facilities	19
2.2.7	Measuring Success.....	20
2.3	Goal Three: Plan for Future Needs of Citizens and Businesses.....	20
2.3.1	Objective 3.1: Provide a Robust and Reliable Infrastructure.....	21
2.3.2	Objective 3.2: Build a Sustainable Roadway Grid	21
2.3.3	Objective 3.3: Attract Data Centers to Promote Tech Businesses	21
2.3.4	Objective 3.4: Attract Major Corporations with Warehousing Needs.....	21
2.3.5	Objective 3.5: Protect Data and Maintain Privacy.....	21
2.3.6	Objective 3.6: Establish an Innovation Hub	21
2.3.7	Measuring Success.....	22

3	SMART TOWN CENTER STRATEGY.....	23
3.1	Strategy 1: Build on Current Strengths.....	23
3.2	Strategy 2: Build to Future Strengths	24
3.3	Development Strategy.....	24
3.4	Innovation Strategy	24
3.5	Technology Strategy	25
3.5.1	Communication and Information Technologies.....	25
3.5.2	Supporting Infrastructure	25
3.6	Service Delivery Strategy.....	25
3.6.1	Connectivity	25
3.6.2	Citizen Services	26
3.6.3	Public Safety and Security.....	26
3.6.4	Recreation.....	26
3.6.5	Walkways and Bike Paths.....	26
3.6.6	Water Elements	26
3.6.7	Sports.....	26
3.6.8	Farmer’s Market.....	27
3.6.9	Entertainment and Amusement	27
3.6.10	Memorial and Statue(s)	27
3.6.11	Life-Long Learning.....	27
3.6.11.1	Children’s Digital Museum.....	27
3.6.11.2	Lectures	27
3.6.11.3	Digital Library.....	27
3.6.11.4	School Programs	28
3.7	Operations Strategy.....	28
3.7.1	Staffing Public Safety	28
3.7.2	Ongoing Training	28
3.7.3	Emergency Preparedness	28
3.7.4	Dedicated Technology and Operations Management	28
3.7.5	Parking Management.....	29
3.7.6	Trash Management	29

3.8	Marketing and Promotion Strategy.....	29
3.9	Primary Funding Strategy.....	29
3.10	Additional Funding Strategies	29
3.10.1	Developer Investments.....	30
3.10.2	Government Grants	30
3.10.3	Sustainability Fund.....	30
3.10.4	Monetize Data.....	31
3.10.5	Public-Private Partnerships.....	31
3.11	Community Engagement Strategy.....	31
4	SMART TOWN CENTER REQUIREMENTS	32
4.1	High-Level Design Concept for Smart Town Center	32
4.2	Technical Requirements	33
4.2.1	Cloud Computing	34
4.2.2	Integrated Networks and Communication Infrastructure	34
4.2.3	Middleware Infrastructure.....	34
4.2.4	Solution Innovation and Service Integration	34
4.2.5	Smart Town Center Dashboard and Governance	34
4.2.6	Social Computing and Social Media.....	36
4.2.7	Integrated Command Center (ICC)	36
4.2.8	Smart Parking.....	39
4.2.9	Smart Lighting and Smart Poles.....	40
4.2.10	Smart Stafford Digital Platform.....	41
4.2.11	Integrated Emergency Operation Center (EOC).....	42
4.2.12	Emerging 5G Networks and Services	42
4.3	Services.....	43
4.3.1	Citizen Services	43
4.3.2	Business Services	44
4.3.3	Government Services.....	45
4.4	Operational Requirements	45
4.4.1	Dedicated Technical and Operational Staff.....	45
4.4.2	Outsourcing of Technical Services	45

4.4.3	Data Protection, Privacy and Governance	46
4.4.4	Training.....	47
5	RECOMMENDATIONS.....	48
6	APPENDIX.....	50
6.1	Appendix A: Information Sources	51

TABLE OF FIGURES

Figure 1: Proposed town center area.....	
Figure 2: Artist’s rendition of the Stafford Smart Town Center concept	8
Figure 3: Sample generic smart city infrastructure.....	10
Figure 4: Shuttle bus service to the Shady Grove Metro station in Rockville	
Figure 5: Stafford Smart Town Center goals and objectives	15
Figure 6: Strengths supporting the two-pronged town center strategy.....	23
Figure 7: Stafford Smart Town Center conceptual overview	32
Figure 8: Snapshot of IoT dashboard and visualization	
Figure 9: Integrated Command Center overview.....	
Figure 10: IC2 Strategy for security & emergency management.....	37
Figure 11: Smart parking features & benefits.....	40
Figure 12: Smart pole with Smart Lighting, EV charger, Wi-Fi, security camera, and environmental sensors.....	
Figure 13: Integrated IoT platform architecture	41
Figure 14: Stafford Smart Town Center benefits.....	43

1 INTRODUCTION

Optimal Solutions and Technologies, Inc. (OST) has created this document at the request of the Center for Innovative Technology (CIT) and Stafford County to visualize and plan for developing the *Stafford Smart Town Center*. The information contained in this document is for concept, strategy and planning purposes. After receiving feedback from CIT and Stafford County, this draft will be finalized to derive technical specifications for Stafford Smart Town Center, which will be used as a part of the overall Request for Proposal (RFP) to be released by the county.

1.1 Executive Summary

In planning for the future, Stafford County's smart growth strategy includes a comprehensive transportation infrastructure and system, developing existing land in a responsible manner that provides optimal value to residents and visitors, while preserving the county's vast natural and historic resources (e.g., historic sites, forests, wetlands along the Potomac River, thousands of acres of public parklands, et al). To this end, local government and elected leaders have engaged with OST to visualize and design a new *Smart Stafford* concept, beginning with a new town center and infrastructure to support additional, controlled growth. With the help of the Center for Innovative Technology (CIT), OST has developed this report for Stafford County officials.

This document presents a vision and preliminary strategy and plan based on extensive interviews with a wide range of city officials, from the fire and police chiefs to County Administrator, as well as based on current market trends in designing and implementing smart cities around the world. The county vision matches the strategic future development plan and elements of that vision relating to the Stafford Smart Town Center project are included here. This document will be the foundation of additional, more detailed documents, to include technical specifications for the final RFP for the development of Stafford Smart Town Center.

1.2 County Overview

Stafford County is a fast growing, thriving community with unique opportunities and challenges. In many cases, these challenges and opportunities are the same. For example, as the third-fastest growing community in Virginia, the population is expanding and becoming more diverse, but traffic has become an issue. With 20% of residents under 18, the population is expected to grow to nearly 200,000 over the next 10 years – up from 146,000 in 2017.

Centrally located between Washington, DC and Richmond, VA (or more locally, between Prince William County and Fredericksburg), Stafford residents have access to many nearby employment and recreational opportunities, but there is little within the county itself to attract the locals. Stafford has a solid rural culture in the south and a growing urban culture in the north, but the two do not generally interact. For these and many other reasons, Stafford County has a chance to leverage its own diversity and strengths to grow into a truly vibrant, inclusive community for its residents and neighbors to enjoy. However, this will require public acceptance and detailed planning.

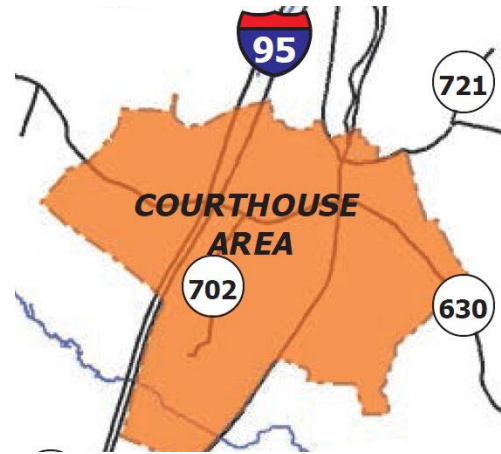


Figure 1: Proposed town center area

Stafford is one of the region's safest and most desired locations in which to live, work, play and raise a family. Unique and inviting neighborhoods are the centerpieces of development and feature walkable urban

experiences, anchored by arts and cultural amenities. Downtown Stafford is planned for the courthouse area around the intersection of Courthouse Road and Interstate 95, providing a variety of authentic shopping, service and dining opportunities. The hospital provides critical services and has sufficient land to expand as needed. The aquatics center and the Emery Hills sports complex attract athletes from across the nation. Stafford has two great rivers for recreation, plus several parks and historical facilities that are enjoyed by many.

County administrators have been fiscally efficient in delivering core services responsive to the ever-changing needs of this multi-dimensional community. Stafford County public schools represent the highest-quality education in Virginia, while residents and businesses have access to first-rate post-secondary education through Germanna Community College and the University of Mary Washington. Stafford has ready access to Interstate 95 (one of the busiest travel corridors in the country), which also has *dark fiber* (unused fiber optic cable) available for extensive broadband Internet access. In addition to the above, Stafford's business-friendly environment, impeccable reputation, and highly educated/skilled workforce is highly attractive to world-class businesses.

Despite the foregoing, approximately 77% of Stafford residents leave the county to work in other locations. Likewise, most shopping and entertainment dollars are spent outside the county. So-called "big box" stores and restaurants such as Target and Applebee's bypass Stafford due to lack of customer density and there are no major hotels. Traffic is known to be extremely challenging, yet there is no public transportation or large parking to accommodate events.

The last major development attempt in the county was unsuccessful. Rather than creating an attractive town center, the only theater in town was closed and only low-income housing was built. This has led to a general distrust of development projects among the local population. These negatives can easily be overcome with positive messaging and tangible results that show Stafford residents how new development meets their needs.

Stafford County has seen many national chains and businesses move elsewhere or refuse to locate within the county, and the tax base has taken a hit. Developing strategies to attract retail and other high-tech businesses is needed to avoid further commercial erosion and to attract new residents. With the sufficient population density, retail businesses, restaurants and entertainment, the new Stafford Smart Town Center will likely benefit the surrounding rural community by bringing in new revenue and tax sources to help keep Stafford's personal tax rates low.

Countless communities have experienced challenges and opportunities similar to Stafford County. The responses these communities adopted have had mixed results, with some successes and some failures. Unrestricted growth in such communities has led to overcrowding and traffic gridlock with a lower Quality of Life (QoL). Planned communities have maintained a better standard of living, and smart communities have taken city planning and QoL to new heights. Stafford leadership is committed to finding the solutions that work best for Stafford residents in a responsible, eco-friendly manner that embodies the local culture and values.

The key is to promote healthy, controlled growth that incorporates the local culture and enhances QoL. To that end, Stafford has identified the following strategic priorities:

- Provide an authentic town center that contributes to a lively and exciting community
- Execute healthy growth management strategies that add value to Stafford living
- Align new development and infrastructure projects with the county's comprehensive development plan
- Maintain tax rates and incentives that are attractive to investors and new businesses
- Promote Public-Private Partnership (P3)
- Incorporate local recreation, history and culture
- Create responsive transportation systems
- Include quality educational opportunities
- Support businesses through a positive job-growth environment
- Provide enhanced security and public safety
- Ensure organizational excellence
- Attract Millennials and retired citizens to live, work and recreate

These priorities directly align with the county's economic development goals, as well as, the priorities laid out in the Vision 2040 document.

A proper vision must be created and shared that identifies these goals and the benefits to the community. Such a vision is proposed in the following section.

1.3 Stafford Smart Town Center Vision



Figure 2: Artist's rendition of the Stafford Smart Town Center concept

A vibrant and authentic community where people live, meet, work and play, using smart technologies that enhance Quality of Life, security, well-being, and economic opportunities.

The transformational Stafford Smart Town Center vision can deliver equality, liberty and new economic opportunities to citizens and residents. Stafford County may not be ready for flying cars just yet, but the future is no less exciting. Leveraging the opportunities mentioned above, the *Smart Stafford* vision begins with the concept of a new Stafford Smart Town Center in the land around the I-95 and Courthouse Road intersection, which will become the new downtown Stafford. This is only the beginning. Expecting that expansion will occur outward from this location, the ultimate design will include the infrastructure and flexibility required to adapt to future growth and changing community needs.

The Stafford Smart Town Center will be the jewel of Stafford County – a place where residents and visitors can gather to work, play or relax. Incorporating local culture and art, the town center will provide an authentic, enriching experience for everyone (Millennials, retirees, families, etc.). It will attract residents from the urban north and rural south, and draw businesses seeking to benefit from Stafford's robust community, strong schools, and highly skilled residents.

With the proper design based on citizen's input, Stafford Smart Town Center can be *the* place to go, with something for everyone. A pedestrian-friendly center can incorporate upscale apartments, cosmopolitan restaurants, comfortable coffee shops, contemporary offices, relaxed gathering areas, and grassy areas with vegetation to showcase Stafford's natural beauty. A movie theater can offer the latest releases and a Whole Foods or similar grocery store and

farmers market can feature local produce grown in the southern part of the county. Fountains can add to the area's beauty and water features such as interactive sprinklers can let children cool off on a hot day. A modern digital library and/or children's museum with digital exhibits can enhance learning and showcase the arts, while a stage can be the center of public events. An artistic sculpture or monument featuring a historical or cultural theme can be displayed prominently, adding an extra touch of class to the area. First responders can manage a local command center with access to cameras and sensor data, reducing response time to medical, fire or other emergencies and ensure a safe environment.

The Smart Stafford concept will include the latest technology to efficiently deliver high-quality services, reduce costs, and generate revenue, but how exactly does it do that? A "smart city" is much more than a city with extensive Internet connections. Rather, it incorporates a wide range of environmentally friendly technologies to simplify community management, increase safety, and improve quality of life, while safeguarding privacy and supporting local culture. Smart technology has been implemented in foreign countries such as Singapore and Dubai, and in American cities from New York, Boston and Austin to San Diego and San Jose.

The first step is to plan the intelligent infrastructure that leverages the Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML), data analytics and visualization, anomaly detection, cyber security, asset/resource management, and other advanced technologies. Wi-Fi will blanket the Stafford Smart Town Center area with a 5th Generation (5G) wireless network, and businesses will benefit from the latest fiber optic cable advancements linking their computers to the outside world. Sensors and connectivity throughout the network will integrate a wide range of devices into an interconnected grid to provide opportunities that were unthinkable only five years ago.



Figure 3: Sample generic smart city infrastructure

The technical foundation for Stafford Smart Town Center will be the *Smart Stafford Digital Platform*, incorporating high bandwidth connectivity and the IoT. This cutting-edge technology can improve traffic flow, enhance community management, alert officials to pending emergencies, and allow unprecedented resident involvement in the community through their interactive communication devices including mobile phones and other devices. In addition to the technical grid, wide roadways with multiple lanes can be designed to accommodate autonomous vehicles (self-driving cars), anticipating traffic growth and ending gridlock. Pedestrian overpasses or tunnels can enable pedestrians to traverse major highways safely and without impeding traffic flow. Land around the Stafford Smart Town Center can be included in managed growth plans with the flexibility to meet changing demands and opportunities.

Such technology is not free, but there are numerous financial options that can minimize the cost and even generate additional revenue. Public-Private Partnerships have proven to be a win-win scenario for both businesses and governments. The county can offer land and permits in exchange for development and infrastructure. Investors and government grants can fund part or all of the requirements, and other financing options may be viable (see section [3.9 Primary Funding Strategy](#)). Well-structured P3 agreements can be profitable to businesses that invest, provide jobs for residents, increase revenue to the county, and bring this vision to reality at minimal cost to the county.

1.4 Stafford Smart Town Center Value

Smart development can add great value to a community. Two local examples come to mind: Tysons Corner and Rockville. Both of these have similarities to the Stafford Smart Town Center project and offer excellent lessons learned.

When Ted Lerner first staked his claim to the area in the 1960's, Tysons Corner was nothing but an empty cow field, but he understood that it was next to the junction of three major highways and close to the recently built Pentagon. It was, therefore, the ideal location for future defense contractors. By 2008, it had become America's 12-largest employment center. However, due to a lack of proper planning, the area is now a cement and steel nightmare. There is an abundance shopping and businesses, but the clogged roads make the area virtually unlivable. Expecting a populations surge from 19,600 people today to as many as 100,000 by 2050, county officials have drafted an urbanization plan to redefine the area with walkable city centers, seamlessly integrated public transportation, and acres of parkland.

As for Rockville, when Montgomery County was formed in 1776, Rockville served as the county seat. Rockville became incorporated in 1860 after the population doubled from 200 to 400. Despite the railroad opening a depot in the area in 1873, growth continued at a slow pace until it exploded after World War II. Due to rapid suburban residential development, population increased from 2,047 to 6,934 by 1950 and to 61,000 by 2010. Excessive traffic, combined with the lack of adequate parking, bike lanes, pedestrian walkways, and street lighting had become problems all too common to growing urban areas. Fortunately, the county adopted a *Town Center Master Plan*. The Rockville Town Square is now a mixed-use suburban infill project that includes restaurants, shops, public buildings, open spaces, for-sale and rental residential units, a 100,000-square-foot regional library branch, a 40,000-square-foot arts and business innovation center, and more than 2,000 parking spaces in three separate garages and on metered streets.

In both of these cases, location, opportunity and demand drove growth. In both cases, that growth led to problems due to insufficient planning. In both cases, as with Stafford County, the solution was a redevelopment project that included a cosmopolitan blend of residential, business, and cultural elements to revitalize the community and support future growth.



Figure 4: Shuttle bus service to the Shady Grove Metro station in Rockville

A few of the benefits anticipated for Stafford County are presented below:

SMART LIVING: The convenience of collocating apartments and hotels with shopping, recreation, and relaxation will increase QoL for all residents. The Stafford Smart Town Center can support a healthy lifestyle by providing bike paths and pedestrian access, perhaps including bike and scooter rental locations in the area. Building height would be limited to four or five stories, allowing everyone to enjoy an energizing sunrise or magnificent sunset. Incorporating nature, art and culture with a vibrant nightlife and special events can draw visitors from throughout the surrounding area and keep entertainment/shopping dollars within the county.

ATTRACTIVE PLACE TO WORK: Incorporating business offices near the Stafford Smart Town Center will increase the convenience to residents, many of whom now travel out of the county to work. Stafford's highly educated workforce could continue working in their chosen field close to home, rather than driving for hours to Richmond or Washington, DC.

CONVENIENT SHOPPING: The town center will incorporate desirable vendors that fit the style of the center and the community. Larger stores such as Target or Costco would be encouraged to open nearby, but would not be included in the town center itself to preserve a community feel to the area.

MODERN RECREATION FACILITIES: Bike and walking paths with exercise park areas can encourage healthy living. Access to the nearby aquatics and sports centers will be attractive to those who want to push themselves to the limit. Part of this vision is to expand the growing

sports tourism generating by the existing aquatic and sport complexes. Nearby rivers offer fishing and other recreational opportunities, as well.

INTELLIGENT TRAFFIC: Integrated road sensors, cameras and traffic lights can use AI and ML to optimize traffic flow, reduce carbon emissions and commute time, while eliminating gridlock. Self-driving cars can service special routes or corridors from the Stafford Smart Town Center to locations such as the Virginia Railway Express (VRE). Charging stations can be located throughout the area to support green electric vehicles (EVs), while establishing Uber or Lyft stops can minimize or eliminate the need to own a car.

SMART PARKING: Strategically placed smart parking lots or garages will keep automobile traffic outside the center, yet support the amount of cars expected for special events. Smart parking can use lights above each space that turn red or green to alert drivers to open spaces, and digital signs can direct drivers to levels or areas with the most available spaces. This increases convenience and reduces CO₂ emissions by intelligently directing drivers, who won't have to drive around aimlessly hoping to find a parking spot.

SMART LIGHTING: Smart lighting in parking lots and throughout the town center can use energy-efficient, cost-effective LED where possible. These lights can automatically turn on, turn off, dim or grow brighter, as programmed. For public areas such as parking lots, lights would maintain a minimum level of brightness for security reasons. Just for fun, lighting can be centrally controlled to shine in different colors for holidays and special events. In emergencies, lighting can be set to strobe, illuminating escape paths much like the floor lighting in an aircraft.

ENHANCED SAFETY AND SECURITY: A centrally located intelligent command center with connections to cameras and sensors can enhance the safety and security of everyone in the area. Sensors included in buildings, on light poles, and other tactical locations can alert officials to potential emergency situations. Flood sensors can send alerts when stream or sewer water levels rise rapidly. Fire alarms can provide the exact location of a fire. Traffic sensors can send an alert if traffic stops moving completely for too long, indicating a possible accident or roadway obstruction. Digital floorplans of each building can tell police, fire or medical personnel the fastest route to a facility or room, reducing response time and potentially saving lives. A secure communication platform with NextGen911 features can simplify reporting and information gathering during an emergency response.

SMART TRASH MANAGEMENT: Modern sensors can tell city officials when trash receptacles are full and require attention. They can also identify excessive levels of odor and potential problems with trash equipment. Alerts from these sensors reduce costs by proposing the most efficient route to empty the trash (rather than waste time visiting empty cans) and helping to maintain a clean environment for everyone to enjoy.

SUSTAINMENT: Smart buildings and green areas will contribute to an ecofriendly environment. The smart infrastructure can help reduce pollution from a wide range of sources, to include smart Heating, Ventilation and Air Conditioning (HVAC) equipment that maximize energy efficiency.

MOBILITY: Intelligent Kiosks can be located throughout the area, enabling patrons to find restaurants, identify services, and access important information. Cellphone apps can enable individuals to report accidents or emergencies, access a map of the area, make reservations, find parking, provide feedback to county officials, etc. Drones can deliver emergency supplies such as an Automated External Defibrillator (AED) to remote areas in minimal time.

Many other benefits can take advantage of a well-structured architecture and smart infrastructure. Stafford County is on the move. The future is now!

2 GOALS, OBJECTIVES, AND MEASURES OF SUCCESS

As described above, there are many reasons for Stafford County to develop and sustain a smart town center. Specific goals and objectives articulated by county officials are summarized in the following table and described in more detail in the sections that follow. A section on how the county may measure successfully meeting and exceeding these objectives follows each Goal/Objective section.

Current Strengths		
VISION		
<i>A vibrant and authentic community where people live, meet, work and play using smart technologies that enhance quality of life, security, well-being and economic opportunities</i>		
Goal One <i>Create an attractive, livable and vibrant place</i>	Goal Two <i>Create new commerce</i>	Goal Three: <i>Plan for future needs of citizens and businesses</i>
Objective 1.1: Design a multi-use location with broad appeal	Objective 2.1: Attract new retail and high-quality food establishments	Objective 3.1: Provide a robust and reliable infrastructure
Objective 1.2: Attract and retain new residents	Objective 2.2: Attract high-tech businesses	Objective 3.2: Build a sustainable roadway grid
Objective 1.3: Enhance public safety through environmental design	Objective 2.3: Attract hotel and lodging businesses	Objective 3.3: Attract data centers to promote tech businesses
Objective 1.4: Connect local buildings with safe bike and walking paths	Objective 2.4: Attract medical and health businesses	Objective 3.4: Attract major corporations with warehousing needs
Objective 1.5: Plan for future needs of citizens	Objective 2.5: Expand the sports complex	Objective 3.5: Protect data and maintain privacy
Objective 1.6: Leverage the strengths already in place	Objective 2.6: Community college, training center and meeting facilities	Objective 3.6: Establish an Innovation Hub

Figure 5: Stafford Smart Town Center goals and objectives

2.1. Goal One: Create an Attractive, Livable and Vibrant Place

Stafford Smart Town Center will be a vibrant place with plenty of activities and choices for those who live there. Walkable and safe, different housing options can meet the needs of single Millennials, young families, and retirees. Design elements such as variable lighting can make it really a cool place to live and visit. Safety will be enhanced through additional design elements and technologies such as smart lighting, smart sensors, and smart roadways.

2.1.1 Objective 1.1: Design a Multi-Use Location with Broad Appeal

Incorporating county culture and history, the town center should attract residents from the north, the south, and even outside the county. The range of businesses and services should make young, hip Millennials feel just as at home as local farmers and retirees. The density of the town center needs to be carefully designed to keep it affordable for young families. Amenities for children can include playgrounds, bike paths, parks, water splash areas, digital museum and other kid-friendly activities. Dog parks and other animal areas can serve our furry friends and their owners. While a Gen Z patron sips a latte, a Tai Chi class can take place on the green, athletes can jog, and kids can play. As needs evolve, the features and services can adapt to keep up with the community's changing needs.

2.1.2 Objective 1.2: Attract and Retain New Residents

Housing options from studios to luxury apartments or town houses can be welcoming to seniors, Millennials, Gen Zers, young families, and working singles. Only a short stroll away, single Millennials and new Gen Zers will find Wi-Fi connectivity, fun places to hang out, great places to eat, and cool places to live throughout the town center. Residents of all ages will benefit from the presence of Germanna Community College and other educational opportunities, healthy eating options, and various fitness options. Quiet areas to sit and enjoy the surroundings can also be highly attractive.

Research shows that Millennials and retirees have similar desires and needs, and they generally get along with each other. Involving Stafford retirees in community events can help to strengthen the sense of community and maintain the rich culture. Younger families will enjoy play zones, bike paths, and sport activities. Retirees will appreciate a safe, vibrant place where they can recreate, relax and engage in life-long learning. A new digital library can be developed to help children, students, and seniors stay active in learning. Why would you want to live anywhere else?

2.1.3 Objective 1.3: Enhance Public Safety through Environmental Design

Many people are moving to Stafford because of the very low crime rate. An effective environmental design, smart lighting, smart parking, and smart traffic management technologies can enhance safety throughout the town center. Sensors and cameras linked to the public safety operations center will alert officials and provide near-instantaneous details on any incident. The Public Safety Department's drone force can be incorporated to help keep residents safe. A satellite public safety center would also enhance safety and minimize response time to incidents. Smartphone applications created to report crime can take advantage of integrated technology platforms.

Residents have already proven they are open to using new technology. More than 2,000 residents already use the smartphone application *PulsePoint* to report health incidents such as a heart attacks or traffic accidents, enhancing public safety throughout the county. Reports are geo-coded to speed response through a connection to the county's Geographic Information System (GIS) system. The app also provides information on the nearest AED devices.

2.1.4 Objective 1.4: Connect Local Buildings with Safe Bike and Walking Paths

Stafford County is defined by two north-south barriers: I-95 and US Route 1. Developing a walkway over I-95, over Courthouse Road, and over Route 1 would connect the town center with the expanding hospital complex and unite residents in the East and West. Interconnected walkways/paths with smart technologies can alert officials of issues and improve safety in the surrounding areas. Wayfinding-type apps could enhance the user experience, highlighting history, culture, and flora and fauna information.

Well-designed access to rivers, creeks, outdoor sports/activities, and wineries can accommodate residents and visitors. Shuttle buses can connect the sports complex, VRE, and other attractions not accessible by bike or walking paths.

2.1.5 Objective 1.5: Plan for Future Needs of Citizens

The type of services provided will evolve over time according to the changing needs of town center residents. For example, single Millennials eventually will get married and start a family. Housing options within the town center will allow young families to thrive, along with retirees, empty nesters, and singles. Existing hospital facilities should expand to provide optimal care for babies, families, athletes, and seniors to cover all stages of life.

2.1.6 Objective 1.6: Leverage the Strengths Already in Place

Stafford County has a rich history beyond being the boyhood home of George Washington. Digital technologies can be added to existing museums to enhance the visitor experience. Perhaps a new museum trail can include a scavenger hunt experience that focuses on Stafford's rich history. Retirees and interested scholars could keep the history of Stafford alive by becoming docents at museums, giving talks in the town center, or writing on the county blog.

The Emery Hills sports complex attracts many visitors every year, hosting between 14 and 16 swim meets with 500 to 700 swimmers and approximately 30,000 spectators every year. Additional services and amenities can be added for these visitors beyond the single café in the center. On a busy meet day, the café generates \$5,000 in revenue. With a concessions fee of 13%, the additional revenue is a plus for the county. A new hotel with additional dining options adjacent to the property (or perhaps near the new I-95 interchange) can provide additional services (and county profits).

Meeting areas for events can provide a venue for public programs, such as the Sheriff's outreach program to school children. The strengths of Germanna Community College in health, physical fitness and public safety can strengthen the connection between the town center and the surrounding community. Today, the sports complex supports several interns from Germanna. Adding facilities and businesses can increase job training and internship possibilities.

2.1.7 Measuring Success

Communities who have established similar town centers have measured results through the following metrics:

- Tax and other revenue generated from businesses, tourists and residents
- Resident satisfaction (as measured by housing demand and quality of life indices)
- Visitor satisfaction (as measured by number of visitors year over year and visitor satisfaction surveys)
- Resident growth and demographic information, creating a diverse population mix
- Number and type of desired new businesses (e.g., restaurants, high-tech, etc.)
- Public safety measures (incidents, response times, crime rate, etc.)

2.2 Goal Two: Create New Commerce

Counties all compete for sources of employment and commerce. An attractive town center with a vibrant business activity will attract both visitors and people wanting to live there. Stafford has recently lowered its business tax rate and is now more attractive than Prince William and Spotsylvania counties. Stafford also has one of the highest rates of college and advanced degreed residents and according to the 2016 US Census, Stafford boasts the 20th highest median family income in the country. Stafford County also has two Hub Zones which make it easy for businesses to locate in Stafford. Stafford has no Business, Professional, Occupational License (BPOL) fees, no M&T tax, no aircraft tax, and no boat tax. Standard and Poor's and Fitch give Stafford AAA bond ratings. All of these, combined with access to high-speed data and smart innovations, should make Stafford County a very attractive place for businesses such as high tech, warehousing and distribution, data centers, health informatics, and cybersecurity.

2.2.1 Objective 2.1: Attract New Retail and High-Quality Food Establishments

The presence of retail and food establishments will attract citizens and visitors to the town center, especially with all the traffic on I-95 and spillover to Route 1. A Whole Foods Market, for example, can provide healthy food options for town center residents and will attract hotel guests looking for another dining option. Whole Foods Markets also contains Amazon delivery lockers so residents can pick up their purchases safely and securely. Attracting a Marshalls or TJ Maxx type of retail business will serve residents of any age.

A musical venue or central meeting place will also enhance the sense of community and the overall town center experience. Concession fees from concerts and other events also will add to the revenue base. In all cases, care should be taken to limit the noise of any events so residents are not disturbed.

2.2.2 Objective 2.2: Attract High-Tech Businesses

High-tech businesses tend to have higher salaries, and Millennials are attracted to high-tech. With the design elements for low-rise buildings, high-tech would be a good fit, creating a "knowledge-worker" campus and vibe. A designated economic development center or

innovation hub will promote entrepreneurship. The proper infrastructure support and low-tax enterprise zones will make Stafford highly attractive to such businesses, providing more employment opportunities to residents.

Many Stafford County residents work in highly technical positions, whether at Quantico or elsewhere in Northern Virginia. A short commute to high-tech businesses in the Stafford Smart Town Center will attract Millennials. The area would also be ideal for cybersecurity firms seeking to support the FBI, which wants to invest in cybersecurity capabilities. Training firms would find an opportunity to instruct the next generation of cyber experts as cyber continually evolves, possibly in conjunction with Germanna Community College.

2.2.3 Objective 2.3: Attract Hotel and Lodging Businesses

The current set of hotels are always full with visitors to Quantico Marine Base in the north. A new hotel closer to Emery Hills Sports Complex or near the town center would expand bed capacity and leverage easy access to I-95's new interchange. A national chain such as Marriott could offer proven hospitality solutions with dining options and meeting rooms.

2.2.4 Objective 2.4: Attract Medical and Health Businesses

Working in cooperation with Mary Washington Healthcare officials would attract complimentary medical and health related businesses that would mutually benefit the town center, the hospital, and Germanna Community College nursing and physical fitness students. The aquatics center's pool can help the injured recover through therapy and help residents stay active and healthy. Health informatics and analytics is another potential new set of businesses, and grants might be an option to benefit the hospital, Germanna, and the county.

2.2.5 Objective 2.5: Expand the Sports Complex

A second multi-use facility could provide services for gymnastics and attract regional meets, bringing additional revenue to Stafford. The facility also could host community events such as craft shows, debates, dances, and industry job fairs. The existing aquatics and fitness center in Emery Hills is already at capacity, constrained by all the soccer and ball fields adjacent to the center. A second facility would help meet the growing demand. Adding a childcare facility will meet the needs of young families and support a healthy lifestyle. Sports tourism is a growing business and Stafford can get a lock on the regional market for selected sports.

2.2.6 Objective 2.6: Community College, Training Center and Meeting Facilities

Germanna Community College (located south of the town center) is running out of space and hasn't been able to keep up with demand, especially for the nursing program. Given the school's strengths in health, physical fitness and public safety, a greater connection with the town center will enhance the feeling of community and provide additional opportunities for internships and mentoring.

The addition of an auditorium with training and meeting rooms will appeal to local businesses that are running out of space, such as those in Quantico. These rooms can be used and

managed by Germanna without the need to hire additional county personnel. Such facilities will also encourage businesses to locate in or near the town center. In conjunction with additional hotel rooms in the area, outside businesses can schedule training or meetings they would not now consider.

2.2.7 Measuring Success

This set of objectives is typically measured by:

- Number and diversity of new businesses (food, retail, hotel, high tech, medical)
- Taxes and revenue from new businesses (including concession fees)
- Percentage of available resident income spent in the county
- Percentage of residents working in the county
- Increase in sports tourism revenue
- Increase in enrolled Germanna Community College students

2.3 Goal Three: Plan for Future Needs of Citizens and Businesses

Because culture is always changing, the Stafford Smart Town Center will accommodate a wide range of amenities, but be flexible enough to grow organically and change as necessary. The land around the center will be available for future development as needed and appropriate.

Over the long term, a town center cannot survive without the essential services residents need and want nearby. Most people don't want to get in a car and hop on the I-95 just to run an errand or pick up a prescription, let alone see a movie, grab a meal, and shop. Residents want local access to groceries, dentists, dry-cleaning, and other essential services. Having a strong town center will meet these needs and encourage new retail businesses to locate within the county. Stafford residents currently spend most of their hard-earned dollars outside the county, but an influx of the proper businesses will keep that money in the local economy.

Incorporating the latest smart innovations in technology will help to facilitate these goals by attracting businesses that will provide the financial base required to support growth. Businesses greatly rely on technology today, so access to high-speed bandwidth and communications is indispensable. Fortunately, Stafford County has access to untapped data access through unused fiber optic lines along the I-95, which can attract data centers that will provide Internet access to support explosive business growth. Moreover, digital systems can efficiently identify current and future demand for physical and social resources through real-time data analysis, supporting long-term planning to drive economic activity and optimize resource management.

Digital technologies such as transportation, communications, energy, safety, water, and waste reduce resource consumption and costs, while enhancing performance and wellbeing. Intelligent roadways will optimize traffic to prevent gridlock, cellular towers will provide mobile connectivity, and smart buildings will reduce operational costs in a green environment. These innovations will make the Stafford County community more desirable to businesses and residents than less-advanced areas.

2.3.1 Objective 3.1: Provide a Robust and Reliable Infrastructure

The planned infrastructure includes a robust energy grid with sufficient power for current and future needs. Sufficient water sources and sewage infrastructure exist to support the growth expected over the next 30 years. A map of roadways is planned to accommodate traffic and eliminate the kind of gridlock experienced today. From a technical standpoint, Stafford County has access to the existing dark fiber network for the bandwidth required to incorporate IoT devices, support data centers, and meet the requirements of new businesses.

2.3.2 Objective 3.2: Build a Sustainable Roadway Grid

Roads will be designed using smart technology to optimize traffic flow. Lanes will be wide enough to ensure safety and include side parking, while the number of lanes will be sufficient to support the maximum traffic expected due to population growth. At the same time, various types of traffic will be routed to preserve the natural beauty of the area and provide access to Stafford's nature areas.

2.3.3 Objective 3.3: Attract Data Centers to Promote Tech Businesses

Data centers have been a prime revenue generator for many communities, not just in themselves, but for the follow-on businesses they attract. The Washington Metro Area (WMA) has become saturated, providing an excellent opportunity for Stafford to attract new data centers and the high-tech businesses that tend to accompany them.

2.3.4 Objective 3.4: Attract Major Corporations with Warehousing Needs

Building upon the data center concept, local businesses can expand in Stafford. Companies such as Amazon and Verizon that have large data and warehousing needs will no doubt find Stafford a very desirable area to grow. Not only is land available, but there is a ready local workforce.

2.3.5 Objective 3.5: Protect Data and Maintain Privacy

Smart town centers generate a great deal of data, all of which must be protected. This will require applying the best cybersecurity protection tools and processes. A data governance plan and training will be needed to keep the cyber skills of county staff and residents updated.

2.3.6 Objective 3.6: Establish an Innovation Hub

With an eye on the future, the Stafford Smart Town Center is only the beginning. As the name implies, the town "center" will be central to continued growth. This will be the hub from which additional business, residential and recreational districts will expand. The vision and planning process, plus the eventual technical specifications and Requests for Proposal (RFPs), will bear this in mind. For example, transportation, roadways, broadband/Wi-Fi capabilities, etc. will be designed to accommodate growth well past 2040, with the ability to include additional technologies that may be developed in the future. With the proper innovation hub, Stafford County can grow exponentially without facing the same problems that other expanding communities have faced (see [1.4 Stafford Smart Town Center Value](#) for additional details).

2.3.7 Measuring Success

At a minimum, measures of success for this type of goal typically include:

- Infrastructure components created
- Broadband up time
- Traffic management data (e.g., commute times, volume, number of accidents)
- Cybersecurity data (e.g., data breaches, cost of breaches, etc.)
- Privacy incidents related to technology and personal data
- Number of data centers, warehousing operations, and other desired new businesses
- Revenue generated from data centers, warehouses, and other new businesses
- Vendor performance data (e.g., percentage of Service Level Agreements met or exceeded)

3 SMART TOWN CENTER STRATEGY

We are recommending a two-pronged overall strategy for creating the new Stafford Smart Town Center:

- 1) Build on Current Strengths
- 2) Promote on and Build to Future Strengths

The following table summarizes the strengths of each:

Current Strengths	Future Strengths
Highly educated and trained workforce	New data centers that will, in turn, attract additional supporting businesses and jobs
Safe and secure community	New relationships with major corporations: <ul style="list-style-type: none"> • Amazon and Whole Foods will attract warehousing and distribution businesses • Cybersecurity and IT business will support large businesses and government agencies
Lower tax rates and strong incentives for businesses	Increased revenues from a new, diverse and expanding economic base
Cybersecurity requirements of local organizations such as the FBI, and military units at Quantico	A new training center in cybersecurity (in conjunction with Germanna Community College)
Growing Sports Tourism industry	Expanded sports facilities and increased Sports Tourism business
High-quality public school system	Expanded learning opportunities with Germanna Community College and satellite campuses of other universities
GEICO's presence	Additional insurance agencies in the county
Myriad of recreational opportunities	Easy access to natural and manmade recreation areas
Rich cultural history	Increased participation in the Stafford community
Central location in the county and surrounding area	Popular attractions to keep Stafford dollars within the county and draw patrons from the surrounding area

Figure 6: Strengths supporting the two-pronged town center strategy

3.1 Strategy 1: Build on Current Strengths

We have found that successful smart city development strategies are more successful when building off the strengths of the community. Stafford County residents are more highly educated and better trained than in other nearby counties and cities. The schools are academically strong and the crime rate is very low. Housing is affordable. There is a rich cultural history, while two rivers, multiple parks, and various nature preserves provide recreational opportunities. The county has established very attractive tax policies and incentives to attract and retain new businesses. The central location of the town center will make it an ideal place to leverage the strengths of the overall community. Additionally, as existing major metropolitan areas in the region (e.g., Tysons Corner) become more congested and expensive, Stafford County will

become ever more attractive as an alternative for nearby businesses seeking to expand in an area central to the WMA and Richmond.

3.2 Strategy 2: Build to Future Strengths

Attracting “seed” businesses that will bring other supplemental businesses is a proven, effective strategy to leverage future strengths. As Loudon County runs out of room for additional data centers and its community desires to stop building new ones, Stafford has an excellent opportunity to pick up this business. With Stafford’s attractive tax incentives, highly educated work force, and land availability, building data centers in the area will attract other supporting businesses. The presence of large companies such as Amazon and Whole Foods Market will attract not only residents, but additional warehousing and distribution operations, as well. Especially with its one-day (and potentially same day) *Prime* delivery, Amazon will need additional fulfillment centers in the area. Stafford’s central location to major population centers abundance of available land make it the ideal location for such distribution centers.

In addition to attracting private corporations, government agencies already located in the county will have an increasing need for cyber-related services and expertise. Working with these agencies, Stafford should be able to attract additional businesses to meet this need well into the future. New cyber certificate training can be developed in partnership with Germanna Community College to help train the local workforce in cyber and related technologies.

Lastly, the skilled call center workforce and sports-related capabilities that exist in Stafford can position future growth in these industries. Insurance agencies such as GEICO or federal agencies such as the FBI and Department of Veteran’s Affairs can expand into the area, as well.

The following sections provides details on the other required strategies: development, technology, service delivery, operations, marketing and promotion, funding, and community engagement.

3.3 Development Strategy

Development of the Stafford Smart Town Center will be a phased-in program in a P3 partnership, typically phased in over a period between 10 and 20 years. In the initial phase, infrastructure including the street grid, utilities, and technology platform will be designed and built. Service elements will be phased in over time consistent with the vision and the new County Master Plan. For example, there will be an opportunity to make connections between the town center and the new courthouse that will be completed in 2023. Over time, adopting a citizen-design process to build in elements desired by the people who live in the town center is a smart way to phase in development and evolve the footprint of the town center.

3.4 Innovation Strategy

The strategy is to incorporate the latest smart technology at every level of infrastructure to meet current and future requirements, based on an analysis of expected growth. A sufficient portion of the Stafford Smart Town Center should be dedicated for businesses to experiment with new and emerging technologies such as autonomous vehicles, AI, ML, new cybersecurity

solutions, etc. This area can be used to promote Stafford Smart Town Center as a modern, high-tech place where companies of small and medium size can work in an entrepreneurial environment. It is expected that this will attract larger businesses, which can be located in the surrounding area in a logical manner.

3.5 Technology Strategy

By incorporating the latest cutting-edge technical infrastructure in all development, Stafford County will be well positioned to meet current and future needs of residents and businesses. Areas that has less foresight have not been able to keep up with technological advances, which greatly limits their appeal. Retrofitting archaic infrastructure is highly expensive. The forward-thinking vision of Stafford leaders will place the county in an advantageous position at minimal cost by including the proper technologies in the Stafford Smart Town Center vision and design that can support growth well beyond the original development area.

3.5.1 Communication and Information Technologies

In addition to broadband, Wi-Fi, and 5G, many smart technologies will be needed: sensors everywhere, lighting, parking, and health (“push button” type safety features in all buildings, for example). County officials will need to assess the viability of new technologies for inclusion as they emerge over time, to include data storage, data protection, and cybersecurity technologies. Leverage existing strengths such as drones can enhance safety. A fleet of EVs can provide transportation to the elderly, perhaps augmenting the existing transit to and from Fredericksburg. Similarly, electric shuttle buses could link the town center to the VRE train station. Wayfinding technology and mobile applications can enhance the walking experience.

3.5.2 Supporting Infrastructure

The existing land parcel already has water and sewer lines. Electric utilities need to be built to accommodate all the smart technologies and expected population growth. Zoning changes to accommodate higher densities to make a town center financially viable will need to be addressed, as well as how the town center will handle waste removal, snow plowing, and parking enforcement. Lockable, movable traffic barriers to protect residents from random cars in a pedestrian area should be included as key public safety infrastructure element. To accommodate the anticipated growth (almost 200,000 by 2036), Stafford will likely need to build a new water reservoir.

3.6 Service Delivery Strategy

Services should be prioritized and phased in once the underlying infrastructure is in place. A wide range of desirable services are presented below.

3.6.1 Connectivity

Smart cities are built on advanced, intelligent communication and information infrastructure. Widely accessible, secure broadband and 5G will be a must-have service built into the town

center's design. Consideration should also be given to expanding the existing Stafford app to provide more information for residents and businesses alike.

3.6.2 Citizen Services

Self-service kiosks and or enhanced mobile apps can enable residents to get information, file for permits, pay taxes, get traffic and other information, etc. online. The kiosks themselves will be strategically placed nodes that can incorporate sensors and other new technologies, as they are developed.

3.6.3 Public Safety and Security

Public safety and health can be enhanced with smart technologies and community alerts such as air or water quality, flooding, and Hazardous Material (HAZMAT) warnings. The design should prevent surveillance camera sight lines from being blocked by buildings or the expected growth pattern of trees. Drones can rapidly deliver AEDs, medical supplies, etc., even to remote areas. An integrated public safety center, complete with police, fire, and rescue, should be incorporated that can also serve as an emergency operations center. Designated staging areas in the town center can leverage the best practices of the four shelters Stafford has now. Residents can also opt in to the Sherriff's alert systems, which is GPS based.

3.6.4 Recreation

Stafford has two great rivers, several parks, and historical facilities that many enjoy for recreation. Connecting the residents of the new town center with these elements must be considered. Some of these are described below.

3.6.5 Walkways and Bike Paths

Connecting both sides of the county (east and west) through walkways and bike paths over I-95, US Route 1, and Courthouse Road to enhance public safety and provide additional recreational opportunities.

3.6.6 Water Elements

Water elements are visually and mentally appealing to many. The many different terrains in the town center parcel can be leveraged to provide cool design elements like fountains and splash areas, as well as to collect rain water and promote flood control. Fountains, water walls, and sprinkler/splash areas can also enhance the beauty of the area.

3.6.7 Sports

The existing Emery Hills sports complex should be connected to the town center and consideration should be given to providing additional sports facilities. This would also leverage Germanna Community College strengths in physical fitness and physical therapy programs.

3.6.8 Farmer's Market

Given the mostly rural elements of the county, having a place where local farmers can sell their produce and products would help to bring the northern and southern communities together.

3.6.9 Entertainment and Amusement

Stafford County, like many other counties in Virginia, has a rich history of country and folk music. A multi-use facility or small amphitheater in the town center would be great for the residents and performers, plus enhance revenue by attracting visitors and their wallets. Incorporating museums, creating a visitor's center with fun scavenger hunts, or even something as big as an indoor skydiving center can provide additional local amusements. Rental boats for the rivers and scooter or bike rentals can also be a design element.

3.6.10 Memorial and Statue(s)

Elements honoring the memory of George Washington, freed African American slaves, and other local elements can honor Stafford's rich history while enhancing the beauty of the town center. Architectural elements such as an obelisk in the style of the Washington Monument or a tall clock tower can be outfitted with technologies such as sensors, cameras, and transmitters to enhance safety and the visitor experience.

3.6.11 Life-Long Learning

With the advance of technologies and the future of work, the town center could provide opportunities for residents to continue learning, whether for new employment or pure enjoyment. Several things to consider include:

3.6.11.1 Children's Digital Museum

An engaging children's museum featuring the rich history of the county would attract families from across the county visitors from swim meets or other sports events. The museum could be fitted with the latest digital technology to involve children in participatory exhibits and enhance learning through touchscreens, recorded audio, and even holograms.

3.6.11.2 Lectures

Learning presentations can be delivered by the experts at Quantico, associated high-tech companies, and experienced retirees living in the town center, much like the senior center in Silver Spring that has monthly international study lectures.

3.6.11.3 Digital Library

A market assessment should explore the creation of a new library. Many library systems are providing new services such as healthcare advice and digital videos or games tailored to adults or children.

3.6.11.4 School Programs

The town center should augment the rich array of non-sports programs offered to children of all ages. Robotics programs, for example, attract both boys and girls at the all grade levels. Sporting events can be tailored for kindergartners or children in higher grades. A music program, public safety, and anti-bullying programs can also be included.

3.7 Operations Strategy

There are several concerns for the efficient operations of a smart town center, including staffing public safety to appropriate levels, continuous training on smart technologies as they are deployed, emergency preparedness, dedicated technology management, parking management and trash management. A proper data collection and analytics strategy can help identify trends to forecast future needs. Proper planning can then incorporate a strategic phased-in approach of personnel and resources to meet demand as the population grows.

3.7.1 Staffing Public Safety

Given Stafford's recent and expected growth over the next 10 years, a staffing strategy for police and fire must be included. It is anticipated that the current staff will need to double over the next decade. This staffing strategy may include the public safety programs offered by Germanna Community College as a recruiting source.

3.7.2 Ongoing Training

Technologies will continue to evolve and county staff must stay abreast of them to determine they can be used effectively in the town center. For example, with the inevitability of EVs, public safety officials will need to plan the location of charging stations and prepare for contingencies if something goes awry.

3.7.3 Emergency Preparedness

In addition to well-trained public safety personnel, it is important to make residents emergency aware. That is, where to go in case of a flood, power outage, HAZMAT incident, or other emergency. Frequent drills will help, as will leveraging the technologies already in place (GPS, alerts, designated shelters, etc.). Backup water supplies may also be needed to tide the residents over during a prolonged incident. A study of the private dams will ensure the dams are safe and in good repair.

3.7.4 Dedicated Technology and Operations Management

Managing all technologies across the Stafford Smart Town Center will require dedicated staff to augment the technical staff within the Chief Technology Officer's (CTO) office and the Sheriff's staff that manage the drones. Stafford may consider using an outsourcing approach to efficiently and effectively manage these technologies.

3.7.5 Parking Management

Smart cities are increasingly using an outsourced, P3 approach to managing parking. There are several smart parking technologies readily available, and parking fees for non-Stafford residents can serve as a revenue source.

3.7.6 Trash Management

Today, Stafford County outsources its trash management to private firms. This likely will not work in a town center environment. However, the addition of trash sensors that alert officials when receptacles need emptying will save time and money by targeting only the areas that need attention, rather than a set schedule that includes visiting receptacles that don't need attention. This also will help to identify areas where more or fewer trash cans might be needed and reduce the problems and health concerns associated with overflowing garbage.

3.8 Marketing and Promotion Strategy

Promoting the new smart town center through print, television and social media will be critical to driving its success. Stafford County already has a large social media presence, complete with key influencers who support county programs. Social media will be one key strategy to leverage in attracting new businesses and residents. One key message is that Stafford is expanding its housing options to meet the needs of its growing population. Another key message is that Stafford is open for business in a location with low tax rates and central location. A third key message is that Stafford's cultural and agricultural history will be preserved and enhanced by the innovative smart town center.

3.9 Primary Funding Strategy

Smart town centers generally require working with one or more partners in a P3 for building and maintenance. This is Stafford's desired and primary funding strategy.

3.10 Additional Funding Strategies

Other funding streams may include grants from the Department of Homeland Security (DHS), the State of Virginia, or university grants for Research and Development (R&D) and technology demonstration projects. For example, South Bend, IN has a strong partnership with the University of Notre Dame to help analyze the water sensor data and to develop innovative solutions to address water quality issues. Vendors can provide financing for the "smart" technology components within the town center (poles, lights, parking, etc.) in conjunction with P3 funding. Smart parking systems and or congestion-based pricing may also be revenue sources for ongoing operations. Monetizing some of the data captured by smart technologies also may provide additional funds.

Smart parking systems and or congestion-based pricing (recently deployed in New York City) can be revenue sources for ongoing operations. Concession tax revenues (similar to that of the aquatics center and currently at 13%) will also provide revenue with the establishment of new concessions in the town center. Philadelphia is establishing Right of Way (ROW) leasing for

hardware vendors to install additional smart technologies on the 5G network. Some cities have established sustainability funds with savings from reduced energy consumption.

3.10.1 Developer Investments

Finding the right developer or group of developers will be critical. It is important that they have proven success and understand/share the Stafford County vision. The investment they are willing to commit to the various projects involved will also be important and can be an excellent indication of their commitment to the area.

3.10.2 Government Grants

The county is strongly encouraged to apply for various federal and state grants promoting eco-friendly development. A list of such opportunities should be compiled and evaluated as part of the planning process.

3.10.3 Sustainability Fund

The Philadelphia Office of Innovation and Technology (OIT) recently developed a smart city concept. We can derive several lessons learned from this development, as it is similar in many respects to the Smart Stafford projects, beginning with the Stafford Smart Town Center.

- **Digital Literacy:** Focused on increasing the skills and knowledge of City staff and residents.
- **Early Childhood:** Focused on increasing skills/knowledge at the youngest edge.
- **Litter Index:** Link to the GIS of all schools and city buildings.
- **Privacy Partners:** Work with organizations such as the American Civil Liberties Union (ACLU), International Freedom Foundation, and the Future of Privacy Forums for data governance.
- **Visibility:** Use 55" screens for ads, public service announcements on events and emergency messages.
- **Digital Accessibility:** Provide kiosks outfitted with tablets to access city services, maps and directions.
- **Metadata:** Create a catalog for improved data governance and interoperability.
- **Green Buildings:** Build automated systems to control HVAC in all city buildings to reduce energy consumption.
- **Carbon Footprint Reduction:** Implement an Automated Vehicle Locator (AVL) system for all city fleet vehicles to increase route efficiency and reduce vehicle use.
- **Inclusivity:** Implement a multilingual voice-powered system to collect and mine opinions, ideas, and thoughts (won the *AWS City on a Cloud Challenge*).
- **Vendors:** Establish ROW leases to hardware vendors.
- **Finances:** Establish a sustainability fund from energy cost savings.

3.10.4 Monetize Data

A portion of the data generated by the smart technologies deployed in the town center may be useful and attractive to businesses to help them understand buying patterns and customer needs. Stafford should keep this option open once data governance policies and practices are developed. Anonymizing the data will ensure no personal information is abused.

3.10.5 Public-Private Partnerships

Stafford County is seeking potential partners that are interested in participating in the development of next-generation Smart City deployment, funding technical solutions and providing planning, management and maintenance services (or a combination thereof). Potential partners must provide next-generation business models to achieve the county's overall Smart City and economic development outcomes. The county may consider a variety of technical approaches and funding models, innovative ways to share operational responsibilities and financial risks, and other benefits to the county.

These partner(s) will work with the county to develop an overall work plan to position Stafford as a prime location for residency and business through the development of comprehensive Smart City technology and systems with significant public value. The county should partner with the following investors:

- Organizations that are primarily financial based, wish to become a strategic public-private business partner, and bring the best-of-breed subcontractors for technical planning, systems integration, equipment provision, construction, management, systems operations, data capture/analysis and system/equipment upgrading and maintenance
- Financial and technical partners that can meet the county's value propositions for infrastructure development, technology deployment, financing, operations, and maintenance
- Partners with the proven ability to provide an implementation strategy and delineate value propositions for Smart City and economic development initiatives

Potential partners are encouraged to share their interests, both broadly and in terms of specific routes that can shape the direction and form of the new smart network.

3.11 Community Engagement Strategy

Town halls, group meetings, and community outreach forums will all be required to promote and message the benefits of the Stafford Smart Town Center. Leverage social media presence and Stafford's influencers to get the messages out on the content that we generate. Redesign the county website. Engage and support the Board of Supervisors vision and have messaging for them as they travel about the county. One such message would be, "Smart growth without overgrowth."

4 SMART TOWN CENTER REQUIREMENTS

4.1 High-Level Design Concept for Smart Town Center

Properly designing the Stafford Smart Town Center requires understanding the initial conditions and level of end-state functionality the town center wishes to achieve. The smart town center concept, design and architecture must be linked to the overall development plan for the area. Ultimately, the design and architecture driven by Integrated Command & Control (IC2) concept will become the central Stafford Smart Town Center technical architecture.

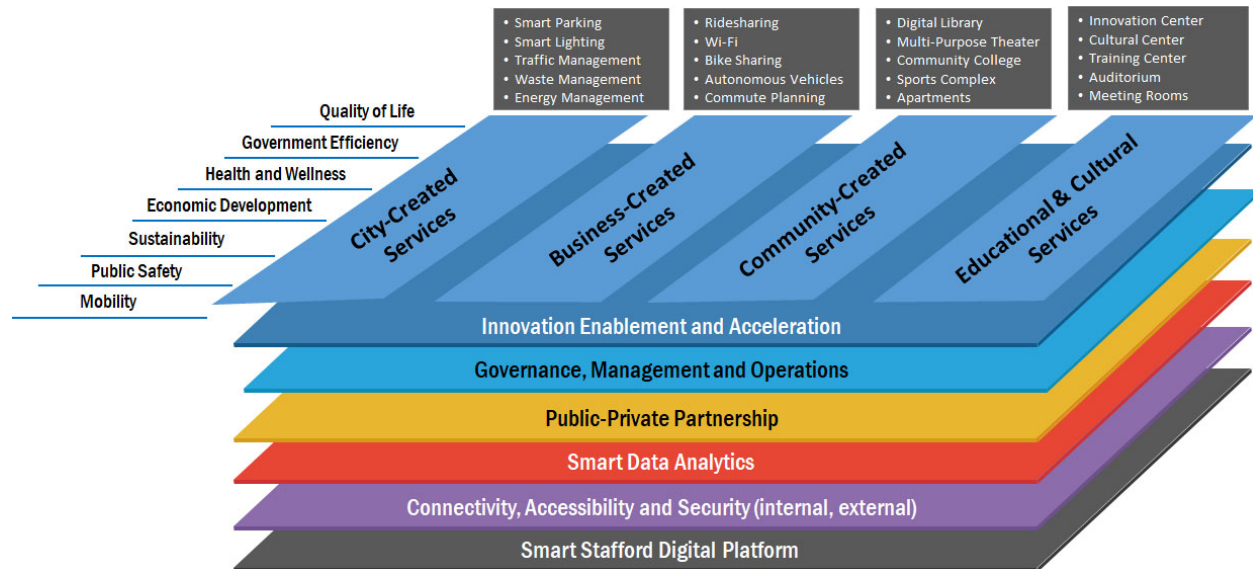


Figure 7: Stafford Smart Town Center conceptual overview

The following principles are required to support the Stafford Smart Town Center design, concept and vision:

CENTRAL REPOSITORY: While the decision to centralize or decentralize data and infrastructure should be tailored, aggregating data into a central repository (that still can live in multiple places for purposes of backup or access) can be a one-size-fits-all solution. With a single data repository where some data is rationalized and synced, data can be analyzed for patterns and anomalies, allowing city officials to see trends that might not otherwise have been captured at a local level only.

OPEN STANDARDS: A published, open-standards architecture accepts various technologies upon integration, and centralizes the display of network assets.

CENTRALIZED SITUATIONAL AWARENESS: Command and Control integrates individual modules into a system of systems across function and application silos helping city officials take action with lower latency based on event pattern, derived from independent applications into a centralized dashboard display.

SHARED ENTERPRISE APPLICATIONS, AND COMMUNITY COLLABORATION TOOLS: Coupling business-oriented objectives with tools to effectively monitor them and mirror these objectives. Enterprise Asset Management (EAM) can establish a uniform business process to monitor work orders, inventory, daily tasks, and asset management. This can be accomplished through Enterprise Resource Management (ERM) and Customer Relationship Management (CRM), with a focus on smart governance based on shared or cloud-based service options facilitating adoption. For example, connections with customer and business communities can be fostered via shared community collaboration tools to support initiatives such as market research, product development, and product feedback.

INTEGRATED REPORTING: Integration of information and services, and provided external access to citizens, facilitate internal governance and government transparency. Just as enterprises develop annual reports with online access and navigation through the data, cities should also expose their performance statistics, and raw data, metrics, and results.

CYBERSECURITY: The very heart of a Stafford Smart Town Center will be a network of integrated and interconnected devices that produces unidentified risks. To prevent personal information, (including financial information) from exposure to increasingly sophisticated cybercrimes, the Stafford Smart Town Center will require strict cyber security countermeasures built directly into its architecture. An established team must continually monitor and update policies and processes for vulnerabilities, while data and Personally Identifiable Information (PII) should be anonymized as much as possible.

MOBILITY: The world is ever moving towards mobile solutions. Therefore, the Stafford Smart Town Center framework shall incorporate the mobility with a rolled-up view, while still allowing non-mobility-based applications and solutions to plug into the network and technical levels. E-Government is a start, but the Stafford Smart Town Center should go further by taking advantage of social media/networking to not only communicate but also solicit feedback from citizens and businesses.

DATA ANALYTICS AND BUSINESS INTELLIGENCE (BI): Insight can be gained from real-time analytics, monitoring data quality and other services, and incorporating outputs from both government systems and social media. BI can support principles such as:

- Automation and synchronization of independent components with automatic discovery
- BI integrated with processes and applications
- Unification of differing process/data views to present a complete system picture
- Borderless exploration and analysis of system resources
- Broad BI architecture to manage integrated metadata and exploration technologies
- Self-service options for different levels of users.

4.2 Technical Requirements

The Stafford Smart Town Center approach is technology and vendor agnostic, with a focus on integration. For example, any vendor's products and devices should be Plug and Play (P&P) to

serve a particular need (smart buildings, smart parking, etc.), while the byproducts from that particular technology would supplement the architecture. The smart town center conceptual framework therefore offers a menu of options to Stafford, wherein only those modules that match its own key drivers will be implemented, emphasizing a convergence technology and systems. In general, several technologies buttress the Smart City framework and are incorporated into Collaborative Situation Awareness & Decision Making (Command and Control) to allow P&P of information and communication technology.

4.2.1 Cloud Computing

Allows applications to share fewer resources, leading to increased flexibility for enterprises looking to reduce cost but keep capability. Especially with the onset of Software as a Service (SaaS) and Infrastructure as a Service (IaaS), the cloud has become more viable for virtual data centers, even from security and availability standpoints. This construct also allows integration of heterogeneous data mashups across requirements by offering a virtualized data services and infrastructure layer.

4.2.2 Integrated Networks and Communication Infrastructure

A communications backbone to support data collection and transfer shall be the backbone of Stafford Smart Town Center. Ubiquitous broadband access is therefore of importance, so investment in networking and telecom infrastructure, often starting with Wi-Fi, is necessary. Another network element is the foundation for a smart electrical/utility grid. Radio Frequency Identification (RFID), sensors, and video surveillance technologies that leverage the broadband backbone can deliver real-time data for transportation, public safety initiatives, education and training, etc.

4.2.3 Middleware Infrastructure

Middleware links physical asset monitoring with databases and analytical engines, and span identity/access management from applications and web portals, to integration software and real-time updates of information across systems. Additionally, content management software allows the coordination and refresh of content across multiple city administration websites, both internal and external.

4.2.4 Solution Innovation and Service Integration

Virtually all technology components will come together in sector-specific solutions addressing a particular piece of the Stafford Smart Town Center puzzle, regardless of technology or vendor.

4.2.5 Smart Town Center Dashboard and Governance

The Stafford Smart Town Center will require new Smart City governance business-process supported by technology enablers through data and systems integration, while incorporating Command and Control (C2) as a roll-up visualization framework. Coupling recognized sector-specific solutions with the tools to manage them will provide a system of applications, including a dashboard with real-time information.

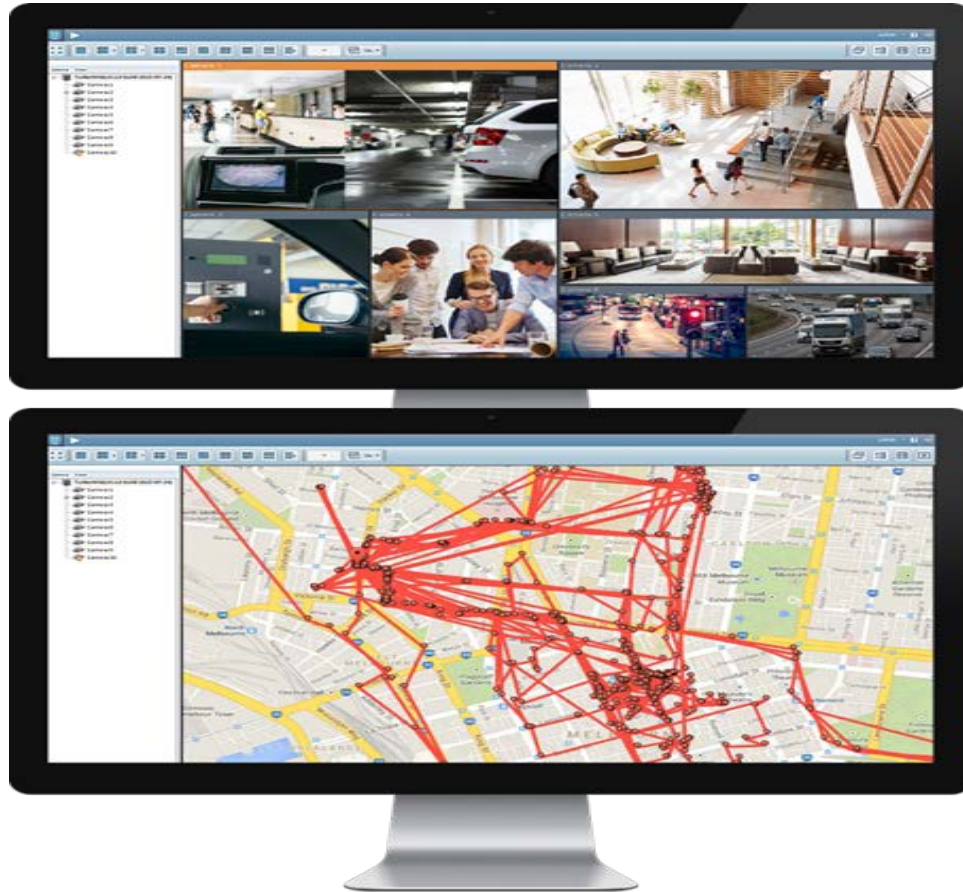


Figure 8: Snapshot of IoT dashboard and visualization

“Command” and “Control” are each processes in and of themselves. Command is the act of making decisions, while control is the process of implementing decisions. The conceptual model for understanding C2 must be understood in context of three specific sub-processes:

- **INFORMATION PROCESSING:** Converts operating environment data into useful information.
- **INTELLIGENCE PROCESS:** Governs how information is converted into awareness, understanding, and decisions at the individual or some shared level.
- **IMPLEMENTATION PROCESS:** Governs how decisions are converted into actions.

Each of these, in turn, is made up of other sub-processes. For example, information processing includes at least tasking, posting, search, discovery, fusion, retrieval, integration, information assurance, and collaboration. Intelligence includes cognitive processes, social processes, and others, such as decision-making that are both cognitive and social. Implementation includes planning processes as well the processes of conveying instructions and guiding the actual movement of objects.

Command and Control is not an end in itself, but it is a means toward creating value (e.g., the accomplishment of a mission). Specifically, C2 is about focusing the efforts of a number of entities (individuals and organizations) and resources, including information, toward the achievement of some task, objective, or goal. The following are essential C2 functions:

- Establishing intent
- Determining roles, responsibilities, and relationships
- Establishing rules and constraints
- Monitoring and assessing the situation and progress
- Inspiring, motivating, and engendering trust
- Training and education
- Provisioning

Each of these functions is enabled by appropriate information sharing policies and culture, and can be seen in the context of a particular time horizon. Provisioning, for example, is constrained to the allocation of existing resources for current operations.

4.2.6 Social Computing and Social Media

Rich trails of preferences, opinions, and behaviors left behind in a kind of “digital exhaust” can be mined, providing insight on positioning and citizen sentiment from both public feedback portals and social platforms alike. By applying search pattern matching and sophisticated analytics to these structured and unstructured reservoirs of social data, the county can better understand constituents’ perceptions and the problems that demand attention. A results-centric and business-led approach focusing on specific issues is important to incorporate into the Stafford Smart Town Center framework. Similarly, social network analysis allows for real-time modeling of behavior across the entire network – leading to better understanding and the ability to explore and manipulate data in the Command and Control solution. Incorporating social media, video, pictures, and electronic documents are needed to reach the next generation. The shift to digital content created via dis-intermediated channels represents a crucial element of social computing today.

4.2.7 Integrated Command Center (ICC)

We are proposing an integrated command center to integrate emergency responses, physical security, and cybersecurity in one integrated, intelligent platform. IC2 achieves unparalleled mission effectiveness by providing actionable information to the right people at right time. Its innovative approach uses information gathering, fusion, rich visualization and analytical techniques to integrate context-aware, real-time collaboration with situational awareness. Collaborative Situational Awareness significantly improves mission effectiveness through these capabilities.

The IC2 solution architecture brings together an integrated suite of mission-ready capabilities that enable decision makers to make faster and better decisions. The IC2 solution does this by enabling the user community (either within a single organization or across multiple organizations) to more quickly and effectively perform their actions as part of the decision-making process by having access to more and better information, and better integrated situation awareness, collaboration, decision support, and information processing capabilities.

An ICC will provide decision makers at all levels with a single, integrated, scalable system that fuses, correlates, filters, maintains, and displays a common view of information on the organization's resources, security management situational awareness, hostile entities, and entities of interest. Integrating this data with available law enforcement intelligence and environmental information will support informed decision and improve execution effectiveness when responding to any safety or security incident.

IC2 will provide the basis for operational excellence and mission effectiveness in normal and emergent operating contexts. Shown below is the ideal strategy for the development of the IC2, which consists of the Command and Control processes, applications and infrastructure working with actionable information.

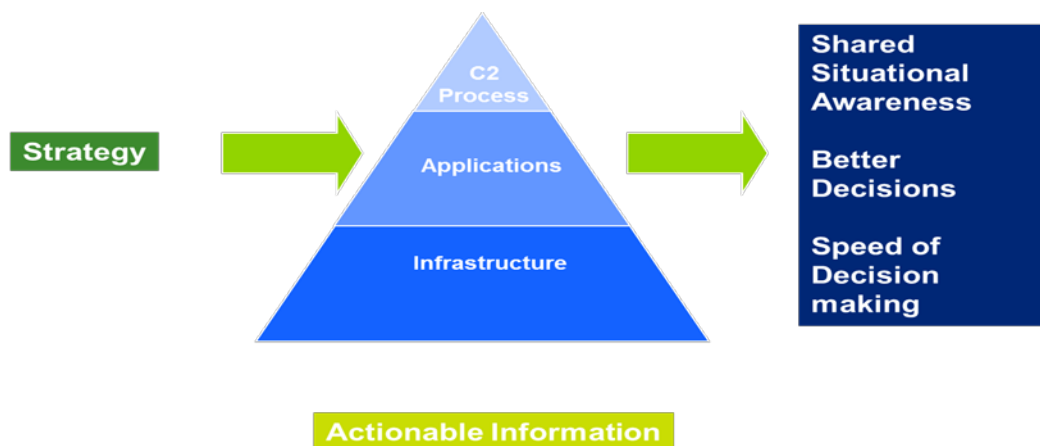


Figure 10: IC2 Strategy for security & emergency management

Core Integrated Command and Control driver and capabilities include the following:



Figure 9: Integrated Command Center overview

RESOURCE READINESS: Enables accurate readiness assessment of resources by providing access to relevant and actionable information.

LAW ENFORCEMENT INTELLIGENCE: Provides timely, relevant and actionable intelligence.

SITUATIONAL AWARENESS: Provides situational awareness of current, planned and projected activities as well as exploiting sensor data and shared data sources.

RESOURCE PROJECTION: Provides the tools for deployment planning during an incident or in response to an emergency that the right resource is dispatched to the right place at the right time.

RESOURCE EMPLOYMENT: Supports C2 activities associated with planning and executing decisions based on shared situational awareness; and timely, relevant and actionable information and intelligence.

The IC2 requires the following:

- Collaboration
- Course of Action (COA) development, Mission Rehearsal, and After Action Review (AAR)
- Training and simulation exercises
- Office automation
- Messaging
- Information Assurance
- Knowledge Management

Activities at the IC2 level link field operations and tactics to strategic goals by establishing operational objectives, sequencing events to achieve the operational objectives, initiating actions, and applying resources to bring about and sustain these events.

The Stafford Smart Town Center IC2 will be a distinct, functionally organized element to conduct and manage citywide (and eventually countywide) operations. Information collection/sharing and logistics capabilities will be fully integrated in the ICC to enhance the ability to assess, plan, and execute operational-level missions, including strategic communications, field operations, security, and law enforcement Intelligence Preparation of the Environment (IPE).

The ICC is defined by government-wide commonality of the core IC2C staff elements (boards, centers, bureaus, cells, working groups, and teams) that fulfill operational procedures and cross-agency processes. The ICC will be capable of operating in a distributed fashion in one or multiple locations.

The ICC value is derived from integrating and fusing various streams of information and law enforcement intelligence, including that flowing from the federal, state, and local governments and the private sector. The ultimate goal of fusion is to prevent manmade (terrorist) attacks and to respond to natural disasters or manmade threats quickly and efficiently, should they occur.

To be effective, the IC2 center must be able to access and exchange information with other mission focus areas. Information access and exchange must be standardized to share information between different organizations, facilitate agility, and reduce the total cost of ownership.

Requirements involve four different domains:

PHYSICAL: Radios, satellites, wires, and other hardware and the software required for their operation.

INFORMATIONAL: Substantive contents of the C2 system such as the location, status, and activities of the relevant entities to the extent that they are known in the information systems.

COGNITIVE: Individual information.

SOCIAL: Relationships between individuals and groups of people.

The recognition of these four interrelated domains is crucial to understanding the requirements for a successful ICC based on next-generation technology. The IC2C *Concept of Operations* (CONOPS) needs to be developed, providing methods by which different organizational staff may standardize the assessment, planning, and execution of security and emergency management at the operational level.

Establishing an ICC is an effective approach to gather, analyze and disseminate information in a real time fashion to prepare, prevent, detect, mitigate, and respond to security and public safety situations. Flexibility and scalability in the ICC design will position the county to exploit existing resources (such as the existing Public Safety Center) and technological investments fully.

4.2.8 Smart Parking

The county needs to provide a Smart Parking management system for the new town center.

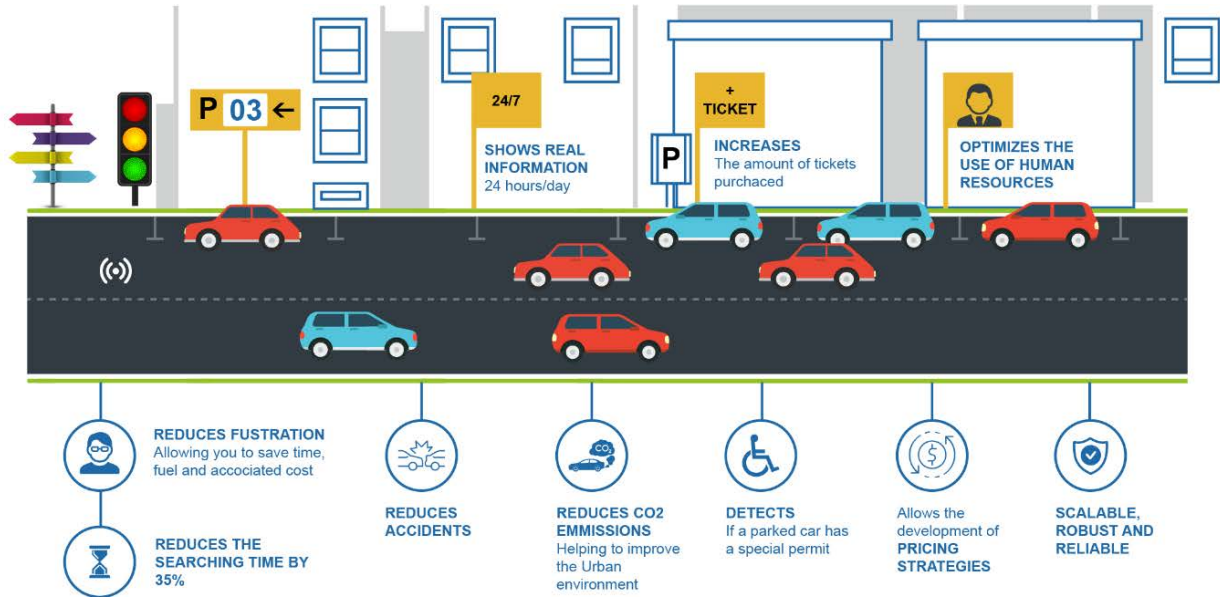


Figure 11: Smart parking features & benefits

The goal of the parking management system is to provide a seamless, efficient, customer-friendly, and cost-effective parking operation for the Town Center with the following benefits:

- Real-time information on parking availability is provided to drivers (whether on-street, surface lot, or parking garage) through a mobile application. Additionally, information may also be provided via digital signs directing drivers accordingly (mobile apps must be operable on the common mobile device platforms, such as Android and iOS)
- Parking reservation capability via the mobile app
- Mobile and/or digital payment for the parking session
- Support of parking enforcement activity by having the capability to alert enforcement agents of the location of a vehicle that is in violation
- Provision of tools, analytics, and reports to the City to include information on the real-time status of parking spaces as well as historical and predictive usage statistics and data.



Figure 12: Smart pole with Smart Lighting, EV charger, Wi-Fi, security camera, and environmental sensors

4.2.9 Smart Lighting and Smart Poles

Stafford County is looking to modernize the public lighting infrastructure by installing Smart street lights on roads and sidewalks to improve the quality and reliability of public lighting while

at the same time reducing operating and maintenance costs. Some of the requirements for the implementation of Smart Lighting are listed below:

- Convert all outdoor street lighting to LED
- Connect all LED lights to an IoT platform for monitoring and maintenance
- Provide remote monitoring and programming, adaptable dimming and brightening, intelligent energy metering and billing, and reporting
- Ensure interoperability between devices to collect and transmit data to the community, utilities, and government departments

The county is open to the implementation of Smart Poles that will integrate LED lighting along with other features and smart devices such as security cameras, environmental sensors, EV charging outlet, Wi-Fi connectivity, digital kiosks, etc.

4.2.10 Smart Stafford Digital Platform

The Stafford Smart Town Center will require an Intelligent Management Platform to help several county departments streamline their operations by automating the management of IoT devices and applications. Its architecture and feature set will allow the remote management of fixed and mobile devices, plus the applications on various devices.

The primary advantages of implementing such an IoT platform would be the visibility of all county operations on a centralized system connecting various departments, staff and devices. The officials would be able to view data in real time and leverage the analytical capabilities of the platform for better insights and decision making.

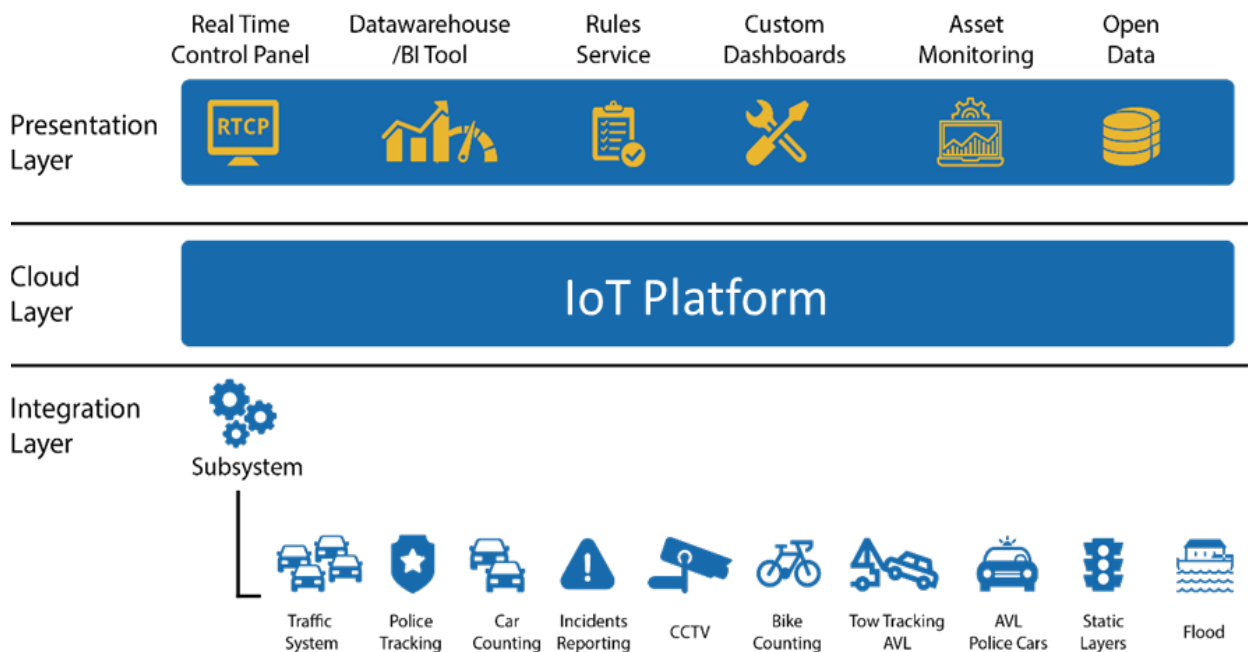


Figure 13: Integrated IoT platform architecture

Some features and functionalities of the IoT platform include:

- Collect and integrate data from sensors (including third-party sensors for parking, lighting, etc.)
- Real-time visualization and monitoring using geolocation for collected data
- Monitor external system and asset status
- Integrate remote external system maintenance and management (e.g.: LED light settings)
- Automate workflows and connect with workforce via calls or text messages
- Report functionality using data analytics, BI, and dashboard tools

4.2.11 Integrated Emergency Operation Center (EOC)

The Integrated EOC will enable stakeholders to monitor, assess, and react to emergency incidents from a single, central location, providing a faster, more efficient, and transparent emergency response. The EOC will support the following capabilities:

- Interconnected public safety and emergency systems to provide complete situational awareness
- Connect Emergency Services to the public
- Manage any incident or emergency event in a reliable and organized manner
- Provide citizen-centric services such as transit notifications and weather warnings
- Display caller location to dispatchers using a digitized GIS map
- Integrate new and legacy surveillance systems such as surveillance cameras
- Provide reports to manage records, databases and information systems by day, week or month

A Fusion Centre will have to be designed to collect and compile the data from various agencies and organizations, integrating with records for people, property, places and related information.

4.2.12 Emerging 5G Networks and Services

Each successive generation of wireless network technology has delivered new and exciting services to consumers and businesses. For example, 2G delivered voice transmission, 3G spurred the growth of new applications and services, and 4G contributed significantly to higher transmission speeds. 5G is expected to replace the wired home broadband network and help develop complex systems such as autonomous cars and real-time virtual reality. 5G will make the *Internet of Everything* (IoE) possible by using shorter-frequency radio waves to interconnect all electronic devices, vastly increasing the data reach for Internet connectivity.

Designing the Stafford Smart Town Center will include developments in 5G technology and systems. Although it is too early to predict all the benefits of 5G, market trends indicates improvements to applications in synchronized urban transportation, education, healthcare, manufacturing, et al.

4.3 Services

Stafford County can expect the following benefits from the proposed smart town center:

Smart Technologies																
Services	Smart LED Lights	Smart Poles	Autonomous Vehicles & EVs	Smart Parking	Smart Buildings	Data Analytics	IoT	Smart Cameras	Wi-Fi / Broadband	Emergency Alerts	Smart Trashcans	AI	Tablets	Drones	Smart Apps	Kiosks
Connectivity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Government Services				✓	✓	✓	✓		✓	✓		✓	✓		✓	✓
Citizen Services						✓	✓			✓			✓		✓	✓
Business Services				✓	✓	✓	✓		✓	✓		✓	✓		✓	✓
Public Safety & Security	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	
Walkways / Bike Paths	✓	✓					✓	✓							✓	✓
Water Elements	✓						✓		✓			✓				
Sports Tourism	✓						✓	✓		✓					✓	
Entertainment	✓			✓			✓	✓	✓				✓		✓	✓
Memorials / Statues	✓				✓		✓	✓	✓		✓		✓		✓	✓
Scooters/Bike Rentals	✓					✓	✓		✓			✓			✓	
Canoe/Boat Rentals	✓			✓		✓	✓	✓	✓						✓	✓
Life-Long Learning					✓		✓		✓				✓		✓	✓
Digital Children's Museum	✓			✓	✓		✓		✓				✓		✓	✓
Digital Library					✓	✓	✓		✓				✓		✓	✓
School Programs				✓	✓		✓		✓				✓		✓	✓
Parking	✓	✓		✓		✓	✓	✓	✓	✓		✓			✓	✓
Traffic Management	✓	✓	✓			✓	✓	✓	✓	✓		✓		✓	✓	✓
Trash Management						✓	✓		✓	✓	✓	✓	✓		✓	
Energy Management	✓	✓			✓											

Figure 14: Stafford Smart Town Center benefits

4.3.1 Citizen Services

Stafford County residents have access to a wide range of citizen services via the county website. Many smart cities and communities leverage their online services and develop applications for smartphones to replicate many of the services available to citizens. Kiosks located in the town center can extend access to citizen services including:

- Public safety through the *Notify Me* alert system and the *Report a Concern* application
- Public Health (including optional access to the *PulsePoint* location-based service)

- Licenses
- Inspections
- Real estate appraisals
- Tickets for events
- Permits
- Paying taxes
- Transportation information (including traffic alerts)
- Recycling information
- School information
- Social services
- Planning applications
- Project information
- Filing FOIA requests
- New resident guide
- Court information and victim assistance
- Paying tickets
- GIS maps
- County Staff directory and organization chart
- Employment information

A mobile app or kiosk function may support programs such as the *Buy an Armed Services Memorial Brick* with only a few clicks, and provide visitor services modelled after the county website, such as:

- Historical information
- Walking maps
- Scavenger hunt games
- Event calendar
- Things to do
- Maps, directions and weather information

4.3.2 Business Services

Many of the services provided to businesses through the county website can also be replicated via kiosks and smartphone applications, including:

- Vendor registration
- Planning applications
- Online permits
- Building forms and checklists
- County code information
- County profile information

- Bid opportunities/procurement
- Economic development program information

Smartphone applications for lodging and dining may also enhance the business and citizen on-line experience in the Stafford Smart Town Center. For example, a resident walks by a new café in the town center and is texted a coupon for a \$1 off a new latte, or a visitor is alerted to a special sale at the new women's clothing store.

4.3.3 Government Services

Services offered on kiosks or smartphone applications may include:

- Animal Control
- Citizen requests and complaints
- Employment services
- Virginia Employment Commission
- Community engagement
- Volunteer opportunities
- Cooperative extension

Once the strategy for handling trash and snow removal is determined for the town center, additional government services may include the deployment of smart trash cans, smart recycling bins, Smart Parking, and Smart Lighting. An app similar to Boston's *StreetBump* can be used to report potholes, which is geo coded and connected to county services. Smart Digital libraries may be another option to meet the needs of a growing population. An innovation hub can provide entrepreneurs with access to state or other grants for special R&D projects.

4.4 Operational Requirements

4.4.1 Dedicated Technical and Operational Staff

We have found that the most successful smart city implementations have hired and trained dedicated staff to manage technology and operations. For example, Philadelphia created a new Smart City Director role to work hand-in-glove with existing functional units of the city, including the CIO, CTO, Public Works, and Transportation. Given the phased-in development strategy of the Stafford Smart Town Center, we are recommending a phased-in approach for recruiting, hiring, on-boarding and training of technical and operational staff in the ICC, ensuring integration of the physical and informational assets. Staffing the ICC must consider the existing staffing policy of the EOC and other county functions. We have also found that successful implementations often cross-train staff to ensure coverage and backup capabilities.

4.4.2 Outsourcing of Technical Services

An option for Stafford County to consider is outsourcing the technical services included in the town center like communities such as Columbus, OH have done. Essential services like fire and rescue and public safety should not be outsourced, however. Smart Parking is typically a great service to outsource and special gain-share arrangements can be made in a P3 relationship.

Since most of the trash and waste removal services are currently performed by private firms, Stafford may consider a similar model for these services as well, although there are advantages to keeping these services government managed. Some communities have entered into performance contracts with private firms for waste and trash removal.

We are assuming that the VDOT will not provide road maintenance nor snow removal services in the town center. There are compelling reasons for in-sourcing these services, but it may be more cost effective to outsource some of the maintenance functions. If in-sourced, the county will need to determine how they can budget for new road maintenance and trash removal services. A combination approach may work best, but more analysis is needed to determine the best strategy for Stafford.

4.4.3 Data Protection, Privacy and Governance

As we engage in the digital transformation, it is pertinent to remember that we must protect fundamental digital rights of citizens in Smart Cities. Prominent among these are the right to internet access, the right to privacy and data protection, and the right to data transparency. Smart City development must respect what some have called the “human-centric digital society.”

Protecting personal the data has become a major concern in smart city development. In 2018, New York City, Amsterdam, and Barcelona launched the *Cities Coalition* to protect the digital rights of their citizens. Additionally, New York City has convened a special task force on “algorithmic bias” as it relates to the New York Police Department and Office of Criminal Justice. Smart city leaders are also taking steps to promote “responsible digital innovation.” For example, a new project called *DECODE* is dedicated to helping smart cities protect digital rights and personal privacy.

Smart Cities are heavily dependent on new and emerging technologies. Three key technologies are driving the development of smart cities round the world: IoT, Big Data, and Cloud Computing. These are also the three leading sources of technological threats to privacy and data security.

Increasingly data privacy and protection are becoming much-discussed issues in smart cities. California recently passed new privacy and data protection laws. Nationally, social media companies such as Facebook and Google have raised eyebrows regarding data privacy and protection. As cities move aggressively toward implementing smart city infrastructure and digital services, privacy and data protection will remain high-visibility issues.

Stafford County must avoid such controversy and plan for privacy and data protection in the Stafford Smart Town Center. The county will need to develop new policies and regulations governing digital rights, data privacy and protection. Defining the right to data, for example, in a P3 project will be critical for maintaining the highest level of privacy and data protection.

Early engagement with citizens and privacy advocates will help to overcome privacy and data protection concerns: the type of data involved, the purpose of data collection and usage, and

the organization or persons collecting and using the data. New data governance structure must be built around such concerns.

4.4.4 Training

Even assuming that the technical services are outsourced to a third party, county staff will still need smart technology training on new processes, automation and smart applications, data protection, privacy and governance responsibilities, and cybersecurity. Smart technologies generate a lot of data that can generate insights through data analytics on how better to manage and operate the Stafford Smart Town Center. For example, sensors that detect hazardous chemicals in Stafford's stream, rivers, and lakes can lead to faster intervention and remediation. Data from energy-use sensors on buildings and other infrastructure can improve energy management and reduce costs. An investment in staff training for data governance and data analytics will help the county take advantage of the smart data that is generated and collected in real time.

The DHS National Institute of Science and Technology (NIST) published a new cybersecurity framework in April 2018, which is an indispensable tool for assessing smart town center and building vulnerability to or resiliency against bad actors. Though there are many benefits to IoT, there are also many vulnerabilities. Providing training in cybersecurity in general or in the NIST framework in particular is required.

5 RECOMMENDATIONS

We recommend the following:

1. Infrastructure Development: work with existing vendors already doing business in the county to build the critical infrastructure
 - Tap into the dark fiber already running down I-95 and Route 17 and connecting the Town Center
 - Provide wireless and Broadband access to businesses and residents in the town center
 - Embrace 5G technology to prepare for the future
2. Financing
 - Develop one “master” RFP of Stafford Smart Town Center requirements and specifications
 - Consider funding smart aspects separately as a P3 or vendor financed
3. Services
 - Make tradeoff decisions between revenue generation and QoL, striking a balance for long-term livability and economic sustainability
 - At a minimum, provide broadband access and install intelligent kiosks throughout the town center
 - Prioritize and sequence citizen, business, education, and government services
4. Environmental Sustainability
 - Consistent with Stafford’s *Vision 2040*, build for long-term environmental sustainability
 - Green buildings meet LEED standards and incorporate smart components like air and water sensors, intelligent LED lighting, and energy efficiencies
 - Waste management, including treatment and disposal meet the expected population growth and business growth projections for the county
 - Storm water management, including a long term assessment of water needs to meet growth expectations, and solutions for managing the increasing storm water intensity due to climate change
5. Security & Public Safety
 - Building off Stafford’s excellent safety and security record, plan and build an Intelligent Command Center (ICC) to integrate emergency management, physical security and cybersecurity elements
 - Mandate the use of smart lighting (including in parking facilities) to promote citizen safety while walking, biking, and driving in the town center
 - Own the Smart Poles as a viable financing strategy
6. Energy Efficiency

- Enhance long term energy savings by implementing
 - Smart Lighting
 - Smart Poles
 - Smart Parking
 - Energy-use sensors
- 7. Privacy and data security
 - Develop new data governance and data usage policy for the Smart Town Center, including what (if any) data can be monetized
 - Promote *controlled* use of facial recognition technologies
 - Follow leading-edge industry standards, including the NIST cybersecurity framework to “harden” smart city infrastructure against IoT risks

We believe these seven recommendations are consistent with and complimentary to the priorities outlined in Stafford’s Vision 2040.

6 APPENDIX

6.1 Appendix A: Information Sources

In addition to reviewing a wide range of documentation, OST gathered information and solicited feedback from the following people:

Thomas C. Foley, County Administrator

Mike Cannon, Chief Technology Officer

Joseph Cardello, Fire Chief

David Decatur, County Sheriff

Jeff Harvey, Planning and Zoning

John Holden, Director, Department of Economic Development and Tourism

Fred Presley, Deputy County Administrator

Andrew Spence, Public Relations

Jason Towery, Public Works

Dr. Janet Gullickson, President, Germanna Community College

Kristen, Acquatic Center