

Chapter 2

Funding a Smart City: From Concept to Actuality

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Introduction

Imagine a city of the future where citizens have access to all types of information and technologies “at their fingertips”, from real-time bus schedules and traffic rerouting data to intelligent street lights and electrical energy systems. We have the technology to create these advanced “smart cities”; however, larger cities are plagued with large city issues, including increased urbanization and pollution. In fact, cities are highly urbanized areas that are responsible for the consumption of nearly 75% of the world’s natural resources and the production of about 70% of the world’s greenhouse gas emissions [1, 2]. Such environmentally unfriendly consumption and emissions is a threat to the sustainability of the city and the quality of life for future generations. Cities are in need of new solutions that tackle the harmful effects of urbanization while creating a citywide environment that is information-lush, environmentally sound, and attractive to residents and businesses alike.

Cities are starting to embrace the Smart City concept due in part to urbanization growth; an increase in energy and resource demands; a “smart” population with high-technology needs; and an infrastructure desperately in need of repair and renovation for future city loads. According to the United Nations, urbanization is growing at an alarming rate. In 1950, only 30% of the world’s population lived in urban areas. By 2014, urban populations were at a sizable 54% of the global population. Analysts are now projecting this growth will continue, and that by 2050 more than 66% of the global population will live in urban areas. This projection means that, by 2050, an estimated 2.5 billion people will be introduced to the urban population [3].

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City governance is taking notice of urbanization trends as well as current projections for the Smart City market. Analysts estimate that the Smart City market will surpass the size of all traditional business segments and reach \$3 trillion U.S. dollars just in the next few years [4]. Even more astonishing is the projection that cities around the world will invest an estimated \$41 trillion by 2037 to upgrade citywide infrastructure and system connectivity [5]. City governance needs to stay savvy of their city's technology, mobility, and system needs to ensure their city remains a 'hot spot' to live, work, and travel.

The need for smart technologies and the Smart City model is burgeoning. The task of envisioning a successful and sustainable Smart City involves creativity and planning; however, the singular most important question in any Smart City design is: "How will it be funded?" Many larger cities seeking enhancement of their city service portfolios are forced to find alternate ways to fund their smart projects, particularly through public and private investors. Although most smart project investments are grounded in public funding [4], cities are also looking into the private and quasi-federal sectors for more funding options.

Investors, nonetheless, are hard to secure because investments into a Smart City are usually extensive and costly [4]. Additionally, investors, particularly private funders, want to know the probable return on their investment prior to committing funds to a smart project or program. Smart programs often require multiple funding streams to bear witness to positive results. Although the Smart City model is flourishing worldwide, little is certain about the ultimate significance of a smart project or how the intelligent technologies will truly add value to a city [4]. Planners and investors must have a shared vision of the Smart City and desired benefits to reap any type of program success. Ultimately, without project capital and the *right* committed funding, a Smart City vision will remain exactly that: just a vision.

The following chapter examines the complex process of identifying, pursuing, and securing funds for a Smart City program, and offers tools and considerations to help advance Smart City concepts from a vision to actuality. The chapter addresses common project considerations and potential funding sources for Smart City programs. Discussion about aligning potential funds with specific project components and the overall pacing of the smart project work follows. Finally, the chapter closes with the important matter of funding management. Without a fundamental understanding of project funding, Smart City governance will be hard pressed to succeed and may ultimately succumb to the seemingly indomitable challenges of planning and realizing a true Smart City.

Creating the Smart City Vision

Every great Smart City design begins with a vision of life enrichment for those who live, work, visit, or lead the city. A Smart City vision is relatively simple in concept; however, the process to realize this vision is far from simple. Creating a vibrant

Smart City concept involves many considerations ranging from project economics and feasibility to constraints and realistic execution. The following subsections outline important considerations to progress a Smart City vision of any complexity toward actuality.

Location, Location, Location

Successful smart cities have great locations. Chief among these considerations are locals that are primed for change and have enough outside appeal to validate a Smart City rejuvenation. The impact for such a citywide endeavor requires investment by the local agencies, a population ready for technological transformation, and an economic development landscape capable of sustaining revolutionary changes to the city. Creating the Smart City vision requires a location populous ready for the undertaking and a landscape ready for advancements.

Not all locations can make a Smart City vision work. Extremely rural areas or geographically vast areas are not ideal for Smart City solutions. Locations need some degree of population density and technological interests, along with the desired appeal to drive in citizens and travelers alike. With the right foundational basics, some lackluster locations can transform into enthralling smart cities.

What Are the Long-Term Visions of a Smart City Program?

Long-term visions for a Smart City differ from location to location, stakeholder to stakeholder. In less dense, less advanced locations, a Smart City may only involve advances in water quality and wastewater management, whereas larger urbanized cities in progressive nations will have much more robust Smart City needs and visions. Ironically, there is no definitive description of what constitutes a Smart City [6–8]. However, all smart cities involve newer technologies to solve existing quality-of-life issues. Long-term visions of the Smart City encompass quality-of-life improvements for citizens while employing intelligent technologies to enhance the appeal of the area.

Many Smart City models incorporate integration of multiple systems through a network of information and communication technologies [9]. Other long-term visions of smart cities are grandiose, involving a mix of intelligent transportation systems, “green” infrastructures, seamless connectivity, economic development, and citizen social improvements. Incidentally, with populations becoming more connected Smart City visions will undoubtedly incorporate intelligent transportation systems. Think of using a mobile phone to get real-time estimates on train and bus arrivals all while staying connected to your fare card balance and geolocation of your vehicle, and while riding on smart roadways with LED stoplights and pollution-free electric vehicles. Intelligent transportation systems will play a larger

role in Smart City mobility, commuter data integration, and multimodal transportation operations within cities, towns, and communities [10]. Ultimately, intelligent transportation systems and projects aimed at enhancing the city's quality of life are principal elements to most Smart City conceptual visions.

Who Are the Stakeholders?

Smart Cities are generally located in medium to large urbanized areas and contain stakeholders interested in advancing the area for both economic and holistic benefits. Smart cities encompass the latest technologies aside a foundation of intellectual resources and developed infrastructure [11]. Citizens with the Smart City architecture are technologically savvy, whereas the governance with the city has interests in maximizing user data, connectivity, and intelligent technologies. Stakeholders are often varied and, depending on the size and geographic locale of the smart program, stakeholders can range from residents and private business owners to city economic development corporations and the government. Smart city stakeholders generally comprise local governments, research institutions, grassroots movements, technology vendors, business owners, tourism boards, and property developers, all of whom hold sometimes conflicting interests in designing a Smart City [6].

In heavily urbanized areas, the citizens can be the most powerful stakeholders in a Smart City and, as such, need to be involved with “smart” planning. These “smart” citizens need to be trained by local governmental agencies to not only be able to embrace the new technologies surfacing in their city but also serve as invested stakeholders in their growing city. Additionally, having smart citizens, in tandem with Intelligent Transportation Systems, smart technologies, and citywide interconnectivity, is crucial to a sustainable and healthy Smart City [12].

Stakeholders have very distinct desires for investing in a Smart City, including economic development, advancing technology use, and personal capitalism. When smart projects are surfacing, individual stakeholders are aligning with other individual stakeholders to develop mutually beneficial and prosperous smart destinations. These partnered stakeholders are looking beyond citizens and city services to a more dynamic return on investment through tourism [13]. Partnered stakeholders can collectively translate their differing interests into a broader tourism pull, and generate new income streams to the Smart City. Stakeholders, if deeply invested, possess the power to transform a technology mecca into a desired travel and business destination.

Understanding “Lighthouse” Projects

Not every urbanized area or city has the right components to become a Smart City. Without invested stakeholders, a pool of potential infrastructure necessities and a

population ready for technological change, a city is unlikely to adequately sustain the Smart City architectural model. Then there are those urbanized areas that are destined for the Smart City model. These areas have a colloquial name: “lighthouse” cities. The term “lighthouse city” refers to the convergence of city governance, administration, bureaucracy, and city planning to form the groundwork of a Smart City model [14]. The imagery of this convergence of city leadership can be likened to the converged beam of a lighthouse, whereby city leadership, like the beam of light, progress in a singular, unified direction. Projects within lighthouse cities may be called “lighthouse” projects. Individual Smart City projects are considered “lighthouse” projects, with both terms used synonymously.

Smart City Project Considerations

Smart city programs are complex, diverse endeavors that encompass various new technologies, sustainable designs, and humanistic innovations. Smart city project considerations include, but are not limited to:

- New technologies;
- Intelligent transportation;
- Energy usage and efficiency;
- Digital automation;
- Public security and resiliency;
- Sustainable processes and urbanization;
- Hybrid approaches to manufacturing;
- Connected residents, workers, and visitors;
- Innovation;
- Economic impacts; and
- Return on investment.

These considerations have a common thread—centralization. Perhaps the greatest consideration aside from the above specific program concerns is how these individual components are integrated with one another, and how the Smart City governance can use generated information from the components to enhance the ease and quality of citizen lives.

From personal experience, intelligent transportation systems offer a robust, integrated mechanism for city resident ease, and simultaneously impacts many other aspects in Smart City living. Intelligent transportation systems lead to improved road and pedestrian safety; better management of and user insights into traffic; heightened vehicle connectivity; and enriched driver comfort [15]. This “smart mobility” consideration offers a blending of new technology, planned transportation hubs, and ease of population movement. Additionally, intelligent transportation solutions are fantastic assets to Smart City programs because they have sound architecture, optimized technology, economic sustainability, and are environmentally friendly. However, if a smart transportation solution is not the right

fit for a specific Smart City visionary, it should not be forced as a consideration. With any project component, supportable solutions are ones that are encouraged by the citizens and backed by city governance. Without ridership and user interests at the core of a transportation design, any funded intelligent transportation or smart mobility system will fail and eventually lose funding [16]. City planners must remain creative and visionary, yet realistic, with their overall smart program concept to provide a solid path that leads to success.

Planning a Realistic Path to Reach the Vision

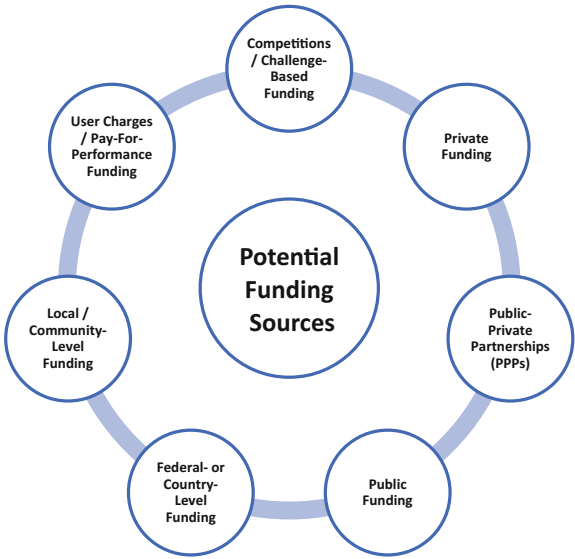
Smart city planners must develop a holistic yet realistic path to move from the concepts of their Smart City architecture to triumphantly achieving the program objectives. The initial step beyond conceptualizing the Smart City is discerning the necessary smart projects within your program and researching all potential funding sources to realize those projects. Since projects are complex and multifarious in design, Smart City planners can match particular elements of a project or sub-parts of a program with accessible funding sources. Part of this funding exercise is to prioritize projects from the “must do” projects to the “would be nice” projects, and put concerted effort for those smart projects with the greatest benefit to the city, the citizens, and to society as a whole. Additionally, when planning out the path to reach the overarching vision of the Smart City, planners need to recognize that delays occur on projects, that there may be unexpected obstacles, and that all funds used on smart projects must be carefully managed. Without meticulous care taken on every step of this pathway, project execution blockades may unceremoniously surface while the sought Smart City vision may remain only a vision.

Funding Sources: Lighthouse Projects and Smart City Programs

Any Smart City endeavor, whether it is for a small “lighthouse” project or a large Smart City program, is an expensive process. From conceptualization and planning to development and implementation, costs rapidly rise and can easily cause a much needed project to perish. A key step in any Smart City effort is to evaluate all potential funding options early and determine what financing source, or what combination thereof, offers the best fiscal solution to bring the project from idea to realization.

Figure 2.1 portrays the most common funding sources for “lighthouse” and Smart City endeavors. The mix of financiers extends from governmental and public entities to private and creative financing pathways. As garnered from the array of funding sources, Smart City projects have piqued the interests and support from various levels of government, stakeholders, and residents. The fiscal sources

Fig. 2.1 The potential funding options for Smart City projects are numerous and can be combined to form a collective, program-wide funding solution



described in following sections have varying levels of availability and particulars, along with distinct benefits to the development and long-term sustainability of the smart technologies employed.

Government-Level Funding

For many Smart City programs, government-level funding is a critical component to whether the intended project can be completed as originally envisioned and proposed. Government funding comes from country-sponsored (or federal) agencies, and is generally one of the first funding options considered by Smart City developers. Governments are generally well invested in the urbanization of areas. They use the availability of their capital funds to remain connected to the holistic urbanization, and ensure a measured increase in the country’s quality of life.

Government-level funding is beneficial to both Smart City developers and to the Government. This form of funding allows transparency to and from the citizens, and enables governmental access to different types of user data. For example, in a Smart City, governments can obtain critical data and metrics related to the use and efficiency of their transportation systems. Access to this data allows Governments a way to improve their service platforms and heighten their electronic governance (or e-governance) of citizens. In fact, e-governance is a significant component to intelligent populations (smart cities) by allowing public agencies a viable method to uphold transparent, proficient, and expeditious administrative services [17]. Furthermore, government-level funding is a straight forward and practical approach to secure capital for a smart project. Funding may or may not have to be repaid over

time; however, the mutual economic and user information benefits to the Smart City and Government may serve as a quick return on the investment.

Local-Level Funding

Smart projects are targeted to large urbanized areas and smaller improvement zone communities alike. A powerful funding source for targeted smart projects comes from local-level funding sources. Incidentally, most investments made in a Smart City program occur through public funding sources [4]. Such local-level sources include public development agencies, local economic development corporations, city/state/providence sources, and other locally invested quasi-agency organizations, such as utilities. Local financiers are generally highly invested in the urbanized area and may reap the rewards associated with Smart City technologies and projects. Often local financiers designate monies for local region development with the hopes of driving population, the local economy, tourism, and the area's attraction to new businesses. Local-level funders are stakeholders looking at a return on investment and may require repayment over time through tax dollars or land allotments.

Community-Focused Funding

Another source of smart project funding comes from community-based sources, such as grass roots environmental community groups, large businesses invested in a community, local businesses looking for area rejuvenation, and targeted project economic stimulus. Unlike the local-level funding sources that are invested in large to small urban areas, community-based funding sources target individual communities within the urbanized or improvement areas. These community-focused funders usually have a vested interest in aspects of a larger smart project or interest in singular smart projects that can benefit a specific community. Often, community-focused funding pays for part of a larger Smart City project and not whole programs. This form of funding is a good way to supplement the costs of a total project and should be used in tandem with other funding sources. Community funds can be considered, for the most part, an approach to match other types of source funding.

Public–Private Partnerships (PPPs)

Many smart projects have significant benefits for both the private and public sectors, and can generate increased consumer mobility and economic gains. For these reasons, Smart City projects may be funded through Public–Private Partnerships. A Public–Private Partnership, commonly known as a PPP or P3, is an “arrangement

(s) between government and private sector entities for the purpose of providing public infrastructure, community facilities and related services” [18]. PPPs are desirable funding mechanisms for smart projects not only for the mutual economic benefits but also for the sharing of capital investments, program risks, oversight, and responsibilities among the partners. Additionally, with multiple partners invested in a smart project or program, the likelihood of successful completion of all phases increases due to the additional project oversight and union of financiers wholly invested for a successful outcome and quick return on investment (ROI).

Loans and Municipal Bonds

Oftentimes funding sources are not available, hard to acquire in a reasonable timeframe that aligns with the project timetable, or inadequate to fund an entire smart project. Developers can turn to more traditional sources of funding, including loans and municipal bonds, to help supplement other project funding or keep smart projects aligned to the project schedule.

The upside to using loans and “muni” bonds is, after obtaining the appropriate approvals, the lump sum capital made available to pay for the project work. Monies from loans and bonds can be used as fast or as slow as necessary to pay for the project. Smart projects can face delays due to a poorly timed distribution of funds or restrictions on how monies can be spent. Each funding source has its own peculiarities for releasing funds, which can negatively impact the project deliverables schedule. However, municipal bonds and loans make the funds available for spending when necessary and appropriate during a project. The lenders, that include investment banks, insurance firms, and the government, typically take on an oversight role, auditing project deliverables and ensuring the monies are being spent appropriately and as initially intended.

However, the downside to using loans and “muni” bonds is that all loans and municipal bonds must be paid back in full over a fixed timeframe. The duration is dependent on the financier’s agreement and the specific loans and bonds used to finance the project, and often have set deadlines for payback, interest applied to the outstanding balances, and is constrained by amortization schedules. For the capacity of upfront project capital, project developers ultimately will spend more for the financed smart project than initially estimated by the end of the entire payback period. The loans and bonds funding route is a balance between funding availability and project cost returns, and is a decision left for developers.

Private Funding

Lighthouse or smart projects can be funded by private sources. Private funding is a viable option for both smaller projects with targeted stakeholders or aspects of

larger projects. Rarely will private funding sources be used for entire Smart City programs or large, multifaceted, urbanized area projects. Private funders often have interests in specific aspects of a project including, among other reasons, economic development interests, tourism, better people mobility in congested areas, and sustainability. Private funding sources have constraints on project expenditures arranged by the financiers and agreed upon prior to releasing funds. Private funds often have expenditure limits per a certain fixed period (i.e., per year or per month). Smart projects using private funds are disposed to audits, oversight by a board of directors, milestone approvals for the release of funding, reduced or withdrawn funding, and funding inconsistencies. Private funders may also be susceptible to funding shortfalls, reduced or lackluster interest in a project over time, and impatience to any project delays. Overall, private funding can be a powerful approach to getting a lighthouse project completed; however, project developers must anticipate increased oversight, amplified “outsider” influence, and the need to reaffirm stakeholder interests.

User Charges and Pay for Performance

Smart city design and implementation is expensive regardless of location around the globe. New technology and advanced city transformations require upfront capital and a long-term economic plan to provide sufficient payback. Many Smart City programs are designed with a built-in repayment solution in the form of user charges and pay for performance. The idea is that users want an expanded and heightened city experience associated with a Smart City, and would be willing to pay a small surcharge for the experience. The concept is similar to the pay-for-use wireless networking (“WiFi”) on an airplane, where users pay a small fee for the ability to stay connected at 30,000 ft.

Smart cities may choose to incorporate user charges into area taxes, city and utility bills, and other billable services. Some smart cities, such as in India, have begun applying parking fees, water and sewage surcharges, telecom fees, and utility (gas/electric power) surcharges to help pay for the available Smart City technologies [19]. Proposing these small pay for performance user charges helps the Smart City developer communicate a sustainable, fiscally sound vision for the Smart City concept. User charges are “built-in” funding sources that avail a stronger return on investment and a viable approach to paying back secured funds.

Smart City Challenges and Competitions

With the surge in technologies, city leaders often have lavish desires to transform their growing city into an urbanized, technological mecca—a place where people will want to live, work, and spend their money. Funding for a program aimed at

meeting these lavish desires and endorsing a holistic approach to citywide mobility, accessibility, opportunity, connectivity, and sustainability can be difficult to secure. In fact, such a vision would likely require many funding sources collectively. However, these lavish desires for a transformed city are not impossible.

One of the most exciting demonstrations of Smart City funding has surfaced through organized and sponsored Smart City design competitions and challenges. In an effort to promote urbanized area qualities such as integration, mobility, economic development, and technological prowess, many countries have begun sponsoring Smart City competitions and conceptual challenges. These activities invigorate creative conceptual thinking and help stimulate progressive city projects. With funding difficult to secure for one-of-a-kind or progressive (and fiscally risky) projects, design competitions can bring the brightest futurists and conceptual thinkers together in a competitive setting to showcase how a holistic program or smart project can be realized along with the resultant quality of life and economic benefits. Ultimately, these Smart City competitions showcase ingenuity, problem solving, and fantastic ways to transform a city.

Here is just one example. In late 2015, the United States Department of Transportation launched a country-wide Smart City challenge focused on, of course, smart transportation. The challenge requested conceptual designs from mid-sized cities for a smart transportation system that could integrate multifarious data and applications throughout the city in tandem with the latest technologies. The overarching objective of the challenge was to help move people and goods throughout the city in an efficient, quick, and inexpensive way. Ultimately, after 78 applicants, and seven finalists, Columbus, Ohio was the winning city. As the winner of the challenge, the City of Columbus is now in the process of developing and implementing their *SmartColumbUS Vision* that boasts a connected transportation network, electric vehicle structures, and integrated data exchange. Through this competitive challenge, the City of Columbus gained the required funding and the one-of-a-kind opportunity to develop their Smart City program through a series of funded pilot projects [20].

Stay Creative and Vigilant for New Funding Sources

With the vast portfolio of funding sources just described, one might believe that every city can be a Smart City. This is hardly true. Although Smart City planners have many options, funding is still very limited and highly competitive. A magnificent Smart City design may not be enough to get it funded in whole or in part. Many factors play a role in Smart City decision-making including local politics, community opposition, and the inability to operate and maintain the proposed new systems. For example, high speed rail transportation thrives in Europe, China, and Japan; however, the United States consistently meets obstacles with planned systems related to gaining right-of-ways and the long-term operation and maintenance costs involved with these rail systems.

For new Smart City programs to be sustainable and successful, city planners need to remain vigilant and creative to find new funding sources. As stated before, a magnificent Smart City design is not enough to gain funding. Creative approaches to funding, including a matrix of funding sources, a progressive approach to matching funds, and an ironclad cost–benefit analysis, along with a solid design and invested stakeholders, can cue the magic needed to bring a Smart City concept to partial or full fruition.

Matching Project Elements with Accessible Funding Sources

An effective smart project funding approach involves a strategic plan to secure monies from different sources for different aspects of the whole project. Matching project elements with accessible funding sources offers significant advantages to any Smart City endeavor, but plays a vital role when more complex, larger scale Smart City programs need funding. For those large endeavors, single funding sources are rarely sufficient. As a result, a current trend is to move away from the large-scale Smart City planning approach and focus on small-scale integrated projects [4]. The following discussions briefly examine specific aspects of such a strategic and multifarious funding approach.

Specific Project Components

Designing a Smart City concept and eyeing the funding routes to actually build the Smart City involves a laser-sharp focus on the various project components. A Smart City is an amalgamation of four distinct design forces, namely urban features; knowledge and innovation economy; a push for technology push; and a pull for applications [18]. Understanding these forces on a smart design helps coagulate ideas for the fundable project components. Such components revolve around transportation systems, connectivity, new technologies, safety and security features, economic development, tourism hot-spots, citizen sociality, and sustainability, among other location-specific components.

Put in a simpler context, a prosperous, sustainable, and thriving Smart City requires a balance between economic, environmental, and social factors [6]. Focusing on these macroscopic areas of smart program interest allows easier discernment of important project components. For example, let us consider the local economics of a Smart City program. A significant consideration in the planning, funding, and design of smart cities is the effect on the local economy. Stakeholders want their “piece of the pie”; whereas governance and citizens want a significant level of economic competitiveness. Some economic concerns include job generation; area growth; diverse business products and markets; personal development,

returns on investment, and enhanced productivity [21]. Consequently, specific smart project components can be presented systematically as the solutions for these economic concerns. This type of strategic thinking related to project presentation for fund acquisition is both creative and stimulating.

Sometimes these larger Smart City solutions are unwarranted and the better solution may be a smaller project piece. In large, urbanized areas, a Smart City solution needs to be dynamic, wide-ranging, and encompassing. However, in smaller urbanized areas, particularly in less progressive or poorer parts of the world, larger project components are overwhelming and not realistic. In fact, in less advanced countries, Smart City solutions are generally focused on specific local issues, such as better water quality and roads [22]. Smart city developers need to assess the local economy and determine realistic project thresholds for the smart project area. Additionally, project components must always be scaled for the particular local needs and always staying pure to the original Smart City concept—to help improve the quality of life for citizens in dense or urbanized areas [22].

Clustering Entire Program Elements

Once program elements are understood and determined, smart developers can straddle the power involved with clustering similar program components to determine new funding avenues and sources. Clustering elements, say under the banner of environmental or transportation, can avail stronger funding lines and visionary marketing messaging to secure particular monies. Having additional project components collected into a singular project can support greater returns on investment, dynamic integration, and even more striking quality-of-life benefits.

Clustering project components requires strategic thinking as well as a clear vision of program objectives and technology integration. With greater focus on how multiple parts of a program work together, Smart City visionaries develop a broader understanding of how to position the program to potential funding sources, how to capitalize on project component synergies, and how to inject efficiency into service overlaps. This sharper view of the program allows smart developers to recognize when to pursue monies for singular project solutions and when to pursue funding for a clustered program solution. This type of heightened understanding adds credence to the Smart City program's objectives and helps valid the overarching economic and society benefits for the program to be realized.

The Social, Environmental, and Economic Values

Regardless of whether smart project elements are clustered or kept singular or whether the targeted local is in the heart of an advanced region of the world or in a developing country, the core values of why a Smart City is desired must be upheld.

Smart cities must be built on an urban model to guarantee an increase in citizen life quality and social prospects, while sustaining balance with natural resources [23]. Put another way, a prosperous, sustainable, and thriving Smart City requires a balance between economic, environmental, and social values [6].

The social values of a society form the core incentives of a Smart City concept. As a city uses more intelligent technologies, the quality of living in that city should increase. Citizens want an easier way of life that heightens their ability to socialize and achieve work-life balance. Smart city solutions generally incorporate innovative and more efficient uses of infrastructure, which is ultimately needed to improve living standards and assuage the harsher living norms of economically weaker portions of society [1]. Other enhancements in society that are valued by citizens include greater connectivity to normal aspects of their life, such as transportation use, community events, and exciting new technologies. Funding and spearheading Smart City projects that enhance the social values of the city will produce increases in population, tourism, and economics.

On the flip side of this discussion, not everyone wants to live in an information-lush, technology-driven city. Citizens may want to unplug from the Smart City framework and go “ghost” for a period of time. These citizens would become disconnected from the hyper-connected society in which they live and rely on more traditional forms of connectivity, namely physical encounters and face-to-face communication. Such socially valued opportunities to become disconnected from the Smart City framework should be included in the overall design and strategy for the Smart City, thus allowing ample opportunity for human interaction and in-person social networking [24].

Working in tandem with a Smart City focus on society values is a dynamic view on sustainability and environmental values. Successful Smart City designers plan for climate change and incorporate new technologies into their concepts to minimize pollution, maximize sustainable solutions, and engage an environmentally safe approach to city life [1]. Citizen interests expand in smart cities due to, among other things, a citywide approach to environmental sanctity and “green” solutions. Cleaner living environments that are hyper-focused on maintaining future clean living is perhaps the common core to all environmental values related to a Smart City.

We have already spent a fair amount of time discussing the economic values and benefits of a Smart City program. However, a specific economic value surrounding Smart City projects involves governance and how the governing body can add layers of efficiency and cost savings into a Smart City. A major citizen appeal for the Smart City concept is the ability to have real-time city information; however, this large data processing is an enormous undertaking that requires significant technologies and resources. Data beyond a real-time time window is aged and has reduced value [25]. Economic value can be reached through the integration of available real-time data concentrated on very distinct, but important aspects of Smart City use. As efficiencies are developed in how governing bodies analyze and incorporate data, a wider array of economic value can be realized through a slow, but wider implementation of user data application. Collectively, these economic

values, along with prominent social and environmental values, make Smart City solutions appealing to citizens, business owners, and governing bodies alike.

Prioritize Projects and Design Your Funding Approach Using an AFM: Accessible Funding Matrix

After funding sources have been researched and project determinations have been made, Smart City developers are left with hard decisions related to where they will put their efforts to gain funding and in what order. The activity of prioritizing the needed Smart City projects and designing the final funding business approach is often complex and requires a systematic methodology to ensure all major aspects of all projects are being considered. This exercise is in alignment with the availability of resources to pursue funds, the time necessary for proper Smart City messaging, and the realistic constraints of project-award pacing.

A particularly effective methodology to prioritize projects and develop the right funding approach is through an Accessible Funding Matrix (AFM). Figure 2.2 depicts a typical Accessible Funding Matrix. An AFM can be used for entire Smart City projects requiring funding or project scope components, such as Intelligent Transportation Systems, enabling technologies, sustainability features, and other project scope items. The AFM, similar in design to common risk matrices, serves as a template to recognize where on the spectrum a particular project lies with regard to overall society needs, benefits, and ease of funding. AFMs are particularly useful in understanding the needs of the Smart City governance who, with the help of new

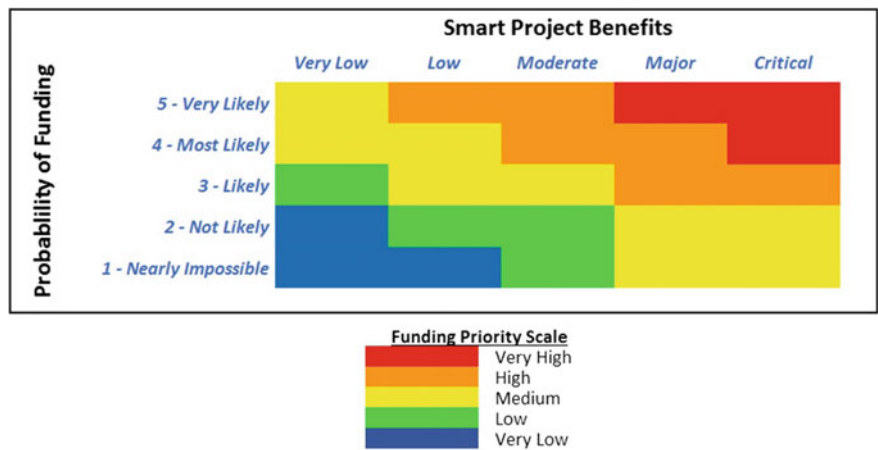


Fig. 2.2 The accessible funding matrix or AFM is a comprehensive method to prioritize smart projects through benefit, resource and timing analysis. A comprehensive AFM is a critical activity in crafting an effective Smart City funding approach

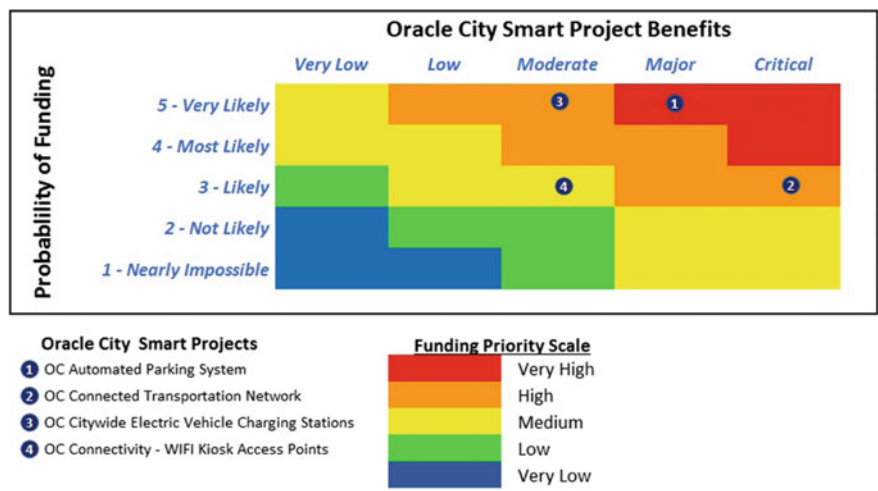


Fig. 2.3 An example Oracle City governance AFM which highlights four example Smart City technology projects: automated parking system; intelligent transportation system; citywide electric vehicle charging stations; and WiFi Kiosk access points

technologies and system data availability, are progressing from traditional delivery methods to more collaborative and integrated service models [26].

Figure 2.3 showcases an example Smart City governance AFM for a fictional Smart City: Oracle City.

In the example, the governing body at Oracle City has over 20 potential Smart City projects conceptually planned, but has limited resources for implementation. The City government used an AFM to determine priority for their four near “shovel-ready” project slated for this fiscal year. However, Oracle City governance recognizes that one or two of the projects will have to wait until the next fiscal year. Using the AFM, Oracle City now has a better understanding what smart projects are current priorities and which projects should be delayed until next fiscal year.

Evidenced by the figures, the AFM is an effective tool for scheduling smart projects, and a useful technique for rationalizing project funding. Other formats of the basic AFM can be used if there are many projects being assessed on the same matrix. The AFM is a guidance tool and can be modified by individual city governing bodies as necessary for their particular intelligent project needs.

Aligning Deadlines, Awards, and Project Pacing

Any discussion of Smart City funding must address the “after the award” timetable. Intelligent projects do not occur overnight or in a vacuum. Like any project, there are project milestones, internal deadlines, award timeframes, funding release schedules, and project pacing. Let us not forget delays and opposition. Aligning

deadlines, awards, and project pacing must occur during the planning phase prior to the pursuit of any funds. The following subsections cover appropriate elements of economic and project alignment with the overall objective to stabilize and secure a smart project.

Proposing with Project Pacing in Mind

Smart city projects are complex and are generally considered one-of-a-kind endeavors for the pursuant cities. Considering the mix of concept, funding, and realization, Smart City developers can often overlook the realities of project pacing. As example, implementing new equipment requires having funding in-place and available, while incorporating equipment manufacture and delivery logistics into the project schedule. Misalignment between these and other aspects of the project can cause terrible delays, result in lost funding, increased costs, and a domino effect with future schedule milestones. Without proper pacing and deliverable timing, a slippery slope of delays and shortfalls will surface among project scheduling and funding.

Aligning Project Scopes with a Realistic Funding Source

As mentioned earlier, Smart City programs may require a combination of funding sources to support the various project scope areas. In fact, Smart City plans that are realized involve the alignment and integration of intelligent project foci including economy, energy, mobility, community, and the environment [27]. Further, Smart City performance indicators encompass smart economics, smart people, smart governance, smart mobility, smart environment, and smart living [28]. Alignment among these indicators and project scope areas has significant advantages to lining up the right funding sources as well as the winning message to secure those funds. Without proper assessment and understanding of this alignment, Smart City developers will have an inefficient and ineffective funding approach that may ultimately shelve the particular smart project or critically hinder the conduct of the Smart City program. Clean alignment among project factors and indicators feed into another significant step in Smart City realization: the cost–benefit analysis.

Cost–Benefit Analysis: Definition and Importance to the Smart Project

A critical aspect to the long-term success and positive ROI of a funded smart project, regardless of size or complexity, is to conduct a Cost–Benefit Analysis

(used synonymously with Benefit–Cost Analysis). A Cost–Benefit Analysis (CBA) holds different meaning for different governing bodies and stakeholders. According to the Federal Government in OMB Circular A-94, a Benefit–Cost Analysis is “a systematic quantitative method of assessing the desirability of government projects or policies when it is important to take a long view of future effects and a broad view of possible side-effects” [29]. Another investor, the United States Department of Transportation, defines a Benefit–Cost Analysis differently, considering the analysis as a way to measure fiscal value of all the anticipated benefits and costs connected with all members of society [30]. Using this definition, the calculated benefits are linked with what all the people in society would be willing to pay to have the project built. If people are willing to pay more than the project actually costs, then the project will have positive net benefits (i.e., benefits minus actual costs).

Private stakeholders hold refined definitions of CBAs which are particular to business. As example, Heinzerling and Ackerman [31] from the Georgetown Environmental Law and Policy Institute suggested that a CBA sets a fiduciary standard for quantifying the success or failure related to government projects and programs. This definition highlights the significance of a CBA in project oversight and initial due diligence related to the feasibility of conducting a project. Ultimately, regardless of the definition applied, a CBA is used to better realize the reasonability and long-term sustainability of a project or program.

Further clarifying the need for this analysis, the CBA scrutinizes the prospective project from the standpoint of the citizenry, and accounts for the net benefits and net costs based on the criteria outlined by the funding sources. The analysis is conducted to answer the question, “Is society better off with the project or without the project?” The CBA addresses, at a minimum, travel time savings, operating and maintenance costs and savings, emission reduction, and economic development. Recognizing the overall benefit of the project, the analysis delivers a benefit-to-cost ratio for the project over a period of years (typically 30 years) and discounted to present value at alternative rates (generally 3 and 7% alternatives). The CBA provides a comprehensive overview of the project’s fiscal performance throughout a long-term, fixed duration.

A CBA is a critical step in any smart project planning process and, if comprehensive in development, can offer durable proof-points to the legitimacy of the project. The analysis quantifies the overall benefits of a proposed smart project long before the “shovel hits the dirt.” It enables short-term and long-term views of the proposed project with regard to the impacts and benefits to the surrounding community. Remember, Smart City projects are focused on improving quality of life within the area. The CBA offers a comprehensive understanding of why money should be allocated and spent on the project. Local businesses will rely on the CBA, as well, by enabling businesses and agencies to be forward-looking with regard to their long-term planning and revenue streams. Of greatest importance to local stakeholders is that the CBA addresses the benefits along all avenues of economic growth and public/community interests surrounding the project. Smart city designs embrace society needs and are concentrated exclusively on the citizens [22].

Ultimately, the CBA is a potent, forward-looking analysis of how the Smart City project will contribute to society and at what cost.

A powerful role of every CBA is to outline the fiscal feasibility of the project. Positive effects on society are great; however, the actual costs of the project will ultimately determine if the project is funded or not. Some common current cost discussions include, but are not limited to

- (a) Realistic Short- and Long-Term Project Costs.
- (b) State of Good Repair of Current Infrastructure.
- (c) Current and Future Maintenance and Operational Costs.
- (d) Costs related to Missing Infrastructure/Facility/Mobility/Connectivity/Technologies/Project Structures.
- (e) Deepening Impacts and Needs of the Community (Monetized).
- (f) Current Impediments that Cost Money, Wastes Time, and Lessens the Public's Interest or Value (Monetized).

Lastly, a CBA can serve as the “voice of reason” for why a lighthouse or Smart City project should be funded. Table 2.1 details some considerations when evaluating the required funding and lasting effects of intelligent projects. These considerations are important discussion topics for pitching smart project funding sources and showcasing sustainable economic and communal benefits.

Funding Management

Once project funding has been secured and the monies have been released to the Smart City officials, the task of funding management begins. Like any other project management, close fiscal oversight must occur. Smart city funders, whether public, private, or partnerships, want to ensure the money awarded is used appropriately and for the approved project or program.

The administrative task of funding management is not glorious or exciting; however, it is vital to maintaining a fiscal stream flowing into the project. Meticulous management of awarded funds is an absolutely critical step to safeguarding the likelihood of future scope components or smart projects within the same program will also be funded. This administrative task needs to be considered early on during the initial Smart City planning, and long before the conduct of the funding approach. Management of funds commonly involves documenting the appropriate use of awarded monies; compliance with the funding agreement; timesheet and invoice recordkeeping; comprehensive and timely reporting of expenditures; project milestones; conformance with regulated cost principles; and audit preparation.

One important component of expenditure documentation is the alignment of specific expenditures to distinct project deliverables. Often, and usually during an audit, funds have to be repaid to the funding sources because of a significant lack of documentation. In some cases, money awarded for one project is actually used on

Table 2.1 Considerations in funding or not funding a Smart City project or program

Considerations when not funding a smart project	Considerations when funding a smart project
Public safety concerns	Reduction of public safety issues
Environmental and sustainability concerns	Reduction of environmental concerns, such as pollution, emissions, greenhouse gases
Increased pollution/emissions	Addressing the public and community needs....keeping the public happy!
Increased public/community needs without resolution	Saving travel/commuting time
Increased maintenance and operational costs	Minimizing maintenance and operational costs
Increased public travel time and nuisances	New revenue streams and opportunities for additional capitalization
Increased public dissatisfaction	Maximizing public use and interest
Loss of revenue	New tourism opportunities, increased visitors, and more tax revenue
Loss of public use or interest	Fueling the local economy through economic development
Loss of tourism, visitor dollars, and tax revenue	Adding jobs in the area
Local economic downfall or recession	New infrastructure, technologies, connectivity and mobility
Other adverse community impacts (i.e., property value impacts)	Other positive community impacts (i.e., property value rise)
<i>Think:</i> How much will this “Non-Project” option cost over time!	<i>Think:</i> How much Money and how many Benefits will this “Project” option bring to the community over time!

another project under the same smart program. This is a form of misrepresentation and funding negligence, and can be used to penalize the Smart City developer or agency in charge of using the money. Clean, complete documentation of how every cent of the awarded funds is being spent is a necessary part of the entire Smart City funding cycle. Often, Smart City governance employs dedicated administrators to handle this documentation and provide oversight for the use of funds throughout the entire Smart City program.

Regarding audits, nearly all funders conduct periodic audits. Funding sources will usually ask for and should be given unconditional access to all documentation related to their funded project. Government sources typically have routine, scheduled audits and will require copies of timesheets, invoices, payment stubs, project milestone reports, technology testing results, and other bits of information. For example, the United States government employs what is called an A-133 auditing process, which necessitates (at a minimum) grant spending documentation compliant with federal administrative rules and cost principles, validation of allowable costs, memorandum of understanding and agreements (MOU/MOA), indirect cost itemization, and Buy American Act and Davis–Bacon Act compliance. Other

countries have their own variation of auditing protocols that all Smart City governing bodies need to acknowledge, understand, and plan for. Orderly and satisfactory funding audits often lead to further Smart City funding. It is not uncommon for funding to be withdrawn and future funding pursuits halted after a poor audit.

The final discussion related to funding management encompasses repayment sources. Funding sources are keenly aware that Smart City governance will employ different ways to stimulate income. Earlier in this chapter, we discussed user charges and pay-for-performance fees. These forms of repayment and returns on investment must be disclosed during audits and tracked under the administrative task of funding management. Funding source will be interested to identify ways to get repaid over time through various smart technology charges and fees, particularly if the funded project has formed different income streams for the city. If repayment is part of the mutual funding agreement, the auditors will look carefully at the income streams to ensure that proper repayment is occurring, and that monies generated from the project are not being misappropriated or funneled to another Smart City activity. Ultimately, clean, comprehensive, and thorough funding and expenditure oversight will benefit the Smart City, the administration staff, the auditors, and future Smart City projects.

Conclusion

With global urbanization steadily rising, cities are turning to the Smart City model to help tackle the harmful effects of urbanization and offer society a citywide environment that is data rich, environmentally sound, and attractive to residents and businesses alike. The Smart City model was developed to improve the quality of life and economic opportunities for city populations. However, smart cities are not cheap and involve a strategic and comprehensive plan to find and secure the best funding for the individual smart projects or the whole program. These Smart City investors (funding sources) want to know the probable return on their investment prior to committing funds to the program. City governance, on the other hand, want to enhance their city's technology, mobility, and system capabilities to ensure their city remains a "hot spot" to live, work and travel. Ultimately, smart programs often require multiple funding streams to produce positive results for both investors and city governance alike, while delivering substantial quality of life and economic benefits.

The chapter described the intricate process of identifying, pursuing, and securing funds for a Smart City program. Potential funding sources include public and private investors, as well as some less customary sources such as municipal bonds, capital loans, and user pay-for-performance charges. The chapter presented tools and considerations that typically add value to Smart City approaches. The Accessible Funding Matrix, for example, offers considerable support to Smart City planners as they prioritize individual "lighthouse" projects and optimize their funding strategy. Solid funding management and project pacing are revealed as key

ingredients to maximizing secured funds, minimizing smart program risks, and stabilizing future funding opportunities. A Smart City planner's end goal is always to secure the *right* funding for the *right* smart project to advance their Smart City concept from a creative vision to an extraordinary reality.

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