

Optimizing the City

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August 2021





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ACKNOWLEDGEMENTS

I would like to thank the Charter Cities Institute staff, and particularly Kurtis Lockhart, for motivating many of the ideas and arguments contained in this paper, as well as Jeffrey Mason and Heba Elhanafy for their extensive commentary and feedback. This publication would not have been possible without their suggestions and insights. All remaining errors are my own.

WHY ARE CITIES ILL-EQUIPPED TO DEAL WITH CRISES?

Crises are often characterized as low-probability events with severe negative consequences. Although the likelihood of such an event occurring at any one specific time is extremely small, the likelihood of it happening eventually is virtually 100%. Global recessions, 100-year floods, ecological collapse, military conflicts, and pandemics are examples of these. These events are probabilistic, but not unpredictable. Curiously, some cities have, over time, become better at preparing for such eventualities, while others have not.

This paper addresses how cities, when given the autonomy to design their own institutions and policy-making apparatus, can adapt to thrive even under conditions of high uncertainty. These cities are not only resilient to crises, but antifragile;¹ indicating that they not only survive crises but adaptively learn from them.

1.1 Antifragile healthcare systems during the COVID-19 pandemic

Even before the COVID-19 pandemic was officially recognized by the World Health Organisation on March 11, 2020,² cities like Hong Kong, Taipei, and Seoul had already allocated large amounts of resources to disease surveillance³. These cities generally performed well in terms of cumulative cases and fatality rates compared to the rest of the world (Figure 1).

Figure 1: Cumulative COVID-19 cases and fatality rates in Hong Kong, South Korea, Taiwan compared to global averages

Retrieved from OurWorldInData.org.



¹Taleb, N. (2012). Antifragile: Things that Gain from Disorder. United States: Random House.

²World Health Organisation (March 11, 2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Press Release.

³Shaw, R., Kim, Y-K. & Hua, J. (2020). Governance, technology and citizen behavior in pandemic: Lessons from COVID-19 in East Asia. Progress in Disaster Science, 6.

In hindsight, these East Asian cities had benefited greatly—especially in terms of emergency preparedness—from previous epidemics such as the severe acute respiratory syndrome (SARS) in 2003 and the Middle East respiratory syndrome (MERS) in 2015. These cities created their own domestic equivalents to America’s Center for Disease Control and Prevention (CDC) to prepare for future crises⁴. Intensive care unit capacities were expanded and laws designed to expedite clinical trials and medicine approvals were enshrined into their constitutions. That is, these cities demonstrated institutional learning: they learnt from their experiences, improved their healthcare and legislative systems, and became smarter. This is not unlike how humans learn by reinforcement or how we design computer algorithms to learn from data. At a systems-level, it is valuable to understand how cities learn, retain, and transfer knowledge from one domain to another.

The response of various sub-Saharan African countries to COVID-19 is also instructive. As a result of Ebola, malaria, and dengue fever outbreaks on the continent, many African countries have progressively developed real-time surveillance and outbreak response forces⁵. The Integrated Disease Surveillance and Response Framework (IDSR)—which the WHO African region has implemented over the past 20 years—was an effective starting point for national governments to manage the COVID-19 pandemic⁶. Specifically, the IDSR had significantly improved national and supra-national laboratory capacities for disease testing. A culture of emergency preparedness and crisis-mediated innovation had also seemingly been ‘learnt’ in Ghana (Box 1), indicating that institutional learning is far more than simple organisational changes or one-off legislative reforms.

BOX 1: GHANA'S CRISIS-MEDIATED INNOVATION TO COMBAT THE COVID-19 PANDEMIC⁷

Since the pandemic, Ghana has carried out the second highest total number of tests in Africa despite only being the 16th richest African country by nominal GDP per capita. When compared to countries with similar GDP profiles, its outstanding record on COVID-19 testing despite limited resources is an outlier. The Ghanaian government worked together with private companies, medical researchers, and social innovators to rapidly develop a set of scientific and technological innovations in response to the outbreak.

For instance, Ghanaian scientists reacted to the need for mass COVID-19 testing by being one of the first countries to implement a ‘pooled testing’ method. Multiple specimens are pooled together to efficiently use the limited supply of testing reagents. If the mini-pool sample returned positive, only then would individual testing be carried out. It has also been lauded as the first country in the world to deploy drone technology to expedite the transportation of COVID-19 samples from remote rural areas to laboratories. Its drone fleet can now transport up to 15,000 test samples in a single day. Notably, Ghana’s drone fleet had only been piloted in 2019 to transport medical supplies to rural clinics, reflecting its adaptive use of existing resources.

⁴ An, B. Y. & Tang, S-Y. (2020). Lessons From COVID-19 Responses in East Asia: Institutional Infrastructure and Enduring Policy Instruments. *The American Review of Public Administration*, 50(6-7), pp. 790-800.

⁵ Ihekweazu, C. & Agogo, E. (2020). Africa’s response to COVID-19. *BMC Medicine*, 18, 151.

⁶ Fall, I. S. et al. (2019). Integrated Disease Surveillance and Response (IDSR) strategy: current status, challenges and perspectives for the future in Africa. *BMJ Global Health*, 4.

⁷ Sibiri, H., Zankawah, S. M. & Prah, D. (2020). Coronavirus diseases 2019 response: Highlights of Ghana’s scientific and technological innovativeness and breakthroughs. *Ethics, Medicine and Public Health*, 14, 100537.



Existing fleets of drones are adaptively being used to deliver COVID-19 tests in Ghana. Photo: Zipline Ghana.

1.2 Cities are complex systems that further complicate crises

Urban environments are wonderfully complex. Urban complexity results from the multitude of interacting stakeholders in the private sector, civil society, the public sector, and the environment that operate at different scales (local, regional, national, and international) within the constraints of a city's natural and built environment. Most current methods to conceptualize urban challenges are inadequate because they attempt to reduce the complexity of cities into overly simplified or linear processes. For example, attempts to rationalize the COVID-19 pandemic into 'phases' or 'waves' ignores how people and businesses actually experience the virus, which is often chaotic and idiosyncratic. There is no one optimal solution for the COVID-19 pandemic: heavy restrictions and lockdowns led to significant economic, social, and mental health challenges, but also protected healthcare systems and accelerated business digitisation in many cities. What's more, these effects varied over time and across space.

There is no best solution, but there can always be a better way of planning cities and making policy decisions. This paper endeavours to understand how we can iteratively improve our response to city planning. Section II lays out three principles for complexity-driven urban planning. Section III makes several practical recommendations that cities can adopt, even in institutionally weaker contexts. Section IV explores the limitations of this approach in the wider context of charter cities.

WHAT DOES COMPLEXITY-DRIVEN URBAN PLANNING LOOK LIKE?

Successful urban planning will need to consider the challenges of complexity in the policy and urban environments. Such a planning methodology would be (1) driven by high-quality and high-resolution data, (2) responsive and resilient to expected and unexpected changes, and (3) characterized by tight feedback loops to accelerate institutional learning.

Giving credibility to the idea that data availability is central to robust planning, building up national statistical capacity has been designated as a specific target under the Sustainable Development Goals (Indicator 17.18.1⁸). The SDG Indicator calls for developing countries to “increase significantly the availability of high-quality, timely and reliable data,” which would provide the necessary ingredients to make better policy and urban planning decisions. Although statistical capacity has generally improved across the board, collecting high-quality, timely and reliable data at both national and city levels has been challenging especially where institutional capacity is already weak (Figure 2).



2.1 Rather than intuition, urban policy making and planning needs to be driven by high-quality, high-resolution data

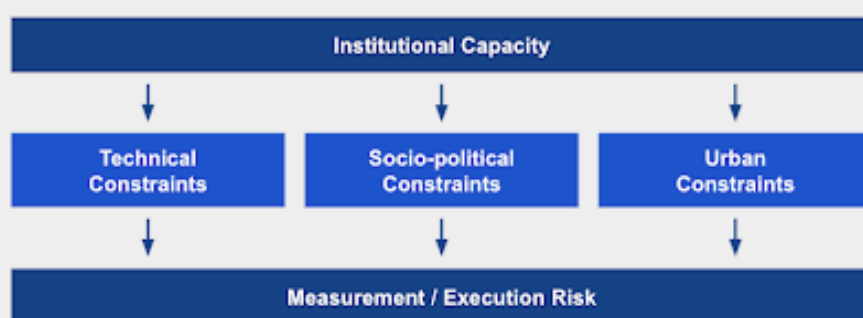
Planning for complexity requires a baseline understanding of the urban environment in which policy makers are operating. Baseline measures help us identify existing urban problems that need solving and allow us to comprehensively evaluate whether particular policy interventions have taken effect. Some of these baselines include:

- Population and household census surveys;
- Geographical mapping surveys;
- Aerial imaging for agricultural and industrial uses;
- Land ownership registries;
- Longitudinal social and health indicators.

⁸<https://sdg-tracker.org/global-partnerships>.

While the need for baseline measures may seem obvious, it can often be challenging in practice to establish this in real-world settings. Some policy planning parameters such as population size and income levels could be captured by census measures, but other useful information such as land ownership or pollution measures may be more elusive. Yet even information that might be captured easily through surveys can be difficult to gather where institutional capacity is weaker. One example of this substantial data gap in the GDP figures in many African countries: these GDP statistics are often highly uncertain or based on baseline data from decades ago,⁹ relegating economic planning to crude estimates that are unlikely to reflect reality and that hinder the emergence of evidence-based policy. This set of challenges confronting city governments is conceptualized in Figure 3.

Figure 3: Potential challenges in establishing a data-driven baseline measure of policy and urban environments



The primary difficulty in implementing comprehensive baseline measurements, such as census surveys or street-level mapping, is low institutional capacity. Inadequate political will or the lack of institutional know-how can prevent data-driven baseline measures from becoming a priority. This may be because extensive census surveys, establishing monitoring stations, or procuring expensive remote sensing equipment do not generate political capital or immediate returns on investment. Even reliable and accurate city-wide address systems that most high-income municipalities take as given are not always established in fast-growing developing cities that often lack the planning capacity to keep ahead of the rapid pace of urbanization. In these cities, digital startups such as London-headquartered what3words¹⁰ (whose geocoding is applied globally) and Ghana's SnooCode¹¹ have attempted to fill this gap and provide digital addressing systems.

While the initial costs of deploying large-scale baseline measurements may be great, it is a mistake to assume that benefits can only be accrued in the long-term. Institutional knowledge spillovers, second-order learning, and direct job creation are short-term benefits:¹²

- **Problem Identification.** Robust surveys can capture how well the population is doing on economic, social, and environmental fronts, allowing public agencies to allocate limited resources more efficiently. For instance, the KEMRI-Wellcome Trust Program¹³ based in Nairobi has aggregated malaria transmission patterns, drug and insecticide resistance patterns, and other epidemiological profiling to understand where further anti-malarial intervention is needed.

⁹Jerven, M. (2013). *Poor Numbers: How We Are Misled by African Development Statistics and What to Do About It*. Ithaca: Cornell University Press.

¹⁰<https://what3words.com/>

¹¹<https://snoocode.com/>

¹²Department of Economic and Social Affairs, Statistics Division. (2017). *Principles and Recommendations for Population and Housing Censuses*. New York: United Nations Publication.

¹³Snow, R. W. & Noor, A. M. (2015). *Malaria risk mapping in Africa*. Working paper prepared in support of the Information for Malaria (INFORM) Project.

- **Employment.** Investing in statistical improvements provides direct employment and training of field workers, supervisors, and statisticians. Building up institutional capacity in research methods, geostatistics, remote sensing, and data science can directly generate new employment in the knowledge economy.
- **Skills Upgrading.** Technology and skills acquired can be reused in other statistical exercises, therefore the initial investment is likely to open new doors in data-driven policy making approaches throughout the government.
- **Funding & Capacity Building for Evidence-Based Policy.** Large-scale baseline measurement projects need not be expensive. Given statistical capacity's designation as an SDG priority, the World Bank and other development finance institutions have funding programs to support such initiatives. The African Development Bank has initiated the African Information Highway to build a "mega network of open data platforms" connecting all African countries and 16 regional organisations to provide statistical intelligence.¹⁴ The World Bank's Trust Fund for Statistical Capacity Building (TFSCB) has funded more than 400 projects since 1999.¹⁵ This includes a Nighttime Light Dataset¹⁶ spanning three decades, which has enabled longitudinal studies on rural electrification and economic activity measurements where data is currently scarce.

However, generating baseline measures alone will not create a culture of evidence-based policy making. A strong data-driven policy making regime is characterized by a decision process that emphasizes testing and experimentation, where insights from data are not subordinate to subjective, personal opinions, and where data is used to identify problems *ex ante* rather than to justify solutions *ex post*.

Implementing data-driven policy making could also be constrained by technical, socio-political, and urban factors. For instance, high-resolution (at household- or individual-level) socio-economic data may not be available in many developing countries despite a willingness among bureaucrats to collect this data. Resource constrained environments where the households have not been mapped to land registries make it difficult to reliably sample the population. An unwillingness for people to be surveyed due to fear that municipalities will misuse the data for discriminatory purposes (e.g., concerns over Kenya's census survey igniting ethnic tensions¹⁷) could also impact the quality of data gathered. Similarly, expensive and technically complex methods to survey the urban environment, such as 3D scanning or hyperspectral imaging, may be out of reach for developing world cities.

Overcoming these constraints is not trivial and is something that even high-income economies struggle with. Pinpointing alternative sources of data could help overcome some of these constraints. For instance, Rwandan researchers used mobile phone metadata to infer socioeconomic status and accurately reconstruct wealth levels in the country. This cost-effective method had more than 90% accuracy in predicting Rwanda's wealth distribution. Whereas a typical national household survey might cost more than \$1 million and take up to 18 months to complete, Rwanda's method of mobile phone surveys cost around \$12,000 and took only 4 weeks to administer.¹⁸

Adding to the difficulty, when the above constraints are overcome or ignored, city governments may still face measurement bias, availability bias, or misinformed judgment:

¹⁴ <https://www.afdb.org/en/knowledge/statistics/africa-information-highway-aih>.

¹⁵ Hiraga M. & Song S. H. (2019). "What is TFSCB?" Retrieved from <https://blogs.worldbank.org/opendata/what-tfscb>.

¹⁶ <https://registry.opendata.aws/wb-light-every-night/>.

¹⁷ <https://www.bbc.com/news/world-africa-50322782>.

¹⁸ Blumenstock, J., Cadamuro, G. & On, R. (2015). Predicting poverty and wealth from mobile phone metadata. *Science*, 350 (6264), pp. 1073-6. [UR.ZS?locations=CD](https://doi.org/10.1126/science.1262518).

- **Measurement bias:** Sampling and estimation errors due to a lack of proficient statisticians could limit the usefulness of the data collected.
- **Availability bias:** Over-reliance on readily available data could obscure factors/signals that are more difficult to measure or not at all amenable to measurement. For instance, citizens' happiness levels or quality of life are notoriously subjective to measure but are not any less important than economic indicators.
- **Misinformed judgment:** Even with the best collected data, human analysis and judgement can diverge. It is a dangerous assumption that all "data-driven decisions" will necessarily produce good outcomes for the intended or unintended stakeholders.

2.2 Planning should be responsive to expected and unexpected changes¹⁹

The city is a dynamic system where policy and urban conditions are in constant flux. The COVID-19 pandemic was a prime example where multiple urban systems were stressed and local conditions were rapidly changing. Inflexible policy planning would be incapable of handling the latest scientific understanding of how the novel coronavirus is transmitted (i.e., asymptotically) as well as the unravelling of global connectivity and supply chains. Instead, countries like Taiwan and New Zealand generally protected their communities from infection by introducing quarantine mandates, travel bans, contact tracing protocols adaptively based on new information from the global scientific and epidemiological communities.

Similarly, assumptions that underpin many of our urban planning decisions quickly become outdated and irrelevant. For example, demographic projections can change based on socio-economic conditions, immigration laws, and a shock to the regional economy, resulting in dramatically different housing needs. An adaptive planning system therefore continuously assesses how changing conditions validate or invalidate original planning assumptions.

¹⁹This subsection aligns with CCI's forthcoming Planning Guidelines. The Planning Guidelines will be made available on CCI's Reference Guides webpage upon publication: <https://www.chartercitiesinstitute.org/category/reference-guides>.

BOX 2: EVOLUTION OF SINGAPORE'S PUBLIC HOUSING²⁰

Singapore's Housing & Development Board (HDB) is a public agency responsible for planning, building, and managing public housing stock for over 80% of its city population. Within a decade after the city's independence, the HDB used low-cost building methods and land acquisition to relocate the majority of Singaporeans from squatter settlements to dense, high-rise apartments.

Since then, it has adapted to the needs of the day, for instance using a range of financial instruments to ensure home ownership remains affordable, or retrofitting older apartments with lifts and new amenities to ensure good liveability standards. The willingness to leverage public housing as a policy vehicle to promote socio-economic objectives demonstrates the Singaporean government's responsiveness to evolving perceptions and the significance of public housing to its people. Some notable policy adaptations include:

1995 - Selective En Bloc Redevelopment Scheme (SERS). Public housing stock reaching maturity (>40-50 years) is selectively slated for demolition, especially if they are deemed to have high redevelopment potential.

2007 - Home Improvement Program. This program provides maintenance works (e.g., upgrading electrical loads, repairing spalling concrete) to housing stock at its 30-year and 60-year marks. This ensures that public housing remains attractive and desirable for both current and prospective public housing occupants.

2009 - Lease Buyback Scheme. This scheme was introduced to allow seniors to monetize their HDB flats by 'selling' the tail-end years of their lease to the government at market prices.

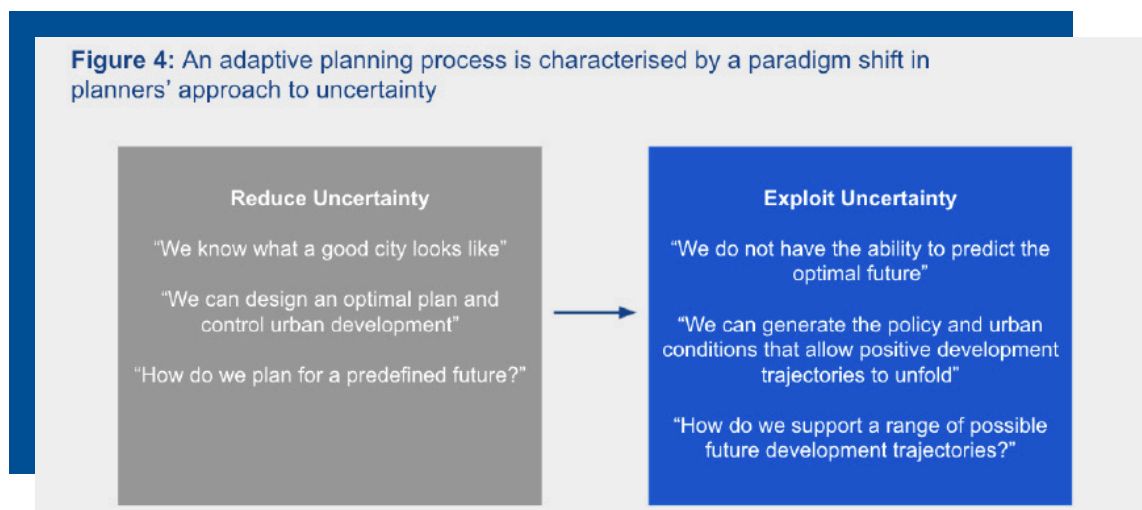
2015 - Flexi Flats. In a departure from the standard 99-year leases, HDB allocated flexi flats with shorter 15 to 45-year leases to allow seniors to own their apartments at more affordable prices.



Public housing blocks in Singapore. Photo: EPA-EFE.

²⁰Mason, J. & Lutter, M. (2020, June 22). Introduction to Charter Cities. Retrieved July 10, 2020, from <https://www.chartercitiesinstitute.org/post/introduction-to-charter-cities>.

Policy makers who embrace adaptive planning accept the uncertainties of the city as a complex urban system. Rather than attempting to reduce uncertainties by making unknown quantities known (e.g., ‘guesstimating’ population growth, assuming citizens as rational agents), planners that prioritize dynamic learning instead must ensure that the city is ready to exploit opportunities that arise from these uncertainties.²¹ This is illustrated as a paradigm shift in Figure 4.



Exploiting uncertainty shares some conceptual similarity to the concept of ‘antifragility’²² which describes systems that thrive the most when they are designed to benefit from uncertainty. Imagine if the scientific community had pre-determined that using conventional adenovirus vaccine platforms was the best chance of developing an effective COVID-19 vaccine, we would not have developed Moderna and Pfizer’s novel mRNA-based vaccine platform. Although there had been very little scientific validation of the mRNA platform, the extreme uncertainty of vaccine development demanded that researchers exploit uncertainty, rather than reduce it.

Similar to how a plethora of vaccine development pathways were embraced to combat the coronavirus, urban planners and policy makers should not avoid pursuing non-conventional interventions. Instead, the focus should be placed on generating the appropriate conditions for allowing positive development trajectories to unfold. This aligns with Prichett et al. (2017)’s notion of “positive deviance” for building state capability,²³ in which they recommended creating environments to facilitate policy experimentation, with the objective of exploring the policy space for non-obvious ideas.

An effective way to generate these conditions is to intentionally encourage diversity in policy making through political decentralization. China’s enterprise reforms in the 1980s were characterized by mandates from the central government that set economic growth targets for municipal actors, but then allowed these local actors the political space to experiment with different policies to hit central targets. This open-ended process of policy formulation allows for divergent and sometimes contradictory policies to emerge through rigorous trial-and-error that pays more attention to local conditions.²⁴ By allowing a range of policy trajectories to emerge, the central government has the ability to observe successes and then replicate these policy successes at scale across the country (Box 3).

²¹Rauws, W. (2017). Embracing uncertainty without abandoning planning. *disP - The Planning Review*, 52(1), pp. 32-45.

²²Taleb, *Antifragility*.

In addition to political decentralization, many of China's empowered local governments partnered with private urban developers to help design, plan, build, and operate new city developments. In developing the Gu'an Industrial City in Hebei province, the local county government signed a public-private partnership contract with China Fortune Land Development (CFLD),²⁵ an early-stage real estate developer. In this and many other instances of new city development throughout China, outsourcing urban planning and management to an urban developer increased the pressure on these developers to build an economically viable city, often successfully avoiding politically-driven, white elephant projects that end up wasting scarce local resources. Scholars have suggested that the privatization of urban planning can increase the quality of new cities built in China, especially in localities where the city government lacks the technical expertise, tax revenues, or institutional capacity to undertake such urban investments and infrastructure builds themselves.²⁶ Nevertheless, it is still unclear whether Gu'an was an outlier success or whether private developers (because of profit incentives and deep technical know-how) can consistently replicate robust urban governance in other contexts (e.g., Singapore-based private developer Surbana Jurong developing cities across Africa).²⁷

BOX 3: CHINA'S COST CONTROL SYSTEM REFORM²⁸

In the early 1980s, China's state-owned enterprises (SOE) struggled with cost inflation which resulted in an increasing debt burden on central and local governments. SOEs required a more efficient way of calibrating production and pricing that was sensitive to costs and market demand.

In 1984, the State Council issued a directive urging SOEs to introduce cost-cutting measures to improve profitability and operational efficiency. Other than outlining basic accounting principles and management guidelines, the central government gave SOEs the mandate to determine their own cost-cutting measures. This resulted in Hangang Corporation in Hebei Province introducing innovative incentive schemes where 100% of employee salaries were contingent on them meeting cost-cutting targets. Incentives were also applied at the branch level rather than the whole company, therefore encouraging cost-cutting measures to be seriously administered at every scale of the organisation.

These incentives were lauded as an exemplar by the central government, which then promulgated the Hangang policy across the country.

Arguably, China benefits from its geographical and demographic scale, allowing many 'micro-experiments' to be tested across the country simultaneously. But this does not preclude adaptive policy making at the city-level. Singapore, a city-state of just 281 square miles, has effectively segmented its geographical space to trial new policies, technologies, and urban planning concepts. Residential spaces are segmented at the precinct, neighbourhood, and town levels, allowing town planners to trial open streets, reduced parking spaces, electrical vehicle charging stations, and pneumatic waste disposal, among others. Selected towns or neighbourhoods are chosen as the sites of experimentation. When these ideas are validated, they are then rolled out nationally or undergo further testing in different contexts. In the next phase of development, Singapore has accelerated the development of 'urban test-beds' where selected urban districts are designated for rigorous technology deployment and testing (Box 4).

²³ Prichett, L., Andrews, M. & Woolcock M. (2017). *Building State Capability: Evidence, Analysis, Action*. Oxford University Press.

²⁴ Katzenstein, P. J. & Seybert, L. A. (2018). Protean Power and Uncertainty: Exploring the Unexpected in World Politics. *International Studies Quarterly*, 62(1), pp. 80-93.

²⁵ Zheng, S. & Tan, Z. (2020). *Toward Urban Economic Vibrancy: Patterns and practices in Asia's new cities*. MIT Press.

²⁶ Ibid.

²⁷ Newirth, R. (2020). 'A Singaporean firm has become the go-to master planner for African cities.' *City Monitor*. Retrieved from: <https://citymonitor.ai/>.

²⁸ Langen, P.W. (2007). *The Economic Performance of Seaport Regions, in Ports, Cities, and the Global Supply Chain*, pp. 202. Ashgate Publishing.

BOX 4: SINGAPORE'S PUNGGOL DIGITAL DISTRICT²⁹

The PDD is a 50ha area in the northeast of Singapore that is currently under development by the JTC Corporation, a government master planning agency responsible for industrial development. Envisioned as Singapore's first 'Enterprise District', it is designed as a compact, integrated precinct that will incorporate a business park, university campus, and other mixed-use developments. The district itself will host the city's first open digital platform, integrating remote sensors and systems to generate real-time data for industry, academia, and community use. If successfully validated, these smart city deployments may be rolled out nationally.

While the state-of-the-art technology that PDD boasts may not be immediately relevant to low-income countries, the parcelling of the country into smaller testing units is a principle applicable in many places. Piloting experimental policies (e.g., rechargeable lamps, cash transfer programs) incrementally in smaller towns could help smooth out implementation obstacles or even demonstrate the policy's ineffectiveness, essentially de-risking the policy implementation at city- or national-scale. In addition to policy experimentation, localizing reforms also adversely affects fewer incumbents or elites who currently benefit from the institutional status quo than, say, reforms at the national-level, implying fewer elites will be mobilized to stymie these local changes. This is another reason why localized reforms may be more politically feasible than national-level reforms.³⁰

2.3 Optimize for the speed and scope of learning within the city

The evolution of smart urban planning in emerging cities can be likened to early childhood development. A young child learns from their environment through the collection of sensory input (data-driven policy making) and engages in trial-and-error that allows them to understand what might be harmful or beneficial (adaptive decision-making). However, the child will also need to remember the lessons learnt in order not to make the same mistakes. Reinforcement learning characterized by tight feedback loops will similarly benefit urban planners and policy makers.³¹ Rigorous data collection regimes and adaptive learning can be expensive and laborious endeavours, particularly for developing cities. As such, cities should think very hard about retaining this knowledge within institutional memory to avoid 'wastage'.

Feedback loops are a learning mechanism where the original input is amplified (i.e., positive feedback) or inhibited (i.e., negative feedback). When a certain policy or urban intervention is implemented, continuous evaluation of the outcomes is necessary to inform policy makers whether they should continue, refine, or terminate the intervention. Participatory planning, where policy makers, local businesses and citizens are actively involved in the planning and evaluation of policies, is an especially important source of feedback.³² New ideas are synthesized at the convergence of such perspectives and ensure that assumptions made about any specific stakeholder are rigorously tested and contested by the stakeholders themselves. Without such feedback loops, policy makers do not have empirical justification to support these interventions.

Management theory³³ suggests two systems of feedback loops (Figure 5): (1) single-loop learning where the aim is to refine the intervention to produce the predefined outcome, and (2) double-loop learning where agents have the flexibility to pivot away from the intervention based on new information gathered. Double-loop learning encourages policy makers to question their underlying assumptions and seek new solutions where necessary.

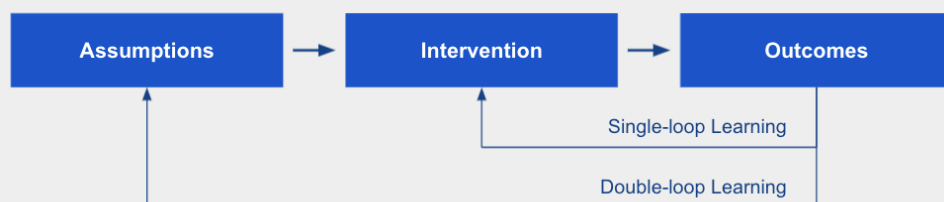
²⁹ JTC Corporation (2020). Punggol Digital District. Retrieved from www.estates.jtc.gov.sg.

³⁰ Olson, M. (1971). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press.

³¹ Lockhart, K. (2020). 'An Ostromian Argument for Charter Cities: Institutional Resilience'. London: London School of Economics International Development Blog.

³² Eriksson, E., Fredriksson, A. & Syssner, J. (2021). Opening the black box of participatory planning: a study of how planners handle citizens' input. *European Planning Studies*.

³³ Argyris, C. (2004). *Reasons and Rationalizations: The Limits to Organizational Knowledge*. New York: Oxford University Press.

Figure 5: Differentiating single-loop versus double-loop learning

To implement double-loop learning, municipal governments have to draw on data and be prepared to adapt to new information, adaptation which is much more likely if the city government or city bureaucrats possess sufficient autonomy to respond to incoming data in real-time rather than have pet projects or political objectives imposed upon them from higher tiers of government. For instance, the “Panca Trotoar” program in Bandung, Indonesia is a positive example of double-loop learning where the municipal government iteratively designed safer, cleaner, and more visually appealing streets for pedestrians, but also reconsidered their initial assumptions about the homogenous benefits of pedestrianization (Box 5). In this way, double-loop learning gets us closer to thinking about the general equilibrium effects of policy changes rather than just a partial equilibrium, i.e., we actively consider whether our ‘positive’ policy outcomes are merely locally optimal for a specific group of people or a specific period in time or a specific urban context.

BOX 5: ‘PANCA TROTOAR’ PEDESTRIANIZATION PROGRAM IN BANDUNG, INDONESIA³⁴

By collecting footfall data and conducting interviews with residents, the Bandung city government adjusted the street widths, visual amenities, and street furniture to encourage greater pedestrian activity. However, it noticed that female vehicle owners were less inclined to walk further even with improvements to the pedestrian environment, due to gender-specific dangers on public streets. The program also failed to change the walking behaviour of residents who were wealthier or had poorer health indicators, revealing how different stratifications within society impacted the effectiveness of a simple policy intervention.

As a result, the city government was prepared to question the assumption that increased pedestrianization of streets was a worthwhile objective for all segments of society. Rather than attempting to increase overall levels of walking, the government recognized the different preferences among groups and that the benefits of pedestrianization may not be homogenous across groups.³⁵

Participatory planning, as demonstrated by the Panca Trotoar example, is effective for gathering context-specific insights that can validate or invalidate general planning assumptions. Enabling community voices helps accelerate double-loop learning.

³³ Tony Blair Institute for Global Change. (2020, January 20). Inclusive growth in Tamil Nadu: The role of political leadership and governance.

³⁴ Tony Blair Institute for Global Change. (2020, January 20). Reflecting on the “how” of Ethiopia’s industrialization push.

³⁵ Nugroho, S. B. Zusman, E. & Nakano, R. (2018). Analysis of pedestrianization program in developing cities: A case of “Panca Trotoar” in Bandung, Indonesia. Institute of Global Environmental Strategies.



Scenes before and after the implementation of Panca Trotoar in Bandung, Indonesia. Photo: <https://kuklintonanbdg.wordpress.com>

Designing policies with the objective of prioritizing feedback loops (i.e., maximizing the amount of feedback received, while minimizing the time it takes to receive it) requires an awareness of the inherent assumptions behind every policy and planning decision. It also requires a well designed data collection system and a readiness to pivot away from the original assumptions. However, this culture of embracing policy pivots may be difficult especially where senior government officials are already invested in certain ideologies or interests.

HOW CAN WE OPTIMIZE THE CITY FOR LEARNING?

To achieve the principles outlined in the previous section, existing governance structures can be adapted to facilitate iterative learning and tight feedback loops. At the heart of some of these suggestions is a culture of organizational learning and an entrepreneurial spirit among staff to actualize this culture. No single government agency has all the expertise or knowledge to make the best decisions; but policies can adaptively become more robust if they are open to scrutiny and testing.

3.1 Transparent policy making and open data practices are effective mechanisms to ‘outsource’ learning to the private sector and civil society

It is widely acknowledged that opening up data to the general public not only promotes transparency, but empowers citizens, fights corruption, and encourages private sector innovation. Open data platforms provide an additional receptacle for the government to receive feedback, criticism, and policy suggestions from both the private sector and civil society groups. By commissioning the release of key government datasets (e.g., land registries, municipal budgets, public health indicators, etc), businesses will develop strategies to exploit this open data while civil society groups can perform independent analysis to hold governments to account or provide insightful proposals (Figure 6). In addition to improving the quality of policy decision making, there is substantial evidence demonstrating how improving government transparency is strongly correlated with a country’s attractiveness for foreign investment. For instance, a USAID study found that a one standard deviation increase in Vietnam’s transparency index is associated with a 10% increase in firm investment, and, in particular, the study finds “that the single most influential aspect of transparency is simply making provincial planning documents available to a wider swathe of investors.”³⁶

Figure 6: How open data platforms contribute to institutional learning

	Data Capabilities	Information Requests	Data Enrichment
Private Sector	Businesses help enhance the quality of public service through data analytics or use data to identify unfulfilled community needs as business opportunities	Businesses help identify low-quality or incorrect data and gaps in data collection when requesting for information for enterprise purposes	Businesses open up private datasets to the public or open-source their analysis of public datasets
Civil Society	Civic hackers and engineers improve communities through open-source projects	Citizens press governments for accountability when requesting for information for private purposes	Citizens participate in crowdsourcing projects or upload personal datasets to be aggregated into larger public datasets

³⁶ Malesky, E. (2019). “Decentralization and Business Performance,” in Rodden, J. & Wibbels, E. (2019). Decentralized Governance and Accountability: Academic research and the future of donor programming. USAID.

Yet, the Open Data Barometer³⁷ reported that in 115 countries, only 7% of key government datasets (e.g., land registries, budgets) are truly open.³⁸ This limits the potential for businesses and civic groups to both incorporate up-to-date information into their decisions and strategies, as well as to contribute data-driven insights for policy planning. To realize the potential of open data platforms:

1. Release key government datasets that concern the economy, society, and environment; ensure that they are free to access and use by anyone for any purpose.
2. Update key government datasets regularly to ensure that they are both accurate and current, while keeping historical archives available.
3. As far as possible, store the data in a machine-readable and reusable format to ensure comparability and interoperability between datasets, for instance using CSV, JSON or XML formats.
4. Enable communities to access, interpret, and use the data through low-tech channels, for instance community focus groups. Although open data can have great potential, their utility becomes limited when they are only truly open to a select group of digitally-savvy, connected users. Data access is often unequal, especially among low-income and rural communities.
5. Develop monitoring frameworks³⁹ to ensure that open data is regularly updated with working download URLs, in their correct format and contains valid metadata which describes the contents of the dataset. The United States Project Open Data Dashboard⁴⁰ provides a simple-to-implement exemplar.
6. The Open Data Charter⁴¹ and its principles are a good place to start, including for developing world cities. Releasing government datasets into the public has helped Kenya to work collaboratively with academics to accurately monitor the growth of its slums;⁴² inspired a whistleblowing platform in Indonesia;⁴³ and allowed Singapore to facilitate face mask collection in a safe and coordinated manner during the pandemic.⁴⁴

Beyond open data practices, which we acknowledge may suffer from ‘openwashing’ where the government opens up data selectively in order to create a guise of transparency, we also advocate for “open decision-making”. Many policies and urban planning decisions cannot be evaluated using data alone; it is crucial to understand the policy rationale and how the city government determines whether a policy is a success or failure. For instance, Nairobi’s implementation of the Jisomee Mita (self-read water meter) appeared to be successful looking just at the scale of installations in low-income settlements such as Kayole-Soweto. Similar pilot projects have also been implemented in Watamu, Kenya.⁴⁵ However, a recent study found that Jisomee Mita may not have empowered end-customers as expected since property owners still held price-setting powers.⁴⁶ Opening up the entire policy lifecycle (assumptions, implementation, and evaluation) to scrutiny would accelerate institutional learning.

³⁷ FThe World Wide Web Foundation (2017). Open Data Barometer, 4th Edition - Global Report.

³⁸ Open Knowledge Foundation (n.d.). The Open Definition. Retrieved from: <http://opendefinition.org/>.

³⁹ Neves, F. T., Neto, M. & Aparicio, M. (2020). The impacts of open data initiatives on smart cities: A framework for evaluation and monitoring. *Cities*, 106.

⁴⁰ <https://labs.data.gov/dashboard/offices/qa>

⁴¹ <https://opendatacharter.net/>

⁴² Mahabir, R., Agouris, P., Stefanidis, A., Croitoru, A. & Crooks, A. T. (2018). Detecting and mapping slums using open data: A case study in Kenya. *International Journal of Digital Earth*, 13(6), pp. 673-707.

⁴³ <https://www.lapor.go.id/>

⁴⁴ <https://mask.gowhere.gov.sg/>

⁴⁵ Drabble, S., Campbell, R., Oyamo, P. & Renouf, R. (2020). Smart meters: innovating to improve water supply in a post-COVID context. *The Journal of Field Actions*, 22, pp. 78-81.

⁴⁶ Nilsson, D. & Blomkvist, P. (2021). Is the self-read water meter a pro-poor innovation? Evidence from a low-income settlement in Nairobi. *Utilities Policy*, 68, pp. 581-603.



Installation of smart water meters in Watamu, Kenya. Photo: Drabble et al. (2020).

3.2 Horizontal agencies can work across agencies to solve wicked problems

Many urban challenges, such as increasing public safety or improving the local economy, are wicked problems⁴⁷—where there is no definitive formulation, no straightforward solution, and every implemented solution is consequential. Agencies with specific functional mandates (e.g., environment, housing, sanitation) may not have the full authority and powers to address problems that stretch across multiple sectors. Policies implemented to address these wicked problems then become fragmented, piecemeal, and even contradictory. Coordinated approaches to government policy making, such as consistent cross-government audit standards or shared knowledge management systems, are a good start but are often insufficient to solve wicked problems.⁴⁸

Horizontal governance has been proposed as a modern, agile form of government that is suited for solving wicked problems. Instead of hierarchical leadership and siloed agencies, horizontal governance seeks to ally different departments to achieve collaboration, coordination, and shared responsibility for decisions and outcomes.⁴⁹ These unique governance structures improve how cities learn to solve complex urban challenges by giving 'horizontal' government units the autonomy to address the challenge comprehensively rather than from the narrow perspective of a specific ministry or department. Four archetypes of horizontal governance have been identified in practice:

⁴⁷ Rittel, H. & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4, pp. 155-69.

⁴⁸ Russel, D. & Jordan, A. (2009). Joining up or pulling apart? The use of appraisal to coordinate policy making for sustainable development. *Environment and Planning A*, 41, pp. 1201-16.

⁴⁹ Ferguson, D. (2009). Understanding horizontal governance. The Centre for Literacy of Quebec.

- **Interdepartmental working groups** can be convened temporarily to address specific problems that are of interest to two or more departments. These groups are flexibly formed and disbanded as the need arises. A formal work group setting lowers the transaction costs involved in collaboration and negotiations. Strong centralized, non-partisan leadership is critical for the success of working groups,⁵⁰ which may risk compromising the quality of outcomes as a consequence of avoiding disagreements. Singapore's successful Multi-Ministry Task Force for COVID-19 is an exemplar for coordinating the policy execution of all COVID-19 related issues that involve multiple government ministries (i.e., vaccination campaign, enforcement of quarantines, contact tracing, digital surveillance, travel restrictions).
- **Creating new government ministries/departments** may be suitable for large-scale, long-term problems such as climate change or social inequality. In the past decade, many city governments have established or retrofitted existing agencies to tackle climate change. The UAE's Ministry of Climate Change and Environment⁵¹ and Singapore's Ministry of Sustainability and the Environment⁵² are examples of recent ministerial name changes that reflect how existing government bodies can have expanded mandates to work across government to solve large urban problems.
- **Municipal service offices** are different from the previous two archetypes in that they are permanent structures that are built to reduce transaction costs, rather than to solve a specific urban challenge. By integrating public services under one roof, the office reduces transaction costs between citizens and government. The 311 non-emergency contact system in the United States is an example of city-level service integration to offer citizens a seamless route to report and resolve municipal issues. Similarly, the XiongAn Administration Committee organized all urban system administration (i.e., transportation, housing) under a single office—the Bureau of Public Service.⁵³ This streamlines urban management and presents a united, user-centric approach to city services.
- **Delivery Units or Reform Teams** are center-of-government arrangements that have the mandate to convene key officials across government to drive progress towards important, overarching priorities.⁵⁴ These small teams of senior civil servants are typically composed of technocrats that report directly to the city's top leadership. Some notable examples include the Government Action Coordination Unit within Rwanda's Ministry of Cabinet Affairs,⁵⁵ Liberia's Presidential Delivery Unit,⁵⁶ and the Performance Management Delivery Unit in Malaysia (Box 6). Similar Presidential Delivery Units have also recently been formed in Ghana, Senegal, Sierra Leone, Uganda, and Kenya in the past 5 years. These teams have the administrative flexibility to move quickly across government units and implement programs to address cross-cutting issues. By being tasked to solve specific urban challenges, these Delivery Units have the authority to make rapid, evidence-based policy decisions and identify alternative solutions where necessary.⁵⁷ Indeed, in contexts where technocratic and administrative capacity is limited, establishing Delivery Units where bureaucrats of rare competency and ability are clustered can result in so-called 'pockets of effectiveness', which have proven crucial in many low-income countries to delivering particular prioritized services or to kick-starting broader bureaucratic reforms.⁵⁸

⁵⁰ Kowalski, A. A. & Jenkins, L. D. (2015). The role of bridging organizations in environmental management: examining social networks in working groups. *Ecology and Society*, 20(2).

⁵¹ <https://www.moccae.gov.ae/>

⁵² <https://www.mse.gov.sg/>

⁵³ Zheng, S. & Tan, Z. (2020). Towards Urban Economic Vibrancy, 103.

⁵⁴ Criscuolo, A. & Palamde, V. (2008). 'Reform Teams: How the most successful reformers organised themselves', Public Policy for the Private Sector. The World Bank Group.

⁵⁵ Centre for Public Impact (2018). Agile governance: Rwanda's Ministry of Cabinet Affairs. Retrieved from: <https://www.centreforpublicimpact.org/>.

⁵⁶ Gyude Moore, who is a CCI Board Member, was the former Head of Liberia's Presidential Delivery Unit, who described it as the "President's SWAT team" responsible for "[removing] bottlenecks from priority projects" in the country. Read more of his thoughts in our CCI podcast here: <https://www.chartercitiesinstitute.org/post/charter-cities-podcast-episode-2-gyude-moore-on-building-governance-from-scratch-the-importance-of-roads-and-the-challenges-and-opportunities-in-africa>.

⁵⁷ Lafuente, M. & Gonzalez, S. (2018). Do delivery units deliver? Assessing government innovations. Inter-American Development Bank.

⁵⁸ McDonnell, E. (2020). Patchwork Leviathan: Pockets of Bureaucratic Effectiveness in Developing States. Princeton University Press.

BOX 6: ADDRESSING STREET CRIME: CASE STUDY OF MALAYSIA'S PERFORMANCE MANAGEMENT DELIVERY UNIT (PEMANDU)⁵⁹

PEMANDU is one of the most prominent delivery units in the world, in terms of scale and ambition. It is guided by priorities laid out in the National Transformation Program and convenes the relevant stakeholders to implement these transformation objectives through its policy “labs”. These labs are similar to six- to nine-week stakeholder workshops that break down priorities into concrete projects with ministerial leads, timelines, and key performance indicators (KPIs). After these labs, PEMANDU plays a monitoring and evaluation role, ensuring that ministries make steady progress on the KPIs.

One such transformation objective is crime reduction. Through PEMANDU's intervention, Malaysia implemented the Omnipresence Program (increase police visibility in hotspot areas), Community Policing Program (involve citizens in open dialogue and problem-solving sessions) and the Safe City Program (crime prevention through environmental design). Reportedly, PEMANDU achieved a 40.8% reduction in street crime since the projects' implementation. But critics note that the KPI may not reflect ground realities, suggesting that while armed and gang robberies did decrease, the incidence of homicides remained unchanged while reported rapes had increased.⁶⁰ Malaysians might not have qualitatively experienced a 40% increase in safety; nor might businesses or tourism have enjoyed the externalities of safer streets.

These horizontal governance structures are entrusted with institutional authority to design, evaluate, and scale interventions. Their relative autonomy with respect to the issues they are addressing is critical in enabling them to react quickly to new information and adapt their responses. One challenging question is who will convene these horizontal structures and limit their mandates. The first three archetypes have generally well-defined mandates, with interdepartmental working groups generally dissolving as soon as a particular crisis or problem is resolved. Delivery Units, which are typically co-located with the center-of-government in terms of bureaucratic power, have a more amorphous mandate that has the potential to lead to mission creep. Constraining Delivery Units to specific national priorities as in the example of Malaysia's PEMANDU is one way to prevent mission creep.

3.3 Learning networks empower every participant in the planning process to report insights and contribute to feedback loops

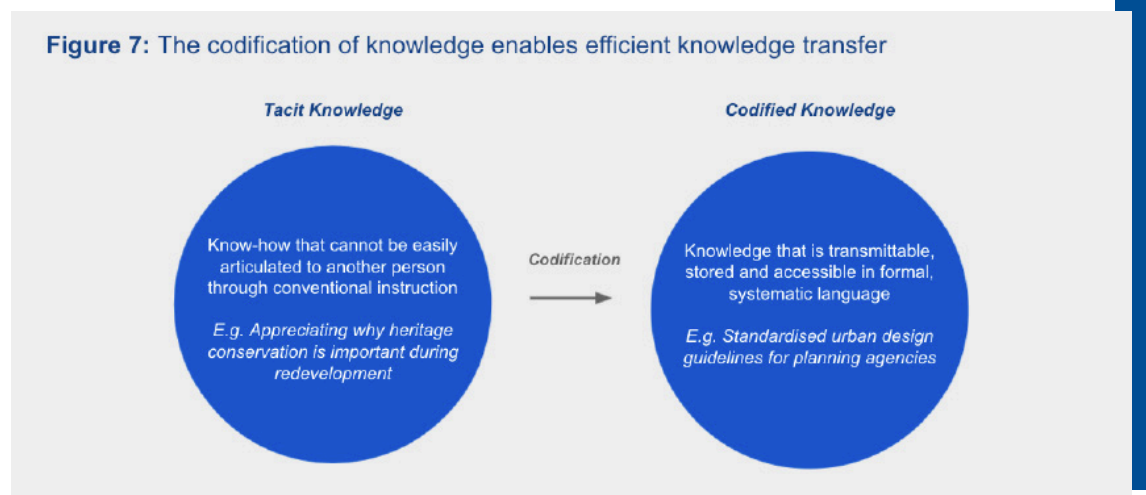
Siloed agencies are poor at learning as they are limited by the experiences of their own department or sub-department. Where there are no learning networks, agencies cannot benefit from the experiences of other agencies that have launched similar policies or made similar planning decisions. By formalising learning networks across government agencies, horizontally and vertically, information knowledge can be diffused across local government.

Effective learning networks are sensitive to the difference between tacit and codified knowledge, as well as the importance of exploring codification possibilities (Figure 7). Codified knowledge, such as guidelines, manuals, standard operating protocols, organizational structures, contract templates, and operating systems, are easily transmitted from one organization to another, either in physical or digital copies. Building up a resource of codified knowledge commons not only allows agencies to learn from one another, but also to learn from the past and to anticipate the future.⁶¹ Simple file archival and retrieval systems, either in a secured physical document library or a digital file sharing system, can kick-start a learning network.

⁵⁹ World Bank Group (2017). Driving Performance from the Center: Malaysia's Experience with PEMANDU. World Bank Group, Global Knowledge & Research Hub in Malaysia.

⁶⁰ Lesley, E. (2014). 'Mapping a transformation journey: A strategy for Malaysia's future', Innovations for Successful Societies. Princeton University.

⁶¹ Brown, J. S. & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science*, 12(2), pp. 198-213.

Figure 7: The codification of knowledge enables efficient knowledge transfer

However, economists point out that much information cannot easily be codified and therefore often remains tacit. For example, a government staffer may not be aware that a particular piece of information is important for action, or it may be that the information is not easily articulated through formal language. Some sectors have decades of domain-specific knowledge that can be tremendously helpful when applied across different settings. For instance, participatory planning is now commonplace for designing urban spaces, with an emphasis on understanding how design may have effects on equity and fairness in society. Empathetic, user-centric design, while common-sense in disciplines like architecture or UI/UX design, may not be so obvious when planning for public transport infrastructure or a piece of policing legislation. As such, there is difficulty to ‘transfer’ such tacit knowledge across agencies.

Nevertheless, tacit knowledge can be codified,⁶² though not necessarily in standardized forms such as protocols or guidelines. Conferences and forums can be organized to allow government staffers to share best practices, otherwise known as ‘social learning systems.’⁶³ The Natural Capital Accounting Community of Practice Africa⁶⁴ is an example of a regional learning platform where practitioners from 18 African countries discuss best practices and policy experiments for natural capital accounting.

Developing robust learning networks requires three conditions to be met:⁶⁵

- A variety of approaches, policies, or decision-making frameworks should be present so that comparisons can be made. Departments should be willing to share the planning rationale, implementation challenges, resource/manpower allocation, evaluation criteria, and policy outcomes; avoiding the temptation to only show polished or whitewashed results. Learning should be celebrated.
- Particular approaches, policies, or decision-making frameworks should be designated as models—not only in terms of outcomes, but also process. That is, policies with negative outcomes can also be lauded for their exemplary formulation, implementation, and evaluation processes, and policies with seemingly desirable outcomes can sometimes be perceived as procedurally illegitimate.

⁶² Viale, R. (2013). Tacit and codified knowledge in economics. In: Methodological Cognitivism. Berlin: Springer.

⁶³ Snyder, W. M., Wegner, E. & Briggs, X. (2004). Communities of practice in government: Leveraging knowledge for performance. *The Public Manager*, 32(4), pp. 17-21.

⁶⁴ <https://seea.un.org/content/africa-community-practice>.

⁶⁵ Ammons, D. N. & Roenigk, D. J. (2014). Benchmarking and interorganizational learning in local government. *Journal of Public Administration Research and Theory*, 25(1), pp. 309-35.

- Knowledge should be disseminated throughout the city government, through circulars, seminars, or interdepartmental shadowing. Lessons should not be transferred wholesale, but should be tailored 'at the margin' to account for local context, as the policy environment across varying functions and services is often different.

Learning networks can also be scaled to the international level where cities share their own case studies, experiments, and interventions, for example, through platforms like the Global Parliament of Mayors, the World Urban Forum, IGC Cities that Work, or C40 Cities.⁶⁶ If scaling learnings across planning contexts is difficult, scaling them across geographies and cultures is an even greater task. Figuring out how to operationalize these learning networks is crucial to avoid duplicative work and accelerate the global knowledge commons.

4. How far can we optimize the city?

City government institutions do not have a natural 'cognitive process' as individual human beings do.⁶⁷ Instead of treating 'learning' anthropomorphically, this paper has focused on the processes and procedures that enable the city to learn⁶⁸ from empirical evidence from various sources—organizational history, academia, industry, the wider public, and from various governmental functions.

However, simply implementing the processes listed in this paper is insufficient without the appropriate autonomy given to city governments to facilitate and review institutional learning. Critical examples of "smart" governance, such as Songdo, Dholera, or Masdar City, show that jurisdictions that are beholden to higher tiers of government often have limited political space to iterate on policy or urban planning decisions. Easterling describes these restricted cities as "extrastatecraft,"⁶⁹ where their governance powers have been absorbed by concessionary tariffs, asymmetrical private contracts, and external consultants. Worse, such cities would have 'overfitted' their policies and planning decisions to the present, constraining future generations to being 'managed invisibly' and controlled by premeditated decisions.⁷⁰ A continuous learning system mitigates this. But the institutional learning frameworks described in this paper are irrelevant if cities do not have the mandate to make their own decisions and experiment over time. This paper's framing of institutional learning thus resonates strongly with the charter cities model: granting cities special jurisdiction to create their own governance systems that allow for greater adaptive learning.

Talent in the civil service is another limiting factor. In cities where administrative capacity is weaker, the public sector is not the most sought after employer; a "talent drain" pulls away high-potential civil servants from critical developmental functions, leaving ministries and departments with less knowledge, experience, and overall competency. Public service talent programs, such as the Management Associate Program in Singapore or the New Wave Leadership Development Program in Thailand, are designed to identify, nurture, and retain talented public servants.⁷¹ It is unsurprising that many of these programs incorporate talent management schemes and incentive structures first developed in competitive private industries.

⁶⁶ Barber, B. (2013). *If Mayors Ruled the World: Dysfunctional Nations, Rising Cities*. Yale University Press.

⁶⁷ Blackman, D., Connelly, J. & Henderson, S. (2004). Does double loop learning create reliable knowledge? *The Learning Organization*, 11(1), pp. 11-27.

⁶⁸ Barrados, M. & Mayne, J. (2003). Can public sector organisations learn? *OECD Journal of Budgeting*, 3(3), pp. 87-136.

⁶⁹ Easterling, K. (2014). *Extrastatecraft: The Power of Infrastructure Space*. New York: Verso Books.

⁷⁰ Coley, R. (2015). 'The terminal city: Elemental politics and mediated urbanism', *Political Agency in the Digital Age: Media, Participation and Democracy*. ECREA Communication and Democracy Conference, Copenhagen Business School.

⁷¹ Poocharoen, O. & Lee, C. (2013). Talent Management in the Public Sector: A comparative study of Singapore, Malaysia, and Thailand. *Public Management Review*, 15(8), pp. 1185-1207.

4.1 Cities should be cautious of over-optimizing for social outcomes

Some of these proposals may suggest that the city should be viewed as a collection of variables and parameters that can be optimized for certain outcomes. This paper does not suggest that there is an optimal answer to many of these complex urban challenges. This is particularly so because every policy or planning decision affects lives and livelihoods. Regarding these citizens as mere agents in a system waiting to be calibrated has a strongly dehumanizing effect that cities should avoid. Instead, this paper's proposals are compatible with participatory planning and decision-making where citizens are involved in the learning. Ethnography, citizen forums, design thinking workshops or even field surveys could yield important insights.

Scientific management of the city is not an entirely new concept and has been deployed in many 'smart city' projects. However, a stylized, succinct, and simple enumeration of the principles and structures discussed in this paper, to my knowledge, does not exist. This paper attempts to fill this gap. Ultimately, optimizing a city for learning should always aim to uphold and advance a city's very premise: to uplift people's quality of life and opportunities through economic agglomeration and good governance.

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