Chapter 8
Smart Healthy Cities: A Case Study from Brazil in Public–Private Partnerships

Washington Tavares, Katia Galvane and Jody Ranck

Introduction: Why PPPs in Digital Health and Smart Cities?

Public–private partnerships have been growing in popularity over the past decade. From global health market failures for drugs and vaccines to major infrastructure-related investments, PPPs have become an important vehicle for both public and private value creation when normal market mechanisms fail to meet public needs. Increasingly, governments are attracted to PPP models in the context of a long-term financial crisis as a means to drive innovation or productivity without incurring as high levels of risk or debt. PwC estimates that BRIC and OECD countries will spend more than $68.1 trillion between 2010 and 2020 on non-infrastructure issues.[1] This level of expenditures will demand greater government efficiencies and means a growth in opportunities for private industry to partner in synergistic ways. The past history of healthcare sector PPPs was largely focused on infrastructure without much attention to technology, but we are now entering a new phase of healthcare PPPs focused on services. Digital health will be one of the focal points for redesigning healthcare systems for quality improvements at a

---

[1]Build and Beyond: The (r)evolution of healthcare PPPs. December 2011.

W. Tavares (✉) · K. Galvane
Tacira Technologies, São Paulo, Brazil
e-mail: wtavares@tacira.com

K. Galvane
e-mail: katia.galvane@tacira.com

J. Ranck
Strategy and Business Development, Ram Group, Washington, D.C., USA
e-mail: jody.ranck@ramgroup.com.sg

lower cost. New incentives are slowly taking hold and will gradually move the incentives in healthcare away from the traditional "sickness" economy to a more prevention and wellness focus over the next decade. Another important area for PPPs is the growing business in smart cities which by definition, must be a public–private partnership. We will explore some of the emerging issues and innovations that are happening in Brazil and how they may help build critical frameworks for creating smart healthy cities in the future.

New digital health PPPs will demand new strategies and ways of thinking about innovation. National-level technology strategies are entering into a new era where investments in education and IT infrastructure fueled by more open approaches to innovation will be required to meet the demands of a more agile marketplace and more demanding patients and citizens. Open innovation requires skill sets in collaboration, managing social processes and platforms. We see this with the impact that social media is having in healthcare almost daily as even hospitals are developing social media strategies. PPPs can offer a means to share risk across both public and private sectors while offering a means to stimulate productivity and innovation in resource-constrained contexts. For many observers of public sector investments, PPPs offer a more strategic and entrepreneurial approach for government investments than many traditional, more bureaucratic approaches to investment. In some national contexts where privatization efforts have become controversial, PPPs when structured appropriately have offered a less controversial means for improving efficiencies in services while still maintaining public trust.[2] In the global health arena, a number of PPPs were launched in the late 1990s to address market failures for new drugs and vaccines for neglected diseases. Partnerships such as the Global Alliance (Global Alliance for Vaccines and Immunizations, formerly GAVI) brought together global health donors such as the World Bank and the World Health Organizations and private funding from the Bill and Melinda Gates Foundation to offer incentives and innovative financing mechanisms to incentivize private sector biopharmaceutical companies to develop new vaccines for diphtheria, tetanus, and pertussis to name a few.

In the digital health domain, we are seeing growing interest in the use of PPPs and cooperative business models to help transform health systems through adoption of new health information technologies, or digital health products and services. The telecommunications sector is eagerly embracing the idea of cooperative business models as they look at the complexity of healthcare systems and healthcare challenges. Globally, health systems are straining to provide higher quality care at a lower price point. Governments have the ability to shape markets for health IT as the largest consumer of health IT, but the nimbleness that the technology sector requires is rarely the strong suit of government. The consumer electronics industry is in the early days of making forays into the digital health arena, but the effects of how this industry operates are already being felt in healthcare.

---

[2] Kikeri, S. and J Nellis. 2004. "As Assessment of Privatization." The World Bank Research Observer, Vol 19, No. 1, Spring 2004.

Healthcare and medicine are accustomed to a more top-down, reductionist approach to services that has reached a turning point where the next generation of leaders and innovators will be those who can master more participatory, distributed, and localized types of services and approaches to care. This will be a market with much greater transparency in the past and PPPs will need to respond to these trends as well as address the regulatory cultures that are struggling to keep up with the rapid pace of technological change. Engagement with the public is going to be a key ingredient of success of both government and private sector healthcare innovations in the future, as we found in our work on best practices and case studies on successful efforts to "bend the cost curve" in healthcare globally.[3]

There is a great deal of risk in health IT from the perspective of entrepreneurs and private sector players. Physicians and the health sector in general have been slow adopters of new technologies. Health systems are some of the most complex sectors of the economy with many legacy systems that have created a large number of silos that often defy market rationalities. In the case of the USA, fragmentation of the healthcare system is exacerbated due to the unique history of the evolution of healthcare that has been employer-driven, dominated by a large number of small medical practices that make scaling up new technology systems a rather challenging endeavor. Even in developing country and middle-income markets such as Brazil, there is fragmentation due to the existence of both public and private sector markets for healthcare. One indicator of the complexity of the US healthcare system can be seen in a recent Institute of Medicine report that estimates the level of healthcare expenditures lost to inefficiencies and waste annually to reach over $750 billion.[4] There are dramatic costs associated with fragmentation and inefficiencies that also have an impact on health outcomes and patient safety. Health IT is expected to play a major role in addressing these challenges in the coming years as we have seen with the investment incentives in the HITECH Act. It is a well-known fact that sharing data across government agencies and private sector companies is a serious challenge for all parties involved. Recent developments with health standards such as HL7's Fast Healthcare Interoperability Resources (FHIR) standard may alleviate some of these challenges, but this will likely take several years more before there is a robust deployment globally across systems.

Transparency through open data and new accountability incentives that are driving adoption of health IT will make the effects of the data silos and lack of interoperability more visible in the coming years. The same holds true for urban planning where silos across the sectors that city must manage, from transportation to healthcare, result in less efficient services. To maintain economic competitiveness, countries and cities will need to cut waste and develop more nimble medical

---

[3]PwC, 2012. Healthcast: Global Best Practices in Bending the Cost Curve.

[4]Institute of Medicine, 2012, Best Care at Lower Cost. The Path to Continuously Learning Health Care in America. National Academies Press.

technology and urban planning sectors. These trends along with several of the trends we have identified from the PPP sector should help inform strategies and designs for PPPs. Some of the key drivers of PPPs that PwC has documented from their PPP practice area include the following[5]:

- Investment Need: A shift from assets to efficient operations. Growth in health-care expenditures due to aging societies and chronic diseases during a period of significant belt tightening provides an important incentives for governments to look to the private sector for efficiency gains in both healthcare and urban planning.
- Better Procurement: Shifting government's role from provider to regulator. With nearly two decades of PPP experience, a number of private organizations have developed the capacity to work with governments on PPPs and vice versa. There is also a need to bring both the public and private sectors into alignment to strengthen the overall system. PPPs are a proven vehicle to accomplish this.
- Access to Skills and Knowledge: Health PPPs require more than dealmakers. As healthcare PPPs move beyond infrastructure, they will require a more diverse array of experts and stakeholders. As they shift to a focus on improving health outcomes, they will be working more with networks and information technologies and seeking ways to overcome the silos and fragmentation that have hampered health systems to date. This is going to be a central facet for digital health PPPs.
- Service Capacity: Infrastructure PPPs have had a focus in the past on hospital beds which can further feed the perverse incentives in health systems that drive up costs. Emerging PPP models will seek to go beyond the models used in the past.

Challenges for PPPs

One of the most difficult technological and business challenges for healthcare systems has been the lack of interoperability of health IT services. It is not uncommon to find within a single hospital a scenario where the different IT systems used by different departments (laboratory, operations and financing, clinical, billing) are not interoperable. This is one of the problems that smart cities technologies work to resolve as well. This has implications for patient safety and the quality of care and has become an important dimension of "meaningful use" requirements for compliance with the government EHR incentive programs. A team of researchers at Harvard University that focuses on interoperability challenges across different sectors has identified several of the underlying elements of interoperability

---

[5]ibid.

that make building interoperable IT systems a challenge. In a recent book, *Interop: The Promise and Perils of Highly Connected Systems,* John Palfrey and Urs Glaser have mapped out the risks and dimensions of interoperability with some insights into the various roles that both government and the private sector can play. There are four major dimensions to interoperability that they have identified:

- Technological layer: hardware and computing systems
- Data layer: data from EMRs and other devices as well as standards used across the telecommunications and health systems
- Human layer: how human beings on each side of an exchange communicate and work together
- Institutional layer: the legal frameworks, internal processes, and rules that guide institutional behavior.

Palfrey and Glaser note that one of the most difficult challenges for interoperability in the healthcare sector has been the issue of different actors in the system having different meanings of interoperability depending on the context and technologies used. This is clearly an issue where governments through vehicles such as PPPs can use their convening power to bring a diverse system of stakeholders together and co-create the "rules of the road" that can satisfy both the business and regulatory requirements from which to build a sustainable technological and business framework that can have the scale and optimum level of interoperability to safeguard privacy and security standards as well as improve patient safety, health outcomes, and the continuity of care. When the market gets too far out in front of the "backend" issues of interoperability, reimbursement policies, and so on, we run the risk of contributing to fragmentation in the system and making the goal of better care at lower cost as a goal in the distant future. We will address the interoperability challenge in more detail later, but this is an obvious issue where PPPs could make an important contribution in the coming years. In the global health arena, there has been some activity in recent years to build PPP structures to address interoperability challenges in developing country markets such as the HI-PPP (Health Informatics-PPP) funded by PEPFAR that has focused on developing an enterprise architecture for national-level eHealth systems in Rwanda, Cambodia, Mozambique, and Zimbabwe.

Mobile network operators (MNOs) increasingly view the interoperability challenge as a business opportunity where they can leverage their strengths in networks, cloud computing, and enterprise-level data management capacity. PPPs in digital health and smart cities should also be aware of the dynamics of change in the telecommunications sector. Chetan Sharma has identified the dominant trends in the telecommunications sector that may also shape the engagement of MNOs in digital health in the coming years.[6] MNOs are facing a transition point or the

---

[6]Sharma, Chetan, 2012. Operator's Dilemma (And Opportunity): The 4th Wave. Mobile Future Forward Paper. http://www.chetansharma.com/OperatorsDilemmaFourthWave.htm.

fourth cycle in their maturation. The first waves involved voice and text messaging as their primary revenue sources. In the fourth wave, MNOs must find ways to eliminate costs and produce efficiencies while simultaneously driving innovation in data and applications for their consumers while fighting off competition from "over-the-top" competitors such as Facebook, Google, and Microsoft. These dynamics are fed by a growing market in the area of "digital lifestyle" solutions that include health and wellness. This has profound implications for business models and the way MNOs will operate in the future. The era of dumb pipes and a focus on an increasing number of smart devices (rapidly becoming commodities) is going to give way to offerings that focus more on smarter solutions, enterprise-level integration of data and devices. In other words, a New Service Economy for telecommunications.[7] MNOs are beginning to engage in more open innovation strategies that mark a departure from the past. The demands of the New Service Economy and those who see the new innovation landscape emerging recognize that new skills around cooperation and co-creation are going to be in higher demand. This will likely be a major trend that will influence the shape of emerging PPP practices at the intersection of health and telecommunications in the coming years. Yet healthcare still lacks serious platform approaches to services as we see in other sectors of the economy. When the health IT systems evolve to become more API-driven, we will likely see platforms that generate new business models the way that Apple, Facebook, Google, and Amazon have in healthcare. Ideally, this would make health services more patient-centric and enable greater liquidity of data.

New Service Economy, Digital Health, and PPPs

Digital health PPPs can certainly build on the lessons of PPPs past; however, there is also an opportunity to innovate in terms of strategies, platforms, and innovation approaches that a PPP nestled at the intersection of information technology and healthcare can aspire to in the coming years. Innovation in digital health will demand that we grasp the broader dynamics of the emerging digital economy and digital lifestyle offerings and understand how these may shape consumer engagement with prevention and healthcare in the coming years. Some deep thinking around the structural shifts that we are now undergoing in both sectors could be useful for plotting the path forward and identifying emerging opportunities. What both healthcare and telecommunications are now grappling with is a new technological revolution that will fundamentally shift business models and innovation strategies in the coming years. One view of the deeper transformation comes from

---

[7]See Jody Ranck, 2012, Mobile Operators and Digital Health. Mobihealthnews, 2012 Report.

the work of political economist John Zysman (UC Berkeley) and the other from the Italian philosopher of information, Luciano Floridi. PPPs that understand this transition and are designed to catalyze innovation in this context may be more successful in generating a willing pool of private sector suitors as well as offering opportunities for the public as co-creators and participants in design of new services. While the complexities of such partnerships are more challenging, novel designs may go a long way in generating political support as well as build on successful precedents that have been implemented in the open data space in recent years.

Zysman has spent much of the past decade studying the digital revolution and what it means for the overall economy and how governments and companies need to rethink innovation in the area of digital services. What we are now going through is an "algorithmic revolution" that is about the growing application of rule-based information technologies and tools to activities we label as services.[8] In contrast to the services of the past, the New Service Economy is the source of high value creation. Many services that were once performed by workers providing highly personal activities can now be performed through the use of sensors, mobiles, and other technologies requiring a different set of skilled workers to manage the technologies and often removed from the place where the services are provided. We see this happening slowly in telehealth and telemedicine with the use of outsourced radiologists, for example, who provide teleconsultations to health systems in the USA but from telemedicine centers in India. Furthermore, the algorithmic revolution often blurs the distinction between product and service. Think of how the iPod and iTunes worked in tandem to up-end the music industry. The iPod provides a channel or distribution point for access to the service, iTunes. General Motors makes money from its OnStar Service even when the platform for the service, the car, is declining.[9]

The algorithmic revolution has implications for how countries rethink national technology and innovation strategies. Zysman argues that the implications mean finding more nimble innovation processes and modular approaches to problem solving, finding innovative ways to manage increasingly fragmented knowledge, and balancing the flexibility of workforce management with adequate social supports. On the latter issue, he looks to Denmark where the flexibility of US companies and the social supports of France find a finer balance than either the USA or France. But the central dimension is the management of two key stacks of tools:

- The Data Network Stack
- The Service Tools Stack.

---

[8]John Zysman, 2006, The Fourth Service Transformation: The Algorithmic Revolution. http://brie.berkeley.edu/publications/wp171.pdf.

[9]ibid.

These two layers will be important for digital health PPPs going forward. Many organizations are currently focusing on a device such as the mobile. However, the range of sensors and technologies is growing and the technology ecosystem deployed in the management of chronic diseases and wellness, for example, may be very different three years from now. What is important to recognize is that data and services build around the devices are where value creation will happen. Since PPPs are generally long-term relationships, it will be important to have a some-what agnostic framing of the technology that can encompass technological evolu-tion but also not lose sight of the health data needs and economics of health data. The World Economic Forum has recognized the growing economic value of per-sonal data so far as to proclaim personal data as a "New Asset Class".[10] Alongside the growing economic value of data, we find growing controversy over the uses of data by the private sector as well as new cultures of data sharing and data philan-thropy. Therefore, the data network stack should be taken seriously as an area for investigation and significant PPP activity and innovation that could generate new products and services derived from data that may benefit under-served communi-ties. This is an area of significant market failures at the moment but could also be sources of significant public and private value creation as we will explore later.

PPPs will need the foresight to play a role in these various transformations and identify the key leverage points where public–private cooperation can facili-tate value creation for the public as well as contributing to a vibrant, competitive ecosystem in digital health. This is where the complexity of government strate-gies across sectors and divisions within government often become a roadblock to sectoral innovation strategies. The national broadband strategies of Japan and South Korea and how these efforts encountered numerous roadblocks to success when different pieces of broadband challenge fell under different ministries with diverse goals. PPP architects will need to map these roadblocks and have the abil-ity to convene parties from across, not only the private sector, but different parts of government to form at least tacit consensus around the major barriers that could undermine long-term success of digital health PPPs. PPP managers could have an important role as facilitators and managers through the creation of trusted, neutral spaces along a variety of axes.

The cycle depicted below illustrates the need to rethink how governments in the New Service Economy will likely need to operate. While skeptics of govern-ment may view the challenge as overwhelming, there are already some examples of actually existing practices in US government ranging from the new Consumer Financial Protection Bureau to the Health Data Initiative of Health and Human Services that have created a precedent to build upon, and we will visit these later.

---

[10]World Economic Forum, 2011. Personal Data: The Emergence of a New Asset Class. http://www.weforum.org/reports/personal-data-emergence-new-asset-class.
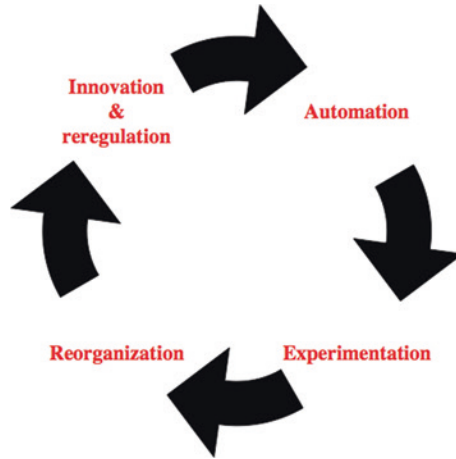
Innovation and Experimentation in the New Service Economy. *Source* John Zysman (2006). Services, Networks, and Competition: Creating Value in a Digital Era.

In digital health, the lack of clarity around the future regulatory environment is frequently cited as a roadblock to investment and innovation. While PPPs have limitations on the role of the private sector in discussions of regulatory issues, there are clearly opportunities for cooperation around coordination of the multitude of government agencies that can help shape the environment for digital health. One of the difficult challenges for policy-makers is creating a regulatory environment that remains current with the rate of technological change. In some countries, telehealth and telemedicine could technically be illegal due to the technology policies created in the 1980s–early 1990s that are still on the books and pre-date the technologies that are actually in place. Cloud computing offers an interesting case study in this regard when servers for a particular cloud computing application are geographically located outside of the country of origin of use of the service. Data privacy and security regulations pre-dating cloud computing services can occasionally render the service as a privacy violation in some national contexts.

A final note on the transformation of health and data comes from Luciano Floridi, the philosopher of information, who has been studying the effect of the information revolution on healthcare and medicine. Floridi observes that we are now in the Fourth Technological Revolution (Copernicus, Darwin, and Freud launched the first three) inspired by the development of the computer by Alan Turing. The impact this has had on healthcare is that digital health technologies are rendering the body more more transparent (e.g., MRIs render the body into a digital format), shareable (we can share the data from our trackers on platforms like Patientslikeme.com), and more democratized (the web and information about health and wellness are making access to health and medical knowledge more widespread and usable as tools by a wider variety of people). Information is

increasingly embedded in our environments, or infospheres, as Floridi terms it. It is almost meaningless to empirically speak of a divide between the online and offline world(s) as information becomes embedded in our environments. We are moving from an era of informational scarcity to an era of information overabundance which will require a rethinking of policy, privacy, and governance. This means that for digital health and digital cities, we are dealing with a far more engaged set of users with vastly more powerful tools and platforms at their fingertips, literally. We are increasingly seeing engaged patients, frequently referred to as "e-Patients", asserting their voices into health IT policy debates in some very important ways. They now have very important online communities that can be useful platforms for policy creation, support. e-Patients are also important test beds and user communities for digital health tools, and innovators would be foolish to neglect their value and voices in the creation of new innovation ecosystems.

PwC has been researching the growing role of social media in healthcare and some of the challenges and opportunities this creates for healthcare organizations in our social media "likes" healthcare (http://pwchealth.com/cgi-local/hregister.cgi/reg/health-care-social-media-report.pdf) report. There are lessons here even for PPPs given the new environment for consumers of healthcare in a more social media-driven world. Consumers are expecting more transparency and faster responsiveness to their issues. This creates substantial challenges for even leading edge private sector healthcare businesses, but the challenges are even greater for government. There are also opportunities to leverage the platforms for research, ideas for greater patient engagement, and marketing of efforts. These will be more pertinent to PPPs of the future than we have seen in the past.

Goals of Digital Health PPPs

PwC's Health Research Institute has taken a global perspective on health sector PPPs and generated substantial insights on where trends in the PPP domain will go in the coming years. In *Build and Beyond: The (r)evolution of healthcare PPPs* they have presented an analysis of the various models and the transition to more service-oriented PPPs in the coming years. Healthcare PPPs since the 1990s have focused predominantly on healthcare infrastructure such as hospitals and medical facilities or product develops partnerships for drugs, vaccines, and diagnostics. With the emphasis now of system efficiencies, prevention, and chronic diseases, the opportunity space for digital health PPPs is growing. In global health, there have been a few early PPPs to emerge in the area of mHealth:

- SMS for Life[11] is a PPP that involves the Tanzania government, Novartis, CDC, and academic partners to address the problem of stockouts and supply chain management for anti-malaria drugs

---

[11]http://malaria.novartis.com/innovation/sms-for-life/index.shtml.

- Health Informatics PPP (HI-PPP)[12] is a global partnership to develop health information systems in low-resource settings with HIV prevalence rates. It is funded by PEPFAR and has several NGO/social business partners including INSTEDD, Jembi, Regenstreif Institute, WHO, Public Health Informatics Institute and focuses on developing enterprise architecture frameworks for inter-operable systems
- Maternal Alliance for Mobile Action (MAMA)[13]: an mHealth PPP focusing on maternal health formed by Johnson and Johnson, USAID, mHealth Alliance, and Baby Center.

These early examples of digital health PPPs in the global health context have largely focused on the use of SMS and rather simple tools that can be deployed readily in low-resource contexts with the exception of the HI-PPP endeavor that is a much more complex task centered on both front-end and back-end technology development that can strengthen entire health systems. The HI-PPP is also more politically complex due to the focus on "country ownership" of the process when local skills to manage complex health informatics systems are in short supply. The tension point here also highlights a possible PPP opportunity for partnerships that can build the health informatics knowledge and expertise for health systems globally. The shortage of health informaticians may only grow in the coming years as the private sector need for data scientists grows and pulls individuals out of the public sector where wages are lower.

From our review of PPP projects globally, we have identified a number of insights for both government and the private sector as they build new partnerships.

For Governments:

- Establishing a national framework for PPPs that includes standardized processes, risk management, and contracting expertise is important for developing professional discipline as well as the flexibility that can enable PPPs to succeed in the long run
- Investment in skill teams that can deliver results. Many governments will be able to leverage expertise from past PPPs to apply these skills to next-generation service-oriented PPPs
- Flexibility is a key element of success particularly with rapidly changing technologies
- Entrepreneurial approach and thinking: This involves transparency, business plans execution, and staying in tune with consumer preferences.

For Business:

- Focus on lowering costs: measuring outputs of the PPP and the value for money and efficiencies created

---

[12]HI-PPP.org.

[13]http://www.babycenter.com/mama.

- Share the risk according to competencies: Government can transfer risks that are better managed by the private sector such as in areas of new technology development and professional development
- Accept fair margins: responsible behavior that support competitive and efficient capital structures while government should also acknowledge fair margins that can support a sustainable long-term partnership
- Reassess what information is proprietary and what should be published. Transparency on metrics can help build public support for PPPs. Resistance to PPPs often comes from public views that private firms are the primary beneficiaries of PPPs. Demonstrating increased access to care and quality of care and/or cost savings will generate support.

We will now turn to a case study of smart cities that actually responds to some of the issues outlined by PwC above in this introduction to PPPs. Telefonica Vivo and ISPM, both in Brasil, are piloting an approach to smart cities that aims to fill in some of the gaps with existing smart cities programs and create new efficiencies and more effective approaches to building smart cities in a modular fashion.

Smart Cities and Cooperation Case Study in Brazil: Telefonica Brasil and ISPM Cooperate with Local Governments

Smart cities represent one of the best use cases for cooperative business models given the public–private partnership model that is inherently part of the operating business model. Smart cities are based on the premise that networking technologies, sensors, and data analytics can provide citizens of cities and city managers the ability to dramatically improve services and facilitate the overcoming of data and communications silos that characterize most city planning departments. The market for smart cities technologies is expected to reach $400 billion by 2020.[14] As the internet of things and big data continue to grow, the range of services and technologies that can be utilized by cities will only grow. This is why it is important at the current conjuncture to put into the place the basic standards and frameworks that can enable more efficient and effective development of smart cities initiatives. This is where smart cities need to learn from the mistakes of many health systems around the problem of interoperability that plagues most health systems attempting to appropriate digital health technologies for system-wide improvements. The lack of use of standards and common frameworks to guide both city planners and technology companies can impede growth in this area. For this reason, Telefonica and ISPM have initiated a cooperative project to build the frameworks for creating a modular approach and business model for smart cities through a pilot program in

---

[14]Pike Research, http://www.greenbiz.com/news/2013/03/06/growth-smart-cities
https://www.gov.uk/government/news/new-initiative-to-support-40-billion-smart-cities-in-the-uk.

Brazil. This chapter will provide an outline of the approach that we are currently deploying in a small city in Brazil, Águas de São Pedro.

Smart Cities and Health

The most popular smart cities technologies tend to be those associated with transportation and smart grid technologies. These use sensors and geospatial systems to monitor traffic flows in real time and provide data on traffic patterns to city planners. But the actual range of smart cities initiatives is far more vast with applications in everything from education to smart grids, economic and financial systems, and smart buildings. Healthcare is also an important city service in most cities and urban planners must manage a broad range of factors that are linked to health outcomes. In the 1980s, the World Health Organization launched the healthy cities and communities initiative that combined urban planning with public health in order to think pragmatically about a more holistic approach to health planning. Under this vision, traffice and physical infrastructure are important inputs for producing better health outcomes. Brazil was at the forefront in many ways for the healthy cities movement in cities such as Porto Alegre who utilized participatory budgeting initiatives that became some of the most innovative approaches to building more inclusive cities and in the process gained important insights into how residents "used" the city and their infrastructural needs and offered a mechanism for citizens to play a central role in improving public health outcomes in a democratic manner. Today, we have an opportunity to use tools such as open data initiatives, technologies, and healthy cities initiatives in a coherent way to improve the public's health. However, interoperability across these sectors remains a major challenge. A quick look at the complexity of this challenge also highlights the importance of building a framework to address the underlying architecture, standards, and business models in order to build platforms capable of meeting the health needs of cities.

Graphic by Telemetry Associates Limited
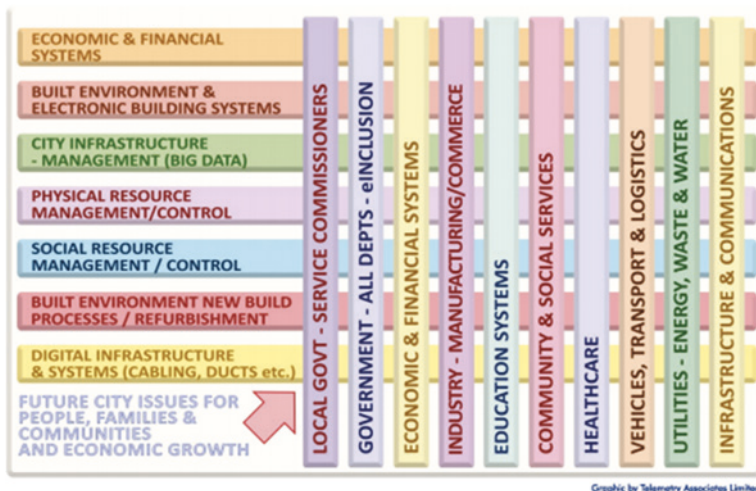
Case Study: Áquas de São Pedro: The First 100 % Digital City in Brazil

Telefônica Vivo initiated an important pilot project in Áquas de São Pedro, a small coastal city known for its tourism industry, and a population that swells from 4000 to several fold higher during tourism season (but this program involves a number of other companies including ISPM, Ericsson, Fundação Vanzolini, Grupo Bem, DataNext, Informar Saúde, Gol Grupo, Huawei, and _Onthespot). This means transportation issues can become a major problem during certain parts of the year. The goal is to prepare a new type of infrastructure for the city to enhance digital services for the population, businesses, and city managers using both data and voice enabled services initially. What this means in a context like Áquas de São Pedro is a major transition from a network that was 100 % copper cable to fiber optics and a move away from one centralized telefonics center to handle all of the services to a multiservice cluster of 5 networked centers to serve the needs of the population. The initial investment for this segment of the project costs nearly $US 900,000 and was needed to significantly upgrade the quality of digital services that the city could provide to citizens. But the investment offers a payback for local businesses who can now use the much faster bandwidth to offer more rapid, higher quality services that can take advantage of streaming, gaming, file backup and storage, etc.

The initial infrastructure upgrade will then form the foundation for building a new generation of connected services: digital education, tourism, eHealth, and municipal management. In the digital health arena, this means better access to medical records and care plans as well as telehealth services that can connect physicians and patients to specialty care centers, the ability to manage public health campaigns for issues such as dengue fever that are a serious problem during rainy seasons, general health education campaigns, and the development of a new Health Portal for the general public to access health information from public health agencies.

The broader initiative will enable the city to better monitor energy use and find efficiencies across the city. An important area is transportation, particularly during high tourist season where monitoring traffic flows will enable better mobility and monitoring of air quality levels throughout the city. Other applications include public safety initiatives that can monitor lighting in cities and breakdowns in infrastructure that could cause public safety issues such as crime rates to increase where lighting declines. An education initiative that will involve smartphones and tablets is also being developed.

One of the challenges that vendors currently have with city governments is the lack of standards and common frameworks that both vendors and city planners can use to prioritize and plan smart cities as well as implement programs in a modular manner that does not lead to silos in services and data usage. The telecommunications industry (see Chap. 7) has a set of standards for business practices that we cover in our chapter on the telecommunications approach to developing digital health services, can be extremely useful in developing the building blocks for piloting and scaling up digital services across the verticals that smart cities focus on. The first step that we will be implementing is research that leads to the creation of profiles of different cities by digital service ***needs***. Modular components for digital services can then be developed that match the set of needs that various cities have and they can pilot individual services initially while adding on new layers of services in a coherent interoperable manner.

Some of the initial experiences with smart cities globally have demonstrated that purely top-down, technocentric approaches often encounter resistance or lack of engagement by the users of the city, that is, citizens. A number of observers of the first generation of smart cities have noted that participatory approaches will be a key ingredient for future success so we will be looking at the use of open data and civic hackathons where students, citizens, programmers-at-large have an opportunity to identify gaps in services and then co-create services with the smart cities initiatives. Telefônica Vivo has extensive experience in the digital health and broader digital services space with these types of programs via the "Campus Parties" and business accelerators/incubators sponsored at various universities and cities to catalyze further innovation on the platforms created by Telefônica Brasil.