Mastering Mobility: Mapping paratransit services

Practical guide

28 Sept 2022

Transport for Cairo
Consulting agency

Mobilise Your City

Unit 1: Field Research Project Planning

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Some General Notes on this session

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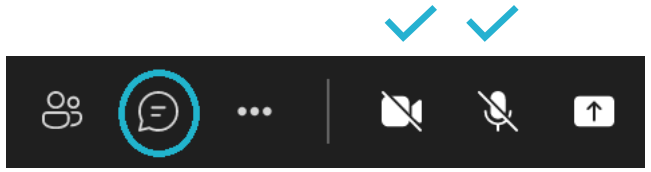

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Mastering Mobility Series

Workshop objectives

→ Understand the main elements and process of mapping paratransit services

→ Provide cost estimates for field research surveys

→Identify main barriers and potential solutions of paratransit services

Contents

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Speakers

Abdelrahman MELEGY

Mohamed HEGAZY

1.1

Data in Transportation

Technical explanation

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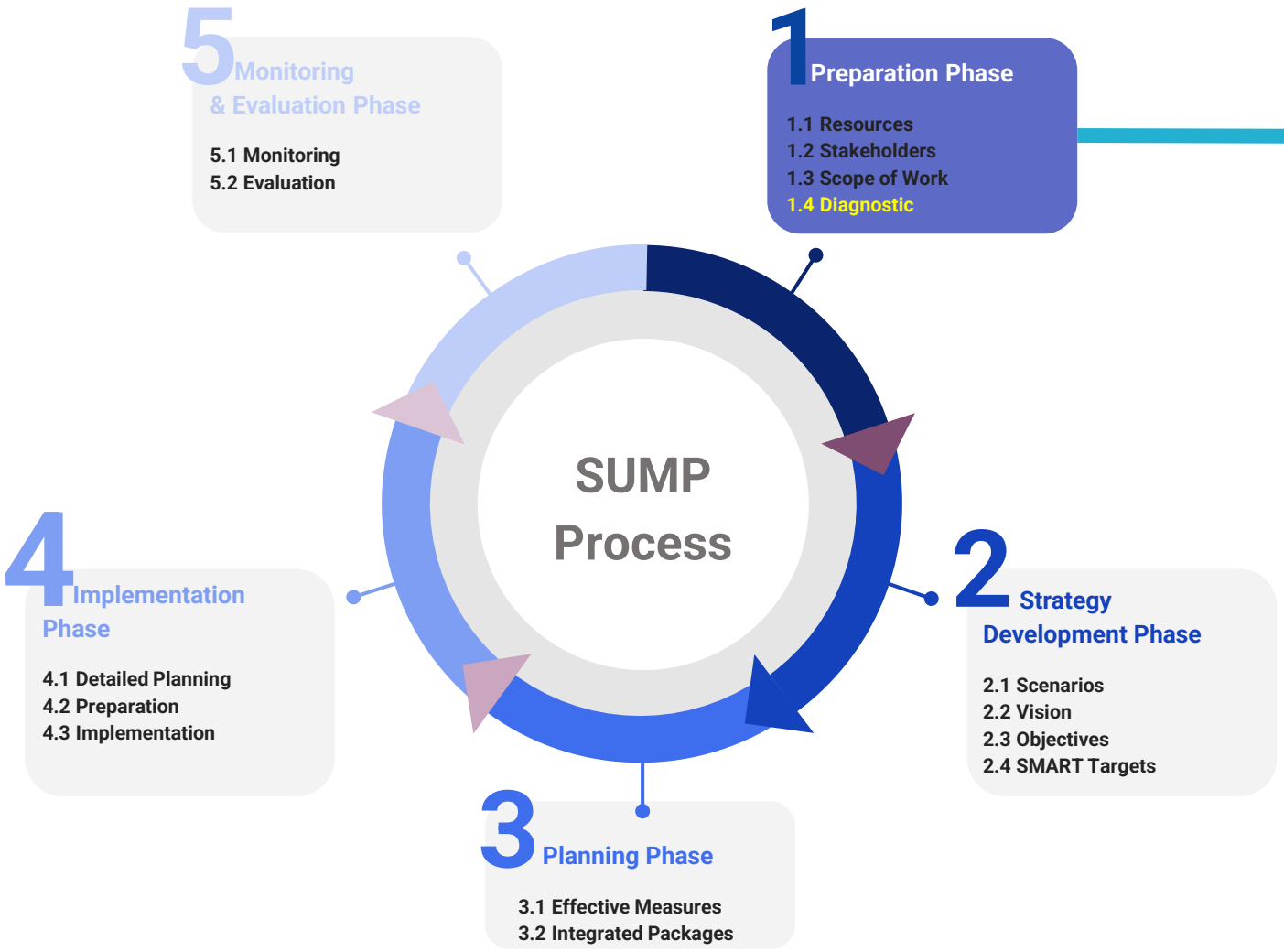
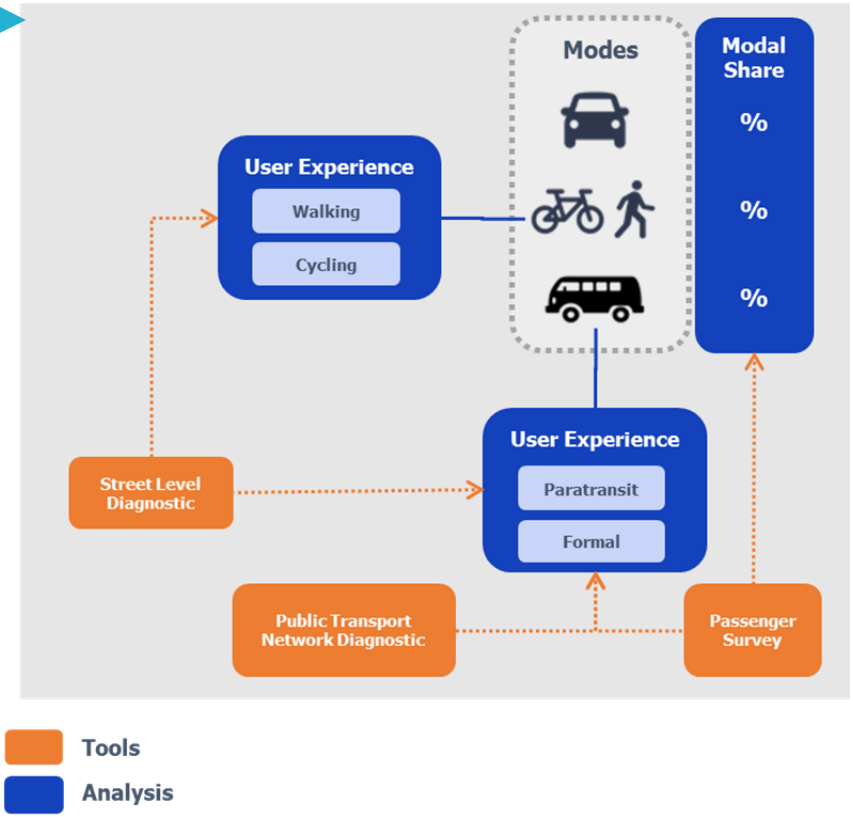
Data in Transportation

Data needs for a Sustainable Urban Moility Plan (SUMP)





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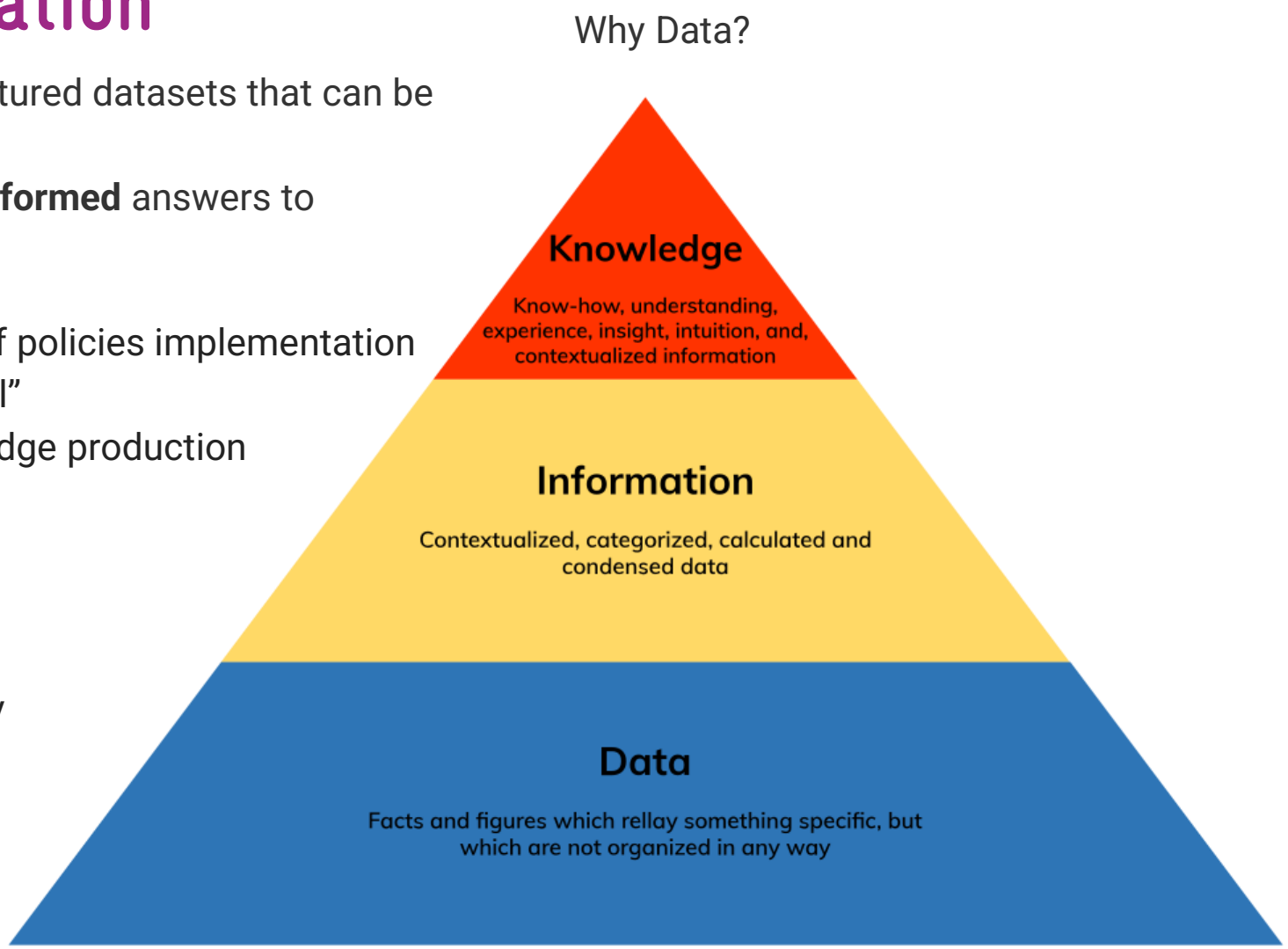
Data in Transportation

- → "Data" means quantifiable, relational, structured datasets that can be aggregated and analysed
- → Acquiring data is the first step to getting **informed** answers to **pressing** questions
  - Researchers
    - How to measure the effects of policies implementation
    - How to promote "Active Travel"
    - How to utilize data for knowledge production
  - Operators
    - How to optimize operations
  - Government
    - Where to invest
    - How to maximize accessibility
  - Citizens
    - How to get from A to B
    - When will I get there



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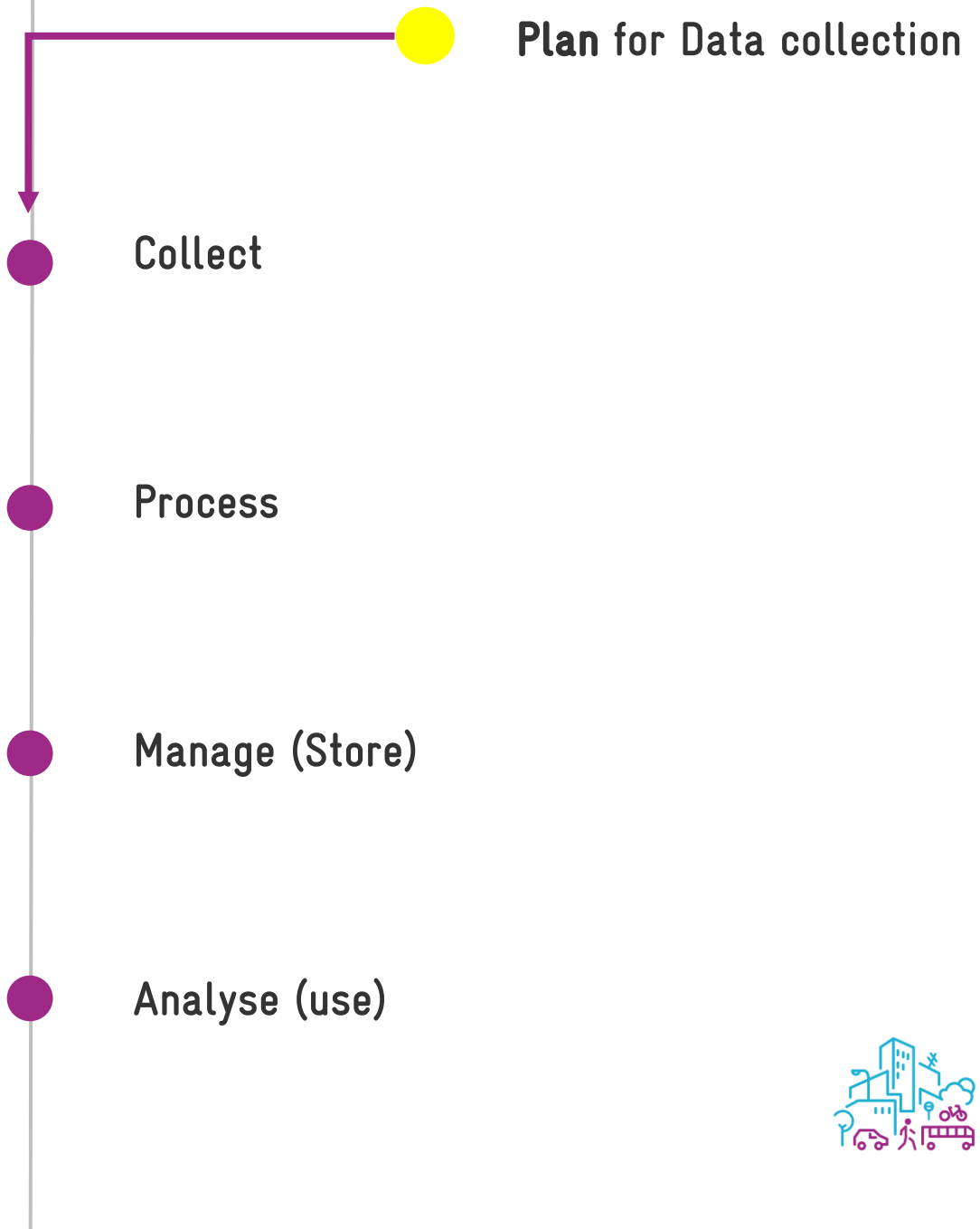
The Data Lifecycle

We should employ Software tools to enable every step



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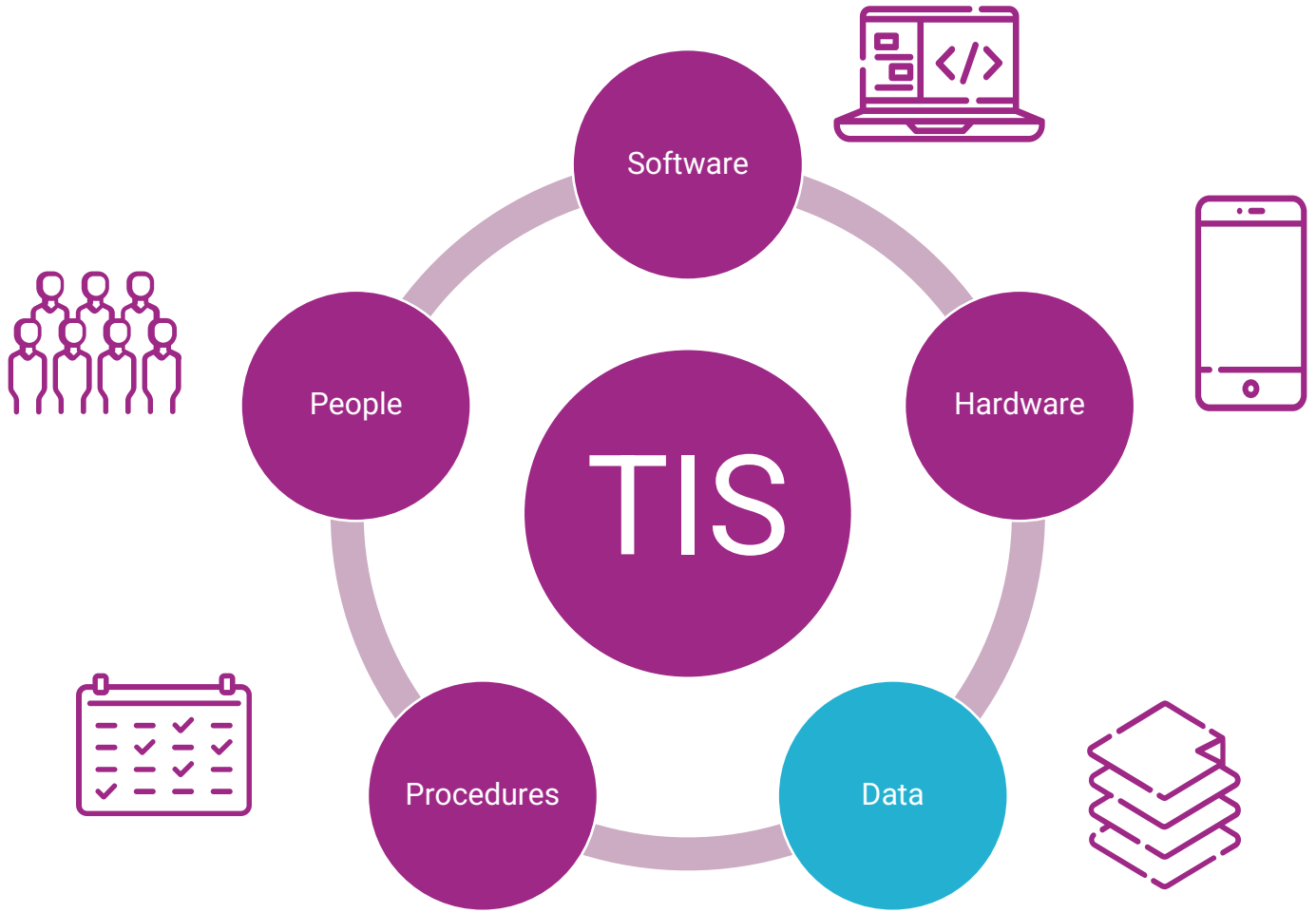
Data in Transportation

TIS: Transport Information System



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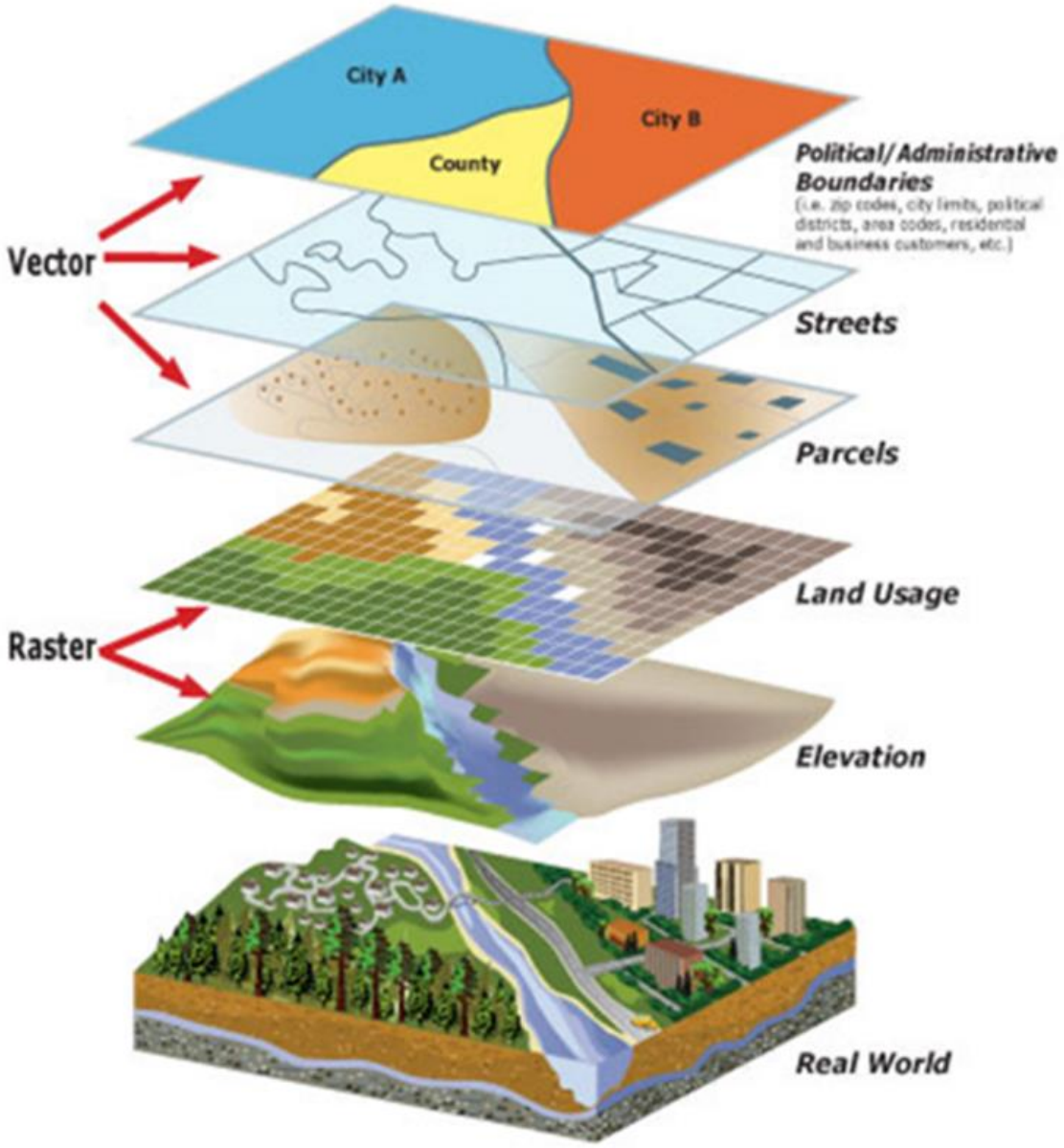
Data in Transportation

Data Types

→ Geographic (GIS) & Tabular data
- Data with location information
- E.g.: Where do passengers commute from and where do they go to everyday?
- E.g.: To which economic class do those passengers belong? Why are they commuting? (Work, school, leisure, etc.)

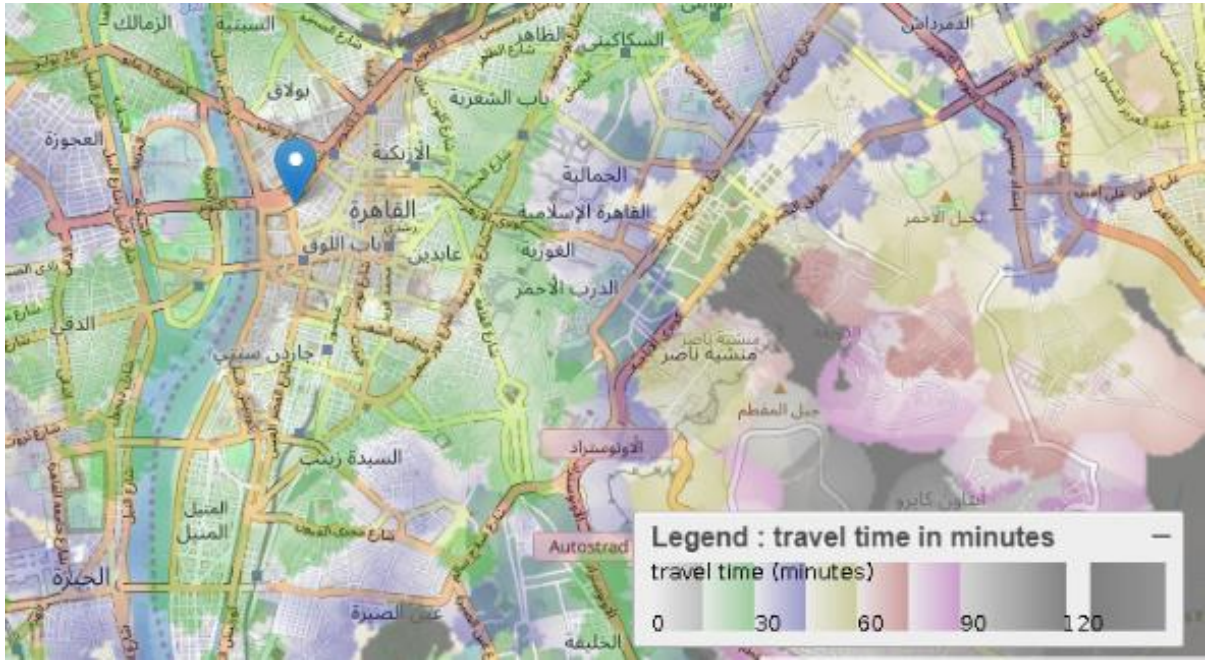
→ General Transit Feed Specification (GTFS)
- Location data on transport, coupled with temporal data (schedules, travel time, etc.)

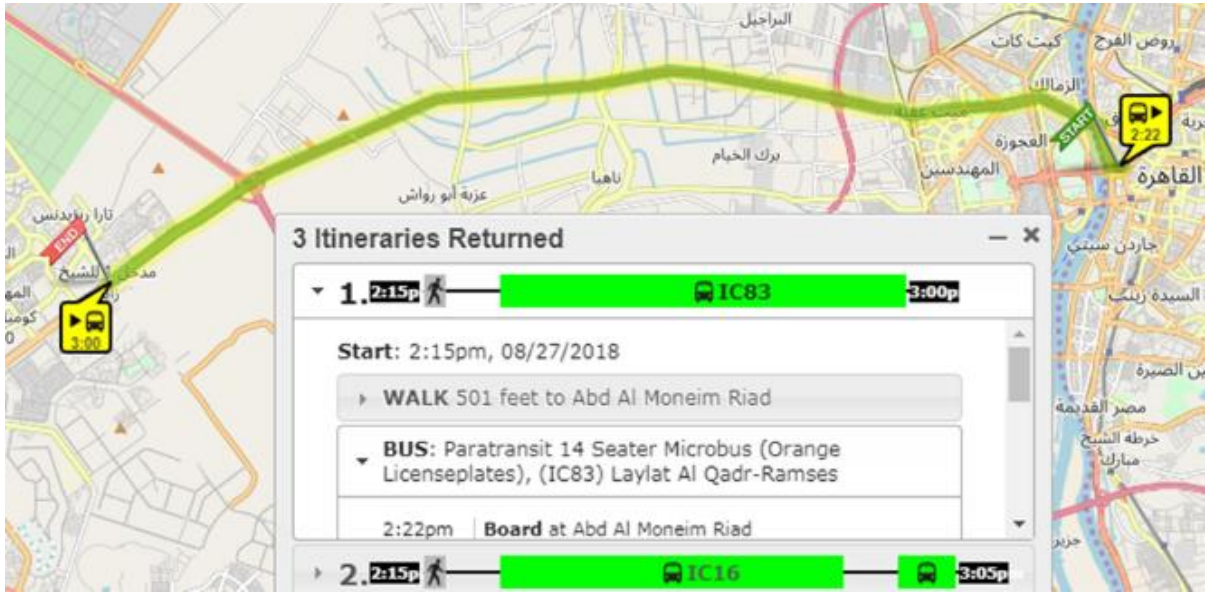


Data in Transportation

The GTFS Standard

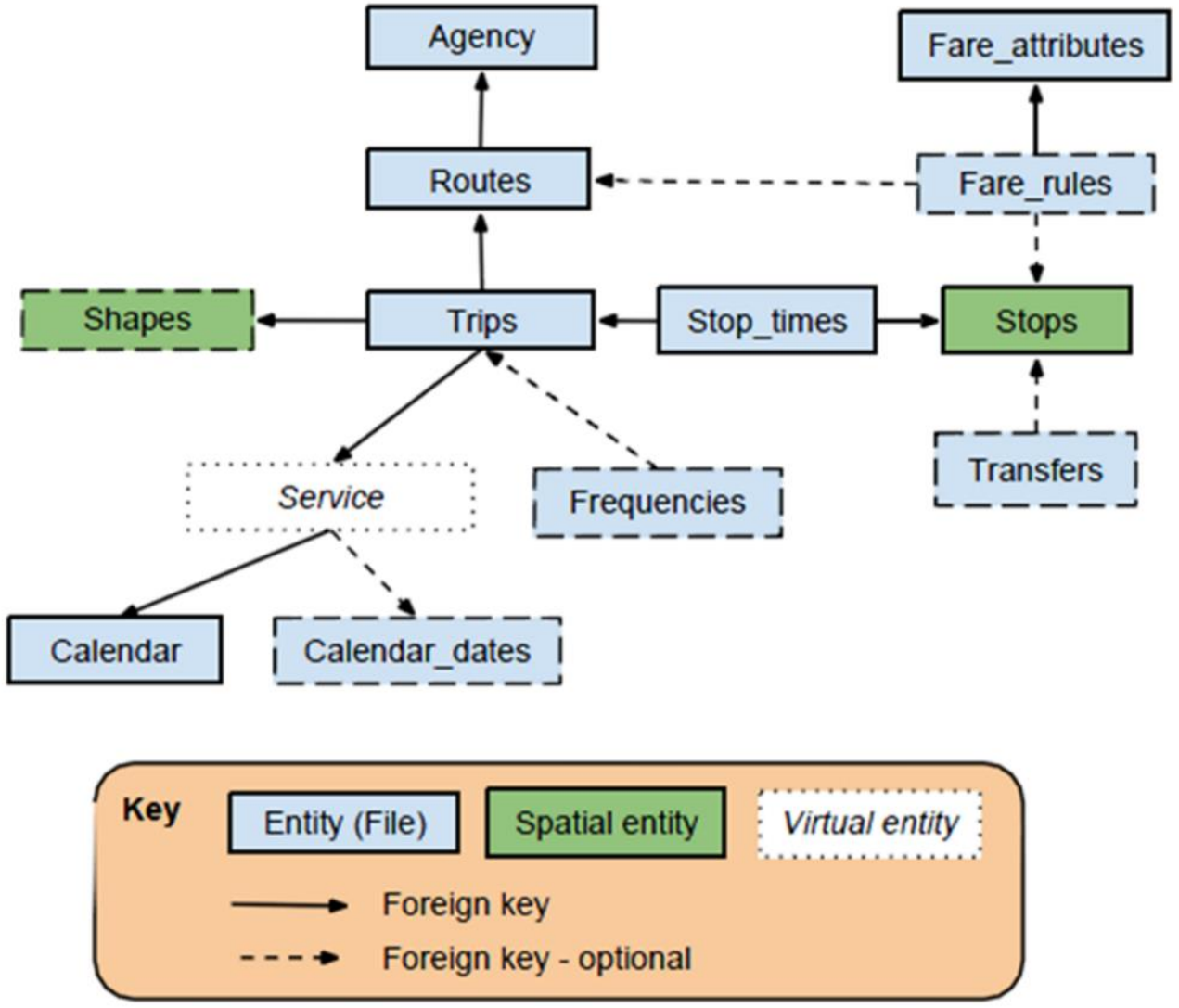
- → General Transit Feed Specification
- → History: TriMet -> Google
- → Stored as CSV Files
  - Each line of the file is a data record. Each record consists of one or more fields, separated by commas
- → Used for Trip planning & Analysis (e.g., Service Area)
  - Image to the top right show the areas you can reach from a point in downtown Cairo in different time intervals





Data in Transportation

GTFS Composition



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Data Points

what are the most common data points in transport?

→ Cells highlighted in blue are “inferred” data, rather than data collected directly.

Category	Data Points
Road and Traffic	Travel Speed
	Travel Time
	Traffic Volume
	Road Capacity
Public Transport	Route Itinerary
	Route Frequency
	Ridership
	Fare
	Boarding and Alighting
Demographic	Population (by age and gender)
	Income
	Number of households
Passengers	Mode Choice
	Behavioral Parameters (safety, affordability, accessibility, etc.)
Other	Job Opportunities
	Special Attractors (public offices, hospitals, schools, etc.)

1.2

The Paratransit Context

An overview on what we're aiming to map

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The Paratransit Context

Why it exists? (features)

- → Unmet demand
- → Cheaper or Pay as you go (distance, congestion, special circumstances)
- → Passenger-defined stops (less walking)

Modes of Operation

- → Fill and Go
- → Variable Fare
- → Express or Trunk
- → Demand driven

The Paratransit Context

Data Challenges

→ Defining a route
- Inconsistent origin and destination
- Deviation in itinerary

→ Defining a stop
- “Virtual” stops are created in areas with high boarding and alighting activity

→ Defining a terminal
- A formal terminal vs a street corner where vehicles gather
- Any point where a route consistently starts or ends

→ Very dynamic schedules

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1.3

Mapping Paratransit Services

A project Management Perspective

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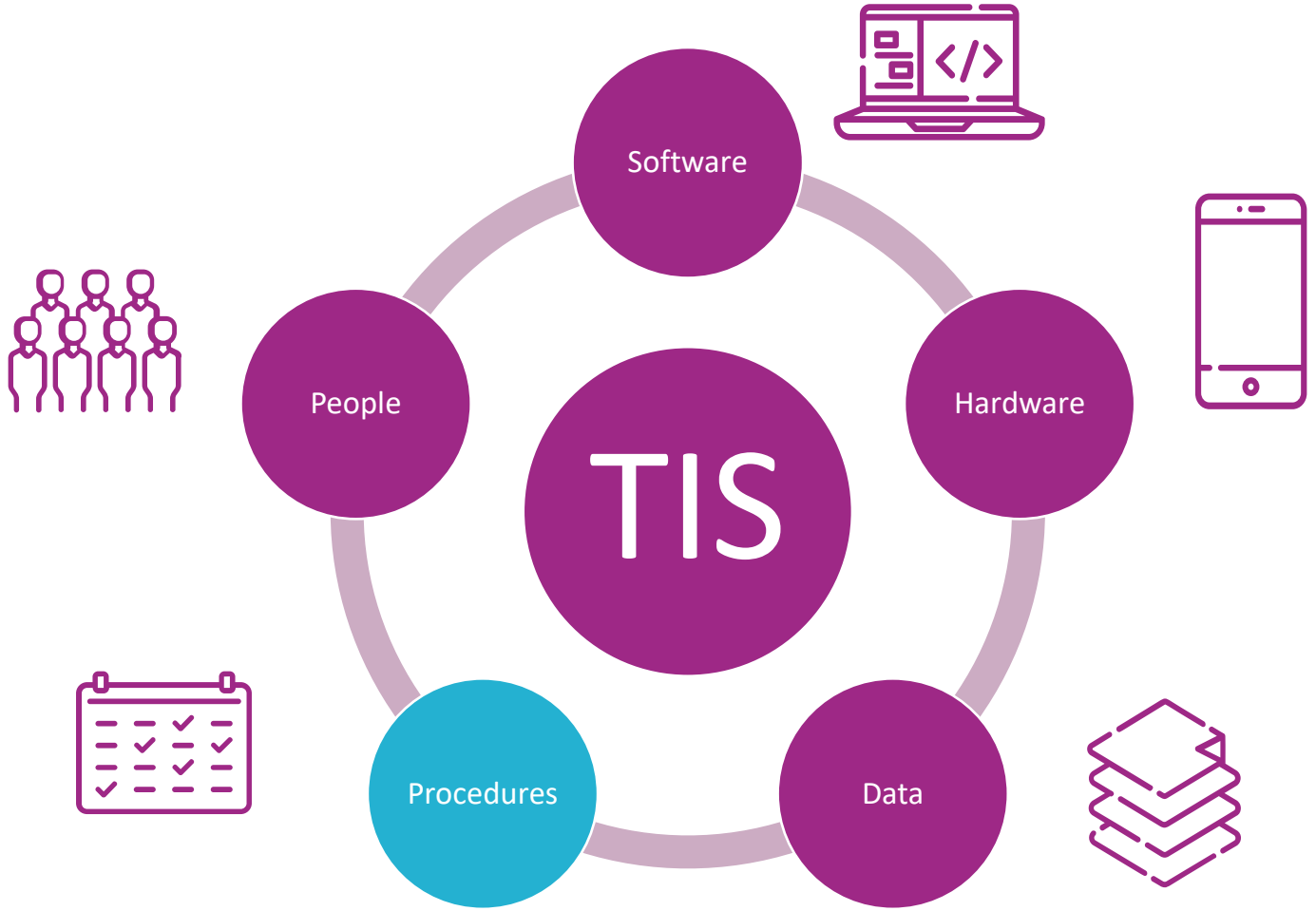
Data in Transportation

Transport Information System



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The “project” & Milestones

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Most Common Surveys

Route-focused / Passenger-focused

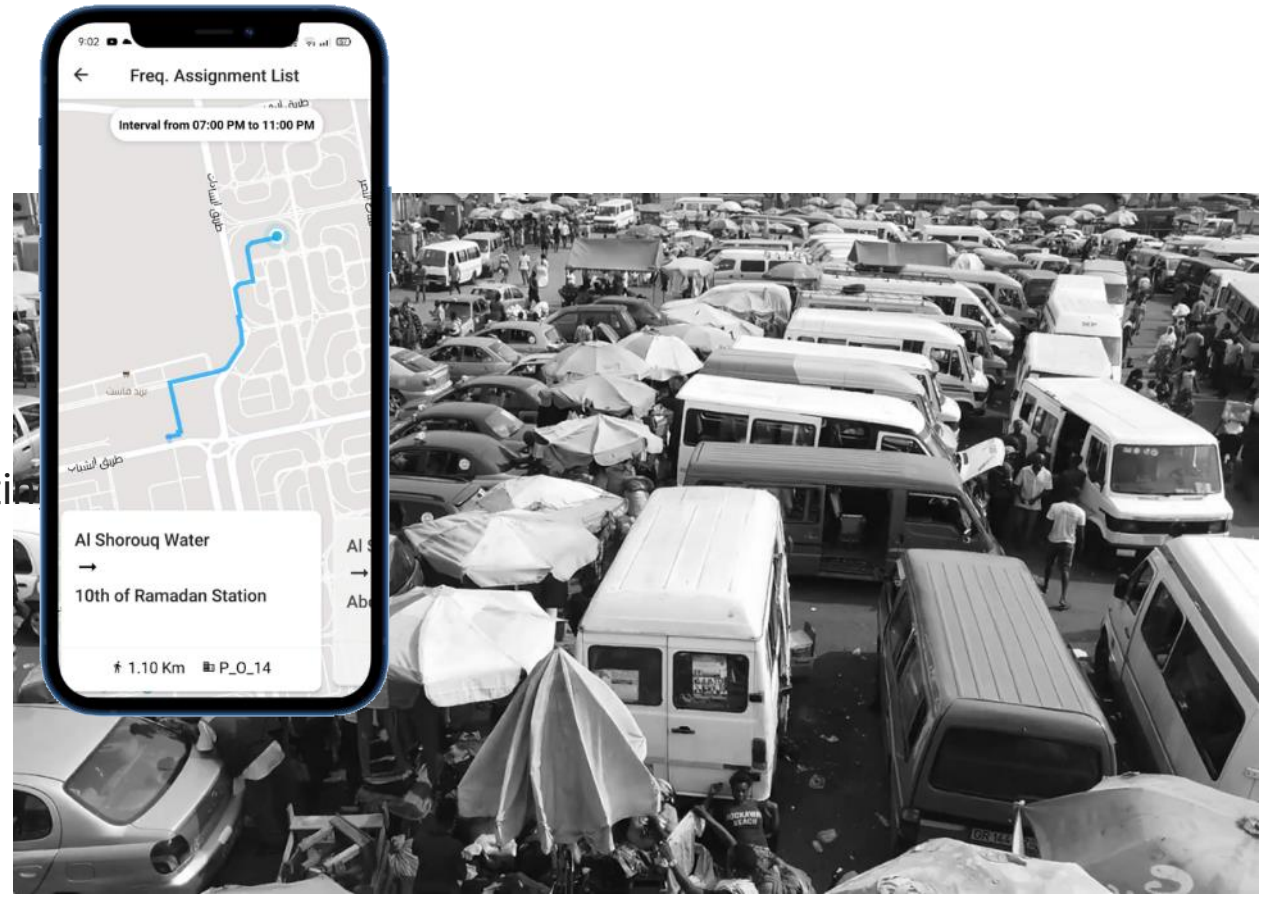
→ Identification

→ Onboard
- Route itinerary, length and fare
- Trip travel time and boarding and alighti… patterns
- Service Type (Express, Local)

→ Frequency
- Headway
- Occupancy level

→ Origin-Destination

→ Passenger Surveys
- Customizable



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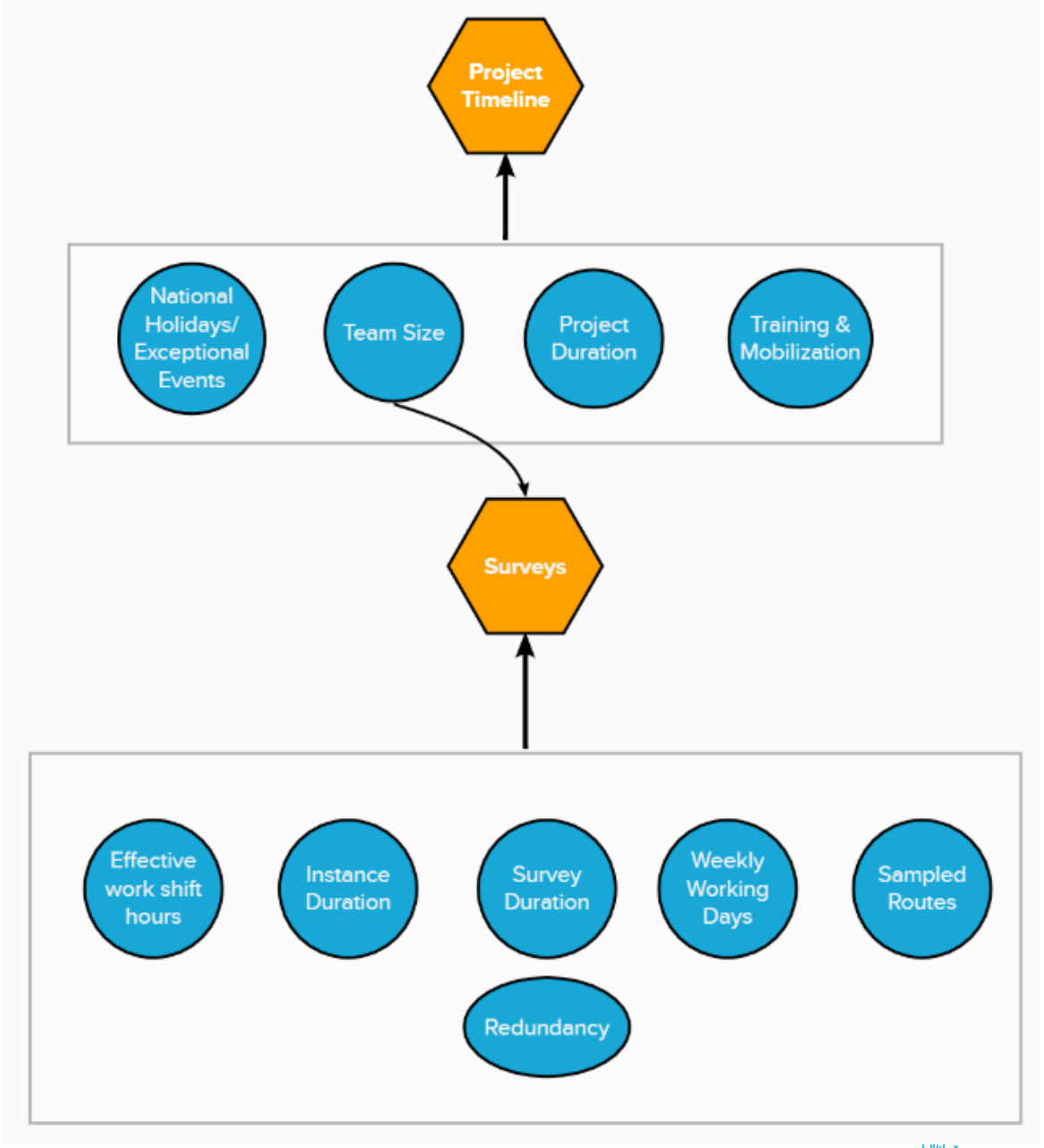
Parameters

Areas of Field Research Project Planning

→ Timeline

→ Surveys

Plan for each survey individually. But all surveys share most parameters



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Field Research

[1] Onboard Surveys

Instance Duration	1	hours per instance
Effective FR Hours	6	working hours per day
FR Performance	6	instances per Day
FR Working days	5	working days per week
FR Duration	2	weeks
Team Capacity	25	team members
Field Research Capacity	**250**	person-days
Estimated Routes	120	Unique Routes
Estimated Route Legs	240	Route Legs
Route Leg Redundancy	4	Instances per Route Leg
Total Number of Instances	960	
Training/Feedback Sessions	1	person-day / FR
Route Identification	2	person-day / FR
Required FR Capacity	**235**	person-days
Contingency	15	person-days

[3] Passenger Survey

Survey Duration	0.2
Targeted Sample	500
Effective FR Hours per Shift	5
Required FR Capacity	**20**

- Some parameters are input from the planner (user) and others are calculated based on input (highlighted in purple)
- The main target is to have a “Field Research Capacity” that is slightly more than the “Required FR Capacity” to allow for some contingency
- The Field research capacity is based on team size, the sample size, the duration of each working shift, and other parameters that are adjusted to come up with realistic estimates

Challenges & Risk Management

- → Field Researchers turn-over
  - Hire more than you need
  - Build a network of reliable contractors
- → Weather conditions
  - To be accounted for during initial planning (avoid rainy seasons or annual dust storms)
- → Extraordinary traffic incidents
- → Safety concerns (drivers, passengers, police)
  - Always have permits and copies for each Field Researcher
  - Notify stakeholders in the field whenever possible
  - Devise alternative ways of geo-locating field researchers via their phones (e.g. Google's "find my device")
- → Internet & Cellular connection
  - Which sim card to get for smartphones is an important decision
  - Consider offline solutions and manual data transfers (using cable from phones to a PC)
- → Geo-location
  - Hard to get location with roofs, underneath bridges and indoors

1.4

Cost Estimation

How much can an efficient mapping process cost?

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Cost Estimation

→ Budget Items

- Team members fees
- Hardware expenses
- Software expenses

→ Based on activities, we estimate time of team members for each activity

Item	Unit	Quantity	Unit Cost	Total Cost
GIS Project Manager	Working Days	40.0	$ 80.00	$ 3,200.00
Research Associate	Working Days	50.0	$ 70.00	$ 3,500.00
Equipment	Mobile Phones	27.0	$ 125.00	$ 3,375.00
Field Research Manager	Working Days	15.0	$ 50.00	$ 750.00
Field Research Team	Working Days	270.0	$ 26.00	$ 7,020.00
Field Research Expenses	Working Days	270.0	$ 9.00	$ 2,430.00
Net Total			$ 20,275.00	
VAT Taxes		0%	$ -	
Gross Total			**$ 20,275.00**	

Fees / Expenses Ratio	Fees	33.0%	Expenses	67.0%
	$ 6,700.00			$ 13,575.00
	Fees Percentage			**Expenses Percentage**
	33.0%			67.0%

Field Research

[1] Onboard Surveys

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1.5

Quiz

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Quiz – Plan a Field Research Project

→ What are the main data points you're looking to collect? (mention 4)

→ What TIS are the components of a "Transport Information System" ?

→ Which TIS component has to do with the field research planning exercise?

→ Please draw a simple diagram showing the main activities of a field research project in order.

→ What are the top 3 risks you should take into account? What are your thoughts on mitigating them?

Unit 2: Digital solutions of mapping paratransit services

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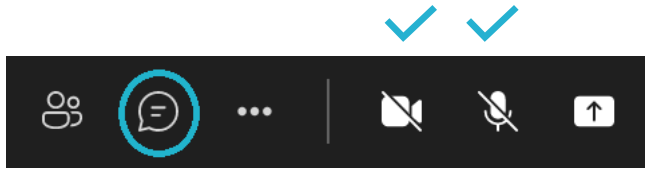

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Workshop objectives

- → Understand digital solutions available to map paratransit services and their multiple purposes
- → Relate the Data Life cycles to the different software solutions
- → Gain insights from real-world mapping projects (examples)

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2.1

Digital solutions

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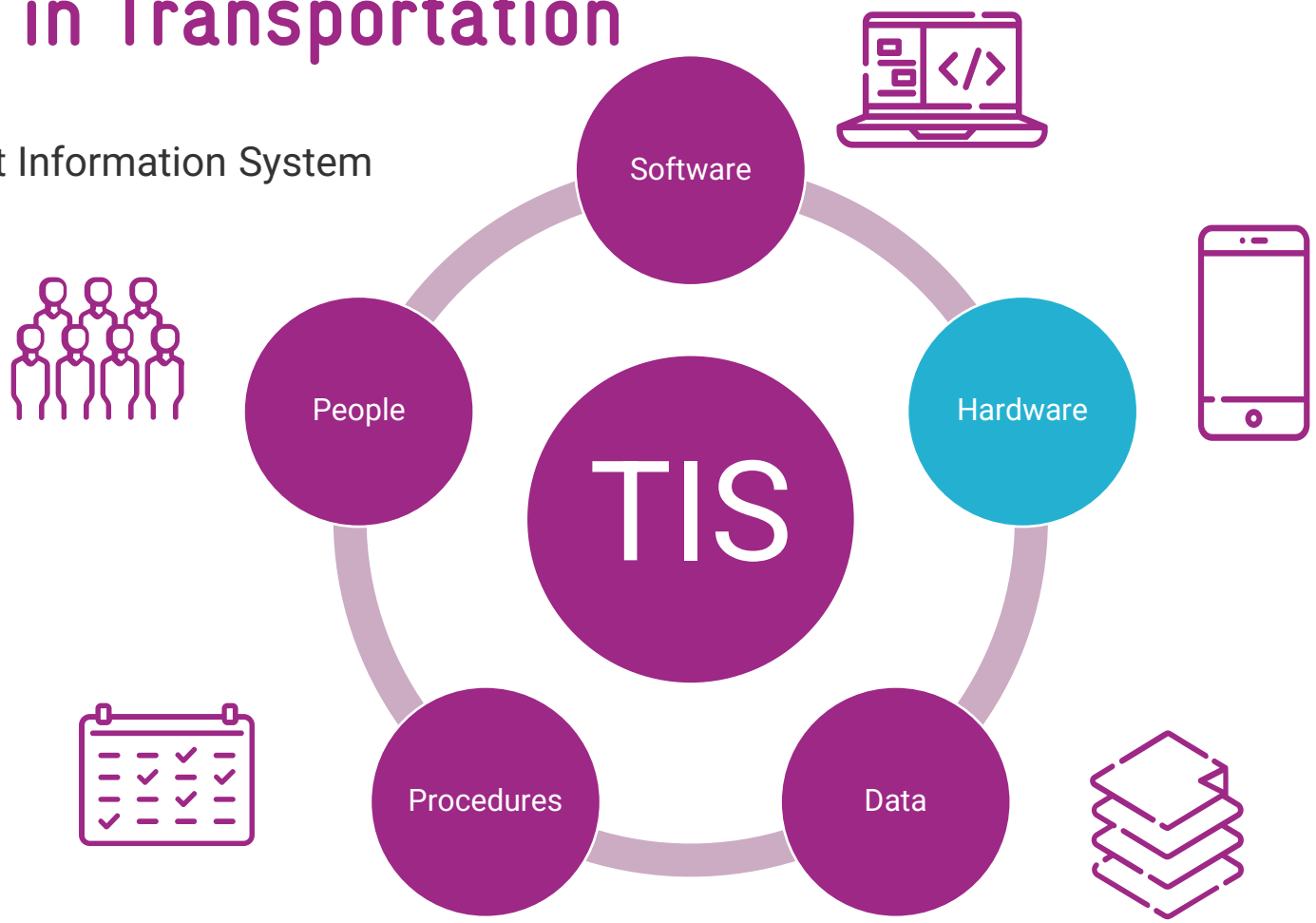
Data in Transportation

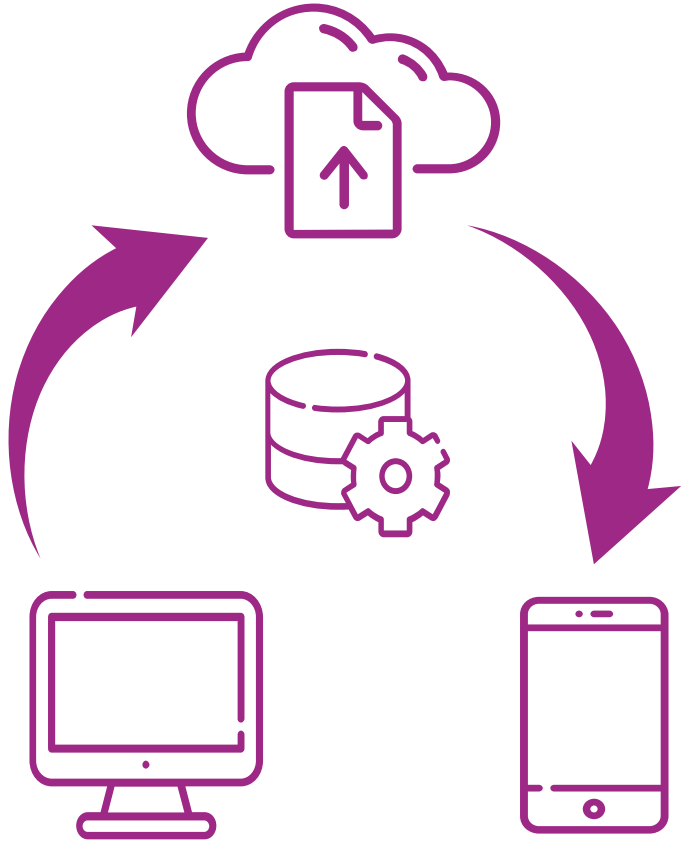
Transport Information System



Hardware

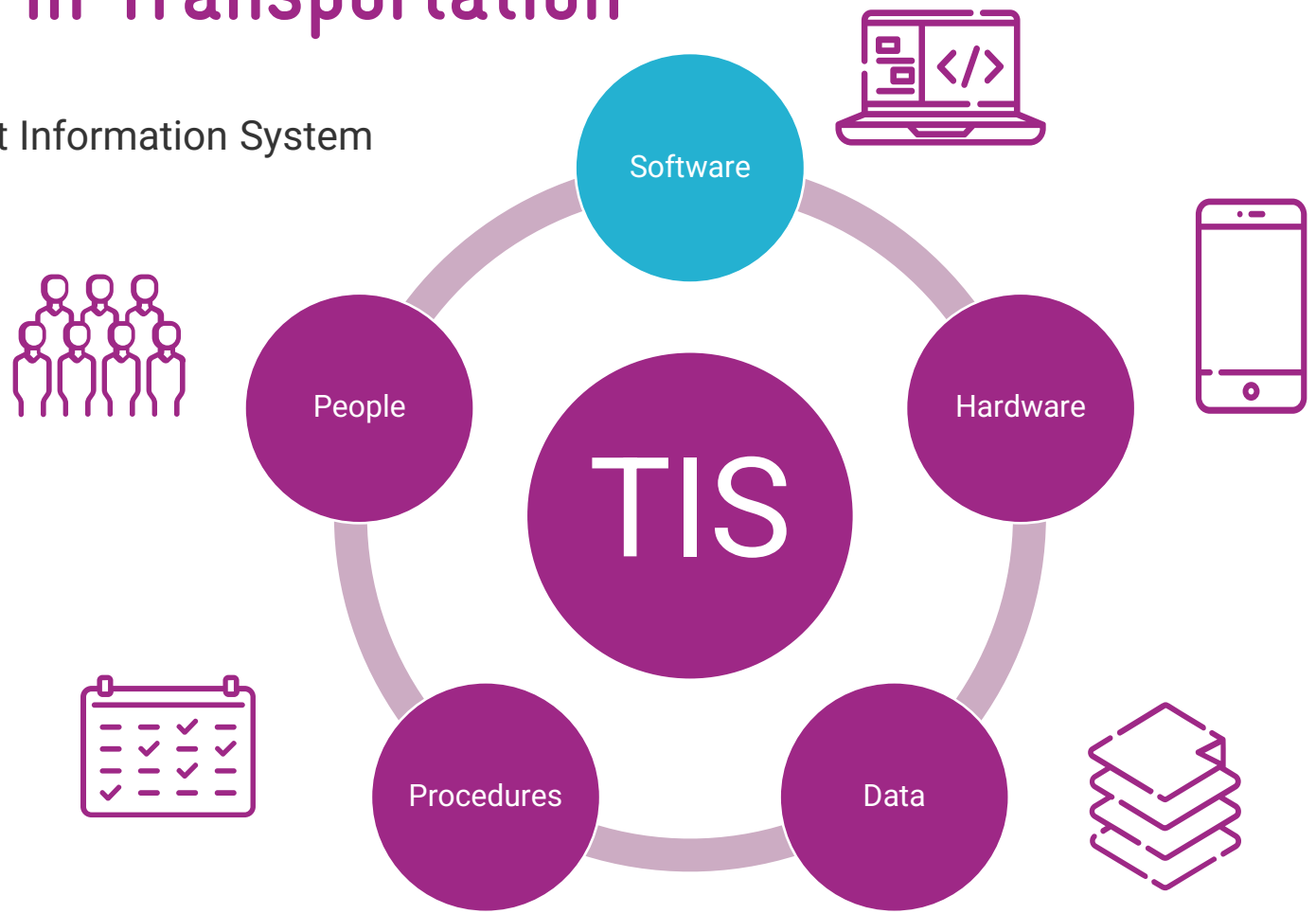
Cheaper and more efficient

- Technology now allows for powerful specifications with lower prices
- Best Case Scenario
  - Powerful smart phones for field surveys
  - Laptops and PCs in back office
  - All devices reference a centralized Database Server
  - Database Server is hosted on the cloud
    - Automatic Backups
    - High availability
- No-Internet Scenario
  - Smart phones in the field
  - PCs in the back office
  - A local database server
  - Manual connectivity at the back office between the field smart phones and the database server over a local network



Data in Transportation

Transport Information System



The Data Lifecycle

We should employ Software tools to enable every step

Collect

Data Collection Apps installed on smart phones

- Mobile Apps
  - Off the shelf
    - Free and available, but..
    - No Backend
    - No Live Synchronization
    - Many Workarounds
  - Custom Built
    - Built to do the job, but..
    - Not always free
    - Technical Support required
    - Coding skills needed to edit

Off-the-shelf

Custom Built

Route Lab

GoMetro PRO

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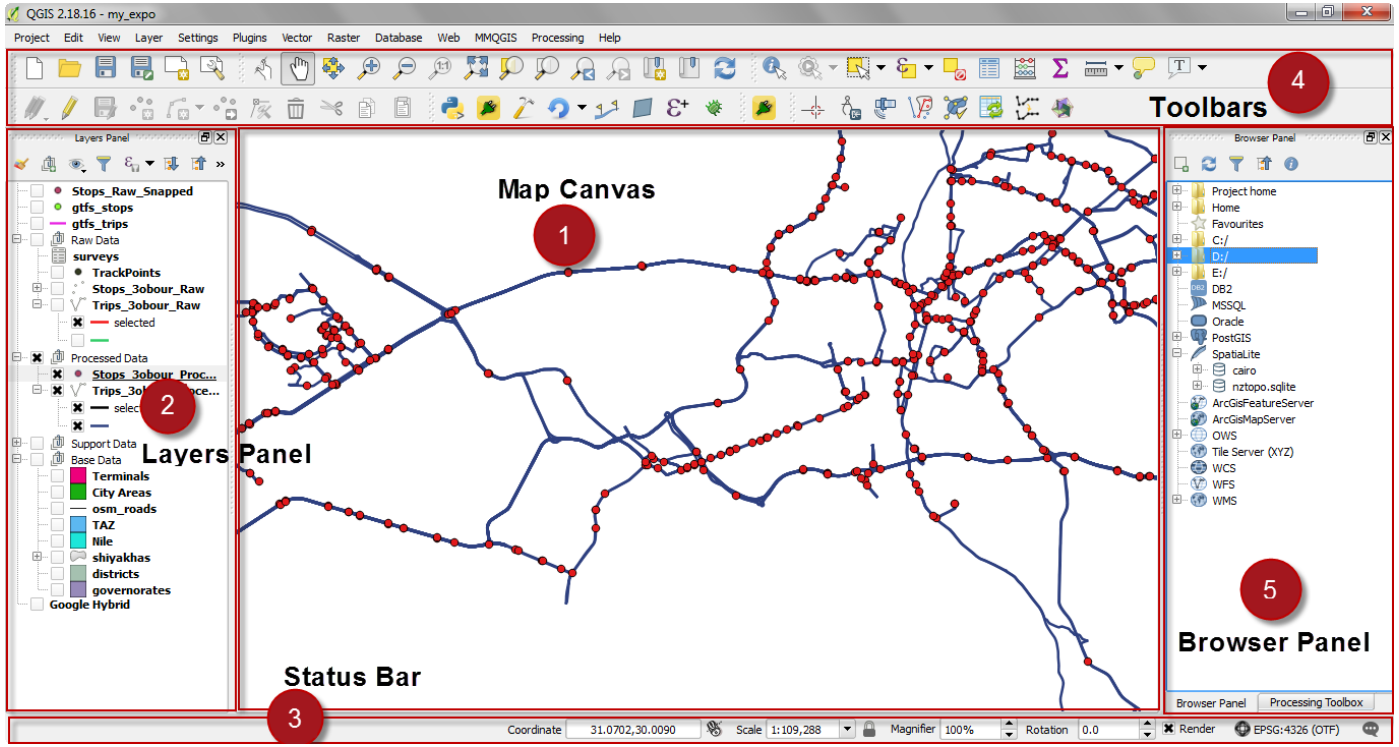
Process & Manage

Receiving, cleaning and storing Data

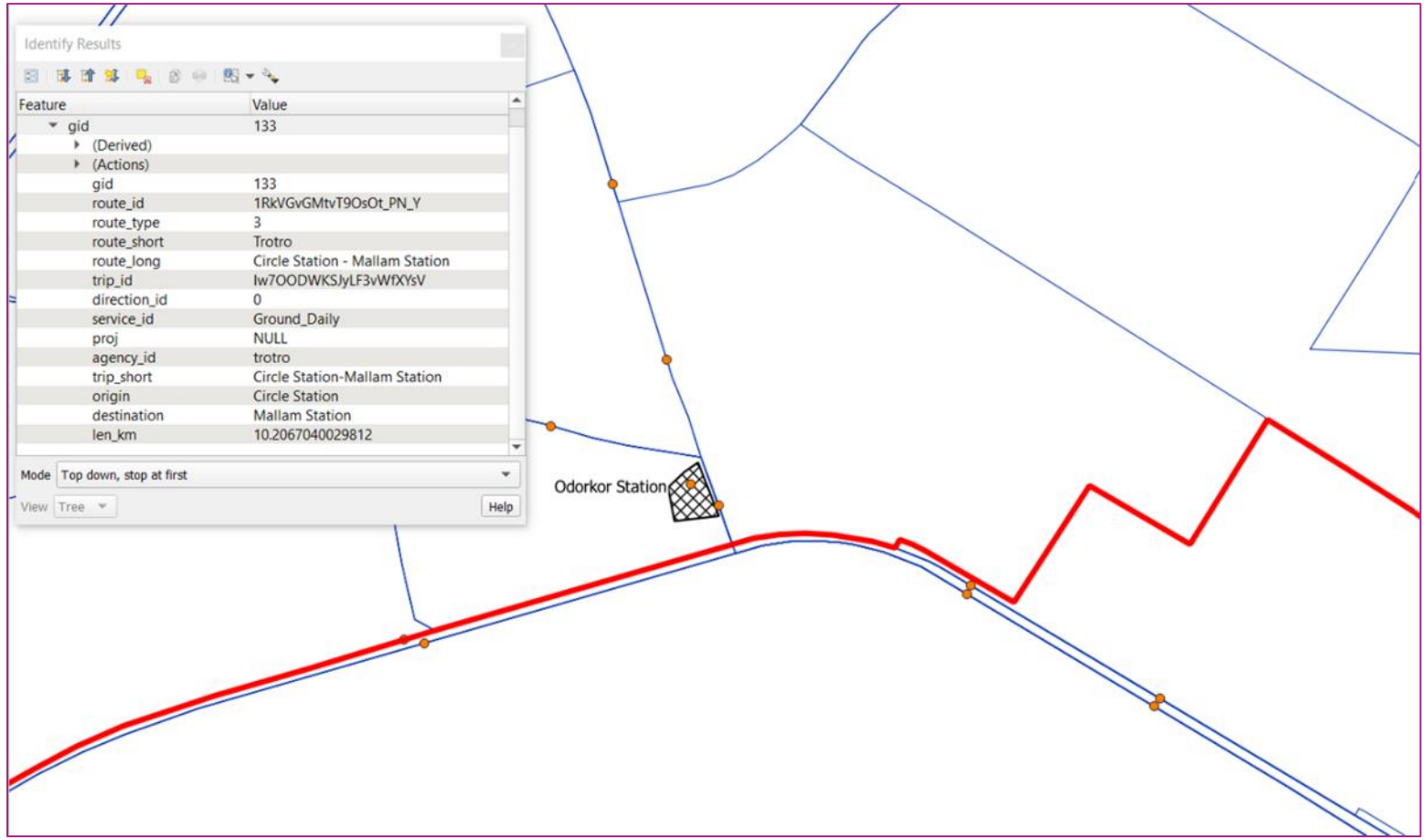
- Data is stored as:
  - Database Tables
    - Postgres, MySQL, Oracle
      - Relational Database Management Systems (RDBMS) are commonly used for multi-user editing environments
      - They also support versioned editing, backups, and recovery
  - Flat files
    - CSV, Shapefile, GeoJson
      - Files that are stored directly on the disk
- Desktop Software
  - GIS (**QGIS**, ArcMap)
  - Database Admin (Dbeaver, phpMyAdmin, PgAdmin)

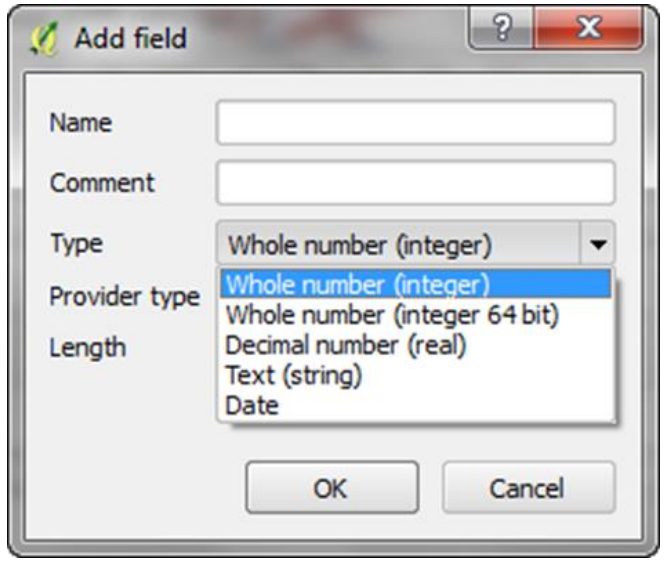


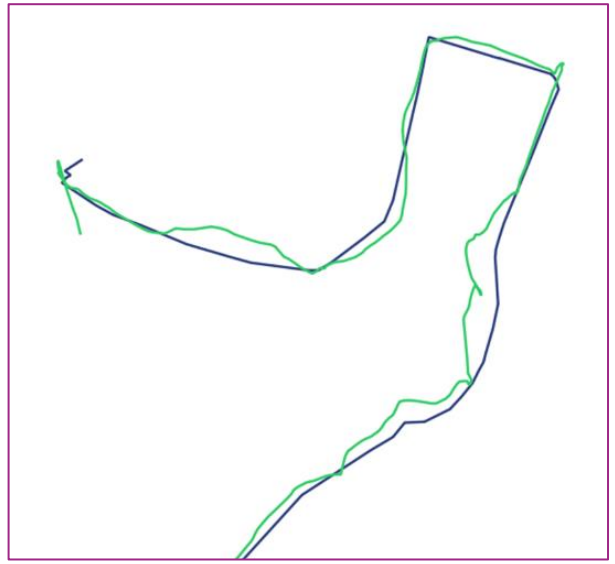
Process & Manage

Each layer has “features”

Each feature is a row in a table and each feature has attributes







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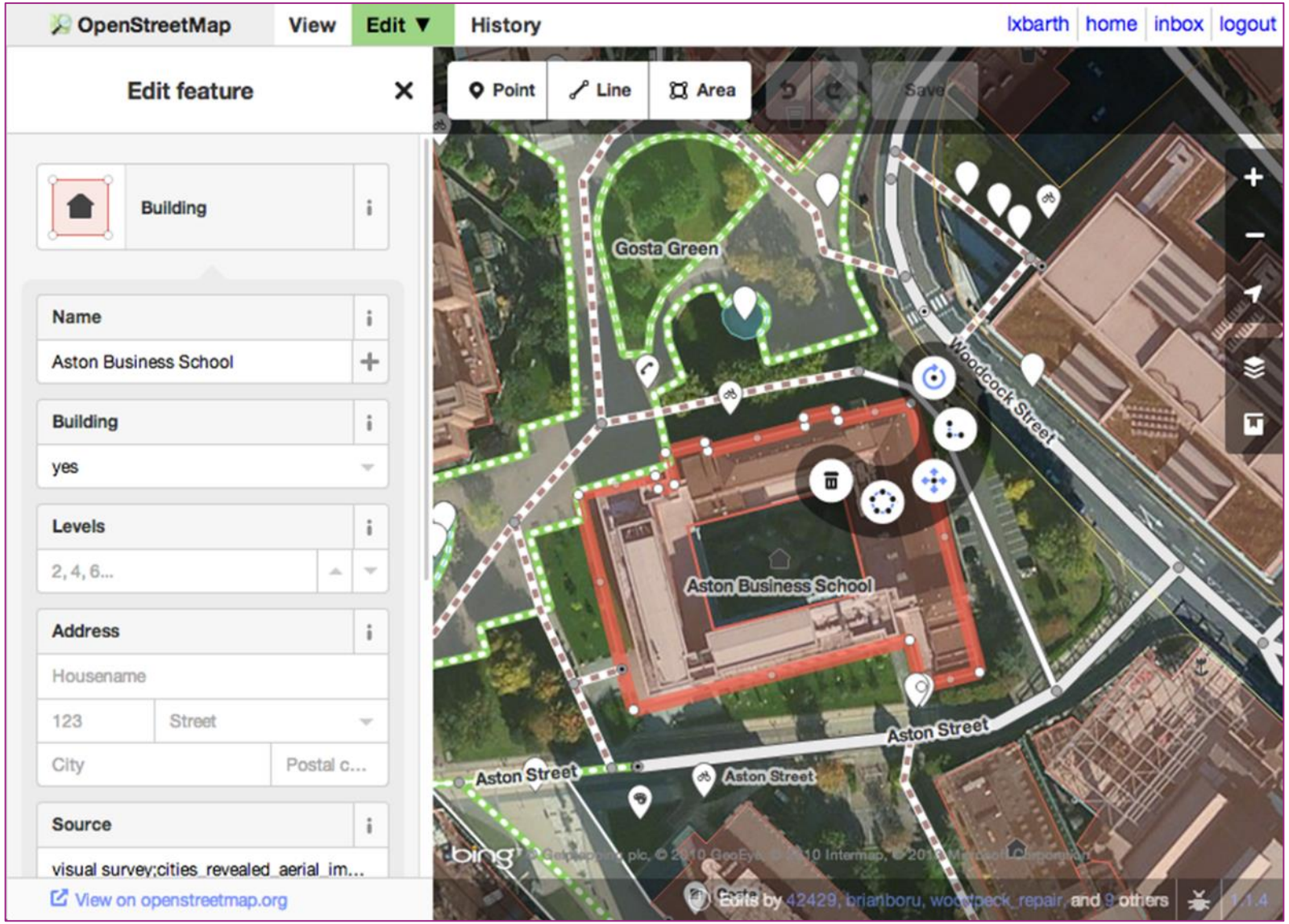
Process & Store

OpenStreetMap – The Free Wiki World Map

- → https://www.openstreetmap.org/
- → Stores vector data
- → The Free “Google Maps”
- → Data is editable & downloadable
- → More than eight million registered users
- → Data on roads, buildings, points of interests, natural features, landuse, transport (basically everything!)



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2.2

Use cases

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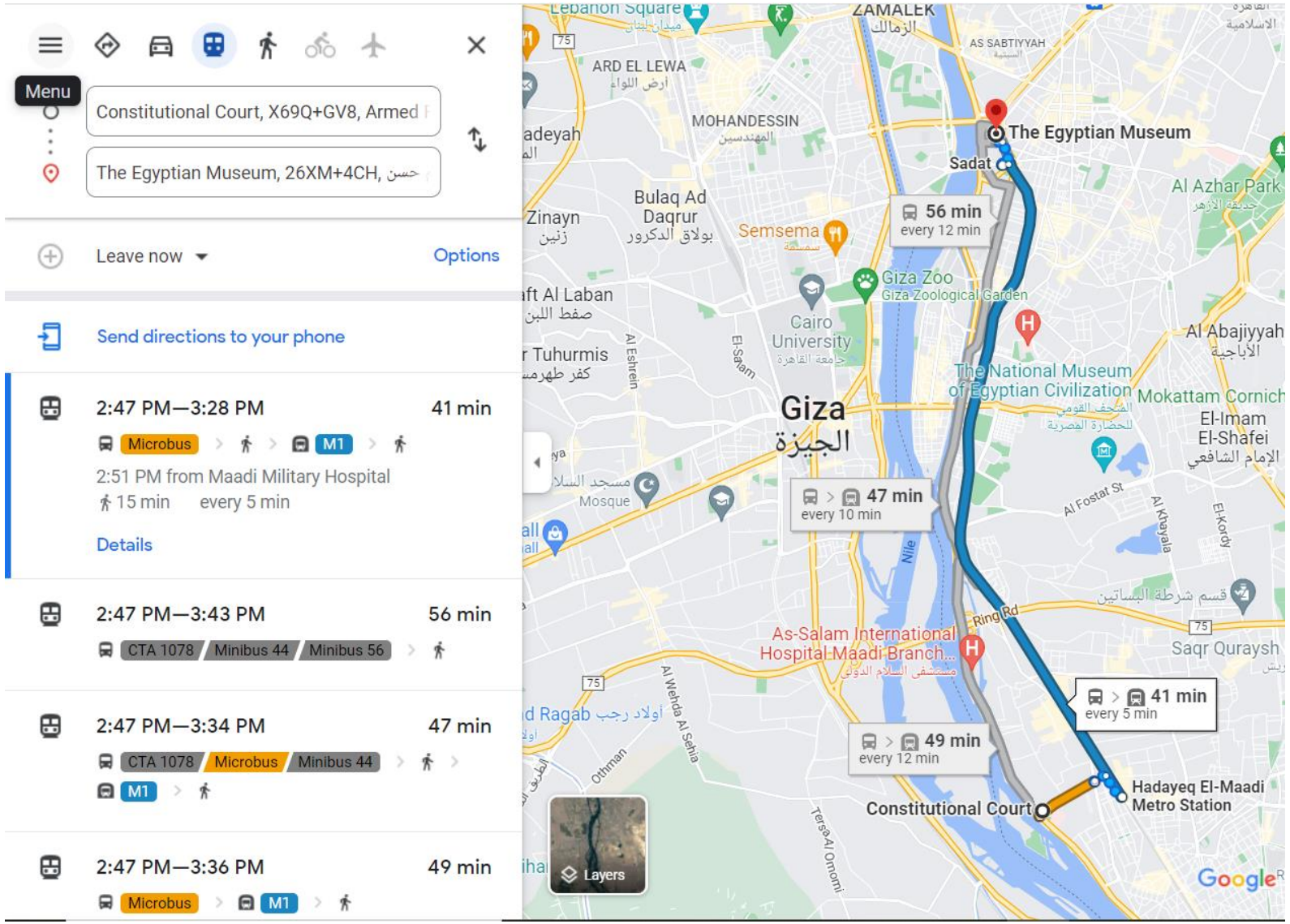
Use Cases

Trip Planning

- **Identification Surveys**
  - Routes
  - Terminals
- **Onboard Surveys**
  - Route Itinerary
  - Travel Times
  - Virtual Stops
- **Frequency Surveys**
  - Route Frequency

GTFS



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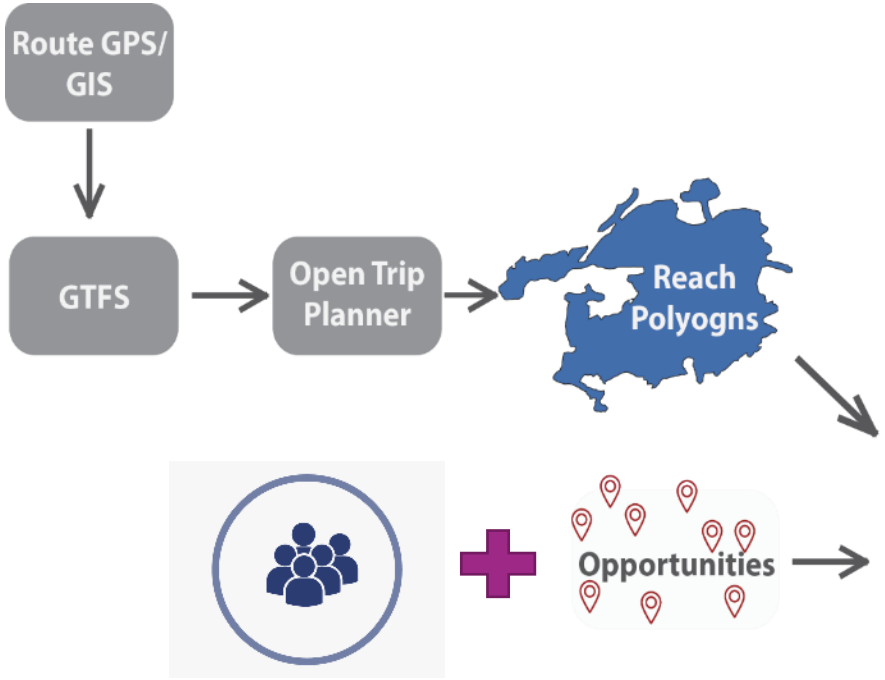
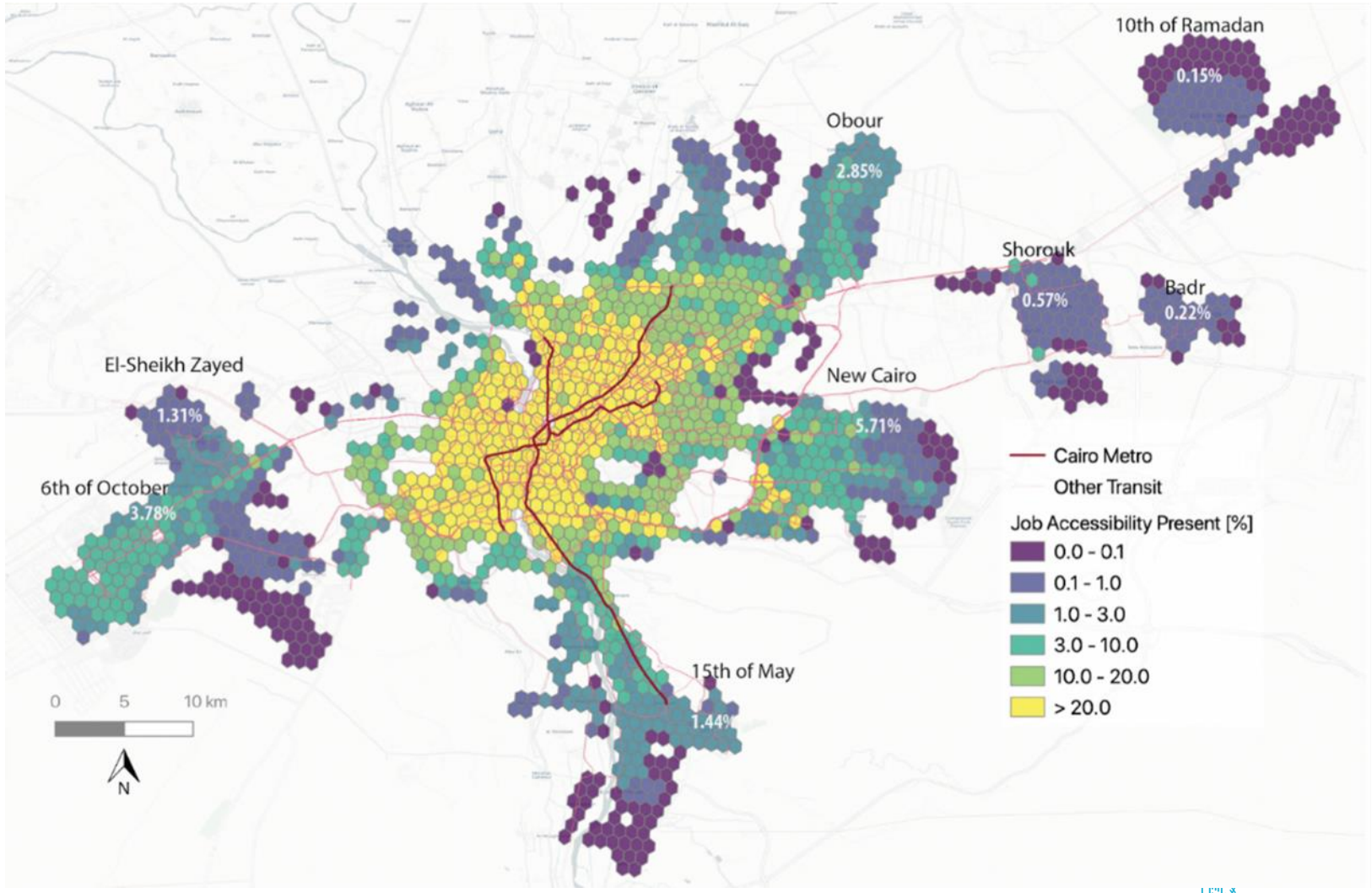
Use Cases

Accessibility Analysis





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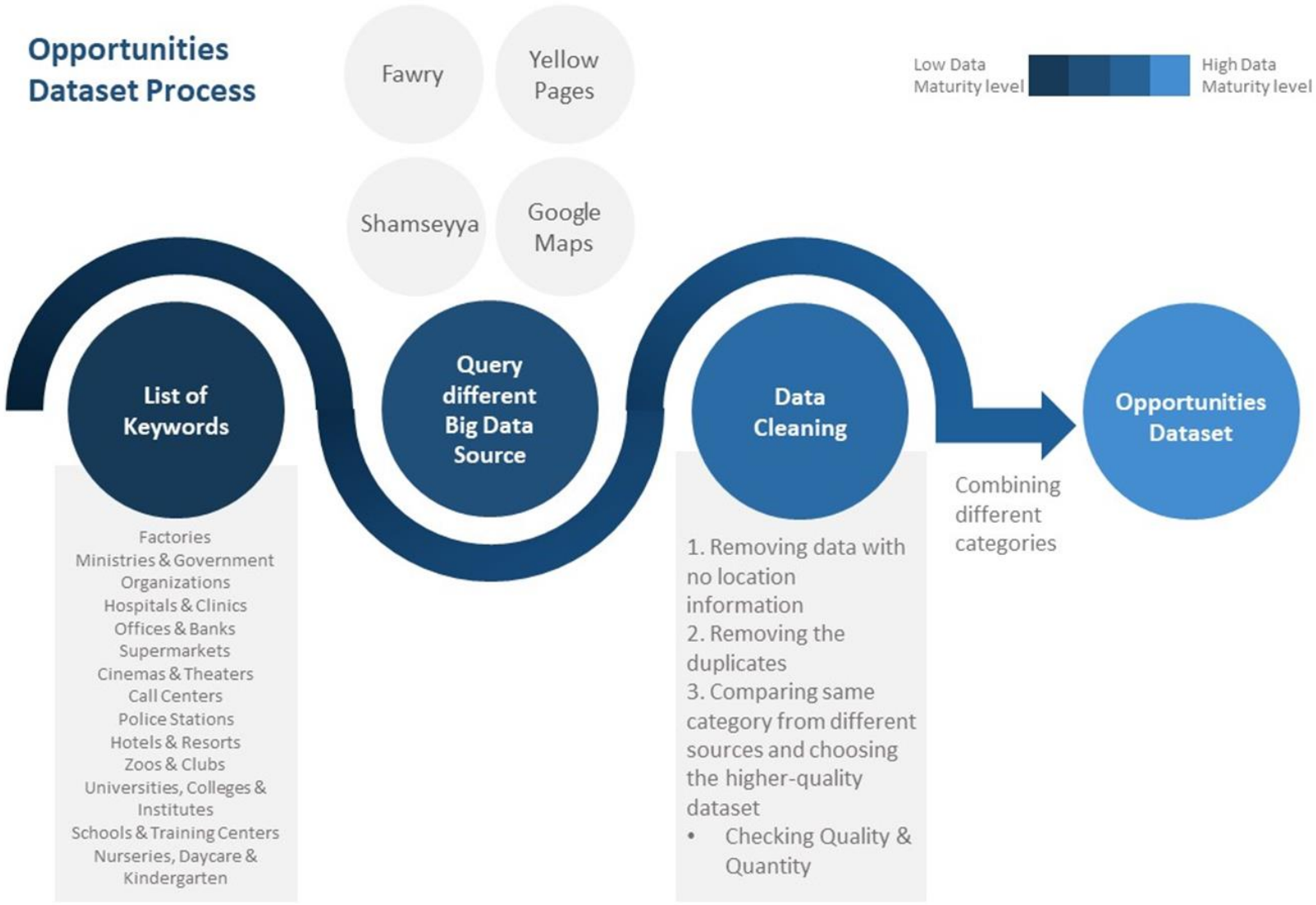
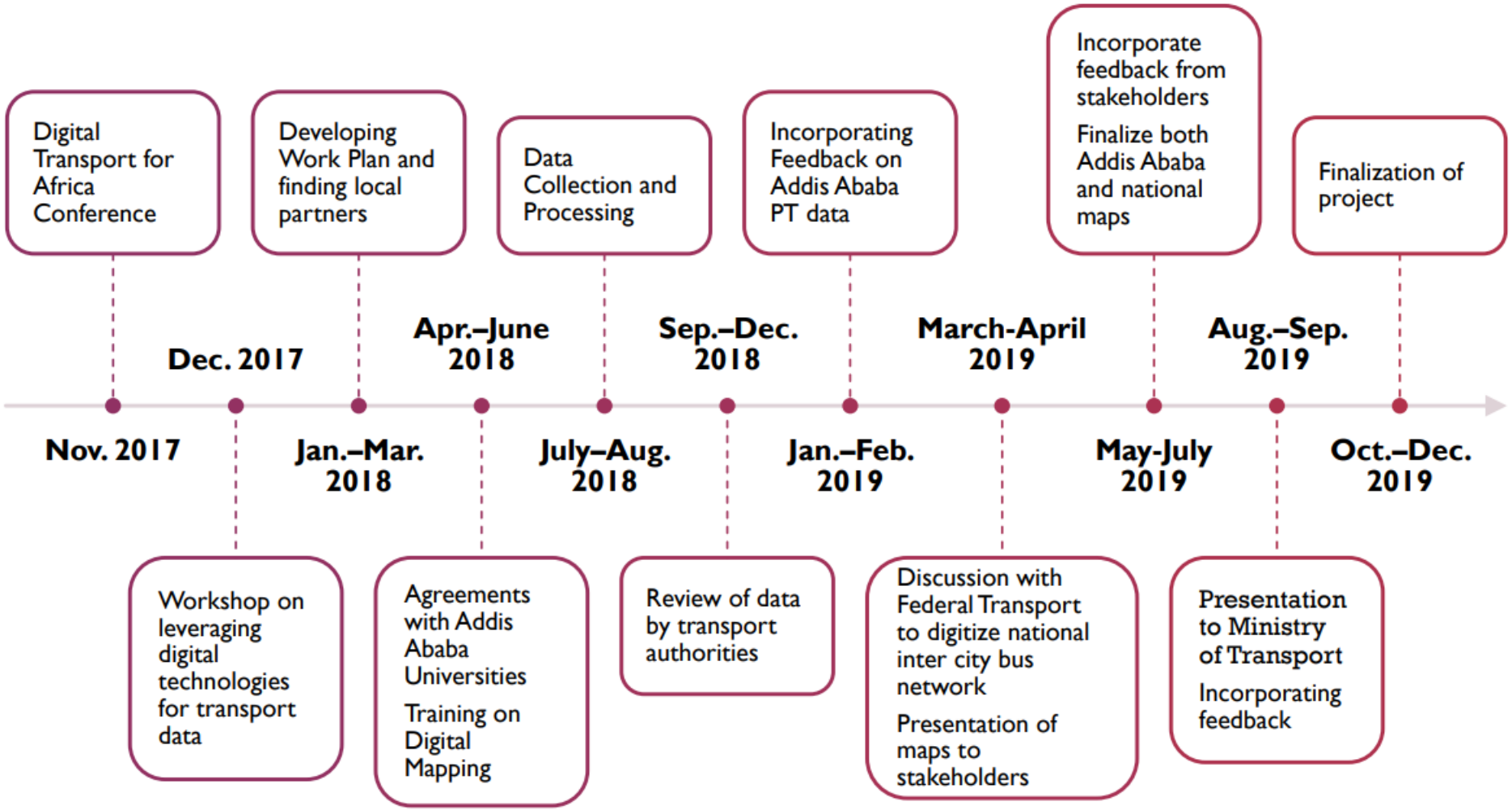
Use Cases

Example on Data Challenges



Use Cases

Addis Ababa



Use Cases

Addis Ababa - Challenges

Challenges for WRI/TfC

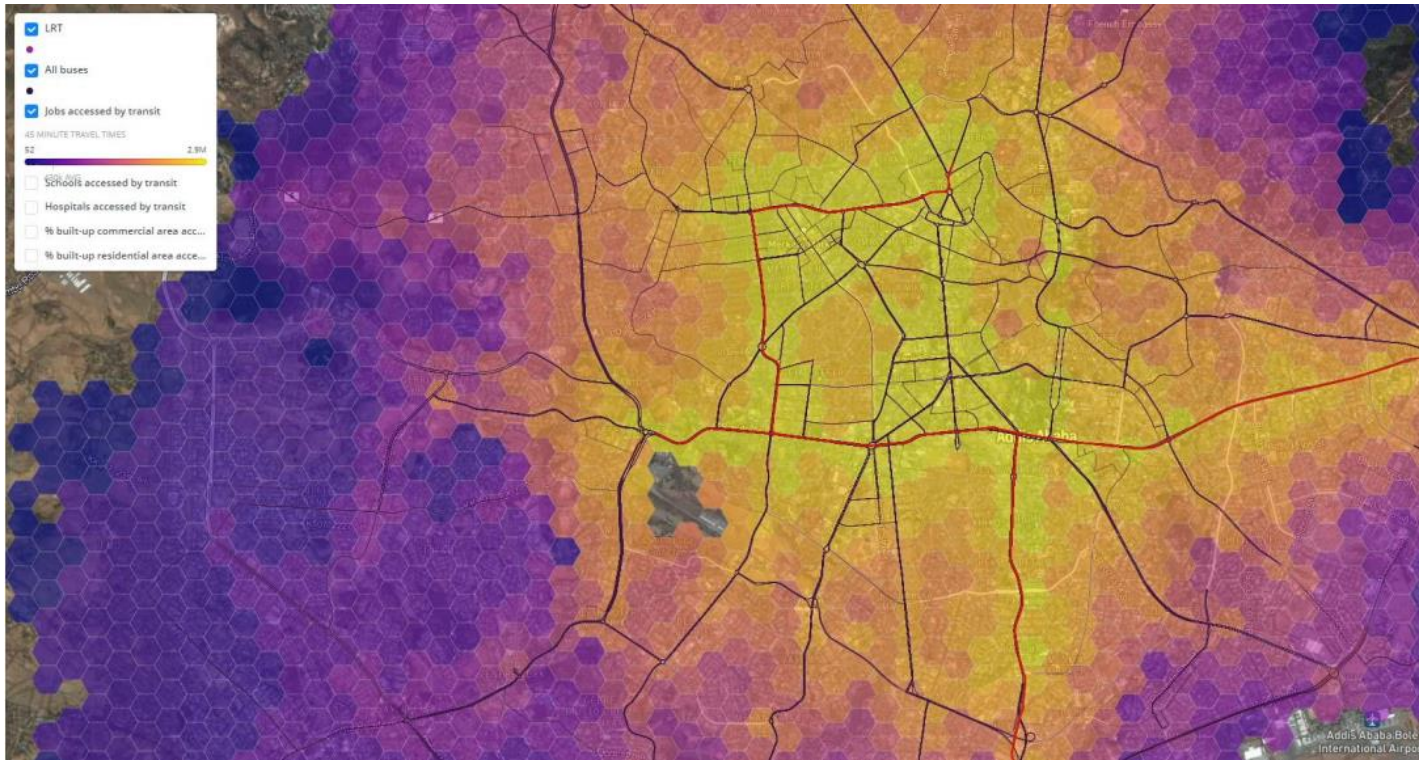
- Baseline data – inaccurate, overlap
- Unreliability of transport services
  - easier to map paratransit
  - inactive routes
  - Difficult to locate buses
- Working with University Students – building capacity simultaneously
- Time constraint

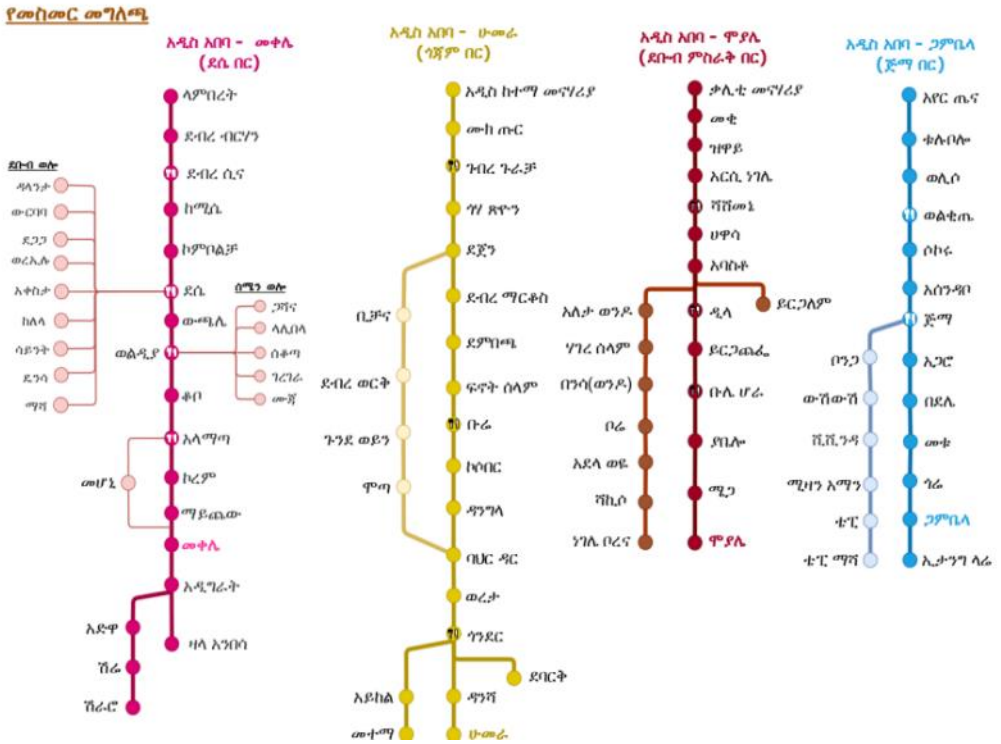
Challenges for Data Collectors/Processors

- Unreliability of transport services
  - Inactive routes
  - Difficult to locate buses at stations
  - Some buses that don't come
  - Could only map 1-2 routes a day but we had proposed 3
  - Duplication of routes
- Weather affects GPS
- Taxis take route different than assigned:
  - Shortest/convenient route
  - Demand of passengers too low on assigned route
  - Tariffs not respected i.e. Shero Meda - Shenkuru students paid 23 birr vs. 7 birr
- Technology (app) - not reliable

Use Cases

Addis Ababa





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Use Cases

Addis Ababa

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Break 10’

2.3

Quiz & Exercise

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Quiz – Utilize Technology to Map Transport

→ What are the four stages of the data lifecycle?

→ Draw a diagram of the Hardware and software tools you aim to use for the four stages in the data lifecycle

→ Mention 2 common applications to digital transport data.

Exercise – Paratransit Mapping Demo

- In groups of 4 or 5, we are to plan a paratransit mapping exercise from start to finish
    1. List the surveys, activities and timeline for the project
    2. Budget for software and hardware expenses and team members fees
    3. Mention expected challenges to be faced, especially in due to local context
- We can use either digital tools such as excel, word, etc. (preferable) or draft on a piece of paper and scan to share with the rest of the team
- After each exercise we'll pause and give time for each time to share and review

Conclusions & Summary

- → We gain an understanding of why data is needed, and what we mean by the word “Data” in transportation mapping
- → We dive into two main structures: The data life cycle, and the components of a Transport Information System
- → We go into the different data types and what each of them can represent (GIS, GTFS, Geography, time, etc.)
- → We list the unique challenges of paratransit when it comes to mapping and data
- → We view data collection (mapping) as a project and how we can “manage & plan” this project
- → We relate the software tools to each stage of the data life cycle and how those tools can enable each stage
- → We go over actual use cases of data in Cairo and Addis

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