Decision-Support Tools for Urban Governance

FUTURE CITIES SA

UK Government

Lessons from the Future Cities South Africa Programme

Contents

Acronyms/abbreviations

ACT:	(CRG) and Area Coordinating Team
API:	Application programming interface
ATP:	Ability to pay
CBA:	Cost Benefit Analysis
CCT:	City of Cape Town
CKAN:	Comprehensive Knowledge Archive Network
CoJ:	City of Johannesburg
CRG:	Community Reference Group
CTDE:	Cape Town Data & Economics
DST:	Decision Support Tools
EAM:	Electricity Asset Management (use case)
EMM:	eThekwini Metropolitan Municipality
ETOD:	eThekwini Transit-Oriented Development
FCDO:	Foreign, Commonwealth and Development Office
FCSA:	Future Cities South Africa
GESI:	Gender Equality and Social Inclusion
IS:	Informal Settlement
J4IR:	Johannesburg 4th Industrial Revolution & Mobility
JCED:	Johannesburg Community Economic Development
JSAF/SSAF:	Johannesburg/Soweto Strategic Area Framework
ISIMS/EISM:	eThekwini Informal Settlement Information Management System
POPIA:	Protection of Personal Information Act
SOP:	Standard Operating Procedure
SSAF:	Soweto Strategic Area Framework
TOD:	Transit-Oriented Development

1 Executive summary

This Learning Brief distils the lessons surrounding evidence-based governance and decision making that have emerged from the delivery of Future Cities South Africa (FCSA) programme funded by UK Government's Foreign, Commonwealth and Development Office (FCDO). The document is informed by the municipal and FCSA experience in three cities— Johannesburg, eThekwini/Durban and Cape Town—where the programme was delivered. The document should offer valuable insights on data-driven urban management and governance to other South Africa cities, international development agencies, government and civil society stakeholders, as well as future delivery partners of FCDO programmes.

This document aims to set out the process of, and the lessons learnt from, developing key decision support tools and delivering data-oriented projects within FCSA programme. The document categorises these lessons across five components: conceptual complexity, tools development, data issues, tool testing and the institutionalisation/uptake process. These recommendations include:

- Qualitative data inputs and processes like effective stakeholder engagement as a key value-add alongside quantitative data and technology.
- A well-defined problem statement and clearly articulated vision as foundational to all tool development.
- Awareness of data processes' potential to influence decisions to create more equitable service delivery outcomes. However, this outcome requires data equity (i.e. addressing data gaps biased towards a particular grouping or outcome) and validation of assumptions and decisions by affected communities.
- Use of an 'agile' methodology—with a focus on problem-solving and co-creation—to deliver fit-for-purpose results and facilitate user buy-in.
- An understanding among decision makers that knowledge gained is not absolute, and thus efforts to optimise a decision are just that: an ongoing improvement process, rather than a once-off perfect simulation of an entire decision criteria and outcome.
- Awareness that building technical literacy and defining the governance roles needed to support evidence-based approaches across the city will help institutions to leverage momentum from decision support tools, ultimately supporting greater investment in city-wide data strategies, data governance councils etc.
- The critical importance of evolving beyond simply providing tools, and into actualising data culture and evidence-based decision-making within city systems for long-lasting and ubiquitous institutionalisation.

Drawing on the experiences and insights of South African city officials and FCSA consortium partners, we trust this Learning Brief will inform and influence behaviours and systems to better harness and employ evidence for more effective, just and transparent decision making.

By building technical literacy and defining governance roles needed to support ubiquitous use of evidence-based approaches across the city, institutions can leverage momentum from decision-support tools to support investment in city-wide data strategies, data governance councils etc.

The eThekwini transversal working group members and the FCSA team workshopping ideas for implementation.

Introducing Future Cities South Africa

The Future Cities South Africa (FCSA) is funded by the UK Government's Foreign Commonwealth and Development Office (FCDO). Focused on the South African cities of Johannesburg, eThekwini/Durban, and Cape Town, the FCSA programme's five core projects—Johannesburg Fourth Industrial Revolution (J4IR), Johannesburg Soweto Strategic Area Framework (JSAF/SSAF/JCED), eThekwini Transit Orientated Development (ETOD), eThekwini Informal Settlements Information Management System (EISIM), and Cape Town Data and Economics (CTDE)—were designed to contribute to inclusive and sustainable economic development and poverty reduction, while mitigating gender, social, and economic inequalities. In the context of rapidly urbanising South Africa, apartheid's spatial legacy persists in the ongoing disparity between where poor people live and where economic opportunities lie. As such, the FCSA's five core and eight shorter projects (the latter representing the programme's direct response to the Covid pandemic and civil unrest in some of the cities), targeted transportation and mobility, urban planning, resilience, and the innovative use of data (see Appendix 1 for more detail on the individual projects).

Future Cities South Africa is a unique alliance of organisations and individuals, anchored by PwC (UK & SA) and including Open Cities Lab (OCL), Zutari, Palmer Development Group (PDG), Violence Prevention through Urban Upgrading (VPUU), Isandla Institute and others, together with a range of independent specialists, working in a complementary, agile, and adaptive way that offers our city government partners global expertise, local insight and trusted relationships to ensure enduring impact. Aligned to the UN's Sustainable Development Goals Agenda 2030, as well as South Africa's National Development Plan and Integrated Urban Development Framework, FCSA programme learnings are anticipated to inform national practice and policy, and contribute to higher rates of sustainable development and greater investment and trade flows, while also strengthening the relationship between UK and South Africa's cities.

Figure 1: FCSA Programme structure

	CITY OF JOHANNESBURG (COJ)	ETHEKWINI MUNICIPALITY (ETK)	CITY OF CAPE TOWN (CCT)
CORE PROJECTS	**Soweto Strategic Area Framework (JSAF)** Exploring the insufficient development response to previous public investments in the area, the JSAF project and its associated Implementation Tools focused on collaboratively producing a sustainable spatial and economic development vision for the area.	**Transit Oriented Development (ETOD)** This project aimed to develop a coordination tool to plan, implement, and operationalise Transit Oriented Development (TOD) (i.e., development to maximise residential, business, and leisure space within walking distance of public transport), and to formulate a change management process to foster alignment between public and private sector stakeholder plans.	**Data & Economics (CTDE)** Providing technical support to the City of Cape Town, the CTDE project aimed to give effect to CCT's Data Strategy through data use and application case studies related to transport, economic analysis, resilience, and human settlements.
CORE PROJECTS	**4th Industrial Revolution & Mobility (J4IR)** Seeking to address some of Johannesburg's transport-related challenges, the J4IR project sought to take advantage of the fact that mobility is one of the sectors most affected by technological advances (sometimes referred to as the Fourth Industrial Revolution).	**Informal Settlement Information Management System ISIMS/EISM** Ultimately aiming to improve the lives of informal settlement dwellers, this project set out to provide the eThekwini Municipality with a planning tool to make better-informed decisions to address spatial, social, and economic inequalities.	
COVID RESPONSE	**Urban Mobility and Reopening**	**Economic Recovery**	**CKAN Data and Data Core Support**
COVID RESPONSE		**Informal Settlement Data Support**	**Impact and Recovery Support**
COVID RESPONSE			**Vaccine Roll Out and Planning Support**
Inclusive Economic Recovery	**Johannesburg Inclusive Economic Recovery (JIER)**	**eThekwini Inclusive Economic Recovery (EIER)**	

2 Introduction

Evidence-based governance is moving beyond the realm of research for policy and planning, and into a wide range of data-enabled systems, models and tools for operational, engagement and strategic processes. This includes fairly simple as well as more complex systems, using small or large datasets, that change the way once-off, routine or even automated processes in the planning and delivery of public goods and services occur. Over its three years of operation, the FCSA programme invested in strengthening capabilities around data collection, analysis and modelling in the South African cities of Cape Town, eThekwini and Johannesburg. Many lessons emerged both conceptually and practically, concerning the methodologies, processes, tools, capabilities and systems that are needed to meet the diverse demands for improved evidence in the South African urban governance context.

Problem statement

Urban development policymakers, managers and implementers are constantly making decisions on both a strategic and day-to-day basis. Depending on where they sit in the planning and delivery value chain, these decision makers have varying degrees of discretion in terms of how they factor in existing policies, regulations, service delivery models, resources, capabilities, citizen expectations and other variables. The question of how to make decisions that will render the best—most equitable, effective and efficient—developmental outcomes is undeniably contested territory. Access to information that curtails arbitrary decision making, and improves rigorous, transparent and informed decision making, is critical to supporting and demystifying this complex process. Such a shift requires not only the technical capabilities to produce new data tools, but also deeper changes to the whole decision-making ecosystem, which includes data pipeline management, decision support tool development and use, and clear articulation of roles and responsibilities among decision makers as users of these tools.

With the growth of data volume, data science, and technology tools, evidence-based governance is moving beyond the realm of once-off research missions for use in policy and planning, and into a wide range of processes, tools, and systems that structure information for ongoing use in operational, engagement, and strategic processes.

Why evidence-based urban governance?

The building and management of cities is made possible by a multitude of complex systems and operations. Identifying the 'best' course of action and how to take it can be difficult amidst the volumes of information that are potentially available but not necessarily in a clearly organised way, and a constantly shifting assemblage of dynamics, both known and unknown. Additionally, conflicting interests, biases and power imbalances can influence decision-making processes. The use of evidence in governance is regarded as a tool to sort through these complexities, making decision making more rational and transparent. Embedding tools that display or allow for the analysis of information in decision making processes (see Table 1) will not entirely remove these conflicts of values or interests, or resolve all blind-spots, but it can provide a framework for decision making that is based on common access to information.

With the growth of data volume, data science and technology tools, evidence-based governance is moving beyond the realm of once-off research missions for use in policy and planning, and into a wide range of processes, tools and systems that structure information for ongoing use in operational, engagement and strategic processes. "Evidence", thus, becomes a realm of structured information—pulling from datasets, engagements, analysis of results—that can more easily feed into the deliberations, events or procedures where decisions are taken in part by evaluating what the information means.

About this learning brief

This learning brief focuses on decision support tools developed for the FCSA programme. Documenting key lessons gleaned from the FCSA experience, the choice to narrow the focus from the broader theme of evidence-based urban governance down to decision support tools (DST) was largely pragmatic. That is, in considering projects' intermediate outcomes around evidence-based urban decision-making (a pillar of the programme's Theory of Change [TOC]), the esoteric nature of the topic revealed itself; that is, how do you prove whether a decision was made based on evidence or not? Thus, in the interest of making this learning brief as practical and useful as possible, it looks at a variety of FCSA project tools developed for more informed decision making.

Intended for the public sector and urban development practitioner community, resultant learnings are divided by thematic focus of: development lessons, use/implementation lessons, data lessons, and uptake/institutionalisation lessons. Looking at how the tools helped to progress certain sets of decisions within FCSA projects, the brief reflects on how data and information can be better harnessed to continue to improve decision making in the context of South African municipal governance.

What is a decision support tool?

Narrowing the focus from evidence-based decision-making to decision support tools (DST), this learning brief presents a range of tools developed by the FCSA projects (see Table 1). DSTs **used input data**, some of which (but not all) was quantitative; **provided a structure and framework** for existing tools that allowed teams to logically compare variables; and facilitated sets of decisions within FCSA projects and/or in an ongoing way with cities.

In defining which tools should be included for consideration, FCSA project teams unpacked some of the **conceptual complexity** surrounding DSTs, which in itself, proved useful. That is, the initial perception of DSTs as quantitative mechanisms exclusively utilising digital technologies expanded to include any mechanism (including models, frameworks and processes/methodologies) that analyses or presents information or data in a manner that aids decision makers in:

1. thinking differently/more deeply about that information (enabling the consideration of new questions);
2. logically structuring and processing information and data to enable rational comparisons (of scenarios or plans); and
3. making visible and transparent the logic behind decisions.

While DSTs thus included obvious things like **data-driven models** (employing quantitative data inputs, spreadsheets, etc.), equally important were **multi-criteria decision-making tools**, which offer a formal framework to logically structure qualitative and subjective data; **processes** that yield enriched, qualitative intelligence for decision-making; and **frameworks and standardised procedures** to make best use of and provide a logical structure for the use of individual models and tools (whether inputs are data-driven, subjective rankings, or enriched descriptive intelligence).

In defining which tools should be included for consideration, FCSA project teams unpacked some of the conceptual complexity surrounding DSTs, which in itself, proved useful.

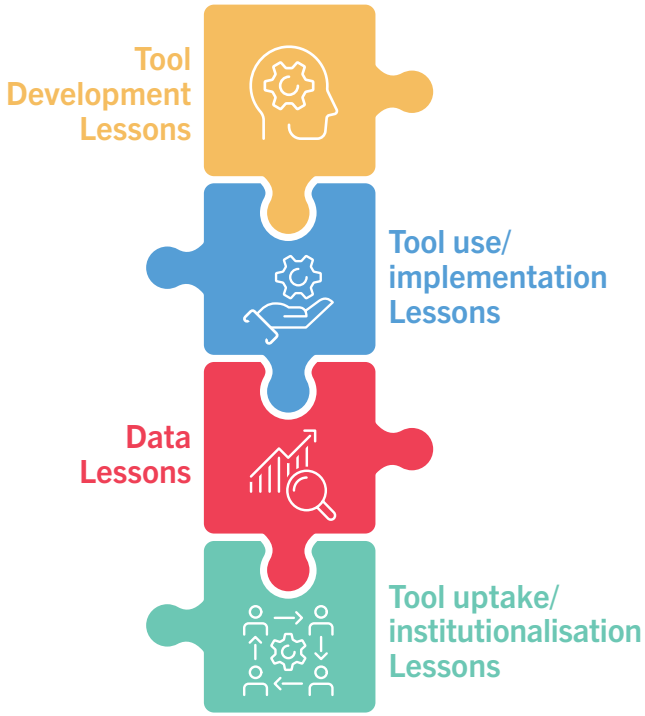


Table 1: FCSA Programme decision-support tools

CITY PROGRAMME	TOOL NAME	DESCRIPTION	DECISION	HOW IT WAS INITIATED	DELIVERY METHOD
CITY OF CAPE TOWN (CTDE)	**Cost Benefit Analysis**	Cost benefit analysis for large capital programmes	Inform decisions on capital expenditure choices within the CCTs stage gate process	CCT prioritisation and stage gate process had no standard economic analysis methodology	Best practice in CBA, adapted to CCTs needs through test cases
	Electricity Asset Maintenance Tool	Shows electricity asset maintenance data analysis	Can the city reduce maintenance effort, improve condition ratings, and refurbish more mini-subs	Use case decision making process	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design
	Informal Settlements	Data collection/pipeline tool that allows for surveying and automatic data piping to enable analysis and produce certificates of residence	Assists to connect household level survey data to the IS spatial data set, Optimises data collection in informal settlements	Use case decision making process	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design
	Service Delivery User Interface	Creating the mechanism for an automated data pipeline (API) of area-based service delivery statistics	Allows for insight into service delivery statistics by area	Request from the city	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design
	Internal Application Programming Interface (API)	Improving the usability of the service request API + documentation	A data pipeline that supports any decisions that need service request data	Through finding limitations with the existing API during COVID support work	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design
	Internal Application Programming Interface (API)	Improving the usability of the service request API + documentation	A data pipeline that supports any decisions that need service request data	Through finding limitations with the existing API during COVID support work	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design
	Willingness to Pay	A tool that calculates household ability to pay across the city	How to improve the City's ability to predict domestic consumption responses to utility pricing by improving the understanding of the impact of pricing on household ability to pay.	CCT sought to improve the City's ability to predict domestic consumption responses to utility pricing by improving the understanding of the impact of pricing on household ability to pay	Best practice in ATP, adapted to CCTs needs through test cases
	CKAN Data Portal	A data portal that stores datasets with full metadata	Acts at the nexus of many of the other tools, as a data warehouse and connector between data sources and tools (and data sources and data sources and tools and tools)	The need emerged for a central data portal during COVID support; the city requested a data portal to connect external researchers to city data	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design

Table 1: FCSA Programme decision-support tools (continued)

CITY PROGRAMME	TOOL NAME	DESCRIPTION	DECISION	HOW IT WAS INITIATED	DELIVERY METHOD
ETHEKWINI	**Informal Settlements Information Management System (ISIMS)**	A system to support decision-making on upgrading, and providing service delivery, to informal settlements	Many - how to provide better services, where and how to upgrade, etc	Need for dedicated IS unit or data solution that is organised specifically for collaborative IS decision making	
	ETOD precinct prioritisation	Ranks precincts according to their comparative advantage for TOD	Select precincts for piloting TOD delivery methods	Proposed as part of the FCSA methodology for TOD delivery against the TOR	Best practice for prioritisation, adapted together with eThekwini by applying their weighted criteria and preferences
	ETOD land use model	Simulate the impact of land use on socio-economic and environmental criteria.	Decision support tool to select spatial parameters that best fit the precinct vision.	Proposed as part of the TOD focussed land use planning and management procedure.	Uses economic value added, equity, jobs created and environmental impact to measure land use alignment with the precinct vision.
	ETOD financial model	Calculate the financial impact of the proposed land use mix on the City and developers' financial sustainability.	Measure the long term budget requirements and revenue potential for the City, and the potential returns for developers of investing in the precinct.	Forms part of the decision support of selecting the preferred land use mix in the precinct by modelling the financial resilience and sustainability.	Uses generally accepted financial analysis methodology to calculate long term cash flow, net present value and internal rate of return of City and developers' investment in the precinct.

The **Informal Settlements Information Management System (ISIMS)** tool supports decision-making on upgrading, and providing service delivery, to informal settlements

Table 1: FCSA Programme decision-support tools (continued)

CITY PROGRAMME	TOOL NAME	DESCRIPTION	DECISION	HOW IT WAS INITIATED	DELIVERY METHOD
CITY OF JOHANNESBURG (CoJ)	**J4IR filtering tool**	Evaluates and ranks local 4IR transport and mobility solutions	Prioritised relevant solutions to CoJ 4IR transport needs. The Filtering Tool can be used by the CoJ team for future evaluation and shortlisting of technology types.	In order to determine relevance to CoJ, the market scan was not sufficient – the solutions needed to be evaluated and shortlisted using a tailored and novel tool (a first in SA to our knowledge).	Market scan through primary and secondary research, criteria development in conjunction with CoJ, adapted to CoJ needs but is scalable.
	J4IR intervention tool	Evaluates and ranks international and local 4IR transport and mobility interventions	4IR mobility examples were collated in a database and grouped into concepts, based on if they leveraged similar technologies, targeted the same demographic and/or were designed to address the same mobility challenge.	International and local interventions, with example case studies, needed to be outlined in the context of Johannesburg. These interventions were intended to inform the next steps on the path towards 4IR mobility within CoJ.	Developed a multidimensional criteria assessment framework, with inputs from CoJ and wider stakeholders, against which the interventions were to be rated. Tailored the Suitability, Acceptability and Feasibility framework by adding an additional component, Equity, to ensure considerations around safety, gender and social inclusion were considered in a consistent and thorough manner.
	SSAF co-creation	Engaging stakeholders and community groups and using structures such as the ACT and CRG to co-create the SSAF	Surveys provide more in-depth quantitative data, whilst engagements provide qualitative/ anecdotal evidence to improve intervention design	Increased engagement was called for in the ToR, but the FCSA methodology proposed an increase of the level of participation to co-creation, including the creation of institutional structures.	Best practice for engagement. The method was adapted to work at the larger scale of the SSAF (traditionally at a precinct level)

The **Soweto Strategic Area Framework (SSAF)** explores the insufficient development response to previous public investments in the area. The project and its associated Implementation Tools focused on collaboratively producing a sustainable spatial and economic development vision for the area.

Table 1: FCSA Programme decision-support tools (continued)

CITY PROGRAMME	TOOL NAME	DESCRIPTION	DECISION	HOW IT WAS INITIATED	DELIVERY METHOD
CTDE (COVID-19 Response)	**CCT COVID Finance Models**	Uses economic impact model and CCT SAP consumption and rates data to project impact of COVID on City revenue	Inform risk rating and exposure to City and any financial/budget adjustments needed	CCT request	Developed initially in excel and later converted to R by City team and expanded for longer term uses
	CCT Covid Risk Models	Weighted risk on different internal and external systems to support the City's Covid response and service continuity	Inform decisions on where to prioritise capacity in the balanced response	CCT request	Co-developed with CCT team working on the risk approach, using excel
	CCT COVID Economics Models	Projected economic impact scenarios of the lockdowns on the Cape Town economy	Inform various planning projects, communications, financial model and strategies being developed as well as the economic recovery strategy	CCT request	Co-developed using existing economic accounting methods. Expanded for leading-indicators work.
	CCT COVID Logistics Models	Modelled capacity in the clinics and fatalities systems in the metro and identified potential bottlenecks on a weekly basis	Informed resource prioritisation across a network of providers	CCT request, informed by observing critical issues in Cities that were hit earlier by the crisis	Developed on logistics software that was familiar to the FCSA team
	CCT Covid Informal Settlements data collection	Data collection pipeline for residents in informal settlements to water and sanitation services	How to respond to service delivery faults (operational, day to day decisions)	Jointly identified	Manual uploading of data from a data feed onto the City's SAP system. Automation was not achieved due to architecture requirements
	ETK COVID Data Support	Visualised fault reporting on live dashboards	How to respond better to service delivery faults	The city need data better visualised	Development of a living data tool that was integrated within the city through an agile methodology and user-centred design

CCT **Covid Informal Settlements data collection tool** provided a pipeline for residents in informal settlements to water and sanitation services.

Multicriteria tools: Structuring a formalised logic

Multicriteria decision-making tools are frameworks that logically structure and formalise a set of rankings on criteria that can be conflicting—they are useful when there are complex decisions to be made, and/or when multiple objectives need to be achieved via one decision. The input information can be qualitative or quantitative. Providing a structure to compare information (which in itself may be subjective) on a fairly equal basis, these tools help support decision making within complex emergent environments (e.g., 4IR/mobility and technology), which present numerous choices or options about which more traditional data is not necessarily available. For example, the J4IR interventions tool organised international and local technology-linked mobility interventions by Suitability, Acceptability and Feasibility for the CoJ urban development and mobility context, assisting the team in prioritising interventions for the roadmap.

Community as evidence

The FCSA programme found that intentional **engagement processes** can elicit important nuanced, qualitative and often descriptive intelligence. Referring to this DST as "**community as evidence**", it is predicated on the observation that there exists a body of critical contextual intelligence that can only be extracted by engaging in-person with people (stakeholders, community members, etc.). To that end, projects like JSAF used and legitimised engagement as a decision-making tool, wielded "for the purpose of producing a product that informs the city", as Monique Cranna, JSAF Project Lead, explained. The **process of engagement** not only enriched and legitimated technical analysis, but was the *place where decision making was occurring*. This was a key learning for all tools—that the product itself needed to be positioned within a community of users, allowing for deliberation and feedback loops to legitimate the process and the tool.

Frameworks and procedures

Frameworks and structured procedures to order and make the best use of data were another DST identified by the FCSA projects. Employing information coming from the use of other models, projects developed formal/standardised procedures for how to use that information to make decisions. For example, the ETOD project created a suggested procedure for employing land-use models, so that when an individual land-use application lands on an official's desk, that person has a standardised procedure to follow when considering and weighing each application.

The launch of the CRG in Soweto as part of the JSAF/JCED process.

3 Tool Development Lessons

Table 1 indicates how each tool was initiated: some were part of the FCSA scope from the beginning, while others emerged as projects progressed—reaching a point where participants in the work realised that there was a need or opportunity for better-structured evidence to decide the next step in the work. Key lessons have been learnt in terms of the utility and value of tools based on where the demand for them originates, and the process followed to develop them.

Defining the problem, focusing on a vision

Perhaps the most universal learning from the FCSA's development of a diverse spectrum of DSTs was the foundational importance of **defining the problem being solved**. That is, knowing what decision needs to be informed and what the current challenges are was critical to asking the right questions in user design engagements (i.e., to inform how the tool is designed), and thus ensuring that the resultant DST is capable of providing the information decision makers require. Putting it another way, the tools should help decision makers select the best option in relation to a **clearly articulated vision**, enabling rational analysis of the trade-offs in terms of outcomes resulting from different choices. For example, the ETOD land-use model demonstrated which land-use plan would perform "best" according to selected outcomes (e.g., economic value-added, equity, jobs created, etc.) and precinct vision. "There are trade-offs, you can't always have all of the desired outcomes. So it's not an absolute measure, but gives a relative certainty that one option is better than others for achieving the defined precinct vision," explained Francois Botes, ETOD Project Lead, of the model.

That said, Richard Gevers, CTDE Project Lead, warned DST developers not to focus too heavily on over-defining the scope of the problem, or overtheorizing how a tool will function. That is, when building tools—assessing potential use, theorising how they will work, etc.—the temptation to remain in a documentation stage can divert energy away from the daunting and often messy work of simply building and then practically applying the tools for testing, assessing, pivoting and iterating accordingly. Rather than rooting down in theory, strategy, and documentation, the **problem-solving focus** of the **agile methodology** of prototyping and testing **builds critical momentum**. "There has to be a practical application and interplay between iterating and documenting.... You've got to build mechanisms that are flexible and innovative around decision moments, by testing, experimenting, and pivoting," advised Gevers.

Richard Gevers, CTDE Project Lead, warned DST developers not to focus too heavily on over-defining the scope of the problem, or overtheorizing how a tool will function...the temptation to remain in a documentation stage can divert energy away from the daunting and often messy work of simply building and then practically applying the tools for testing, assessing, pivoting and iterating accordingly.

A site visit with the energy department and FCSA team, to take forward user testing.

Who are the tools for?

Users versus Owners

An important learning was that while every tool has an owner (a tech person or data scientist, who builds, updates and maintains it) and a user (the person who applies it), more often than not, they will not be the same person. It is important to identify and distinguish users from owners upfront, particularly for the purposes of properly defining the problem for which the tool will provide information to aid decision making.

For example, for the CTDE's Electricity Asset Management (EAM) work, the data science team was the owner of the tool, while the electricity asset management team were the identified users. Going back to the problem definition, the CTDE team noted the importance of ensuring that the problem statement originates with the user—that is, the people or department actually grappling with the question or issue on the ground—rather than the tool's technical custodians (who may seek a solution that suits organisational needs for trailing new technologies, or building new data structures, more than it does the immediate need for a visualisation of existing data to inform decisions for the line department in question). "The whole methodology was… to turn it around and make sure someone's actual real-life problem was solved," said Gevers. In other words, the owner needs to identify the user who will be using the tool and interpreting its outputs. "When you start with just the owner, you can build wonderful data products that may not be useful to anyone because you haven't started with who is the user," noted Jodi Allemeier, FCSA Deputy Team Leader.

Fit for purpose (and for users)

A critical lesson learned by the J4IR project was the importance of ensuring City partners are taken along in the tool development process, and that the sophistication of the tools built speak to the technical capacity of the people who ultimately are meant to use them.

In the case of J4IR, initial enthusiasm for the project's ambitious agenda foundered when the project's City champion (who had been part of the project scoping before the FCSA programme started) moved on. Given that human churn over a multi-year project is not unusual, the project perhaps should have reassessed its plan at that point, ensuring that it still spoke to the capacity and interests of the partner City. Instead, the project "ended up building quite a sophisticated tool on our own, but for a client that can't use it", as Roland Hunter, Johannesburg City Lead, reflected. Spending a good amount of time debating the scoring criteria that were the foundation of its decision-making matrix to rank different interventions, the J4IR team presented those results to the city, but did not involve the City in the formative discussions. "Each criterion needed a lot of debate. We did this internally as team. The City was only reacting. The lesson was that the City should have been engaged in the co-creation of the tools," Hunter reflected in retrospect.

A critical lesson learned by the J4IR project was the importance of ensuring City partners are taken along in the tool development process, and that the sophistication of the tools built speak to the technical capacity of the people who ultimately are meant to use them.

City of Cape Town energy department officials engaging as part of user needs and capabilities assessments.

Decisions for whom?

In developing DSTs, mindfulness of the different needs of owners (developer/creator) and users (decision-maker) has already been discussed. However, there is a third critical party that must be explicitly considered in the process of developing decision-support tools, and that is the population for which any given intervention is intended. As with the problem being solved, and the different perspectives that an owner versus user might have about what questions need answering, clear and thoughtful identification of the target population affected by the decisions being made is a key foundational element of a good DST. .

Developing qualitative tools

Certain decisions will require deep local knowledge, the sourcing of which requires more qualitative (versus data-driven) inputs. Realising the importance of such knowledge, the JSAF team tested the efficacy of different forms of engagement. Experimenting with surveys conducted face-to-face, telephonically, and via digital platforms (WhatsApp, email, etc.), the team found that when gathering community intelligence, nothing beat in-person engagements (in fact, the team noted that communities often rejected any other method). For example, when trying to understand why Soweto residents were not accessing apparently available mechanisms to finance backyard development, it was only when the team went and spoke to people that they were able to get the information (comprised of a complex mix of stories—including personal histories from "gogos" fearful of being victimised by scams) that resulted in an improved decision about the next steps to take (in this case, a set of interventions that extended far beyond than the original land-use planning recommendations, to include finance-training and trust-building elements). The learning here was the need for cognizance around the fact that many problem statements will require DSTs that can produce and use qualitative inputs that enrich data interpretation, and that data validation and decision making through diverse and representative structures is an important methodological step.

Embedding GESI

Related to the problem statement, considerations of Gender Equality and Social Inclusion (GESI) are critical to the relevance and efficacy of decisions made around interventions intended to support inclusive urban development. A key FCSA learning was the importance of GESI being embedded into project scoping, inception and frameworks from the very beginning. That is, a shared understanding around the relevance and importance of GESI principles, and a commitment to making those principles tangible and visible in a project's products and outcomes, need to be established between all parties—project teams delivering and city beneficiaries alike—from project inception.

In terms of the experience of embedding GESI considerations within DSTs, FCSA teams found it far easier to do so when creating tools 'from scratch'. "When there wasn't an existing methodology or anything remotely off the shelf… it was easier to have the GESI discussion, because from the beginning you could say that one of the variables that needs to be built in here is some consideration of GESI," noted Allemeier.

…the team found that when gathering community intelligence, nothing beat in-person engagements… For example, when trying to understand why Soweto residents were not accessing apparently available mechanisms to finance backyard development, it was only when the team went and spoke to people that they were able to get the information (comprised of a complex mix of stories—including personal histories from "gogos" fearful of being victimised by scams) that resulted in an improved decision about the next steps to take.

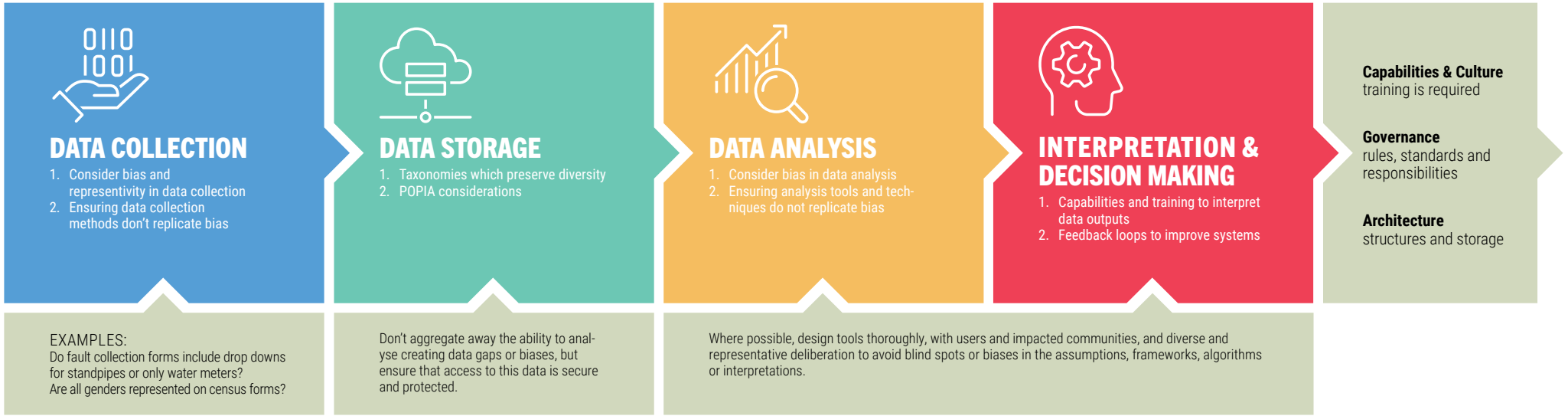
By contrast, teams struggled to build GESI into existing tools or processes that they were tailoring for use as DSTs. For example, the CTDE's Cost Benefit Analysis (CBA) tool was based on an existing methodology that reduces all inputs to a financial number. Resisting a distributional GESI interpretation—in that gender (for example) cannot be reduced to a net value—such a methodology thus cast measuring GESI as out of scope, rather assuming that GESI concerns would be addressed through the systemic impacts of assessing and delivering the right portfolio of projects.

In such cases, the answer is to ensure that such DSTs are part of a suite of tools and processes that acknowledge the larger system in which the specific tool exists, and includes assessment and analysis of GESI variables (distributional impacts, impacts on affordability/ability to pay, etc.), or to choose a different methodology. The danger here, however, is that the full complementary suite is not developed or used, and that GESI considerations are ultimately left out. "The point is that if you can't do every form of analysis within a particular tool—which is fair, tools and particular forms of modelling have their limitations—then your full suite of tools needs to offer complete analysis to the decision maker," Allemeier explained.

The broader lesson is that quantitative data-driven decision making only supports GESI considerations if disaggregated data is available, and if models and tools can be built in a way that that data is given value. Thus, if this is the preferred methodology, care must be taken to actively advocate for GESI concerns, whether that means innovating a new tool, or creating an inclusive framework that includes the capabilities and systems to complement more data-driven tools. Figure 2 below depicts the value-chain approach developed through the CTDE set of tools:

The broader lesson is that quantitative data-driven decision making only supports GESI considerations if disaggregated data is available, and if models and tools can be built in a way that that data is given value.

Figure 2: Enhancing the data value chain



Creating systems

As discussed above, no tool can do everything, and every decision made should be understood as linking to a larger ecosystem of decisions and interventions. As such, the best DSTs are conceived as part of an operating system or strategic framework, rather than as purely standalone models (which have their value in once-off decisions, or steps in, for example, procured research processes). Additionally, creating logical structured frameworks within which tools are placed can help to get more and different information out of existing tools and data. In other words, the data and information needed to make decisions often do exist, but the problem is structuring that information into a logical format to ensure that the decisions made are more evidence-based. A good example of this was seen in Cape Town, where cognisance of which operational system each tool belonged within was high: the CBA work was positioned within infrastructure planning and stage gate processes, where project managers are supported by the economics team to improve the economic analysis in designing and gearing their projects for capital funds approval; meanwhile, the EAM and informal settlements systems were housed within the respective departmental operating processes. Key lessons learnt were that improving a DST for leadership created a demand pull for capacity building throughout a data system value chain; in other words, **training on data standards, data collection, analysis and use goes hand in hand with the introduction of a new DST.**

Link to cities' existing strategic plans and frameworks

Because the FCSA projects were intended to serve the three Cities, it became clear that the tools developed should speak to the Cities' existing strategic frameworks and plans. For example, the premise of the J4IR project was to improve mobility by adding and incorporating fourth industrial revolution elements (e.g., eHailing, mobile payments for integrated ticketing, better understanding of changed mobility patterns due to work from home, etc.) to the City's transport plan. The 4IR transitions under consideration spoke to transport department operation (e.g., better use of data), human movement (e.g., better use of technology in modes of transport, such as electric vehicles, eHailing, etc.), and meeting demand for transport (e.g., better understanding 4IR impacts on industry and housing). For this reason, the work needed to be grafted onto the transport department's plans in different operational and strategic ways, including how the department incorporates and uses technology, as well as how it governs transport in this era. This, however, was not fully achieved due to the project closing early (at a roadmap stage) due to a lack of a clear "owner" on the CoJ's side.

While unfortunate, this experience provided a critical learning, which is that tools (and projects for that matter) should be planned alongside existing strategic frameworks and plans, such that they are integral to those plans. "You should be working alongside transport planning to integrate [the tools], at every step asking: how does technology relate to this or that aspect of the transport plan?" reflected Allemeier. Barring this, tools should be developed so that they can address real and specific questions linking to the existing objectives and needs of the larger system's agenda (e.g., a City's SDF, IDP, etc.).

The 4IR transitions under consideration spoke to transport department operation..., human movement..., and meeting demand for transport. For this reason, the work needed to be grafted onto the transport department's plans in different operational and strategic ways, including how the department incorporates and uses technology, as well as how it governs transport in this era.

Stakeholders in the Johannesburg mobility sector engaging data about the status quo as part of the J4IR process

Tools as part of a system

Another key learning was the importance of developing and articulating clear procedures, such that DSTs are a step in that logical chain. That is, making the tools part of a clear 'user framework'. For example, the ETOD team suggested a procedure within which its land-use model works. "We've created a system, and are clear about where these [tools] fit in. One of biggest learnings, was that the tools need to fit into a procedure, otherwise it's just loose things that are there—people may or may not use them," advised ETOD's Botes.

Such procedures (SOPs/standard operating procedures) should be automatically built to accompany new tools, but also can be developed to incorporate and improve existing tools. That is, new procedures can also help to better structure existing data and information to ensure more evidence-based decisions are made (eliminating bias and institutional memory). For example, the CTDE's CBA tool used existing decision-making processes and data, but structured and presented them in a new way to reduce the inexorability of institutional forward planning. That is, while the stage gate process had for some time required managers to do an economic assessment for large prospective projects, it did not define a methodology, creating a struggle for technical managers who are not economists, and producing results that are not comparable across alternatives. By introducing a standard methodology outlining the metrics, the ways to measure, and how to compare the different alternatives for an economic assessment, decision makers were given a more evidence-based foundation to compare the various options resulting. In the desalination case, comparing different scenarios using the CBA tool facilitated useful dialogue among decision makers and technical planners to improve the project design, by showing the relative trade-offs of different scenarios and how these would be influenced by key choices on location, scale, timing, energy source, as well as uncontrollable variables such as climate.

A final learning here from the ETOD team was that in order to ensure that procedures or frameworks developed will maximise evidence-based decision-making, existing knowledge of the context (e.g., the city) is required. That is, the people appointed (whether external consultants or from within the cities) to develop the tools and accompanying procedures should have an embedded familiarity with the larger system/context. At the same time, having someone on the team who isn't as aware of the existing models and processes is useful in terms of seeing the work with 'fresh' eyes, and thus being able to challenge and improve it.

A final learning here from the ETOD team was that in order to ensure that procedures or frameworks developed will maximise evidence-based decision-making, existing knowledge of the context (e.g., the city) is required. That is, the people appointed (whether external consultants or from within the cities) to develop the tools and accompanying procedures should have an embedded familiarity with the larger system/context.

4 Data lessons

Data, generally defined as facts and statistics, or discrete values, collected for reference or analysis, is one of the key types of information at the heart of evidence-based decision making and DSTs. In the end, the tools developed are only as good as the data inputted. Regardless of whether DSTs used quantitative or qualitative data, by their nature, they have data as inputs. In this section, we discuss challenges and learnings around finding, accessing and analysing data, as well as ensuring data quality and recognising limitations of data.

Data types & limitations

Not all decision support tools made use of quantitative data. Some, like the J4IR filter and the ETOD weighted tools provided methods to structure and rank **descriptive and qualitative information and assessments**. These tools provide users with a shared platform around which to engage in deliberative discussion about a decision, assess information in an orderly way, and reveal what is most valued, important or appropriate to their decision context. Other tools made use of **quantitative data,** either by going out and directly collecting it (in which case there was more direct control over the parameters and quality), or by looking for what data was available and structuring a tool around that.

Regardless of which type of data is being used, an important lesson was the recognition that within complex urban systems, the "perfect" set of decision parameters, along with the highest quality data to match, is seldom available. As a result, decision makers must understand that knowledge gained is not absolute, and efforts to **optimise** a decision are just that: an ongoing improvement process, rather than a once-off perfect **simulation** of the entire decision criteria and outcome. This was a valuable learning during Covid, when the urgency of the context allowed for neither the luxury of waiting for perfect data sets, nor phased approaches in which years of pre-research could be proposed. Working with *available* data, to make the best *possible* tools and *just-in-time* decisions was a valuable experience in support of *action*-based urban governance.

Key Terms

DATA STRATEGY: An organisations' strategy that sets out its approach to using data for decision making, and how it will improve its data governance, architecture, capabilities and culture to achieve that vision. It may include an articulation of the organisation's understanding of future demands for data and how to meet those, including if there are external demands for data that the organisation should meet by opening up or sharing its data.

DATA GOVERNANCE: setting internal standards—data policies— and the roles and structures to enforce them - that apply to how data is gathered, stored, processed, and disposed of. The procedures and protocols that control how an organisations' data is collected, stored, accessed and managed. The outcome of good data governance is high quality, trusted data accessible to the right people with the skills to use it.

DATA ARCHITECTURE: deals with the management of an organisations' data assets – it is the discipline and technology systems that map and store data – providing a blueprint for how data is stored, integrated and accessed. Contemporary data architecture will work on cloud systems, APIs, data pipelines, and database structures.

DATA PIPELINE: how data moves from one place to another (can be from device to storage to dashboard, or within a series of databases, for example). It is a set of data processing elements connected in series, where the output of one element is the input of the next one.

DATA INGESTION: the process of inputting data into a database (can be manual or automated).

DATA EXTRACTION: the process of obtaining data from a database (can be manual or automated)

DATA ANALYSIS: applying a process of statistical or logical technics to a set of data to arrive at a descriptive, analytical or predictive output that represents the data in a way that can be evaluated.

Finding the data

At various points, all three Cities experienced challenges around **finding data**. Although a wealth of data and information exist, knowing where it is and how to access it is another matter. Not all data will lie within city databases—some will be found in other government institutions, some in old city reports. "That's the nature of any model, you need to know where to get the data. Even if you have a complete open-source system, there will always be a need to gather additional data through research, rather than just logging into some platform and extracting it," observed ETOD's Botes. The J4IR experience of seeking service providers proved massively challenging, requiring the team to "fine comb through plenty of information, reaching out to global networks, speaking to industry leaders, looking at reports on competitors in mobility, etc." recalled Wessel van Wyk, J4IR team member.

With this in mind, FCSA teams suggested that City departments should better advertise their work, and/or contribute to **organisation-wide inventories** of what is known. Additionally, supporting **transversal relationships** and engagements, and enrolling people to understand the value of a new project, process or tool is critical to accessing data that is not living on shared architecture, but exists on individual or departmental drives.

> *The more people interact transversally, the easier it is to extract that data… There's no library as such for all the reports. Sometimes the best way to do this is old fashioned research: going and speaking to people. You can improve data systems and data analysis, but in our world, there will always be these reports lying around with really important information, and someone knows about it, and others don't… The more people talk, the more they start to engage with one another on these [sources]. (Francois Botes, ETOD Project Lead)*

However, in cases where data could only be found in previous reports and studies, it is important to anticipate challenges around **re-codifying** and **verifying** the data and its source. Such data can also present challenges in terms of maintaining and updating tools created. In other words, if a tool is intended to be used in perpetuity, it needs to be fed by a data pipeline connected to an updated supply of data, and not just data manually extracted from other research reports, as that will soon be outdated, rendering your tool useless. Thus, where the intention is for a tool to be used repeatedly, preference should be given to data that has a reliable data pipeline. This is where work such as the EAM or the IS use cases in Cape Town was valuable, as both cases worked the full value chain from collection to analysis.

Creating platforms for transversal relationships to thrive is also key to addressing **potential** gatekeeping issues that can arise from the fact that data ownership is neither centrally held, nor at a point where it is open-source and openly shared.

At various points, all three Cities experienced challenges around finding data. Although a wealth of data and information exist, knowing where it is and how to access it is another matter. Not all data will lie within city databases—some will be found in other government institutions, some in old city reports.

Developing a data strategy

The CTDE project found that working under the umbrella provided by the CCT's **Data Strategy** provided a useful platform for accessing transversal data, and setting in place **pipelines for data flows**, data quality improvements and working on internal capabilities to own and maintain datasets and tools. The strategy's focus on capabilities also provided the support to address issues of **data quality** (i.e., datasets that are incomplete, not at the desired granularity, or include errors in the databases), by upskilling staff on data collection and ingestion.

In the end, FCSA found that a dynamic process of building decision tools that are "good enough" based on available point-in-time data, while simultaneously implementing a data strategy that can improve the data pipeline (with attention to data standards, data skills and capabilities for inputs and extraction, and systems for data flows) was the best way to improve the entire data system.

Where improvements to data systems were outside the scope of work, and decision tools were more of a step in a technical process (rather than part of a data strategy or system), the learning was to focus on structuring the best available information (e.g., for J4IR) and building tools that can use that available once-off data, but also can accommodate new types of input data, as it becomes available (e.g., the ETOD land value capture, which uses point-in-time information on market performance, development rates and tariffs, but is also designed so that tool users can change the variables). .

Adopting an agile approach

The CTDE project strongly endorsed the importance of adopting an agile approach or methodology in developing and using DSTs. "The goal is to build [the tools] together [with the City], be iterative, be quite rapid about responding to developments and changes," said CTDE Project Lead Gevers. In other words, once the problem statement is clear, it is best to forge ahead with tool development in a process based on feedback between theoretical best practice and application of the tool within the cities. The J4IR project also found that actually using the tools helped dispel the 'vagueness' that sometimes came from a lack of technical understanding about what the tools were for or how to use them. Key to this agile approach is a willingness to continually assess tools with partner Cities, so that the projects could simultaneously improve the tools while also building partner City capacity to employ them.

DATA EQUITY: Significance of approach in informal settlements

Every person deserves to be counted and included in operational responses, planning considerations and strategic priorities. However, when working on complex urban development issues—in particular, issues affecting informal settlements, informal economies, and low-income neighbourhoods—the challenge of data gaps repeatedly rears its head. Across the three Cities, FCSA teams addressed data gaps for underrepresented groups and/or perspectives by:

- **Working towards upgrading the whole data system to include all informal settlement residents as data points equal to those already existing for formally housed residents:**
  - Cape Town developed a use case around an ongoing survey methodology for residents of informal settlements. Not only were residents provided with resident certificates which can be used for The Financial Intelligence Center Act (FICA) and other purposes, the data collection process represents a new capacity—and a new source of information—to inform better planning, service delivery and disaster response to marginalised communities. In other words, those who were previously at best erratically counted, now stand the chance to be visible through data.
  - The team working on this process had to navigate several learnings and risks, most importantly the "do no harm" consideration: ensuring that POPIA was complied with, and that visibility enabled dignity, not discrimination, in terms of how the use of the data is positioned within decisions on human settlements and basic services.
  - During the Covid pandemic, informal settlements service availability data collected in both Durban and Cape Town also contributed to improvements in water and sanitation services during the lockdown, and lessons learnt regarding infrastructural and operational processes affecting informal settlement basic services access in general.
- **Ensuring that statistical data is layered with in-person survey and community engagement data to validate and interpret findings as needed:**
  - The JSAF team found several rounds of surveys were required to create an up-to-date and more complete picture of socio-economic realities. This in turn was complemented by community engagements to support interpretation, and find information not already included in standard statistical data or previous reports and plans.

A key learning from all of this work was that filling data gaps requires resources to establish not just once-off research efforts, but to build sustainable data representativity that addresses how all members of society live, move, work and use services.

5 Tool testing/use lessons

The use of DSTs within FCSA projects resulted in data and information that was produced, organised and structured in a manner lending itself to rational comparison and evidence-based decision making. In doing so, the programme observed that tools' effective deployment presumed certain prerequisites, including:

- A non-corrupt environment: that is, a context in which decisions can be made based on evidence and in the spirit of civic responsibility
- Subject matter expertise: capacity among those using the tools to co-create and intellectually receive the work
- The necessary authority: that is, the person or people using the tool being positioned at a level to make decisions

Other lessons learned from the tools' use across the FCSA projects follows below.

Adopting an agile approach

The CTDE project strongly endorsed the importance of adopting an agile approach or methodology in developing and using DSTs. "The goal is to build [the tools] together [with the City], be iterative, be quite rapid about responding to developments and changes," said CTDE Project Lead Gevers. In other words, once the problem statement is clear, it is best to forge ahead with tool development in a process based on feedback between theoretical best practice and application of the tool within the cities. The J4IR project also found that actually using the tools helped dispel the 'vagueness' that sometimes came from a lack of technical understanding about what the tools were for or how to use them. Key to this agile approach is a willingness to continually assess tools with partner Cities, so that the projects could simultaneously improve the tools while also building partner City capacity to employ them.

Process & prerequisites to stakeholder engagement as DST

- **Clearly identify the problem & objective:** as with the development of DSTs more broadly, clearly articulating the problem to be addressed and the objectives of a proposed stakeholder engagement is key to success. This should be done as a co-creation exercise, between the project team and stakeholders.
- **Come with a clear structure and agenda:** An intentional engagement should be a very structured and planned process, with a clear agenda. More specifically:
  - The agenda should be outcomes led: what is the outcome you want to achieve? From there you know who you need to engage, what you will talk about, and the purpose of those dialogues. "An agenda tells a story, and you have to tell that story right," noted JSAF Lead, Monique Cranna.
  - Prepare the space: part of structuring an engagement is ensuring the space speaks to the plan. The location should be set up to encourage communication, and facilitators should know where they are presenting (e.g., if there is electricity for slides, etc.).
- **An experienced facilitator:** Facilitating an effective engagement is an art, and thus requires an experienced facilitator. "If you get a junior to do this work, or you are in a rush, you're not going to get the same value," noted Cranna.
  - An experienced facilitator has the ability to read a room, help participants navigate conversations, and understands when it is more useful to go off-script, especially in difficult moments.
    - Although it is important to start with a clear agenda, it's equally important to understand that community engagements are dynamic situations, and facilitators need to be ready to adjust and respond accordingly.
- **Keep people engaged**: A good facilitator is key to this, but also important is ensuring that the content used is short and impactful. Use different methods to get people to interact and share their opinions (in-person, this can mean breaking up into groups, doing ice-breaking exercises, etc.; if virtual, tools like using a Miro board help ensure that everyone participates). Across all teams, reflections were that in-person engagements garnered more robust engagement and trust building.
- **Schedule the time required:** An effective engagement cannot be rushed, and often requires repetition, iteration, and agility.

Supporting standardised methodologies

Within that agile approach, developing or reinforcing the use of standardised methodologies —for both individual DSTs and the procedures or frameworks in which they are embedded—was found to be critical to evidence-based decision making. That said, FCSA teams observed that decision makers themselves are generally agnostic with regard to what technology or methodology is employed in a tool, so long as it works. This was made clear in the use of the CTDE's Covid tools, which, due to their emergency context, were less subject to the standards and protocols/preferred methods of, for example, the City's data science unit. This speaks to the need to **balance tensions between expediency** (a tool that works now), **and sustainability** (a tool that fits into the City's existing systems and frameworks, and can be maintained and updated over a long-term).

> *Because it was a crisis, the most important thing was getting decision support done, even if it meant just getting a researcher to do something once-off. It's a quicker though less repeatable and therefore less sustainable response. But for longer-term use cases, like in the core work, you have to find ways of making all the stakeholders happy, and build something sustainable and aligned with all the strategies of the whole institution*
> *(Jodi Allemeier, FCSA Deputy Team Lead)*

While the expediency of DSTs for crisis contexts may have been satisfying and appropriate in the short term, in the longer term, a standardised approach should be taken so that tools are integrated within city systems, can be run repeatedly within those systems, maintained by city officials, and monitored for data quality without continual use of (once-off) consultants.

> At various points, all three Cities experienced challenges around finding data. Although a wealth of data and information exist, knowing where it is and how to access it is another matter. Not all data will lie within city databases—some will be found in other government institutions, some in old city reports.

City of Cape Town officials exploring uses of minisubstation performance data early in the user design process

Engagement as a decision support tool

For most people, talk of evidence-based decision making and tools invokes images of spreadsheets and data crunching. But an important learning from FCSA was the need to recognise qualitative processes as a tool that can surface the necessary understanding or knowledge required for decision making.

A deliberative process to understand complex variables

Experimenting with multiple survey types designed to elicit information that would help the JSAF project understand how to unlock inclusive economic development in Soweto, the team found that intentional in-person engagements were sometimes the only way to gather the information required.

> *Sometimes no amount of algorithmic modelling will get you there. You always will be missing variables, so you always have to complement. Sometimes it takes a deliberative process to understand complex variables. (Jodi Allemeier, FCSA Deputy Team Lead)*

In one example, researching the possibilities for spurring backyard housing development, the JSAF team initially thought the barrier to development was related to zoning issues. However, quickly discovering that people already had the rights to rezone, the team realised the problem lay elsewhere. But how do you acquire data on why people are not developing property? It was through **carefully facilitated stakeholder engagements** that the team discovered the barrier to development was based in a lack of trust among the population—elderly women—most likely to engage in this kind of development.

> *That finding from qualitative engagements did not fundamentally change the issue or high-level descriptions of the problem, but it changed the way in which we crafted the intervention, refined it and made it more appropriate and meaningful. (Monique Cranna, JSAF Lead)*

This learning reminds us to reflect on the whole **decision-making value chain**, and acknowledge the place where deliberation and debate fit in. For example, while data collection and descriptive tools were important links in the JSAF project's decision-making value chain, the actual decision-making (around prioritising interventions and projects within the JSAF plan) happened through **deliberation with the community** about that other information and how it would be used. Such engagements should be recognised for their ability to **make meaning of descriptive information**, rendering uniquely layered and enriched information that cannot be found in any report, and that no amount of algorithmic modelling will ever achieve. This perhaps unorthodox conceptual category—engagement as a DST—also points to the importance of project teams and City partners recognising their own internal biases, including assumptions that they can make meaning of a given piece of data or information independent of such engagements. In the end, the back and forth between data collection and analysis, and nuanced deliberation of that

... while data collection and descriptive tools were important links... the actual decision-making happened through deliberation with the community about that other information and how it would be used. Such engagements should be recognised for their ability to make meaning of descriptive information, rendering uniquely layered and enriched information that cannot be found in any report, and that no amount of algorithmic modelling will ever achieve.

Community engagement in Soweto as part of the JSAF process.

knowledge through stakeholder engagements, demonstrates both the limitations of the technical work, and, more importantly, the potential richness that can be achieved by combining the two.

> *In every stage, the technical and engagement work would run concurrently. We would come to conclusions, technically and community-wise, independently [of one other], and then compare them—almost like a sense-checking exercise, as well as a refinement. (Monique Cranna, JSAF Lead)*

The concurrent technical and engagement approach Monique describes is depicted in Figure 3 below.

The model in Figure 4 (on page 24) was developed by FCSA MREL Lead, Cara Hartley, to assist project members in assessing the extent to which the processes they were running were co-created and embedded within the communities and organisations they were working with. This speaks to the importance of engagement and ownership of deliberation processes, design processes, and ongoing use of any designed processes and tools.

Figure 3: JSAF Co-creation Methodology

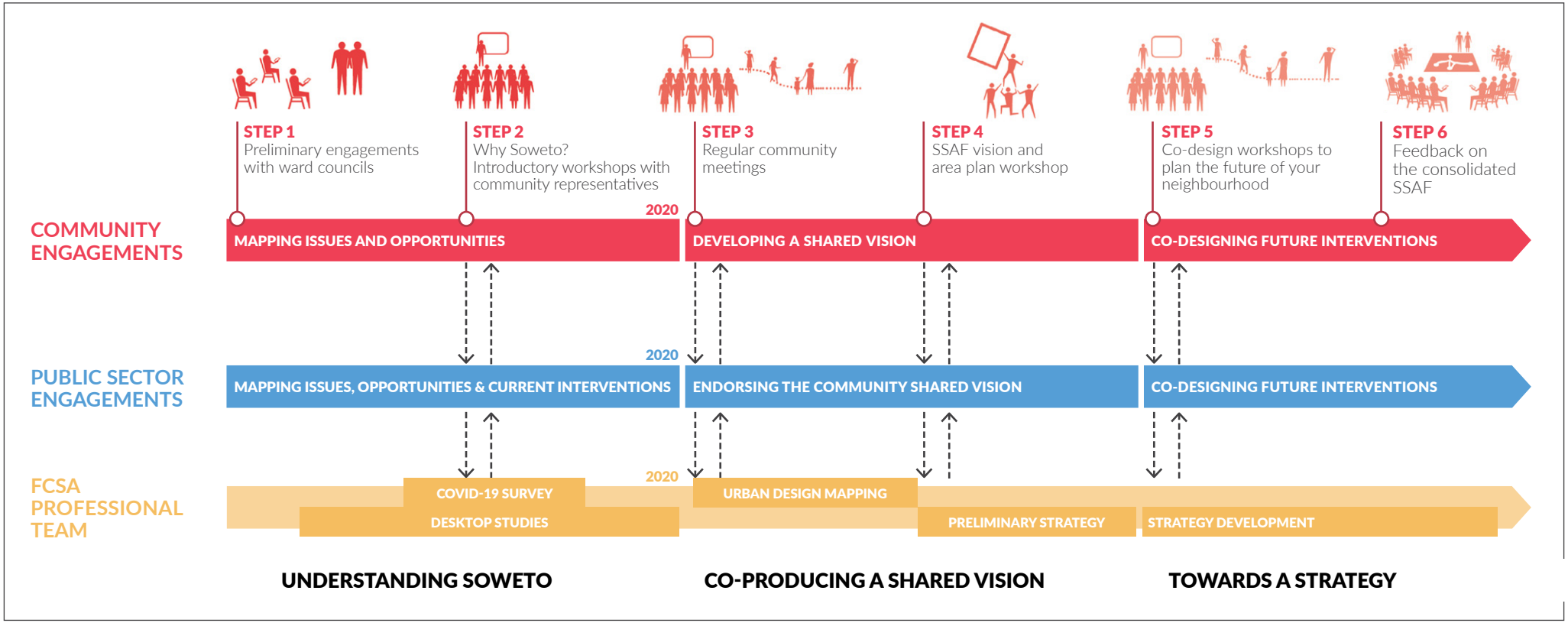


Figure 4: MREL Engagement Levels tool developed for FCSA

	LEVEL	DESCRIPTION
	**Unaware**	The stakeholder does not know that the technical assistance is taking place.
	**Aware**	The stakeholder knows that some technical assistance is taking place, but not the details.
	**Informed**	The stakeholder knows the nature of the technical assistance and what it seeks to achieve. They may have helped to shape the terms of reference, or they may have been alerted of the work by a colleague or subordinate.
	**Kept up to date**	The stakeholder gets regular updates on the progress of the technical assistance. They may be a member of a steering committee or reference group and so have access to information about progress, but are not actively engaging with the process. If requested to comment, they do not offer substantive comments. In some scenarios, this is the minimum level at which senior managers need to be engaging if they are ultimately to endorse the product.
	**Engaged and responsive**	The stakeholder takes an active interest in the process. They ask questions, draw connections back to their area of work, and raise relevant concerns and opportunities. Their comments are constructive. They are advocating for the product in their areas of influence. In most scenarios, this is the minimum level at which senior managers need to be engaging if they are ultimately to endorse the product.
	**Co-creating**	The stakeholder is helping to substantively shape the product. For instance, they are co-drafting sections or workshopping them. They are thoroughly familiar with the approaches, nuances, features and processes being applied. They are helping to ensure the suitability of the product both strategically and practically / operationally.
	**Supported use/application**	The stakeholder is beginning to use the (draft) product as intended, e.g. feeding data into the newly developed data system, or organising meetings to disseminate the research to the right audiences. They may still rely on the consultants for troubleshooting of the tool, or making the presentation to the audience.
	**Independent use/ application**	The stakeholder is using or applying the product as intended, with minimal support from the consultants. They demonstrate the needed skill and understanding to move forward on their own. They can build the capacity of others. They have a good sense of the strengths and weaknesses of the product, and although they may not be able to adapt or enhance it, they could help to scope such enhancement work.
	**Independent enhancement**	The stakeholder is not only a user of the product but is enhancing it by applying similar skills as the consultants, so that the product becomes increasingly useful or is adapted to new circumstances or needs.

6 Uptake and expansion

The development and use of DSTs to aid decision-making in the FCSA programme supported decisions from where to locate expanded clinic capacity during Covid, to how to prioritise infrastructure spend in medium-term capital budgets. However, more significant than these individual successes are whether and how partner Cities will continue to utilise the tools, how well the procedures and frameworks integrate into City agendas, and—perhaps most critically—if the Cities will build on the momentum created by the FCSA and continue developing tools and systems to support and make ubiquitous more transparent, evidence-based decision-making.

The ETOD team also noted the importance of "grinding it out at the lower levels", in terms of familiarising City partners with tool function and use, rather than worrying about formal approvals and adoption; but also pointed out that this was only possible thanks to the FCSA programme's multi-year timeframe.

Ensuring City use of FCSA tools and systems

Agile co-creation

Bringing partner Cities along on the journey of tool development and utilisation via the agile methodology discussed in Part V was key to what CTDE Lead Gevers called '**institutionalising as you go**'. This co-creation practice—which meant moving at the end-user's pace, so they are familiar with tool elements and prototypes from the start—results not only in tools that City partners know how to use from a technical standpoint, but also in the sense of ownership that translates into a desire and will to use them and, hopefully, to promote the efficacy of 'evidence based' decision making down the line. The ETOD team also noted the importance of "grinding it out at the lower levels", in terms of familiarising City partners with tool function and use, rather than worrying about formal approvals and adoption; but also pointed out that this was only possible thanks to the FCSA programme's multi-year timeframe.

> *Just going for council approval [of the tools] wouldn't make the necessary institutional change. It's better to [build the tools] bottom up, to say we've got buy-in from the tech people, we've got the structures to support it, so that formalising [tool approval] is then just a council procedure. (Francois Botes, ETOD Project Lead)*

That said, council support of the tools is of course useful, especially in terms of ensuring that less orthodox DSTs like community engagement are employed post-FCSA. "We've had these engagement structures endorsed by council—that's not typical. So it gives a mandate to engage each other on issues in implementing the SSAF," noted JSAF's Cranna.

Ownership

As far as who within the City should 'own' the tools—that is, who dictates tool positioning with policies, procedures, decision-support use and evolution—we return to the divide between creators/developers and users/those actually employing the DSTs to aid decision making. Global research dictates that decision-making support should be owned by decision makers, not by those running Information Technology (IT) units or related data systems units, and FCSA experience confirms this. While IT remains a key stakeholder, its regulatory, retrospective nature and inherent focus on accuracy fosters a culture that struggles to manifest the forward-looking or innovative ethos that ideally would guide tool ownership. "You don't want a no-risk, backwards-looking culture to be responsible for forward-looking decisions," explained the CTDE's Gevers.

Actualising data culture & evidence-based systems: building momentum

Scoping out from questions around provision and use of individual DSTs, and towards questions around larger systems-level impacts, a key learning from the FCSA was around the importance of investing in the tools' ability to influence the broader data culture as it develops, and to promote the widespread use of evidence-based decision making within cities.

> *That's the whole point, to say these [tools] are examples of evidence-based decision making in motion: to solve a problem, first and foremost, but to pick up momentum from an impact perspective, and use that collateral to get more and more of this happening across the city. (Richard Gevers, CTDE Project Lead)*

Such investment includes developing **city-wide data strategies** and **data governance councils,** which would help cities **build the technical literacy** and **define the governance roles** needed to support evidence-based approaches; that is, where across line departments, and at a strategic and political level, people will be equipped with data skills, tools and analysis to inform their operational and strategic decisions. With increasing inclusion of basic data science in higher education programmes across diverse disciplines, the skills pipeline is already being developed among those who enter public service under various job titles. The question becomes how these skills are captured, structured and governed by large organisations.

Building a data culture

Broader support for developing and integrating evidence-based approaches to decision making in South Africa's cities will rely on people choosing to build and use these systems, which means engaging in the hard work of culture change. To that point, FCSA teams noted the importance of city officials understanding that DSTs are about **human decision augmentation,** and are in no way are meant to replace people in decision-making processes. In other words, the tools will never simply provide answers to complex questions, but rather are there to offer the more nuanced, transparent and rational balance of information that can help decision makers interpret, debate and deliberate.

> *There are some things machines are good at, and we should use those strengths. But when it comes to the complexity of decision making, especially around things like service delivery and informal settlement planning, getting the right mix is key. Ultimately it's called 'decision support', the tools don't decide for you. (Richard Gevers, CTDE Project Lead)*

Because people are so fundamental to DSTs, tool uptake (and expansion) clearly links to **improved data literacy**; in other words, city decision makers need to have a clear understanding of what the models and tools can and cannot be used for. As such, cities should develop **data strategies** that explicitly include capacity building to enable the growth of a culture focused on developing, managing and maintaining **data pipelines** and related DSTs. This was experienced in the EAM and IS use cases in Cape Town, where staff upskilled in new digital processes expressed appreciation for how the digital pipeline had value both in terms of improved data and their careers.

FCSA teams noted the importance of city officials understanding that DSTs are about **human decision augmentation**, and are in no way are meant to replace people in decision-making processes.

An important FCSA learning that emerged here was that among the various data gaps—including those to do with data quality, governance, and architecture—a key need was **embedded governance roles**. However, in attempting to identify who should be responsible for which parts of a data strategy, it became clear that **traditional existing hierarchies and line department structures do not align well with the data governance roles needed**. The learning here being that roles may need to be rethought, or created from scratch. Either way, responsibility for data strategy, governance and pipelines needs to be written into job descriptions as a primary function and not an add-on to existing requirements and duties—something the Cities are still doing. "Taking ownership of something technical and driving it is an added job that is not in any job description," noted ETOD's Botes.

Finally, central to an effective data strategy and data governance is **data-driven leadership** and **buy-in from the top**. FCSA found that developing DSTs that focused on problem-solving was essential to building the momentum that earned that buy-in. "If you continue presenting theoretical ideas and strategies, people lose interest fast. But if you can show real problems being solved practically, that builds momentum, whether that means support, investment, etc. Culture is big," said CTDE's Gevers.

The learning here being that roles may need to be rethought, or created from scratch. Either way, responsibility for data strategy, governance and pipelines needs to be written into job descriptions as a primary function and not an add-on to existing requirements and duties—something the Cities are still doing.

City of Cape Town official capturing performance data at a minisubstation for electricity asset management use case

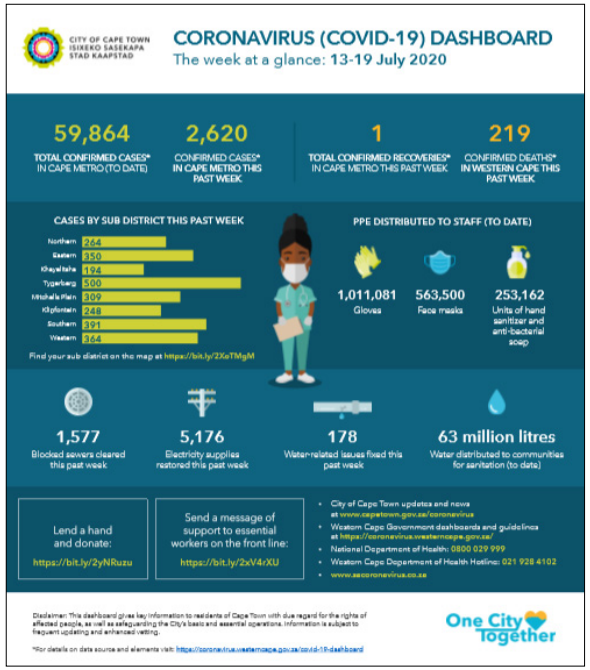
7 Conclusions & recommendations summarised

Complex decisions require information organised and presented in a manner that simplifies decision making by clearly representing how that information will impact both strategic and operational considerations. The FCSA contributed to this need in various ways, from developing simple excel tools to complex automated processes, to rethinking what constitutes a decision support tool. The foundational learnings to emerge from the FCSA's development and use of DSTs are:

- **Know your decision maker:** tool development requires understanding the problem being solved, and the vision the decision maker is advancing towards.
- **Know the decision-making process that the tool fits within:** think of any tool as part of an ecosystem: what existing frameworks, procedures, strategies and structures is it helping to illuminate? How can its design best serve and make sense of the larger picture?
- **Be humble about what a tool can do:** decision making happens within highly complex and dynamic contexts, and a DST is just one tool to help order, evaluate and better understand the incoming data and information. It cannot replace human decision-making, but rather is aiding that process by making information more digestible and comparable and thus decisions more rational and transparent. Decision makers still must be willing to enter into deliberations to fully interpret information—this includes engagements, fact checking, and opening analysis up to scrutiny, including with the community most impacted by your decisions.
- **Don't wait for perfect data, but do think about data availability and quality for tool use sustainability:** if possible, build the entire pipeline/value chain to support a sustainable product and replication of processes.

Finally, always remember that knowledge is power, and the prevalence of data gaps—or the exclusion of groups or perspectives from the evidence—particularly around informal settlements and populations, mean that decisions made with such incomplete data need to be constantly interrogated. Meanwhile, it is critical that as municipalities build data strategies and systems, questions of data equity and the use of a GESI lens to help unpack and interpret data solutions remain at the forefront.

Finally, always remember that knowledge is power, and the prevalence of data gaps—or the exclusion of groups or perspectives from the evidence—particularly around informal settlements and populations, mean that decisions made with such incomplete data need to be constantly interrogated.



Lessons summarised

Conceptual complexity lessons

- **DSTs are not just about technology and quantitative data, but also rely heavily on qualitative data inputs, and processes like stakeholder engagement.**
  - The process of engagement not only enriches and legitimises technical analysis, but also can be the place where decision making occurs.
  - To that extent, all DSTs need to be positioned within a community of users, allowing for deliberation and feedback loops to legitimate processes and tools.

Tool development lessons

- **Well defined problem statement & clearly articulated vision are foundational.**
  - Asking the right questions/know the problem you are solving.
  - Link to existing strategic plans/framework.
  - Don't over-define scope/over-theorize before you start.
- **Use an agile methodology, with a focus on problem-solving, and based in co-creation.**
  City partners need to be part of process, along each step.
  Sophistication of tool needs commensurate internal competency.
- **Every tool will have owner and user, not necessarily the same people, need to identify upfront.**
  The problem being solved should originate with the user (not owner).
- **Deep local knowledge is required to provide guidelines for more qualitative inputs.**
- **Build in GESI from beginning so that it is embedded in ultimate 'products' (roadmaps, etc.)**
  - Tools from scratch easier to embed GESI.
  - Bespoke tools are harder to build in GESI considerations. If tool can't encompass GESI, then:
    - it needs to be part of suite of tools that includes those variables.
    - question if it is the right tool and/or innovate a new tool.
- **Creating systems, not standalone models**
  - Tools and models should have accompanying procedures.
  - Shouldn't be a separate 'product': tools must be planned as integral to city's existing strategies and frameworks.
  - Can put existing tools in logical procedure/framework for structured decision making.
    - New procedures can also help to structure data / info to ensure evidence-based decision (eliminate bias and institutional memory).

Lessons summarised (continued)

Data lessons

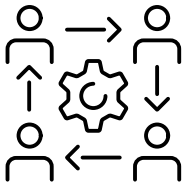
- **Tools are only as good as their input data.**
- **Regardless of whether DSTs used quantitative or qualitative data, they should always be data-led.**
- **Within complex systems, the "perfect" set of decision parameters, along with the highest quality data to match, is seldom available.**
  - Decision-makers must understand that knowledge gained is not absolute, and efforts to optimise a decision are just that: an ongoing improvement process, rather than a once-off perfect simulation of the entire decision criteria and outcome.
- **Finding data can be a tremendous challenge, the best way to address this challenge is through transversal relationships and engagements.**
  - Research will also always be part of finding data.
    - Much data will only be found in previous reports and studies, but anticipate challenges around re-codifying and verifying the data and its source.
  - Cities should contribute to organisation-wide inventories.
  - City departments should better advertise their work.
  - Creating platforms for transversal relationships can also help with gatekeeping issues.
- **Data strategies: all cities should develop a data strategy to**
  - provide a platform for accessing transversal data.
  - set in place pipelines for data flows & improved data quality.
  - work on internal capabilities to own and maintain datasets and tools.
- **Don't let the perfect be the enemy of the good: sometimes you need to forge ahead with building DSTs based on 'good enough' available data.**
  - Simultaneously implement a data strategy for improvements to data system.
  - If improving data system is outside scope of work, focus on structuring the best available information, and build tools that can accommodate new types of data input when it becomes available.
- **Data Equity:**
  - Quantitative data-driven decision making only supports GESI considerations if disaggregated data is available, and if models and tools can be built in a way that that data is given value.
  - Upgrading the whole data system to include all informal settlement residents as data points equal to those already existing for formally housed residents is fundamental to data equity in South African cities.
    - Filling data gaps requires resources to establish not just once-off research efforts, but to build sustainable data representivity that addresses how all members of society live, move, work and use services.
  - When thinking about how to use data to level the playing field, it is critical to take a "do no harm" approach; this means ensuring that:
    - POPIA is complied with.
    - visibility enables dignity, not discrimination, in terms of how the use of the data is positioned within decisions on human settlements and basic services.

Lessons summarised (continued)

Tool testing/use Lessons

- **Prerequisites to using tools: non-corrupt environment; subject matter expertise in city; positioned at level to make decisions.**
- **Training on data standards, data collection, analysis and use goes hand in hand with the introduction of a new DST.**
- **Adopt an agile approach that iterates based on actual use of tool prototypes.**
  - Using tools helps deal with 'vagueness' / potential lack of technical understanding from city partners.
  - Continually assess tools while also building capacity of city.
  - Need feedback between theoretical best practice and application in cities.
- **Develop and reinforce the use of standardized methodologies (SOPs/standard operating procedures) for both DSTs and the procedures or frameworks in which they are embedded** so that tools are integrated within city systems, can be run repeatedly within those systems, maintained by city officials, and monitored for data quality without continual use of (once-off) consultants.
  - SOPs should be automatically built to accompany new tools, but also can be developed to incorporate and improve existing tools. That is, new procedures can also help to better structure existing data and information to ensure more evidence-based decisions are made (eliminating bias and institutional memory).
  - Balance tensions between expediency (a tool that works now) and sustainability (a tool that fits into the City's existing systems and frameworks, and can be maintained and updated over a long-term).
- **Engagement as a tool: need to recognise qualitative processes as a 'tool' that can surface the necessary understanding or knowledge required for decision making.**
  - Recognise importance of deliberation and debate in understanding complex variables in the decision making value chain.
  - Question project assumptions that teams know how to 'make meaning' without engagement processes
  - There is a lot of information that can only be accessed in-person.
  - Back and forth between data collection and analysis, and nuanced deliberation of that knowledge through stakeholder engagements, demonstrates both the limitations of the technical work, and, more importantly, the potential richness that can be achieved by combining the two.

Lessons summarised (continued)



Tool uptake/ expansion/ institutionalization lessons

- **Institutionalize as you go: co-creation process that results in partners knowing how to use tools from a technical standpoint, but also feeling ownership**
  - Agile co-creation brings everyone along on the journey: not a black box
  - "grind out" tool use at lower levels, so adoption is just a formality
    - Advantage of multiyear project vs. consultant jumping in and writing a rpt
    - Council/formal approval is also helpful, especially for less orthodox tools
- **DST ownership should remain with users, not IT departments**
- **Leverage momentum from problem solving DSTs to support investment in city-wide data strategies, data governance councils**
  - Build technical literacy and define governance roles needed to support ubiquitous use of evidence-based approaches across the city
  - Move past providing some tools, and into actualizing data culture and evidence-based decision-making within city systems.
- **Help people understand that DSTs must be understood as human decision augmentation (NOT replacement)**
  - Tools can never provide answers to complex questions
- **Data literacy/internal capacity**
  - people need to understand what tools and models can (and can't) be used for
  - Gap between roles required for data governance and existing hierarchies within line depts
    - Needs to be in job description (not an 'extra' thing)
- **Complex questions require leaders to interpret, debate, deliberate using balance of info**
  - Need champions to drive the capacity building and systems change around use (and expansion) of tools
  - Impact of DSTs is not just around the individual tools, but the momentum created by their (successful) uptake to build data literacy and governance in cities

Annexure: FCSA projects summarised

Soweto Strategic Area Framework (JSAF/SSAF) Johannesburg – January 2020 to September 2022

"Strategic Area Framework and Associated Implementation Tools for Soweto Triangle, Johannesburg" focuses on a specific part of Soweto (a key intervention area defined in Johannesburg's 2016 Spatial Development Framework) which has benefitted from substantial public investments over the last quarter-century. Starting with a comprehensive `Status Quo' analysis, the intention was to collaboratively produce a sustainable spatial and economic development vision and trajectory for the area by exploring the reasons for the apparently insufficient development response to previous public investment. The project had a strong focus on township economic development.

Cape Town Data & Economics (CTDE) – January 2020 to September 2022

The aim of the CTDE project is to provide technical support to the City of Cape Town and give effect to CCT's Data Strategy through data use and application case studies related to transport, economic analysis, resilience, and human settlements. The project was divided into 4 workstream that focused on:

- Project Preparation & Appraisal (PPA): the FCSA team have developed a set of tools, training materials and events, and good practice guidelines as well as applied CBAs to develop the City's infrastructure spend prioritisation methodologies.
- Comprehensive Knowledge Archive Network (CKAN): CKAN is an open-source secure data sharing platform that the FCSA team set up and maintained for data sharing needs during the Covid response work.
- Electricity and Asset Management (EAM): the EAM use case focused on improved data quality (primarily through capabilities interventions) and tooling (data science and business intelligence applications) for mini-substation maintenance, repair and replacement planning.
- Informal Settlements (IS): the informal settlements use case focuses on data collection in informal settlements. The use case focused on capabilities, tooling and data security and privacy for household level surveying in informal settlements.

4th Industrial Revolution & Mobility (J4IR) – January 2020 to September 2021

"Review of Fourth Industrial Revolution (4IR) trends and effects on urban mobility in Johannesburg" sought to take advantage of the fact that mobility is one of the sectors most affected by technological advances (sometimes referred to as the Fourth Industrial Revolution), to address some of Johannesburg's transport-related challenges. Thorough reviews of the international and local 4IR trends in mobility set the scene for an exploration of ways in which these trends could be harnessed to address some of the issues affecting mobility and transport in the city.

eThekwini EISM/ISIMS – January 2020 to September 2022

The eThekwini Municipality faces the challenge of managing and providing services to a growing number of informal settlements. It is estimated that there are over 580 informal settlements comprising 287,000 households and accounting for approximately one quarter of the population in the eThekwini Municipal Area (EMA). The goal of the Informal Settlement Information Management Solution (ISIMS) project is to provide the eThekwini Municipality with a planning tool to make better informed decisions to address spatial, social and economic inequalities and ultimately improve the lives of those living in informal settlements within the EMA.

Transit Oriented Development (ETOD) – January 2020 to September 2022

The overall objective of the proposed intervention was to develop a multi-sectoral institutional model that acts as a coordination tool to plan, implement and operationalise Transit Oriented Development (TOD) and to formulate a change management process to foster alignment of stakeholder plans, both public and private sector. Technical support was required to develop an organisational structure by identifying sector roles and responsibilities in planning, implementing and managing TOD within the municipality and the lead and coordinating function for aligned intergovernmental and private sector initiatives.

Acknowledgements

Foreign, Commonwealth and Development Office (FCDO) and the Future Cities South Africa programme (FCSA) are grateful to the City of Cape Town, eThekwini Metropolitan Municipality and the City of Johannesburg for their time and consideration in the development of this publication.

We would like to thank the following people for sharing their insights with us:

City of Cape Town
Hugh Cole
Paul Court
Delyno du Toit

City of Johannesburg
Eric Raboshakga

eThekwini Metropolitan Municipality
Debra Roberts
Jo Douwes
Sarah Watson

The following individuals contributed to the production of this report:
Rebecca Tron (FCDO)
Shabari Shaily-Gerber (FCDO)

FCSA Programme Management Team
Nishendra Moodley (FCSA)
Jodi Allemeier (FCSA)
Nhlanhla Mncwango (FCSA)
Roland Hunter (FCSA)
Mirjam van Donk (FCSA)
Helen Chorlton (FCSA)

FCSA City of Cape Town project team:
Richard Gevers
Ed Day
Nick Graham
Winston Anderson

FCSA City of Johannesburg (SSAF) project team:
Monique Cranna
Thuli Ndlovu
Claus Rabe,
Sabina Favaro
Thandi Bhengu

FCSA eThekwini Metropolitan Municipality (ETOD) project team:
Francois Botes
Gerhard Hitge

FCSA eThekwini Metropolitan Municipality (ISIMS) project team:
Paul Jones
Abigail Kemper

Writer: Lee Middleton
Editor: Jodi Allemeier
Design: Anna Chappé

FUTURE CITIES SA

Future Cities South Africa (FCSA) is the delivery partner for the South African component of the Global Future Cities Programme, funded by the UK Government's Foreign, Commonwealth and Development Office (FCDO). FCSA is an alliance of organisations and individuals led by PwC (UK & ZA), and includes the Isandla Institute, Open Cities Lab (OCL), Palmer Development Group (PDG), Violence Prevention through Urban Upgrading (VPUU NPC), Zutari and others, together with a range of independent specialists.