The data integration challenge: ‘FAIR’ data for city resilience

Session B4 description

Facilitators

- **Andrew Simmons** - Director of Research, Resilience Brokers, London
- **Simon Hodson** - Executive Director of CODATA, International Science Council, Paris

Panelists

- **Stephen Passmore** - Chief Executive Officer, Resilience Brokers, London
- **Caroline Field** - Committee Chair, British Standard for City Resilience; and Associate Director, Arup, London
- **Piero Pelizzaro** - Chief Resilience Officer, Milan
- **Gayatri Singh** - Senior Urban Development Specialist, World Bank, Jakarta
- **Chris van Diemen** - Co-Founder & Chief Data Officer, Green City Watch, Amsterdam

B4 | The data integration challenge: ‘FAIR’ data for city resilience
10th Global Forum on Urban Resilience and Adaptation
26th June 2019 | 16:00
The Data Integration Challenge:

driving solutions for resilient cities, disaster risk reduction and infectious diseases

Simon Hodson
Executive Director
CODATA
www.codata.org
▪ CODATA Data Policy Committee
▪ One major policy report per year.
▪ 20-Year Review of GBIF currently underway.
▪ New Centre of Excellence in Data for Society being set up at University of Arizona.

▪ Data Science Journal:
https://datascience.codata.org/
▪ International Data Week and CODATA Conference series.
▪ Task Groups and Working Groups.

▪ CODATA-RDA School of Research Data Science.
▪ CODATA China, PASTD and other training activities.
▪ #terms4FAIRskills and FAIRsFAIR Competence Centres.

▪ Regional Open Science Platforms
▪ Data Interoperability for Multi-Disciplinary Research.
▪ Survey and recommendation of good practices.
Formed by a merger of the International Council for Science and the International Social Science Council.

Explicit mission for ALL the sciences and for interdisciplinary and transdisciplinary research.
The major, pressing global scientific and human issues of the 21st century can **ONLY** be addressed through research that works across disciplines to understand complex systems, and which uses a transdisciplinary approach to turn data into knowledge and then into action.

- Require the ability to gather data from multiple sources and extract information from those complex and heterogeneous data.
- The digital and data revolution presents us with huge opportunities and significant challenges.
- Better exploitation of data resources for research is the epochal challenge of the 21st century.
- With the merger of ICSU and ISSC to form the **International Science Council**, addressing the data revolution and global challenges is a priority.
IDDO collects and integrates clinical, laboratory and epidemiological data relating to a number of infectious diseases. Analysis of combined datasets increases the power to determine optimal treatments, identify the most effective intervention in outbreaks.
The government-led response to the West African Ebola outbreak included many different international organisations.
When the outbreak ended and organisations left the region, the data was scattered globally.

Pisani et al. 2018 Estimate 65% of study data not available, not shared.
Data that characterise many of the factors influencing the progression of an outbreak are available, but remain isolated in siloes within the various domain-specific communities, often with their own domain-specific formats, vocabularies and ontologies.

Availability of datasets from industry, the research community, national public health surveillance, climate and environmental monitoring systems, health systems administration, social media feeds, and animal health services will then be sought in order to understand how their integration can fill critical knowledge gaps across disciplines. Reports and lessons learned from previous infectious disease outbreaks have identified clinical, genomic, demographic, pathogen and vector surveillance, communications, land-use, health administration, and environmental data as powerful inputs to support planning and operationalising outbreak response. We can anticipate data in numerous formats such as tabular data in spreadsheets, CSV, TSV, and/or plain text, geospatial point-wise data, geographic data, and a variety of XML and JSON dialects. For the domains of interest, available ontologies will be sourced and compared to determine methods for integration and interchange.
FAIR
FAIR (Findable, Accessible, Interoperable, Reusable)

(Mons, B., et al., The FAIR Guiding Principles for scientific data management and stewardship, Scientific Data, http://dx.doi.org/10.1038/sdata.2016.18)

Image CC-BY-SA by SangyaPundir
To be Findable:
- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

To be Accessible:
- A1. (meta)data are retrievable by their identifier using a standardized communications protocol
- A1.1 the protocol is open, free, and universally implementable
- A1.2 the protocol allows for an authentication and authorization procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available

To be Interoperable:
- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles
- I3. (meta)data include qualified references to other (meta)data

To be Reusable:
- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
- R1.1. (meta)data are released with a clear and accessible data usage license
- R1.2. (meta)data are associated with detailed provenance
- R1.3. (meta)data meet domain-relevant community standards

(Mons, B., et al., The FAIR Guiding Principles for scientific data management and stewardship, Scientific Data, http://dx.doi.org/10.1038/sdata.2016.18)
- **FAIR does not NECESSARILY mean Open**
  - Data visiting rather than data sharing.
- **Findable**: have sufficiently rich metadata and a unique and persistent identifier, to enable discovery.
  - Allows programmatic access for analysis.
- **Accessible**: retrievable by humans and machines through a standard protocol; authentication and authorization where necessary.
  - The descriptions of variables etc follow a shared specification and are commensurable.
- **Interoperable**: metadata use a ‘formal, accessible, shared, and broadly applicable language for knowledge representation’.
- **Reusable**: metadata provide rich and accurate information; clear usage license; detailed provenance.
  - Both humans and their analytical tools know what can be done with the data (license) and can assess its provenance.

European Commission Expert Group, Chaired by Simon Hodson, Turning FAIR into Reality (2018)  
https://doi.org/10.2777/1524

Nature Comment Article: https://www.nature.com/articles/d41586-019-01720-7

Australian Academy of Sciences: http://bit.ly/Australian_Academy_FAIR_Data
The interoperability of data in interdisciplinary grand challenge research programmes is one of the major challenges for global research.

- FAIR provides some of the tools to address this.

As part of the new ISC Science Action plan we have presented a proposal for a major international programme.

- Series of workshops to plan the initiative.

- CODATA, with support from ISC, has been exploring these issues with a set of pilot case studies.
The initiative addresses data integration for pressing, 21st century global challenges, initially through three closely-allied interdisciplinary research areas:

- **Infectious Diseases (IDDO)**
- **Disaster Risk Reduction (CODATA TG, PHE, IRDR)**
- **Resilient Cities (Resilience Brokers)**

With global collaboration within and across domains and disciplines, the overall activities are designed to:

- have practical outputs of value to policymakers and users;
- to develop technical approaches and methods that have generic value; and
- to be persuasive demonstrators to the broader scientific community of the value of the approach.
CODATA and ISC Data Integration Pilot

Intelligence Support for Data Science and Data Integration
Provides generic support for an expanding series of pilots.

Problem Definition:
Interdisciplinary or transdisciplinary research on topics where there is a need for data integration.
Domains include:
- Infectious Diseases
- Disaster Risk Reduction (DRR)
- Resilient Cities

Phase 1:
Understanding the pilot

Phase 2:
Understanding the data

Phase 3:
Identifying opportunities for data integration

Phase 4:
Identifying recommendations and requirements

Phase 5:
Implementation of Data Integration Intelligence
Interoperability and data integration solutions

Phase 6:
Enhanced Research
Innovative research outcomes and recommendations

Phase 7:
Distilling Generic Lessons for Data Integration and Enhanced Research
Recommendations for interdisciplinary research; recommendations for societal actors.
Interoperability of Metadata Standards in Cross-Domain Science

Pilot Case Studies Prepared Data Audits

- What is the overarching question or challenge that is being addressed?
- What are the data sets which, ideally, need to be accessed, assembled in order to address these questions?
  - Who ‘owns’ the data? What is the licensing and use regime?
  - Where are the data stored? What are the access requirements?
- What is the data format?
- What is the metadata format used? What provenance information is provided? Can fitness for use be assessed?
- How are the variables defined? What semantics, controlled vocabularies or ontologies are used to define these qualities, values?
- Is code associated with processing/analyzing the data available?

Dagstuhl Workshop in partnership with DDI

- Detailed examination of the requirements and the challenges of the pilot case studies.
- Recommendations on how to address issues of interoperability and integration: what standards can and should be used; how implementing those standards may assist the pilots; what work is necessary on the standards to assist interoperability in these use cases.
- Articles forthcoming in Data Science Journal.

Workshop: Interoperability of Metadata Standards in Cross-Domain Science, Health, and Social Science Applications
Selbhaus Dagstuhl – Leibniz Center for Informatics, October 1-5, 2019 in Wiesbaden, Germany
Conclusions

- Too much time is lost on data wrangling (estimates as high as 80%)

- Key ingredients for interdisciplinary, grand challenge research where heterogenous data needs to be integrated:
  - FAIR Data (machine readable)
  - Alignment of metadata specifications and ontologies.
  - More effective ingest and FAIR by design.
  - Machine Learning / Artificial Intelligence to assist with data integration

- Data visiting vs data sharing. Allowing programmatic access can help with protection and avoid challenges of data transfer.

- Extracting information from complex systems studied by interdisciplinary grand challenge research initiatives is one of the greatest challenges of our age.

- CODATA is working with interdisciplinary research initiatives to understand the requirements and how these can be generalised.

- We hope that this will become a ISC sponsored global programme. Keen to have input, direction, engagement.

- Examines the theme in China and elsewhere, in the light of the emergence of data policies and in particular the China State Council’s Notice on ‘Measures for Managing Scientific Data’.
- Timely to examine changes in data policy, emergence of FAIR, major initiatives such as EOSC, ARDC, and CAS activities including the Digital Belt and Road.
- Important opportunity for comparative discussions.

CODATA 2019 Beijing Conference, 19-20 September

- Call for presentations and posters, deadline 8 July: https://conference.codata.org/CODATA_2019/
- Sessions on FAIR, data interoperability, on hazards, on cities.
- Information and registration: http://codata2019.csp.escience.cn/dct/page/1
- Ongoing series of CODATA Conferences.
Thank you for your attention

Simon Hodson, CODATA
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Facilitators

- **Andrew Simmons** - Director of Research, Resilience Brokers, London
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- **Stephen Passmore** - Chief Executive Officer, Resilience Brokers, London  [pp.24-50]
- **Caroline Field** - Committee Chair, British Standard for City Resilience; and Associate Director, Arup, London  [pp.42-52]
- **Piero Pelizzaro** - Chief Resilience Officer, Milan  [pp.53]
- **Gayatri Singh** - Senior Urban Development Specialist, World Bank, Jakarta  *(video intervention)*  [pp.42-55]
- **Chris van Diemen** - Co-Founder & Chief Data Officer, Green City Watch, Amsterdam  [pp.57-83]
Data-driven resilient city-regions

B4 - The data integration challenge: ‘FAIR’ data for resilient cities
26th June 2019 - 16:00 - 17:30 - Room: S25-26

ICLEI Resilient Cities 2019
10th Global Forum on Urban Resilience and Adaptation
Bonn

Stephen Passmore  Chief Executive Officer, Resilience Brokers
Paola Pollmeier  program director and open data specialist, Ruta-N Medellín (pre-recorded video)
Introduction to Resilience Brokers and the Trust

- UK group to speed up and scale up transformative urban/rural development;
- Operates in space between private, public, knowledge and civil society sectors;
- Leading experts foster integrated-systems thinking and collaborative approaches;
- Develop tools and demonstrators to support implementation of 2030 agenda in city regions;
- Open source, free-to-use tools - “resilience.io” integrated-systems modelling platform
- Data-driven, social and natural science based.
Data brokering approach - a change in paradigm

Interoperability through mediation -
System of systems integration, linking complex and heterogeneous systems by building bridges between existing network platforms and systems infrastructures.

Geo-locate flows, infrastructure - ML
Data-brokering infrastructure enables access to and interoperability with a wide variety of data sources:

- geo-locational data and from Earth observations;
- open datasets across scales (e.g., local, regional);
- proprietary data sets;
- ground-based sensors;
- crowdsourced data.
Decisions - Investment in infrastructure
- Energy, Water, Transport, Housing, …
- Local, foreign, government, private, …

Decisions - Market Policies and planning
- Taxation, tariffs, quota, subsidies, …
- Land use plans, regulations, …

Indicator outcome range (5-20 years)
- Sector resource and energy flows
- Effects on imports & exports
- Wastes & Emissions (CO\textsubscript{2}, CH\textsubscript{4}, …)
- Employment, income, in(equality)
- Human well-being indicators
- Sector economic activity / GDP
- Access to service / %
Contributing to targets across at least eight Sustainable Development Goals

Icebreaker One could enable data sharing at web-scale to inform investment decisions
‘Smart’ cities and ‘resilient’ cities

Defining the role of open data in different city strategies

‘Is the smart city focus on efficiency at odds with the need for resilient cities to be open, democratic and inclusive, processes which are time and labor intensive?’

Pamela Robinson, Ryerson University and GeoThink Researcher

‘The ability to ingest crowd sourced data, and turn data into actionable information is a trait of engaged administrations and data programmes that leverage platforms to harness new data and feedback on local issues.

This includes the ability to allow partners to stream sensor based data to a city’s open portal.’

Sifa Mawiyoo, Open Data Geospatial Technologist, ICT Authority, Kenya

‘OPEN DATA INFRASTRUCTURE FOR CITY RESILIENCE: A roadmap showcase and guide’

May 2018, available through UNISDR
Implementation

Collaboratory maturity

- X sector champions
- Data audit and integration methodology
- Co-development
- Capacity building
- Evolve and embed
## Implementation

### resilience.io platform use cases

<table>
<thead>
<tr>
<th>Location</th>
<th>Focus Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Accra, Ghana</td>
<td>Water supply, sanitation and accessibility</td>
</tr>
<tr>
<td>Hunter Valley, Australia</td>
<td>Water infrastructure, energy transition, institutional resilience</td>
</tr>
<tr>
<td>Union Canal, Scotland, UK</td>
<td>Water supply, sanitation and accessibility</td>
</tr>
<tr>
<td>Anninghe, Sichuan, China</td>
<td>Integrated multi-hazard modelling</td>
</tr>
<tr>
<td>Queen Elizabeth Olympic Park, London, UK</td>
<td>Digital and social inclusion, green space accessibility</td>
</tr>
</tbody>
</table>

### Additional Resilience Brokers Projects

<table>
<thead>
<tr>
<th>Location</th>
<th>Focus Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medellin, Colombia</td>
<td>Air quality, public health, transport, green space</td>
</tr>
<tr>
<td>Beirut, Lebanon</td>
<td>Green space, urban health, pedestrian and cycling routes</td>
</tr>
<tr>
<td>Western Cape, South Africa</td>
<td>Water supply, energy transition</td>
</tr>
<tr>
<td>Norfolk &amp; Suffolk, UK</td>
<td>Net positive energy buildings &amp; public health</td>
</tr>
</tbody>
</table>
ISC-CODATA Data Integration Initiative

Pilot projects for 3 global challenges - stages

- The initiative addresses data integration for pressing, 21st century global challenges, initially through three closely-allied domain field, with three work stages.

- With global collaboration within and across domains and disciplines, the overall activities are designed to:
  - have practical outputs of value to policymakers and users;
  - to develop technical approaches and methods that have generic value; and
  - to be persuasive demonstrators to the broader scientific community of the value of the approach.

- Through an approach that supports, connects and amplifies the work of existing Communities of Practice and science bodies that are relevant and influential, CODATA's long-term, decadal Data Integration Initiative has the potential to fundamentally enhance the capacity of science in the 21st century.
### Data Integration Intelligence

**Methodology:**

**Phase 1:** Understanding the pilot

**Phase 2:** Understanding the data

**Phase 3:** Identifying opportunities for data integration

**Phase 4:** Identifying recommendations and requirements

**Phase 5:** Implementation of Data Integration Intelligence

**Phase 6:** Enhanced Research

**Phase 7:** Distilling Generic Lessons for Data Integration and Enhanced Research

#### Problem Definition:

Interdisciplinary or transdisciplinary research on topics where there is a need for data integration.

**Domains include:**

- Infectious Diseases
- Disaster Risk Reduction (DRR)
- Resilient Cities

#### Intelligence Support for Data Science and Data Integration

Provides generic support for an expanding series of pilots.

#### CODATA DATA INTEGRATION INITIATIVE

Advancing Interdisciplinary Research on Global Challenges through Data Integration

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### Enhancing Data Integration Intelligence

- **Pilot A:** Infectious Diseases
- **Pilot B:** Disaster Risk Reduction (DRR)
- **Pilot C:** Resilient Cities
- **Pilots D,E ...**
- **TBD**
CODATA pilot project for resilient cities

Medellin case study

Integrated data approach on a topic in Medellin

- a systems approach to air quality (and public health and economic outcomes) has been agreed, advancing existing initiatives in Medellin.

Medellin project working group:

- Ruta N - Business & Innovation Center for Medellin Municipalit - Paola Pollmeier (Medellin lead)
- Universidad Nacional de Colombia Sede Medellin (UNALMED) - Santiago Medina Hurtad
- Medellin Municipality - Planning Office and Chief Resilience Officer (CRO)
- Foundation Makaia
- Instituto Tecnológico Metropolitano de Medellin (ITM)
- Departamento Administrativo Nacional de Estadistica (DANE) - Carlos Felipe Lombo, Angelica Robayo
- Medellin Data Council members
- Medellin Lab (ACI Medellin)
Data integration workshops in Medellin for CODATA
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of absorption of pollutants from urban trees?</td>
<td>What datasets are available?</td>
<td>Who generates the data?</td>
<td>Who needs access to the data? For what purpose?</td>
<td>What datasets are necessary?</td>
<td>Who needs access to the data? For what purpose?</td>
</tr>
<tr>
<td>Rate of absorption of pollutants from urban trees?</td>
<td>* Urban Trees</td>
<td>AMVA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projection of pollutants from the city?</td>
<td>Contaminants monoxide and nitrogen dioxida, ozone (O3), PM 1, PM 2.5, PM10, sulfur dioxida (SO2)</td>
<td>AMVA</td>
<td>Transport, construction, health and education companies</td>
<td>Health</td>
<td></td>
</tr>
<tr>
<td>Correlation between respiratory diseases (according to time of exposure to contaminants, location, travel...)</td>
<td>* Contaminants monoxide and nitrogen dioxida, ozone (O3), PM 1, PM 2.5, PM10, sulfur dioxida (SO2)</td>
<td>AMVA</td>
<td>Medellín's town hall Municipalities Valle de Aburrá</td>
<td>Respiratory diseases (Registry of Ministry)</td>
<td>Sure (Insurance Company) EPS</td>
</tr>
<tr>
<td>* Destination origin survey</td>
<td>Health service companies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Travel information of events (Medellín, Bali and Envigado)</td>
<td></td>
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<tr>
<td>* Duration of event in zones with a higher concentration of pollutants</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>What is the generation rate of pollutants due to congestion?</td>
<td>Mobile Sensing in Garbage Collection Vehicles (Gas)</td>
<td>AMVA</td>
<td>SIATA</td>
<td>Pilot Renting Colombia</td>
<td>Transport companies, vehicle rental and fuel</td>
</tr>
<tr>
<td>How does the quality of the air impact the economic development of the City?</td>
<td>* No Jake, Economic Development - GDP, taxes, budget execution</td>
<td>Multiple public and private sources</td>
<td>RutaN, Sec de Desarrollo Economía</td>
<td>Impact of SIne of Private Motorcycles, No of Disabilities, Tourist Data, Concession of events, Sales of Motorcycles</td>
<td></td>
</tr>
<tr>
<td>* Data of clouds and air quality, temperature, winds, noise, river levels</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>How do mobility measures influence commerce or business activity?</td>
<td>Effects of mobility measures (such as peak and plate) on air quality</td>
<td>AMVA</td>
<td>Mobility secretary</td>
<td>Chambers of Commerce</td>
<td>Movidata Mobility in real-time</td>
</tr>
</tbody>
</table>
Methodology (overview)

Phase 1: Understanding the Pilot

- **Step 1:** What is the research topic?
- **Step 2:** What are the core research questions?
- **Step 3:** What data types are needed?
- **Step 4:** What specific datasets are needed? What datasets are readily available?

Phase 2: Understanding the Data

- **Step 5:** What are the access and usage characteristics of the datasets?
- **Step 6:** What is the format, structure, definitions, and descriptions of the data?

Phase 3: Identifying Opportunities for Data Integration

- **Step 7:** What are the opportunities and challenges in relation to interoperability and data integration?
- **Step 8:** What are the data preparation / transformation functions required to make the data analysis ready?

Phase 4: Identifying Recommendations and Requirements

- **Step 9:** Run intensive data interoperability workshop.
- **Step 10:** Present and iterate outputs with the initiative and the discipline community.

Phase 5: Implementation of Data Integration Intelligence

- **Step 11:** Planning step / meeting
- **Step 12:** Improve stewardship and FAIRness of data
- **Step 13:** Refine Semantics
- **Step 14:** Implement “plinth”

Phase 6: Enhanced Research

- **Step 15:** Conduct and publish analysis using the integrated datasets.

Phase 7: Distilling Generic Lessons for Data Integration and Enhanced Research

- **Step 16:** Evaluate the research and action benefits of data integration using this model
- **Step 17:** Draw general lessons for data integration programme

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2018-08-18
CODATA pilot project for resilient cities
Medellin case study

Action plan

1. Define topic.
2. Define scope. (what questions are asked of the data and who needs to access the data, for what purpose)
3. Identify what data sets are required, and what datasets are available (pm2.5).
4. Identify key areas of interoperability of data between disciplines (air quality, demographics, economics, land use, health, green space, GHG emitters/traffic and transport).
5. What are the data functions required. (e.g., machine learning, extraction of data from pdf documents)
6. Collect data and build integrated data tools & analyses.
7. Conduct intensive data lab at Dagstuhl workshops (1-5 October) – metadata workshop.
8. Present initial results to Medellin and ISC CODATA groups.
The direct and indirect effects of climate change on health and wellbeing

There are complex interactions between both causes and effects. Ecological processes, such as impacts on biodiversity and changes in disease vectors, and social dynamics, can amplify these risks. Social responses also ameliorate some risks through adaptive actions.

adapted from The Lancet – for illustrative purposes only
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FAIR data for City Resilience: British Standard for City Resilience
BS 67000 Resilience Framework.

**ORGANIZE & DEFINE**
- Governance Arrangements
- Engage Stakeholders
- Empower Citizens & Organizations
- Agree Values/Goals
- Shared Understanding

**ASSESS & PRIORITIZE**
- Shocks, stresses, trends
- City Systems Mapping
- System Demand
- System Capacity
- Gap Assessment
- Prioritization

**PLAN & PREPARE**
- Resilience Strategy Development of Options
- Building the Business Case
- Secure Funding

**PARTNER & DELIVER**
- Manage programs
- Capacity Building
- Awareness Raising

**CONTINUOUSLY IMPROVE**
- Re-assess
- Reflect, learn, innovate & improve
Organize & Define: Data Collection

Infrastructure-related data
Demographic data
Socio-economic data
Employment statistics
Environment-related data
Community/neighbourhood related data
Housing
Disaster risk data
Disaster loss data
Assess & Prioritize (Diagnostics)

Population

Health Value Chain
Evidence-based decision making

Resilience Gap
Plan & Prepare: Strategies

Improve data collection & sharing

Information Management System

- Define current state
- Build an understanding
- Demographics
- People and Communities
- Economics
- Infrastructure
- Etc.
- Define End State

Define frame of reference

Understand the Problem
- Hazards (Shocks & Stresses)
- Build an understanding
- Exposure
- Impact
- Probability
- Trends/Change
- Vulnerabilities
- Relative Importance
- Value
- Dependencies

Define and assess existing controls/measures

Data Gap Analysis
- Spatial separation
- Protective measures
- Codes and other robustness measures
- Diversification
- Fail Safes
- Adaptive measures
- Response
- Recovery

Roadmap
- Schedule and manage

Priorities
- Form data priorities
- Define strategies
- Obtain mandates to proceed

- Identify data gaps
- Assess importance of data gap
- Assess cost of bridging data gap
IOT is Ramping Up: Cities Are Generating More Data

- **Water Systems**
  - Water Extraction, Processing, and Transport
  - Water and Gas metering
- **Electricity**
  - Renewable Power Generation
  - Conventional Power Generation
  - Smart Grid
  - Smart Metering
- **Mobility and Public Transportation**
  - Ground (rail & car)
  - Marine
  - Air
- **Transportation Infrastructure**
  - Traffic Management
  - Toll Collection
  - Parking Systems
  - Charging and Refueling
- **Buildings**
  - Commercial
  - Industrial
  - Institutional
  - Residential
- **Public Venues**
  - Borders and Ports of Entry
  - Transportation Venues
  - Stadiums

16.5 ZETTABYTES
Smart Cities Data
forecast in 2020
Data/Tech Hot Topics...

**Open Data Platform**
- Traffic Management
- Energy Generation
- Environment Monitoring

**Top Blockchain Applications**
- Energy Distribution
- Distribution & Supply Chain
- Healthcare & Patient Records

**Top 5G Network Applications**
- Smart Grid Management
- Fixed Wireless Access
- Automated Transportation System

**Top Edge Computing Applications**
- Transportation Management & AVs
- Smart Grid Optimization & Demand Side Response
- Security & Surveillance

**Top Sensor Data and Fusion Applications**
- Video Surveillance
- Smart Parking
- Waste Management

**Top Artificial Intelligence & Machine Learning Applications**
- Video Surveillance
- Traffic Optimization
- Resource Optimization

**Top Smart City Security Applications**
- Emergency Response Services
- Video Surveillance Systems
- Traffic Management Systems

**Top Applications Impacted by Privacy Concerns**
- Video Surveillance
- Energy Consumption
- Security & Access Control
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- Piero Pelizzaro - Chief Resilience Officer, Milan
- Gayatri Singh - Senior Urban Development Specialist, World Bank, Jakarta
- Chris van Diemen - Co-Founder & Chief Data Officer, Green City Watch, Amsterdam
MILAN CIBiX WORKSHOP

CIBiX Series on Delivering Resilience
Resilient Cities Congress 26-28 June 2019 Bonn, Germany

Delivering Resilience in Milan

Identified Challenges and Opportunities

Workshop Details
26 June 2019 - 28 June 2019
Resilient Cities Congress - Bonn, Germany

credit: ICLEI 2019
Facilitators
- Andrew Simmons - Director of Research, Resilience Brokers, London
- Simon Hodson - Executive Director of CODATA, International Science Council, Paris

Panelists
- Stephen Passmore - Chief Executive Officer, Resilience Brokers, London
- Caroline Field - Committee Chair, British Standard for City Resilience; and Associate Director, Arup, London
- Piero Pelizzaro - Chief Resilience Officer, Milan
- Gayatri Singh - Senior Urban Development Specialist, World Bank, Jakarta (video intervention)
- Chris van Diemen - Co-Founder & Chief Data Officer, Green City Watch, Amsterdam
link to World Bank’s City Planning Lab (CPL) initiative:
● https://c4dcommunities.worldbank.org/content/sites/collaboration-for-development/en/groups/city-planning-labs.html

link to CPL’s Municipal Spatial Data Infrastructure (MSDI):
Facilitators

- **Andrew Simmons** - Director of Research, Resilience Brokers, London  
- **Simon Hodson** - Executive Director of CODATA, International Science Council, Paris  

Panelists

- **Stephen Passmore** - Chief Executive Officer, Resilience Brokers, London  
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ICLEI: Session B4
Joining forces!

Chris van Diemen
26 June 2019
“you don't know about real loss because it only occurs when you love something more than you love yourself”

Robin Williams, Good Will Hunting (1997)
Overview

Intro
  Who are we?
  What drives us?

Work
  How do we do it?
  Example: Indonesia

Wrap up.

Time: ~7 minutes
The very best ideas are born out of frustration.

- Richard Branson
Every week *3 million people* move to the city.

(UN, 2015)
Amsterdam: 11% decline in 13 years
Mission

To revolutionize the way we value nature, bring transparency to local government, and regenerate our cities.
The team!

Nadine Galle
URBAN ECOLOGICAL ENGINEERING

Jim Groot
REMOTE SENSING & GEOMATICS

Anjelika Romeo-Hall
SUSTAINABLE DEVELOPMENT GOALS

Florence van der Hoven
MACHINE LEARNING AND SENSORS

Chris van Diemen
DATA
How?
From Local Knowledge to a Global Standard
High resolution Satellite imagery + Green City Watch Indicators = The right solution in the right location
Use Open Source Technology
Invest in Client Engagement
Example: Indonesia
JAKARTA, INDONESIA

Bare ground detection for irrigation planning
Bare ground detection for irrigation planning
Build  Boost  Broker

Source:
September 18, 2018
Technology Solution

Data Input
±30 cm resolution 8-band WorldView-3 satellite imagery with global coverage, OpenStreetMap data, Drone imagery

Algorithms & Compute
Tech: AI using Python & Docker on GBDX & AWS cloud platforms, open source, open access

Visualizations
Tech: Open-source visualizations with R shiny & Javascript nodejs/kepler.gl

Jakarta Monas park, Jakarta

MAXAR

DT4D

WORLD BANK
Implementation Activities

Kickoff
- Indicator Brainstorm
- Study
- Indicator Prioritization

Development & Operation (feedback loop)
- Modelling
- Evaluation
- Data understanding
- User feedback

Dissemination
- Final product
- Launch

Aug 2019
Jan 2020
May 2020

Rapid Iterative Prototyping
2-4 week cycles (i.e. CRISP-DM)
Spreading the word
NOW: Local Governments for Sustainability!

Let's work together :D

Chris van Diemen. . . . . . . chris@greencitywatch.com
“Feel that right there? You are in the middle of the world man”

Mahershala Ali, Moonlight (2016)
Facilitators

- **Andrew Simmons** - Director of Research, Resilience Brokers, London  [pp. 3-22]
- **Simon Hodson** - Executive Director of CODATA, International Science Council, Paris

Panelists

- **Stephen Passmore** - Chief Executive Officer, Resilience Brokers, London  [pp. 24-50]
- **Caroline Field** - Committee Chair, British Standard for City Resilience; and Associate Director, Arup, London  [pp.42-52]
- **Piero Pelizzaro** - Chief Resilience Officer, Milan  [pp.53]
- **Gayatri Singh** - Senior Urban Development Specialist, World Bank, Jakarta  *(video intervention)*  [pp.42-55]
- **Chris van Diemen** - Co-Founder & Chief Data Officer, Green City Watch, Amsterdam  [pp.57-83]