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# Global Future Cities Programme

Smart GIS Training: Session 2  
Data Derivation for Urban & Transport Planning

09 November 2021 (15:30)

# Introductions



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# Agenda

A teal circular graphic on the left side of the slide, containing the word 'Agenda' in white. Four white curved lines of varying radii are drawn within the circle. On the right edge of the circle, four dark teal circles are arranged vertically, each containing a white number from 1 to 4. To the right of each number is a corresponding agenda item: 'Overview', 'Derivation of Data', 'Application', and 'Practical'.

1

Overview

2

Derivation of Data

3

Application

4

Practical

# Overview

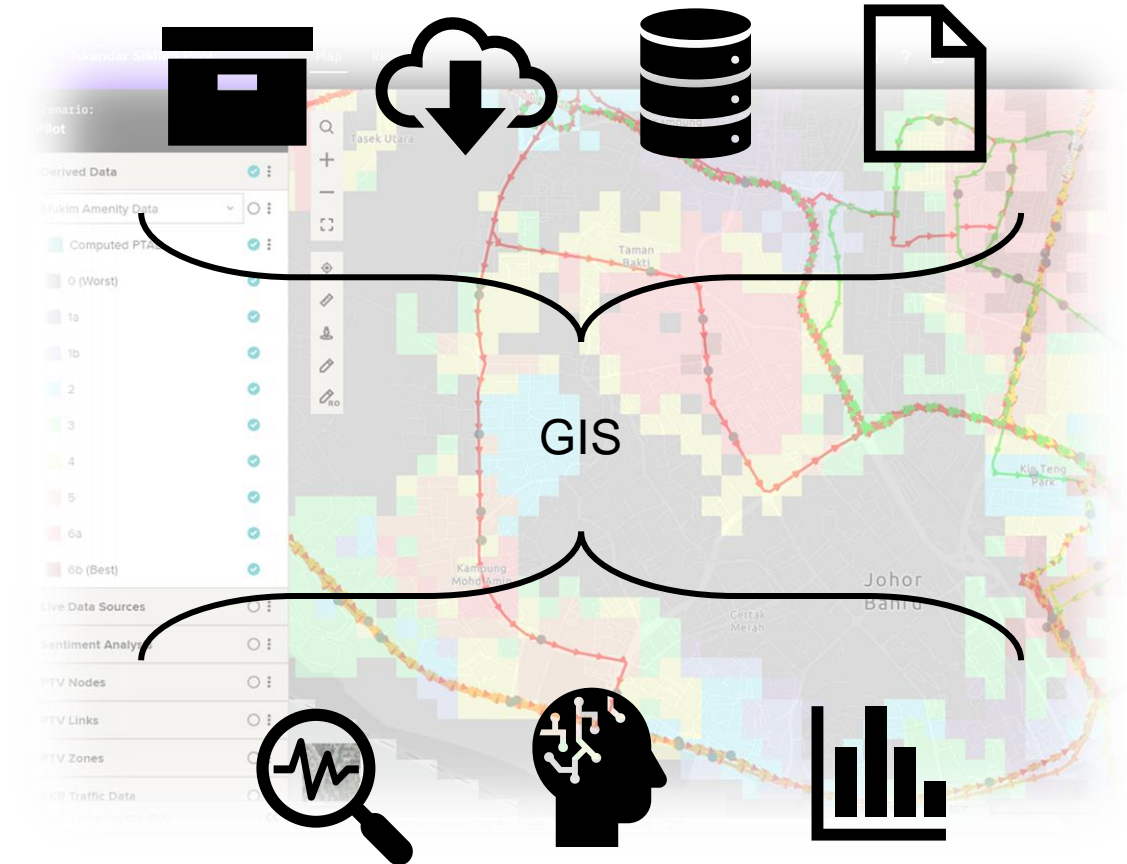
# Overview

Over the next 3 sessions we will look at the work performed to produce the Smart GIS as part of the pilot project on the Iskandar intervention:

- Collect Data
- Process it into GIS formats
- Apply analytics
- Produce visualisations
- Generate additional functionality

We will cover:

- GIS Fundamentals
- Derivation of Data
- Advanced Analytics



# Overview

## Recap from Session 1

### Theory

- GIS Fundamentals (best practice, naming conventions, data formats)
- Online storage and interaction (direct links, APIs)

### Application (via SIMMS)

- ArcGIS servers (Moata Platform)
- Data collection

### Practical

- Basic GIS operations
- Publishing to ArcGIS Online for data collection

# Derivation of Data

# Derivation of Data

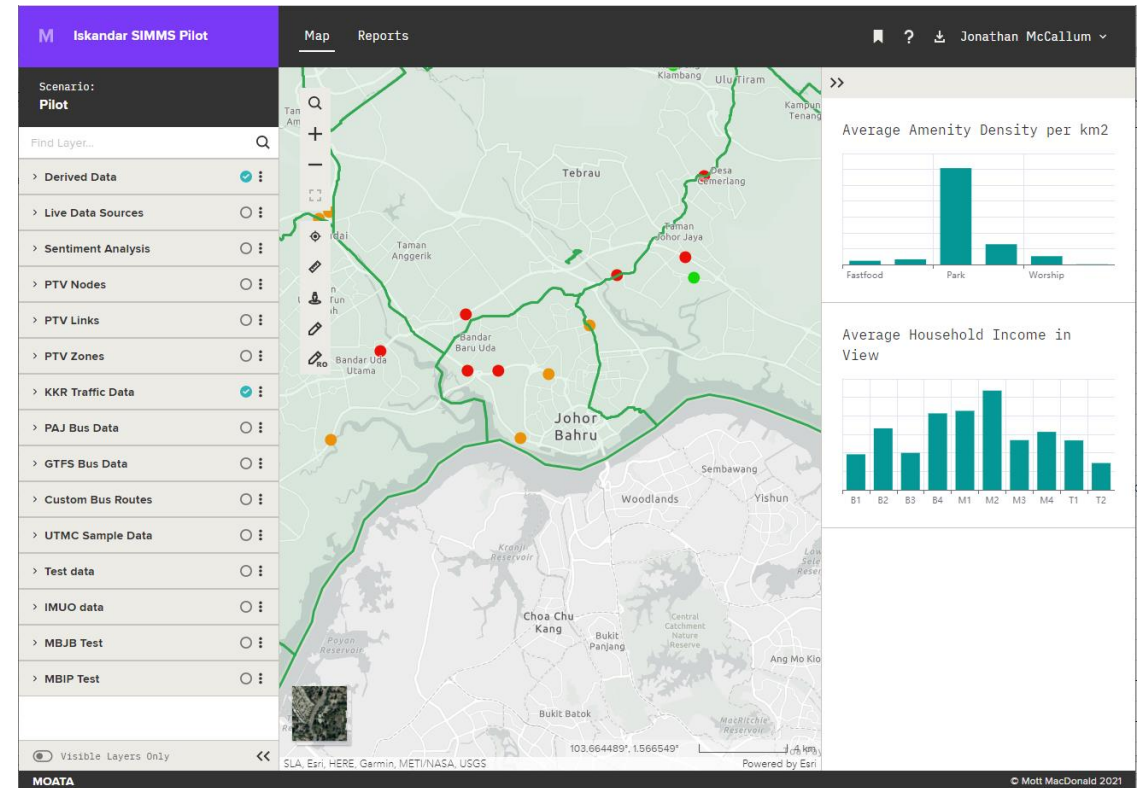
## Raw data

## Data preparation for SIMMS

### Multiple data sources collected:

- IMUO data (amenities, land-use, population)
- PTV (transport models)
- KKR Traffic (accidents, traffic volumes)
- Air quality/Weather forecast
- Bus route data (PAJ)
- UTMC Sample (ITS data)
- Socio-economic data
- User feedback/collections

Data is checked and cleaned then loaded to GIS portal as per details from 1st workshop





# Derivation of Data

## SIMMS Pilot

### Urban and Transport Planning

The intention of the SIMMS pilot was to focus on urban and transport planning

- What metrics would urban and transport planners find useful when making decisions in their work?
- How are cities being planned in a sustainable way and fitting with the UN SDGs?
- What makes a city more “liveable”?

The raw data will provide insights into some of these aspects

However, we need to derive new metrics to getting greater insights into the

Some key aspects to consider in urban and transport planning are:

**Connectivity** – how easy is it to get from one place to another (concepts of the 30 minute city)

**Entropy** – how evenly dispersed are assets (are all the shops clustered in one area leaving other areas with none?)

**Mobility** – transport needs to be available and affordable; just being able to get from A to B might fulfil connectivity requirements but fall short when mobility is considered (this is why “walkability” is critical for a sustainable city)

# Derivation of Data

## Urban Planning

International papers reviewed and different measures explored

Over 200 metrics across the different papers refined down to about 30 to derive based on available data

The derivation involves spatial queries and in particular considering the density of assets in relation to walking distances

Some overlap with the transport metrics

sustainability

MDPI

Article

### Developing Goals and Indicators for the Design of Sustainable and Integrated Transport Infrastructure and Urban Spaces

Liu Yang <sup>1,2,\*</sup>, Koen H. van Dam <sup>3</sup> and Lufeng Zhang <sup>2</sup>

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Received: 14 October 2020; Accepted: 16 November 2020; Published: 19 November 2020

**Abstract:** This paper aims to provide a framework for policy-makers and transport design professionals to evaluate alternative urban plans and infrastructure designs. A set of locally relevant indicators to help assess scenarios considering sustainability and overall system performance improvement in line with specific project goals is proposed, leading to the generation of 64 Key Performance Indicators (KPIs). Qualitative and quantitative, and an indicator set of 227 items. To allow stakeholders to select their own set of indicators, the approaches and tools of measuring these indicators are presented to assist decision-makers in evaluating urban plans and designs.

**Keywords:** transport system; urban spaces; sustainable design; evaluation; and indicators

#### 1. Introduction

The set of United Nations (UN) Sustainable Development Goals (SDG), particularly SDG 11 to “make cities inclusive, safe, resilient and sustainable”, provide structure for a more sustainable future for all, anywhere on the planet [1]. To link these local decision-making processes, clear, project-oriented goals and operational guidelines or frameworks allow decision-makers to develop their own goals in specific contexts and under certain project requirements. In transport and urban planning, evaluation and assessment are also paramount steps in the decision-making process. For making a rational decision on an urban plan, it is necessary to accurately and systematically evaluate the urban system under study, to assess the advantages and disadvantages of different options and to estimate system changes over time as a result of the implementation of a plan.

In the urban transport sector, transportation planning has received significant attention during the past decades [3]. For instance, rail-based transport systems have become increasingly inaccessible, and unfriendly areas, which have a negative impact on the quality of life, and the natural environment. Studies have shown that infrastructure and urban spaces, which prioritize pedestrian and cyclist mobility enhancement, have attracted widespread attention.

**Metrics for Planning Healthy Communities**  
May 2017  
Anna Ricklin, AICP | Sagar Shah

**Urban performance measures**

Sustainability 2020, 12, 9677; doi:10.3390/su12229677

Peter Drucker laid the foundations of modern management insisting that you can't improve, what you can't measure. In urban planning, this line of thought has transformed the way we set goals, track progress and analyze the effects of implemented projects and policies. Urban performance measures help communities make informed decisions and measure results against goals.

# Derivation of Data

## Transport Planning

As with urban planning, international papers reviewed and different measures explored

Nearly 200 metrics across the different papers refined down to about 30 to derive based on available data

The derivation involves spatial queries and in particular considering the density of assets in relation to walking distances

Some overlap with urban metrics, but obviously with more focus on the transport

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**Well Measured**  
Developing Indicators for Sustainable and Livable Transport Planning  
1 September 2021

Todd Litman  
Victoria Transport Policy Institute

A world view taken in 1972 as Apollo 17 left Earth orbit for the Moon. (Courtesy of NASA).

**Abstract**  
This report provides guidance on the use of indicators for sustainable and livable transportation plan development and applied in transport sustainable transport provides recomm particular situation

A shorter versio  
Sustainable Tran

You are welcome and  
author is given attribut

McKinsey&Company

**Elements of success:**  
Urban transportation systems of 24 global cities

June 2018

**GUIDE TO  
SUSTAINABLE  
TRANSPORTATION  
PERFORMANCE  
MEASURES**

EPA United States Environmental Protection Agency

EPA 231-K-10-004  
August 2011  
www.epa.gov/smartgrowth

# Derivation of Data

## Data Visualisation and Dashboard

Develop a series of dashboard “wireframes” to collect similar data together for the planner to see everything in one place and facilitate data exploration

These were grouped into:

- Urban Planning
- Transport Planning
- Economics
- Environmental
- Quality of Life






Other dashboards were added later for other more advanced analytics (such as the bus route assessment tool)



# Application




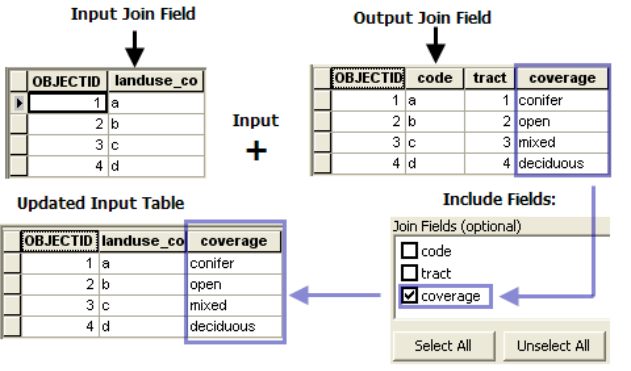
# Application

## Data Preparation - Spatial queries

Input data	Process	Theory	Output Geometry	Output Table																															
 Point  Line  Polygon	Buffer	This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance.	Non-Dissolve  Dissolved 	Same as input																															
	Spatial Join	Joins attributes from one feature to another based on the spatial relationship. The target features and the joined attributes from the join features are written to the output feature class.	Same as target features	Field from target + join features <table border="1" data-bbox="1872 999 2458 1228"> <thead> <tr> <th colspan="4">Tracts_SpatialJoin</th> </tr> <tr> <th></th> <th>OBJECTID *</th> <th>Shape *</th> <th>Join_Count</th> </tr> </thead> <tbody> <tr> <td>*</td> <td>1</td> <td>Polygon</td> <td>1</td> </tr> <tr> <td></td> <td>2</td> <td>Polygon</td> <td>1</td> </tr> <tr> <td></td> <td>3</td> <td>Polygon</td> <td>1</td> </tr> <tr> <td></td> <td>4</td> <td>Polygon</td> <td>1</td> </tr> <tr> <td></td> <td>5</td> <td>Polygon</td> <td>1</td> </tr> <tr> <td></td> <td>6</td> <td>Polygon</td> <td>0</td> </tr> </tbody> </table>	Tracts_SpatialJoin					OBJECTID *	Shape *	Join_Count	*	1	Polygon	1		2	Polygon	1		3	Polygon	1		4	Polygon	1		5	Polygon	1		6	Polygon
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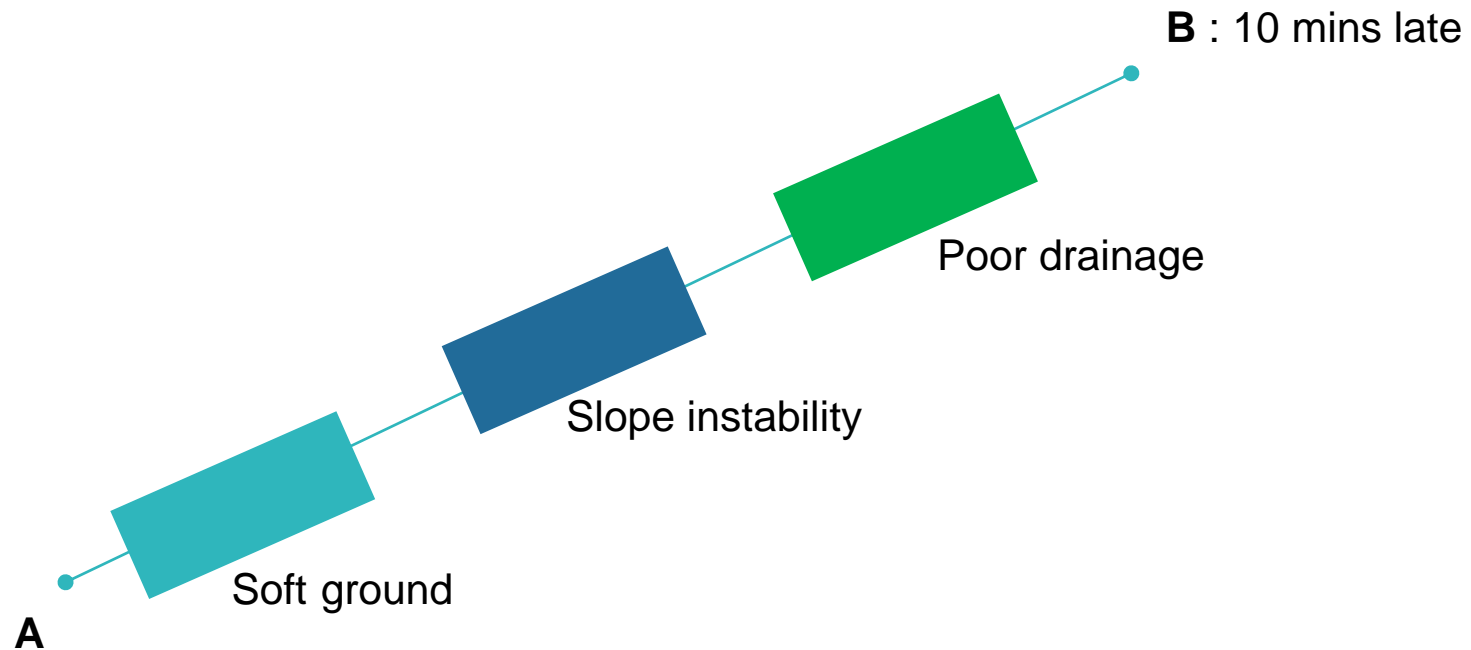
# Application

## Derivation – aggregation and calculations

Input data	Process	Theory	Output Geometry	Output Table						
 Buffer Point   Buffer Line   Buffer Polygon	<p>Summarize Fields - Per Mukim</p>	<p>Calculates summary statistics for field(s) in a table. Available statistics types are as follows:</p> <ul style="list-style-type: none"> <li>• SUM</li> <li>• MEAN</li> <li>• MIN</li> <li>• MAX</li> <li>• RANGE</li> <li>• STD</li> <li>• COUNT</li> <li>• FIRST, LAST</li> </ul>	Table	<table border="1"> <thead> <tr> <th>OBJECTID *</th> <th>FREQUENCY</th> <th>SUM_Elevation</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>12919</td> <td>193.950597</td> </tr> </tbody> </table>	OBJECTID *	FREQUENCY	SUM_Elevation	1	12919	193.950597
OBJECTID *	FREQUENCY	SUM_Elevation								
1	12919	193.950597								
	<p>Append data to Master data set - Join Field</p>	<p>Joins the contents of a table to another table based on a common attribute field. The input table is updated to contain the fields from the join table. The records in the Input Table are matched to the records in the Join Table based on the values of Input Join Field and the Output Join Field</p>	Mukim Polygon							

# A quick diversion on granularity

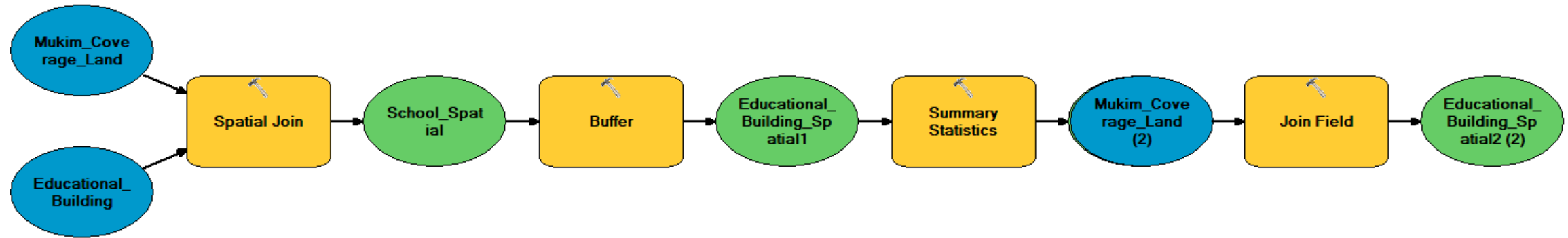
## Network Rail Example





# Application

## Model Builder



Model Builder is a visual programming language for building geoprocessing workflows. Geoprocessing models automate and document spatial analysis and data management processes.

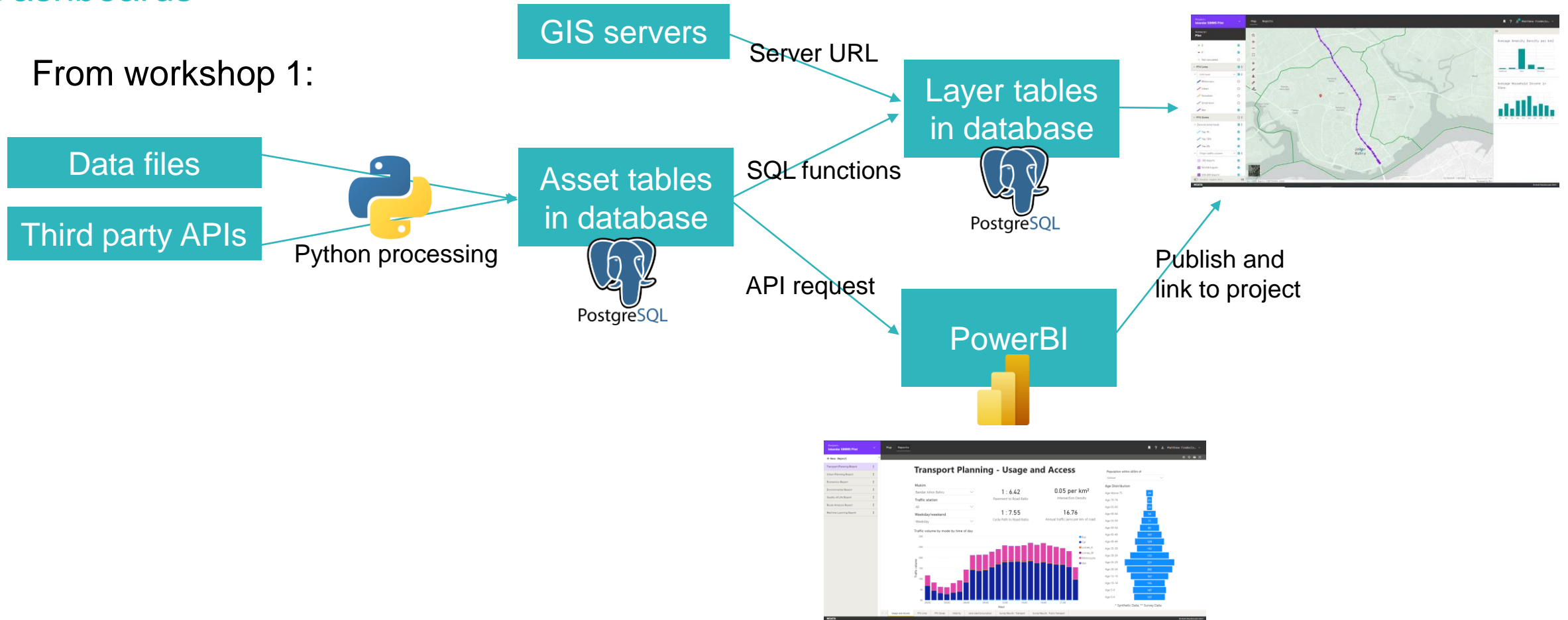
The model runs the following tools in sequence:

1. Spatial Join
2. Buffer
3. Summary Statistics
4. Join Field

# Application

## Dashboards

- From workshop 1:



- Updating the asset info automatically updates both map and PowerBI reports

# Application

## Display/Interface

Using the Moata interface allows us to take advantage of its built-in features:

- PowerBI dashboard integration
- Geospatial tools e.g. table tools, split view tool, Google Maps street view.
- Time series data visualization
- Dynamic charts

# Interface

## Geospatial tools

The screenshot displays a geospatial web application interface. At the top, the project name is "Iskandar SIMMS Pilot" and the scenario is "Pilot". The map shows a geographical area with various locations labeled, including Pulai, Taman Teratal, Universiti Teknologi, Skudai, and Tebrau. A yellow circle highlights a specific location on the map.

The left sidebar contains a layer list with the following categories and items:

- Derived Data
  - Mukim Amenity Data
  - Computed PTAL
    - 0 (Worst)
    - 1a
- IMUO data
  - Built Environment
    - Built Up
    - Commercial
    - Industrial
    - Educational
      - Chinese School
      - Primary School
- Sentiment Analysis
  - Total Sentiment

A tooltip is visible over the "Show Attribute Table" button, which also includes a "Zoom to Layer Extent" button.

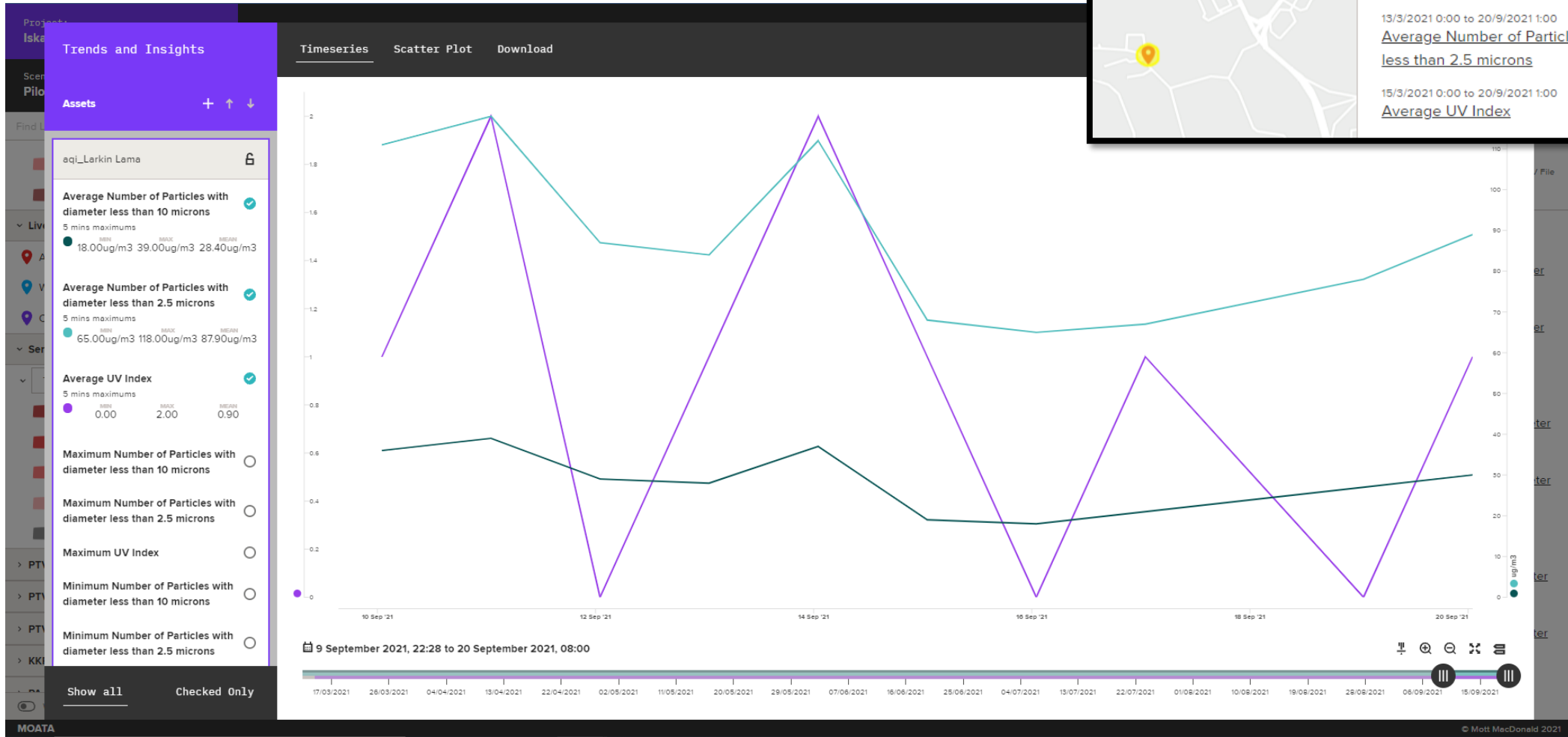
The attribute table below the map displays the following data:

Name	Feature Code	Educational Level
University of Technology Malaysia	BD0010	University
Ibrahim Sultan Polytechnic	BD0010	University
METU Johor Bahru Polytechnic	BD0010	University
Multimedia University - MMU Johor	BD0010	University
Newcastle University Medicine Malaysia	BD0010	University
Wawasan Open University - the Johor Bahru	BD0010	University
Open University Malaysia Johor Learning Centre	BD0010	University
Raffles University Iskandar	BD0010	University
University of Reading Malaysia	BD0010	University
University of Southampton Malaysia Campus	BD0010	University
Sultan Ismail Secondary School	BE0010	Secondary School
Tasek Utara Secondary School	BE0010	Secondary School
Tun Syed Nasir Ismail Secondary School	BE0010	Secondary School

At the bottom of the interface, there is a "Filter to map extent" button and a "Rows: 300" indicator.

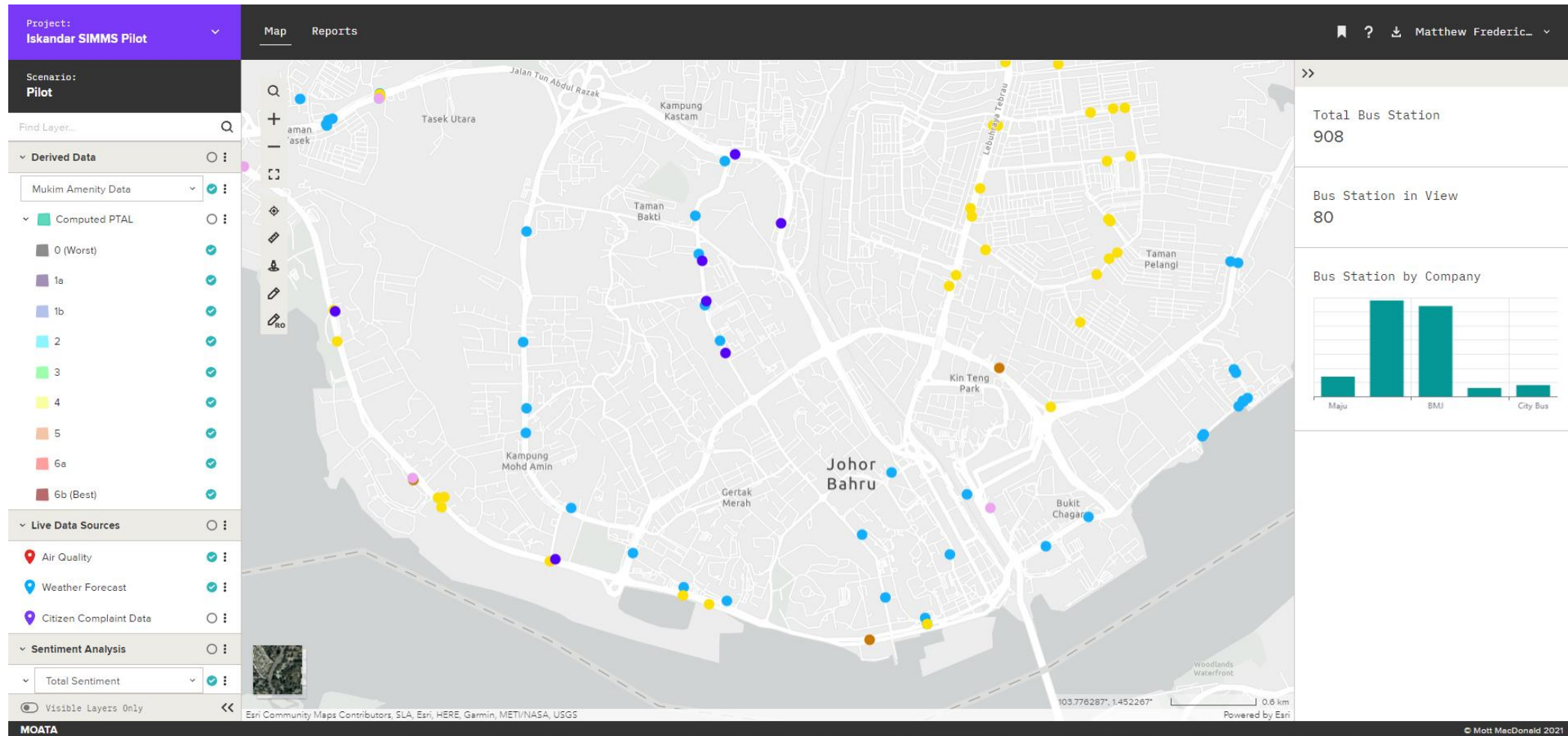
# Interface

## Time series data visualisation



# Interface

## Dynamic charts





# Practical

# Practical

## Population demographics within 100m of schools per Mukim

### Data

- Mukim with Population info polygon
- School point

### Workflow

- School Intersect with Mukim ( get Mukim name & area)
- Create Buffer 50m
- Calculation:  $\text{Buffer Area} / \text{Mukim Area} * \text{Population}$  (Age group, Population, Ethnicity)



# Summary

# Summary

## Theory

- Urban and transport planning metrics
- Concepts of connectivity, entropy and mobility

## Application (via SIMMS)

- How the metrics were derived and use of a master shapefile
- Granularity as a critical aspect of work
- Dashboards and geospatial tools

## Practical

- Performing spatial queries to derive new metrics



# Thank you