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Engines of Innovation:

How investments in data and digital infrastructure and human capital paved the way for customer-responsive and data-informed government in Singapore

July 2020

Introduction

This case study reflects research conducted in early 2020 as part of an exploration of best practice examples of inter-governmental data sharing. The research on this project is funded by a grant from the IBM Center for the Business of Government and will culminate in a research paper in late 2020. As the one international example examined during this research, Singapore is in many ways different from the United States, which has 50 times the population of this small nation-state island, and has four times as long a history. Yet, Singapore with its willingness to invest in the long term for both public and private sector prosperity, provides an interesting example for those interested in government and in particular in technology and data policy in the United States and around the world.

Summary

Since its founding in 1965, the Republic of Singapore has been at the forefront of government innovation. Singapore is unlike other places – it's a sizeable city while also being a small nation-state. It's a place whose economic prosperity and policy achievements largely align with the vision crafted half a century ago of its founding Prime Minister Lee Kuan Yew. Given the lack of infrastructure or natural resources of mid-twentieth century Singapore, his ambitions seemed outsized at the time, but now seem well, visionary – and the willingness to make social and public investment in projects with long-term benefit has paid off handsomely.

Public opinion of government in Singapore is high and has increased recently - public satisfaction with government was 86% and business satisfaction with government was 77% as of end of 2019, the highest satisfaction rates since the survey began in 2012.[1] This case study describes several significant examples of government putting the needs of the public at the center of public services, and using data to connect across the "silos" of government to create a seamless experience for the customer.

[1] Smart Nation Singapore, *Building a Smart Nation with Tangible Benefits For Our Citizens and Businesses,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/whats-new/press-releases/building-a-smart-nation-with-tangible-benefits--for-our-citizens-and-businesses.

Infrastructure for digital government innovation

Singapore continually pushes its government to be more technology-driven and to create horizontal enablers of data and technology connection across the organization. This small city-state is bringing top talent and ideas like agile development and design thinking into everyday government operations.

The Smart Nation and Digital Government Office provides both vision and implementation

The overarching leadership and vision for technology and innovation in data and digital services in Singapore is the **Smart Nation and Digital Government Office (SNDGO).** The office was created in 2017 to be a centralized hub of digital government activity as well as to build up digital infrastructure to serve the needs of citizens and businesses. It functions as a policy-making and thought leadership organization rather than an operational entity of government. With a staff of about 100, it is responsible for long-term strategic planning and developed a Digital Government Blueprint that describes what success looks like by 2023. Along with its operational and implementation arm GovTech this group forms the Smart Nation and Digital Government Group.

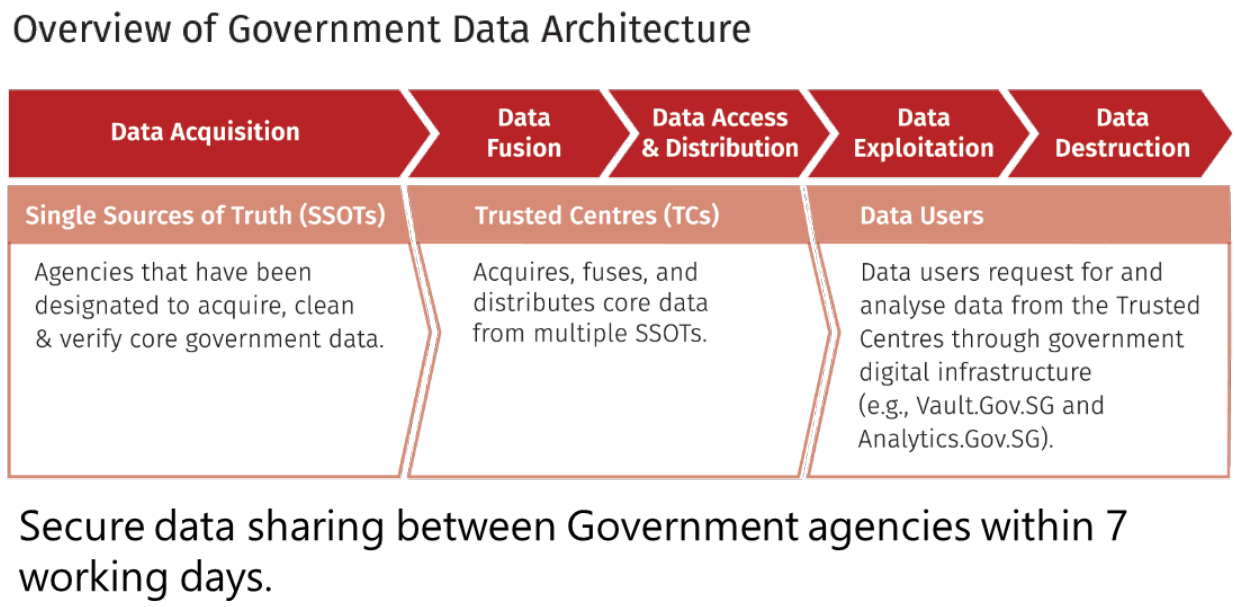
The Smart Nation team is charged with re-engineering government operations for efficiency, and with enhancing digital services to citizens and businesses. Throughout the work, they seek to bring in the voice of the public and to foster co-creation and engagement opportunities. This team has been working with various government agencies to create dozens of apps for public use, ranging from reporting municipal issues, crowdsourcing first responders for emergency situations, to parking. One app contains a suite of services which supports citizens' needs at key junctures. This include bundling services such as birth registration, baby bonus and library membership application for young parents, and for seniors to sign up for events that encourage active ageing and access information on government benefits.

The Government Data Office provides policy direction

The **Government Data Office** (GDO) was established in late 2018 as part of the Smart Nation and Digital Government Office and takes responsibility for policy and strategy the secure sharing and use of data across government. Government Data Office Director, Quek Su Lynn describes the organization's role as helping government "better harness the power of data to improve policies and services to citizens."[2] In addition to setting policy direction, her office oversees development of the infrastructure that enables efficient data flow across government. As shown in the diagram below, a Government Data Architecture has been created to verified Government data to flow easily between and among government agencies. In its current phase,

[2] Medha Basu, "Meet the Women in GovTech 2019," *GovInsider*, December 17, 2019, https://govinsider.asia/data/women-in-govtech-special-report-2019/.

only de-identified data is shared across public agencies for the purpose of policy analysis and insight. "Single Sources of Truth" are designated as authoritative sources for data elements that may be used by multiple government entities or "core data." Agencies that require such data will obtain them from the SSOTs instead of collecting such data themselves – this ensures quality, consistency and inter-operability of data across the Government. It also improves the security of the data by reducing the amount of duplicate data collected across the Government.



Source: Smart Nation Digital Government Office[3]

Quek's future vision involves expanding the scope of data sharing from intra-governmental use to collaborating with non-Government entities in using data advance public interests. For example, she wants to find new ways to collaborate with researchers, non-profit organizations and private sector partners to gain deeper insights than are available with government data alone. Given that this is uncharted territory, she cautioned that attention needs to be paid to working through "the attendant governance and privacy issues to make sure the data and individuals' confidentiality continue to be well-protected."

GovTech is responsible for implementation of the digital and data vision

The Government Technology Agency of Singapore, or **GovTech** is the country's lead implementation team for digital government. Founded in 2016 and now with more than 2,000 staff, this agency has a wide mandate to operationalize the Digital Government Blueprint and to create the apps and user-centric tools called for in the vision.

[3] Smart Nation Singapore, *National Artificial Intelligence Strategy*, Smart Nation Singapore, November, 2019, https://www.smartnation.gov.sg/docs/default-source/default-document-library/national-ai-strategy.pdf.

Toolkit for rapid digital development. GovTech recently led development of the Singapore Government Tech Stack (SGTS), a standard platform for the creation and deployment of digital services that can be used across all Singapore government departments. The tools and services of SGTS are hosted by GovTech on a common infrastructure to ensure the consistency and quality of applications that are developed using this platform, regardless of the user type or department developing them. SGTS allows agencies to focus their efforts on designing the right solutions to meet their customer's needs, without worrying about the underlying technical infrastructure.

The platform includes software development, hosting, middleware, and microservices, most of which was developed in-house. SGTS also includes an Application Programming Interface Exchange (APEX), which allows GovTech's systems to easily "talk" or exchange information with the digital systems of other Singapore government agencies. This shared service approach is highly efficient and a model that has wide ranging applicability.

Digital payments. The government of Singapore has aggressively moved toward cashless payments, and developed a digital payment capability beginning in 2017 and has continually expanded its reach. Launched as a peer-to-peer funds transfer service available for customers of nine Singapore banks, PayNow enables participants to send and receive funds from one Singapore bank to another in real time, without even knowing the recipient's bank and account number. The take-up rate is impressive with over 75% of Singaporeans aged 20 to 75 signing up for PayNow.[4] Increasingly, the public can use PayNow to transact with the government.

Data science and analytics work is led by the Data Science and Artificial Intelligence Division of GovTech

Key to the success of transformation is the work of the **Data Science and Artificial Intelligence Division (DSAID)**, led by Senior Director Der Yao Leong. He describes DSAID as "a fast-growing team interested in all things data, working in partnership with public agencies to improve the lives of fellow Singaporeans using data science and artificial intelligence." DSAID is responsible for growing data science talent in government and for working with agencies to build out data science use cases and to document and share successes. As Leong notes, "Our work is very practical minded and comes from understanding the pain points of our public service officers. Our goal is to enable public officers to be data-driven in their decision-making and whatever it takes to get it done, we'll do it."

DSAID has a three part mission that includes both directly engaging in data science projects with agencies, building data literacy and capacity, and building products that will enable self-service by data teams in the various government agencies. This hub and spoke model is a

[4] Smart Nation Singapore, *Building a Smart Nation with Tangible Benefits For Our Citizens and Businesses,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/whats-new/press-releases/building-a-smart-nation-with-tangible-benefits--for-our-citizens-and-businesses.

scalable approach that aims to transform all of government by energizing leadership of each agency to develop and execute on a strategy that is right for their operations.

One typical example of the DSAID engagement approach is the dashboard DSAID created for analyzing data from Singapore's Municipal Services Office (MSO). The MSO allows citizens to ask for help across many types of public issues – reporting a streetlight that is out, a drain that is clogged, trash that needs to be picked up and so on. Like a 311 system in the US, the MSO was established to coordinate and provide a single touchpoint for requesting government services, and take away the pain of the public having to navigate the array of government organizations providing multiple public services. A lot of data comes in from the public and is then routed to different government agencies for follow up.

As Leong noted, "Often the point of entry to an organization for analytics is dashboarding – it gives them a visual way to look at the data and identify hotspots. We can support the agency's work without getting too fancy, and can deliver direct impact in their ability to make data-driven decisions. Over time we also try to think about how do we identify patterns, how do we help route cases to the right organizations, and other more complex data issues."

Realizing that simply doing one-off projects would not scale and could not achieve widespread data culture change, DSAID now takes data literacy very seriously in an effort to democratize data science. As Leong notes, "Helping government become more data-driven is no different than any other major organizational transformation effort – we need to think of it strategically and holistically." As a result, there is both a top-down and a bottom-up set of activities DSAID takes on.

As part of the top-down effort, DSAID meets with senior executives of government agencies to both help them learn about the value of data science and AI to their operations, and also to help them formulate their own unique data strategy. The goal is to change the thinking to include data awareness and appreciation at the top level of the organization and to set a strategy that aligns with that. Every agency is unique in the degree to which they will need to use data and the degree to which specific operations need to be optimized with data. The goal is not to make everyone a data expert, but to have each agency decide what it needs to be as efficient and effective as it can be. As Leong notes, "We're trying to shift the conversation to data strategy."

On the broader data literacy front, the goal is to give everyone in government some basic competencies to do their work better. DSAID developed a curriculum for data literacy and has published a data science project scoping guide that helps define data projects that it may address. Assistant Director Joseph Tan leads the capability development efforts for DSAID and notes the importance of the role of DSAID in pulling together a data community across the whole-of-government, and the value of a network effect that can accelerate diffusion of a strong collective data culture. To that end, the capability development team sets up the framework for data competencies, the training roadmap, run workshops, meet-ups and

hackathons, and is working toward the long-term goal of raising the data literacy of every public service officer in every government organization.

One of the approach is to establish a minimum standard of data literacy, and to assure that everyone is speaking the same language when it comes to data. As Tan noted, "When we talk about data literacy, a lot of it is tools agonistic, it's about how you understand what data can, and cannot, do for you and the overall approach to problem-solving in data." In the four-hour online introductory data literacy course that GovTech is building, there is a great emphasis on this development of a shared language, common understanding for Data Science & AI terminologies and concepts, as well as provide a good intuition behind how machine learning algorithms work. Tan notes that even the simplest questions like "What is Data Science? What is AI?" can become an obstacle to collaboration if all parties are not in sync as to what they entail.

The DSAID team is also busy developing self-service tools and platforms that can be used by agencies and departments across government. Their idea to develop such products was born from the need for scalable solutions. DSAID started as a team of seven and now has about 70 staff, but not close to enough to provide service to every government entity across Singapore. Noticing that a lot of agency problem statements are quite similar, the DSAID team decided to create central solutions, such as for citizen feedback analysis. Many agencies have platforms for citizens to provide feedback on a service or request assistance and many agencies want to analyze the citizen feedback to look for patterns. DSAID developed a tool that allows agencies to load their citizen feedback data and a simple user interface for them to use to conduct basic analysis of their data. To build products such as this, Leong notes that he needs to have more than just data scientists on his team, "You need people who can do software engineering and product management, too."

Infrastructure for user-centric government

Singapore continually pushes its government to be more citizen-focused, providing a personalized experience for the user that anticipates their needs. Ideas like design thinking are being brought into everyday government operations. Examples of this approach to putting customers at the center and designing government around customer needs include:

- **Secure single sign-on for government services.** Singapore has long had a streamlined approach to user access to government services. SingPass, or Singapore Personal Access has since 2003 enabled users to securely access over 300 digital government services from 110 government agencies. SingPass has been issued to more than 3.8 million citizens and residents, and more than 110 million transactions are conducted annually. Rather than setting up separate username and password (and remembering all those passwords) for every government service, with SingPass a user can create a single account that is recognized across government platforms. Users can choose two-factor authentication to protect their accounts. The mobile version, SingPass Mobile now has

close to one million users. This program of providing a National Digital Identity (NDI) has been expanded to allow businesses to extend to their customers seamless and secure identity verification by using the government's established identity service through an extension called MyInfo. MyInfo is a "Tell Us Once" service that pre-fills a digital form with authoritative personal data each time the user performs a transaction, and offers seamless connection between public and private sector identity verification for digital services. Businesses have reported savings of up to $50 per transaction, and an 80% reduction in transaction time when their customers used MyInfo to prefill forms with information in their SingPass Mobile accounts. Businesses also report up to 15 per cent higher approval rate for transactions due to better data quality input from the pre-filled MyInfo sources.[5]

- **User input, by design.** Singapore is a country that was built a half century ago on the idea that government can be planned and designed from the ground up, rather than grow organically as other governments have. Not surprisingly, the concept of planning and design has taken hold in Singapore in ways that other governments have yet to embrace. As Singapore's Prime Minister, Lee Hsien Loong, said in 2018,
    - "Singapore is a nation by design. Nothing we have today is natural, or happened by itself. Somebody thought about it, made it happen. Not our economic growth, not our international standing, not our multiracial harmony, not even our nationhood. Nothing was by chance."[6]

  One example of this user input approach is Singapore's citizen engagement platform, Smart Nation Co-creating with our People Everywhere, or SCOPE. Over the course of 2019, 23,000 Singaporeans gave feedback on 13 projects via SCOPE, responding to prototypes and beta versions of software and program models at government offices or community organizations. The effort is now being expanded to include a mobile unit to reach people in the community, saving them the trip to a government office or community space.[7]

Response to COVID-19

Perhaps nowhere is the government of Singapore's emphasis on technology and connecting across the silos of government to provide the citizen with a seamless experience more visible and valuable as in the response to the COVID-19 virus. This disease, first identified in China in late 2019, began to spread via travel to other countries. Within days of the first news reports of the virus, public servants in Singapore began to respond, working on web sites and apps that would help provide the public with information to protect themselves against the virus. They weren't starting from scratch because as described earlier, a strong digital infrastructure and

[5] Smart Nation Singapore, *Factsheet — National Digital Identity,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/docs/default-source/press-release-materials/factsheet---national-digital-identity.pdf?sfvrsn=ea1d279f_2.

[6] Lee Hsien Loong, "A better nation by design," Prime Minister's Office Singapore, April 5, 2018, pmo.gov.sg.

[7] Smart Nation Singapore, *Building a Smart Nation with Tangible Benefits For Our Citizens and Businesses,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/whats-new/press-releases/building-a-smart-nation-with-tangible-benefits--for-our-citizens-and-businesses.

user-centric design culture was already in place. Referring to the decision a few years ago to bring more capacity for building apps inside government, GovTech Director Der Yao Leong noted, "With the COVID response, the app development team had to push out many new apps rapidly, and this has shown how valuable it is to have the engineering talent in house."

Examples of tech-enabled and user-centric COVID-19 responses in Singapore include:

- The first digital government response to COVID-19 was a website called **MaskGoWhere.gov.sg**, which launched on February 1, 2020, just nine[8] days after the first reported case of the virus in Singapore. The GovTech team of digital developers worked across departments to create a site that would bring together in one place information from several sources, including the Ministry of Communications and Information, the Ministry of Health, and the People's Association. The website let users know the location, day, and time that they could collect their allocation of protective face masks and provides community notice boards and hotline information. The website had more than 900,000 visitors in the first two days. There is a real-time user feedback function embedded in the website that allows the development team to monitor input and to make updates and improvements in response to public comment.[9]
- On March 20, the Singapore government released its contact tracing app **Trace Together**, and within its first month, 20%[10] of the population (1.1 million people) had downloaded the Bluetooth enabled app. The app is the world's first nationwide Bluetooth contact tracing app, and has been built as an open source[11] tool by government software engineers and designers. Users who download the app allow their phone to capture the information of other users who are nearby and also have the app installed and running. Then, if anyone they have come in contact with becomes infected with the virus, they can be notified by a government contact tracer. This approach eliminates the need for someone who contracts the virus to try to remember everyone they were near in the two week period when they might have spread the virus, and also allows contact of people who were nearby but not known to the individual, such as other shoppers in the same store. The Bluetooth data captured allows analysis of the closeness of the contact and the duration, so that contact tracers can prioritize follow up to those with more exposure to the person with the virus. By working with Apple and Google on the specifications, the contact tracing technology is inter-operable across international borders. As the work developed, more than 50 countries and several companies expressed interest in adapting the technology. GovTech worked with the Singapore Ministry of Health in developing this app. GovTech

[8] Michael Yong, *Timeline: How the COVID-19 outbreak has evolved in Singapore so far,* Channel News Asia, April 18, 2020, https://www.channelnewsasia.com/news/singapore/singapore-covid-19-outbreak-evolved-coronavirus-deaths-timeline-12639444.

[9] Smart Nation Singapore, *Factsheet — Responding to COVID-19 with Technology,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/docs/default-source/press-release-materials/factsheet---responding-to-covid-19-with-technology.pdf?sfvrsn=9383ab2b_2.

[10] Team TraceTogether, *20 April 2020 - One Month On,* TraceTogether, April 20, 2020, https://tracetogether.zendesk.com/hc/en-sg/articles/360046475654-20-April-2020-One-Month-On.

[11] Team TraceTogether, *BlueTrace Protocol,* Government Digital Services, April 9, 2020, https://bluetrace.io/.

Senior Director Jason Bay, the lead developer of the app cautions that the app cannot replace human contact tracers who can go beyond data and pick up on nuances like whether the contact occurred indoors or out, or through a wall, and can weigh false positives and negatives. He says that the app was designed to supplement manual tracing, not replace it, noting "If you ask me whether any Bluetooth contact tracing system deployed or under development, anywhere in the world, is ready to replace manual contact tracing, I will say without qualification that the answer is, No." and he further notes that, "You cannot "big data" your way out of a "no data" situation. Period."

- The government's web site has since 2014 included a chatbot named Jamie. Since the advent of COVID-19, Jamie has added a series of virus-related answers to her repertoire, and answered over 70,000 questions related to the virus from the public, reducing call volume to the call centers. Jamie's responses to questions are continually improved via machine learning to improve accuracy, and data analytics or the content and patterns of questions can detect trending topics.

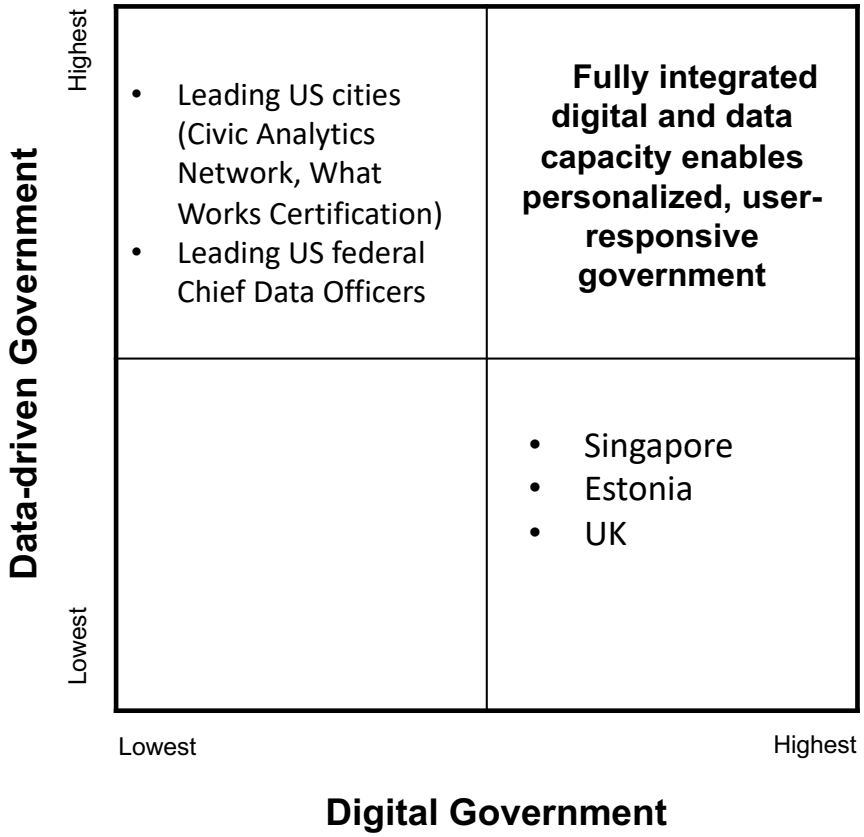
Moments of Life initiative

As noted by consulting firm McKinsey, Singapore government has made great efforts to become more user-centric in its delivery of digital services.

> "Organizing the delivery of services around a citizen's journey, rather than fitting their delivery to existing processes, requires extensive interagency collaboration beyond functional silos. Singapore calls this a "whole of government" approach—one in which agencies collaborate on the basis of shared outcomes for cross-cutting problems."

An excellent example of this type of collaboration is the Moments of Life initiative. The idea for Moments of Life is to bundle services together for specific life events so that the individual does not have to separately transact with different government agencies but instead can have one seamless mobile transaction. Accomplishing this is no small task – each separate government function must be maintained, but in the background, invisible to the user. Yet the rewards of such integration is significant as it provides the opportunity to generate significant amounts of data that can be integrated on the back end, much as the front-end process is integrated for the user. As shown in the graphic below, data-driven government and digital government can if pursued together create the conditions for fully integrated and user-oriented government.

While many governments excel at data use or digital services, few excel at both



Source: Developed by author

There are two moments of life applications already developed as of early 2020, one for the families of young children and another for seniors. The moments of life app for young children is described below.

The Moments of Life app for Families

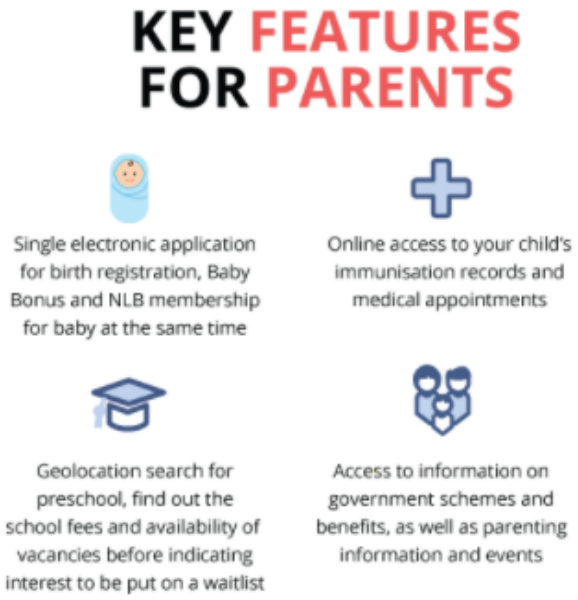
The Moments of Life app for families bundles services related to the birth of a child – a joyous time, but one that can also be a bit overwhelming. Now, registering the birth of a child has been reduced from 60 minutes to 15 and a parent need not go to 15 separate departments but can from one interface register the child's birth, apply for the financial bonus paid to new parents, establish their unique national identity number, keep track of their immunizations (23

in the first 18 months of life!), and register them for a geographically convenient daycare and preschool. Two-thirds of eligible births are now registered through the app.[12]

The mobile app means that parents do not have to wait for the open hours of a government office and wait in line, but can transact 24/7. The personalized, customized service uses the information about the parents from their SingPass accounts to prefill some of the information about the child, and lets parents use location-based services to find child care in their neighborhood.

As can be seen below, the resulting user interface is easy to navigate, and reflects the feedback of young parents during the development phase, including the use of eye tracker software so that app developers could literally "see" how people were interacting with the app.

Figure title:



Source: Singapore Government Technology Agency.[13]

The app was developed over the course of about a year by a multidisciplinary team of 15 staff in the GovTech agency. Agencies involved in the creation of the app include Singapore's Public Service Division, Ministry of Social and Family Development, Early Childhood Development Agency, Immigration & Checkpoints Authority, and the Health Promotion Board. To make the integrated single experience app work, each agency had to look carefully at its existing processes and some had to be modified so that they fit seamlessly together, and this took time.

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[12] Smart Nation Singapore, *Building a Smart Nation with Tangible Benefits For Our Citizens and Businesses,* Smart Nation Singapore, February 28, 2020, https://www.smartnation.gov.sg/whats-new/press-releases/building-a-smart-nation-with-tangible-benefits--for-our-citizens-and-businesses.

[13] GovTech Singapore, *Moments of Life,* Government Technology Agency of Singapore, https://www.tech.gov.sg/products-and-services/moments-of-life/.

Continuing to innovate and improve means not being satisfied with the status quo. "Having to navigate a complex web of government services and information can add to the stress of sleep-deprived new parents," said Ms. Lee May Gee, Director of the Moments of Life (Families) Programme Office. Ms. Lee added: "It is important to have a healthy degree of discontentment with the status quo. We were not satisfied with making citizens fill up the same information multiple times on manual forms and having to queue physically at a counter."[14]

Moments of Life for aging

With a growing population aged 50 and over, Singapore is thinking ahead and creating digital tools for this digital-friendly population in anticipation of their aging years. Launched in 2019, the Active Ageing Moments of Life app seeks to help residents aged 60 and over stay active, healthy and engaged in their community. The app was developed with consultation and user testing sessions with over 400 seniors who advised on a variety of aspects, including font sizes and the symbols used for the icons as well as the navigation of the app. The app allows seniors to access financial benefits and to find activities nearby.

Figure title:

Source: Singapore Government Technology Agency.[15]

[14] Wong Sher Maine, *Bundling Public Services For Citizens With Moments Of Life, Challenge.* Singapore Public Service Division, December 13, 2018, https://www.psd.gov.sg/challenge/ideas/feature/bundling-public-services-for-citizens-with-moments-of-life.

[15] GovTech Singapore, *Moments of Life,* Government Technology Agency of Singapore, https://www.tech.gov.sg/products-and-services/moments-of-life/.

New "smart" town

Singapore continues to develop new ways to connect government infrastructure to businesses and homes. A new town, Punggol is being designed from the ground up as a testbed of tech-enabled, sustainable development. Plans have been in the works for several years, and the groundbreaking was held in early 2020, with completion set for 2023. This new town will include residential areas as well as an office park, a university campus, community facilities, and a network of recreation sites such as parks and waterways.

The academic anchor for this town, the Singapore Institute of Technology (SIT) is working with Smart Nation Singapore and other public entities to co-create this new "smart" town. The idea is to use sensor data to optimize civic operations through ongoing collection and analysis of data in real-time.

A collaboration center will bring together academia, industry and government for experimentation and idea development. Housing will include built-in smart sockets and smart distribution boards that enable optimized household energy consumption for a greener, lower cost energy footprint. The Punggol business park will be fully sustainable and aims to achieve 30% higher energy efficiency than standard commercial buildings, and zero water waste along with recycling 100% of food and horticulture waste into fertilizer.[16]

Public recreation activities in the town will include both traditional analog activities such as fields and parks, but will be complemented by new tech-enabled activities like virtual coaching, augmented reality gamification and online facilities booking. Recreation facilities will be kept clean by a smart facilities management system will use sensors, robots and other technologies to provide more efficient cleaning and maintenance services. Transit in Punggol will include autonomous buses.

National Artificial Intelligence Strategy

In the fall of 2019, Singapore announced its National Artificial Intelligence Strategy (NAIS) and created the new National Artificial Intelligence Office. Long term goals include increasing the number of AI public-private partnerships and innovation labs for the commercialization of AI technologies and growing talent through more PhD and postgraduate opportunities and by training 25,000 professionals in basic AI coding and implementation skills.

The new strategy, which maps out how Singapore will develop and use AI to transform the economy and improve peoples' lives, includes a handful of initial projects were selected across a range of high priority areas for public value, including:

[16] Mohit Sagar, *Smart Nation & Digital Government Office Announce Punggol Smart Town Plan,* OpenGov Asia, January 18, 2020, https://www.opengovasia.com/smart-nation-digital-government-office-announce-punggol-smart-town-plans/.

- **Intelligent freight planning** that optimizes truck delivery routes and scheduling. This will further streamline traffic flows and build on earlier efforts such as congestion pricing and automatic tolling. This effort may also develop AI that can pool truck jobs to optimize asset utilization.
- **Automated municipal problem reporting.** Building on the current chatbot on the Singapore government web site, Jamie, an AI chatbot will be developed and deployed by 2022 that can automate the reporting of municipal issues by the public. The AI can route requests to the appropriate agency for follow up. Analyzing the data for patterns will allow proactive response to predicted events, rather than waiting for service disruptions to occur.
- **Prediction and prevention of diseases.** AI will be deployed to help doctors more efficiently screen for and treat diseases. Among the first disease screenings will be the use of AI-enabled machines that can read retinal photographs to identify early signs of diabetic eye disease. Later work will address prediction and prevention of cardiovascular disease.
- **Improving education.** Later in 2020, AI will be used in a pilot project to grade and provide feedback on short essays written by schoolchildren in English. By 2030 it is expected that the AI will be able to also grade papers in other subjects as well. Additional AI tools are planned that can customize learning pathways for the needs of each learner.
- **Border clearance operations.** Using AI to read facial and iris scans, the border clearance process will be made much faster for travelers by 2025, omitting the need to show their passports to gain clearance into the country.

Many of the AI projects, as well as other data analytics projects in Singapore government, will rely on a Government Data Architecture that advances standardization of platforms and data governance.

Lessons learned

While Singapore has unique characteristics in its government and society, there are yet valuable insights for other governments in the United States and abroad from their experience. Lessons applicable to other governments from the Singapore experience with digital and citizen-centric government include:

- **There is value in thinking big.** Singapore government is ambitious in its technology and innovation agenda and has had demonstrable success from bold moves such as bringing engineering talent in-house and developing its own tech platform.
- **Invest in common platforms.** The investment that Singapore has made in the Singapore government Tech Stack, has enabled faster deployment of solutions by agencies and departments, and has also enabled greater data sharing across entities via common APIs.

- **Be patient as change takes time.** When reflecting on the first year of progress in her office, Quek Su Lynn, Director, Government Data Office noted that engagement takes time and that it is important to actively engage people to understand their perspectives and seek their inputs.
- **Use crisis as an opportunity.** After three high profile security breaches relating to government data, Singapore formed a Public Sector Data Security Review Committee, with respected participants from inside and outside of government. The Committee conducted data management audits of all 94 government agencies and reviewed existing data security policy and procedures as well as industry best practices, over a period of 8 months. The Committee then published a report with recommendations for improving public sector data security. When Singapore implemented the first phase of its new Government Data Architecture in October 2019, many of the data security recommendations of this Committee were included. This is an example of taking a crisis and turning it into an opportunity to establish new and higher standards for government performance. More recently, the COVID-19 response in Singapore was rapid and effective at least partly because the government so quickly used technology to share information with the public on its web sites and mobile applications created soon after the introduction of the virus.

Conclusion

The year 2020 has brought the challenge of governing into the forefront for many. Impending budget problems at the state and local level will undoubtedly mean being asked to do "more with less" for many government managers and leaders. And yet, this case study shows that making investments in infrastructure and human capital can have long-term value. Seeing the long view, as Singapore government leaders do, has been helpful in this difficult year.

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