# DESIGN RESEARCH TO UNDERSTAND USE-CASES FOR TRAFFIC AND TRANSIT MANAGEMENT

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**Design Research:**

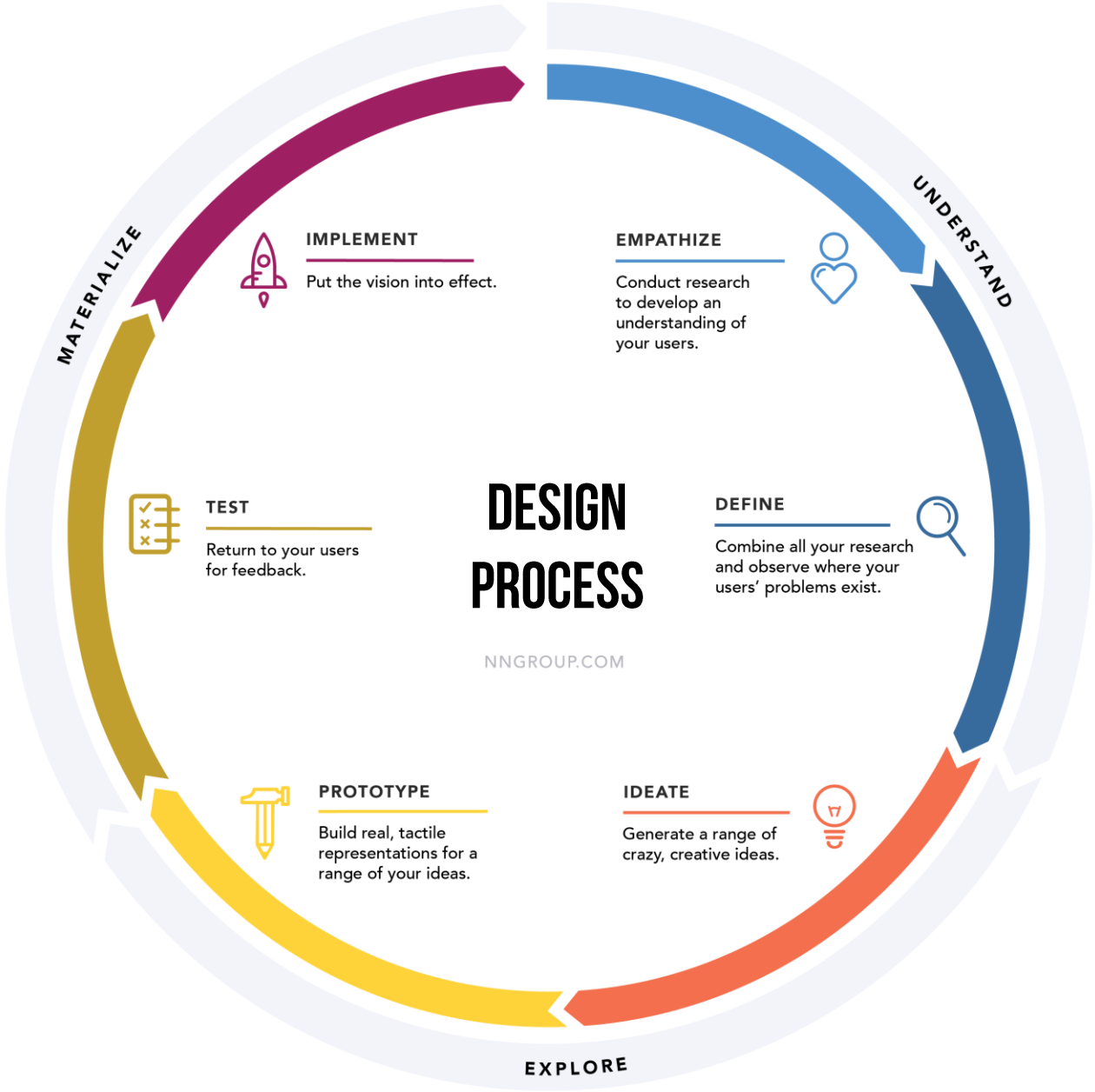
A systematic but flexible methodology practised through **iterative analysis, design, development,** and **implementation**, based on collaboration among researchers and practitioners in real-world settings, leading to contextually-sensitive designs.
*Wang and Hannafin (2005)*

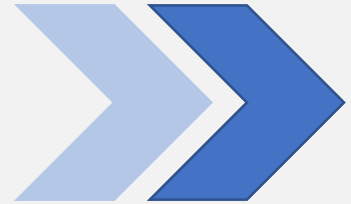
**Use Cases:**

A *use case* is a series of related interactions between a user (or more generally, an “actor”) and a system that enables the user to achieve a goal.

Use cases are perhaps the best way to capture *functional requirements* of a system.

UNDERSTAND – EXPLORE – MATERIALIZE

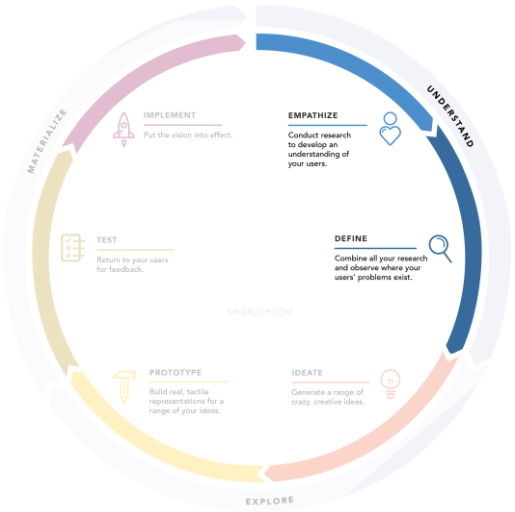




UNDERSTAND – EMPATHIZE
DEFINE

## DESIGN METHODS

- LITERATURE REVIEW
- SURVEY OF USE CASES/ USER STORIES
- EXPERT INTERVIEWS



# ITSoS- ATIS User Stories

## User Roles:

**Transportation analyst/ operator:** a person who is using transportation data to analyze and assess the impact of transportation policies and traffic management strategies on society and environment.

**ATIS Service Providers:** Business entities who offer cyber-physical services that implement abstract ITS functionalities. Provided services shall define interfaces that conform to the standardized data flows defined by the ITS architecture. Services shall also use open street maps to represent traffic networks and GTFS to represent transit networks.

**ATIS Application / Operation Providers:** business entities who provide integrated ITSoS services in response to end users' requests. Application providers define coordination plans that use standardized ITS tasks to compose and coordinate ITSoS cyber-physical components.

**ATIS End users/ travellers:** a person who is requesting an integrated ATIS functionality from the ITS application providers.

## Stories

### Theme 1: Integrated Service Execution

#### Theme 1.1: Context Management (example: knowledge of an incident based on data, information, and analytics)

*Theme 1.1.1: Loop Detectors*

- As an ATIS application provider, I want to trigger and control service composition plans according using real-time counts and speeds observed by existing loop detectors.
- As an analyst, I want to perceive annual average daily counts detected by each loop detector.
- As an analyst, I want to perceive average hourly volumes for a typical weekday.
- As an analyst, I want to perceive average hourly volumes for a typical weekend.
- As an analyst, I want to know Peak Hour Factor (PHF) calculated at any road segment.
- As an analyst, I want to perceive the change in average daily counts due to the variability of weather conditions.
- As an analyst, I want to understand the seasonality in the loop detector data.
- As an analyst, I want to use loop detector data to predict traffic conditions at any road segment.

*Theme 1.1.2: Incidents*

- As an ATIS application provider, I want to trigger and control service composition plans using the available information about current accidents.
- As an analyst, I want to perceive the impact of an accident on the network in terms of traffic delays and queue propagation.
- As an analyst, I want to identify segments of the network with the highest frequency of accidents.

## URBAN INFORMATICS USE CASE PROFILE

**Case Number:** C3
**Date:** January 30th, 2017

**User Type**
**Gender:** Male **Age:** 56 **Nationality:** Canadian **Occupation:** Architectural technician

Laz is a senior architectural technician working for city planning. His area of expertise is reviewing rezoning applications and new development projects.

**Application Scenario**

Laz is processing an application for a building rezoning in the new West Don neighbourhood. The applicants have not provided any parking statistical information, and Laz needs to ascertain whether the existing street, and lot spaces will be overburdened by new users if the project proceeds. He must perform Quantitative Data Exploration and Analysis of existing parking resources, land use, and demographics, to evaluate current and proposed parking space inventory against policy/ regulations, as documented in the city's geodata/survey and 3D model resources.

He needs to provide two documents of his findings:
- an explanatory presentation (slide show) for an upcoming community meeting;
- a formal record of the application's parking implications, context, applicable regulations
- recommended ruling based on the above items.

**Description of Tasks**

*Exploration of geodata & 3D model* of existing conditions,
*record of parking inventory* in defined area,
*calculation of requirements* with/without proposed changes,
*export of tabular data and graphics*,
*preparation of formal document and slide presentation* for ruling recommendation decision support/justification/communication with decision-makers and stakeholders

**Preconditions**

Knowledge of local study area, accessibility to platform, understanding of interface & functionality, availability of peak parking data,both on-street and private etc.

**Technology**

**Software** ArcGIS, CityEngine, Insights

**Environments & Frameworks** html5, webGL, Javascript

**Assets**

**Formats** online .SHP, .CSV, .XLS, JSON, .dwg, .dmg files

**Functions** 3d Bar charts, Geo-Data, Bar chart, interactive digital maps with on/off information layer switching, call-out boxes

**Task Interaction**

**How are you using this software / tool?**

Orbit, Walk/ fly-through, pan, scroll, zoom, select, annotate, measure, (annotate measurement?), zooming inset, scrolling, panning, compare, microsimulation etc.

**Data Visualization**

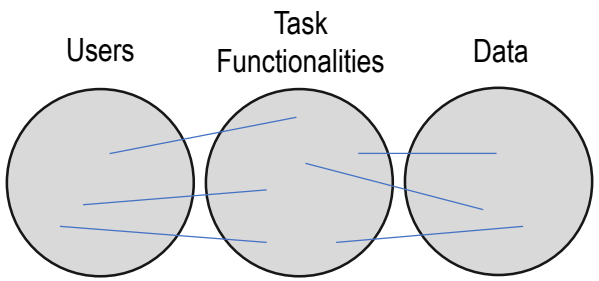
**What is the visualization functionality of this software / tool?**

Uses technological interface to visualize street segment, with displayed data of parking information per location as statistical comparison.
Capture of generated scenario data in a form for presentation. Access of demographic community data to project potential local patrons to future establishments. Interface to select, analysis, and prepare a visual summary of queried data on parking locations.

**Improvements**

**How could the software / tool be changed to support the required tasks?**

Real-time 3D infographics superimposed, 2D map, highlighted statistical charts, prep of visual narrative




USERS

TASK FUNCTIONALITIES

DATA

Urban/ City Planners, Architects, Engineers, Real Estate+ Community Planners

Transportation Planners, Engineers, Municipal Planning, TTC Transit Operations, Signal + Infrastructure Planning

Designers, Artists, Business analysts

Tech. + Engineers, Operation Planning

BIA's, Citizens

SKETCHUP /REVIT BIM/3DS MAX
Planning, 3D modeling, BIM input, animation,rendering,simulation

ILUTE
agent (person, business)-based micro-simulation multi years (over the course of year, scenario)

ESRI/ CITY ENGINE

BETAVILLE
modelling, navigation, visualization, search / exploration, analysis (geometrical), simulation, comment / query, multi-user collaboration (chat, collaborative work environment)

GreenP /Livehoods /Paramics
Explore behavioural data, and navigation of Neighbourhood patterns, Nodes & pedestrian / transportation

STORY FACETS
Explore data through interaction, visual history, presentation, generate consumable overviews, high level -search /browser, visualization dashboard, visualization slide shows,

GOOGLE MAPS
satellite imagery, street maps, 360° panoramic views of streets (Street View), route planning for traveling by foot, car, bicycle (in beta), or public transportation.

Mobile GIS Data Feed

Road Network, TTC Routes, Census Data, Vehicle Statistics, Parking Data, Transit Data

Audio, Video, Tabular data, Markup data

Maps, GPS coordinates

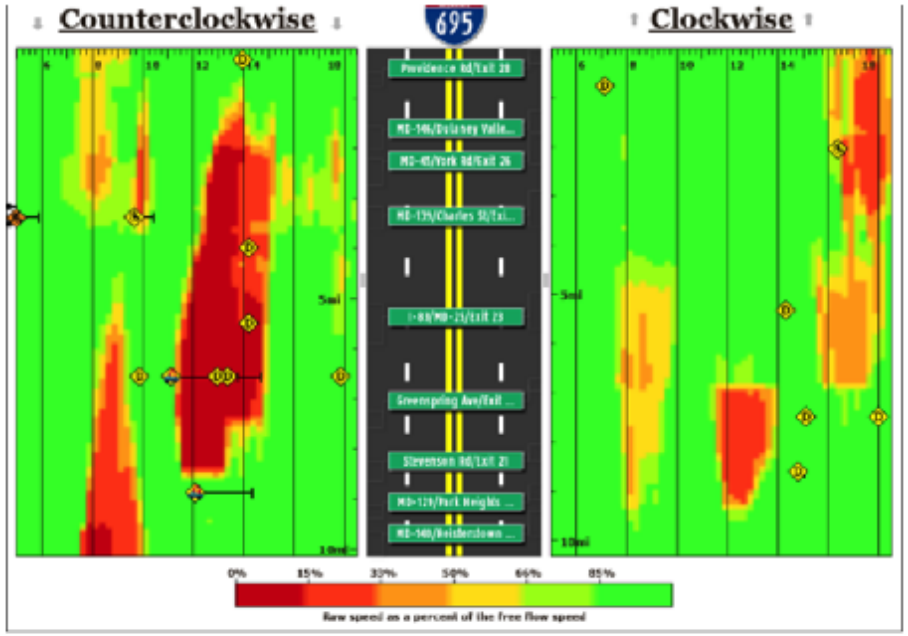
3d Models, Tabular Data, Markup data

CITY GML

*(Data mapping structure derived from Literature Review)*

UNDERSTAND – EMPATHIZE

DEFINE




3- [endif]3-D Spatiotemporal visualization of
- [endif]Weather and road conditions

https://www.youtube.com/watch?v=y3o-uFjd4Eo
- [endif]Color-Coded visualization of the network (taking into consideration speed limits)

https://www.youtube.com/watch?v=TddllO2yTwk#t=51.444979
- [endif]OD analysis

https://www.youtube.com/watch?v=ftIsVoJNCHk

4- [endif]Holograph 3-D spatiotemporal Analysis

https://www.youtube.com/watch?v=vOKVofs5rEg

**Stakeholders**

**All stakeholders have the need to know the basic information about congestion as above. Further they have specific needs that are role dependent such as:**

Travelers: Advanced traveler information systems / ATIS (congestion

Problem space

**Common stakeholder concern (travelers, operators and planners, service providers): Congestion and Travel Cost**
- [endif]Recurrent Bottlenecks
- [endif]Non-recurring Congestions Due to
  - [endif]Constructions
  - [endif]Weather and road conditions
  - [endif]Incidents

**Recommended Visualization Method (based on what we know)**

1- [endif]Dynamic concentric circles + time slider + a popup to display the memory of bottlenecks in this location (or an indicator to show whether it is a known recurrent or new bottleneck) +ranking


2- [endif]Congestion analysis (including how long a congestion will last)

## Traffic Management:

1. Circulation pattern of traffic (Designed, Predicted, Deviation)
2. Distinguish between obstructions (Recurrent expected (rush hour), recurrent unexpected (construction), non-recurrent unexpected (accident/weather))
3. 3d bars with additional info (like StudentMoveTo)
4. Animation/Playbacks
5. Block-level data, and at Intersections lane-data
6. Accidents (Degree and duration of blockage)
7. Time-slider
8. Weather conditions
9. Memory of bottleneck (history)
10. Congestion analysis
11. Spatio-temporal viz (weather, road condition)
12. Color codded visualization (speed limit)
13. Origin Distance Analysis
14. Traveler: ATIS (Real time Congestion, Cost analysis, Navigation, Multi-modal transportation, Trip planning)
15. Operators: ATMS (Advanced transport management system: Real time congestion, cost)
16. Providers: (Real time Cost analysis, congestion, user fed data, ability to share service on the common platform)

## Transit Management:

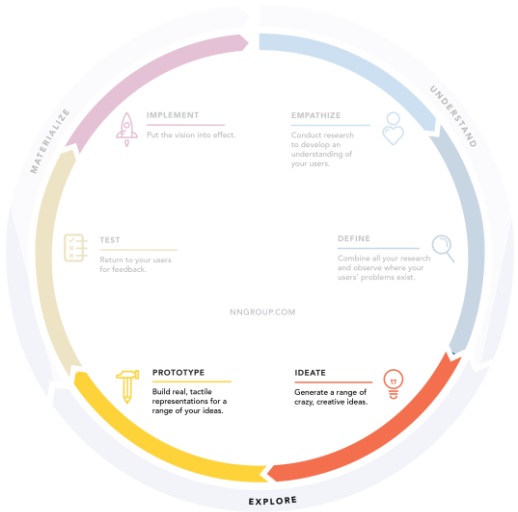
1. Visualization of AVL (GPS vehicle tracking, every 20 seconds)
2. Realtime and Historical
3. Vehicle bunching patterns, other disruptions- streetcars and buses.
4. Time series animation or GeoEvent-based heat maps
5. Layers (Weather, Bike share, Obstruction, Pedestrian Volumes)
6. Twitter Data (tweet volumes reporting Delays/complaints)
7. Visualization of transit performance (Realtime Designed/actual/deviations)
8. Shuttle service (historial data, re-routing, regular routes, delays)
9. New shuttle options (historical data, hypothetical, best routes)
10. Various Transit performance (wait times)

EXPLORE – IDEATE
PROTOTYPE

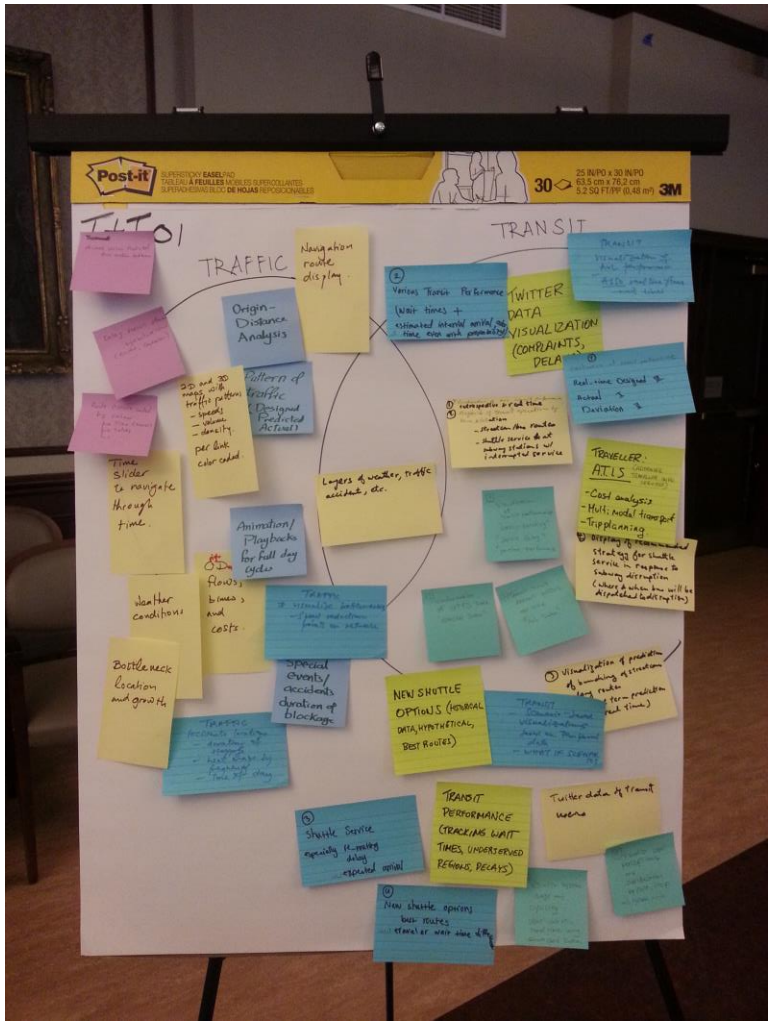
## DESIGN METHODS:

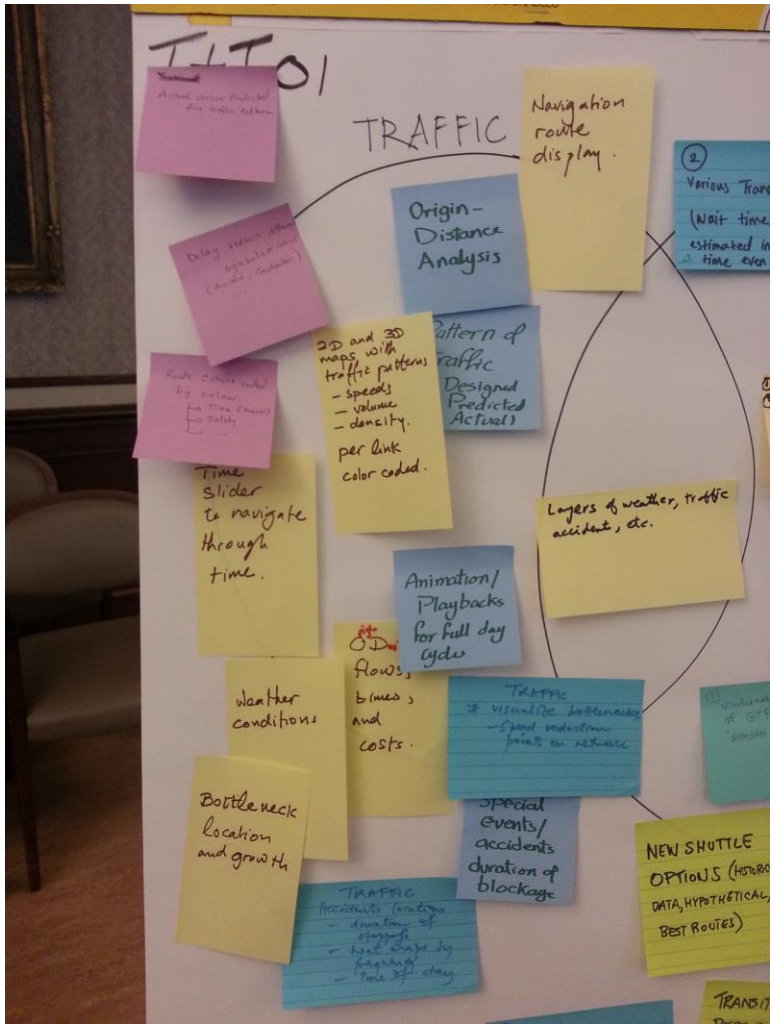
### DESIGN CHARRETTE

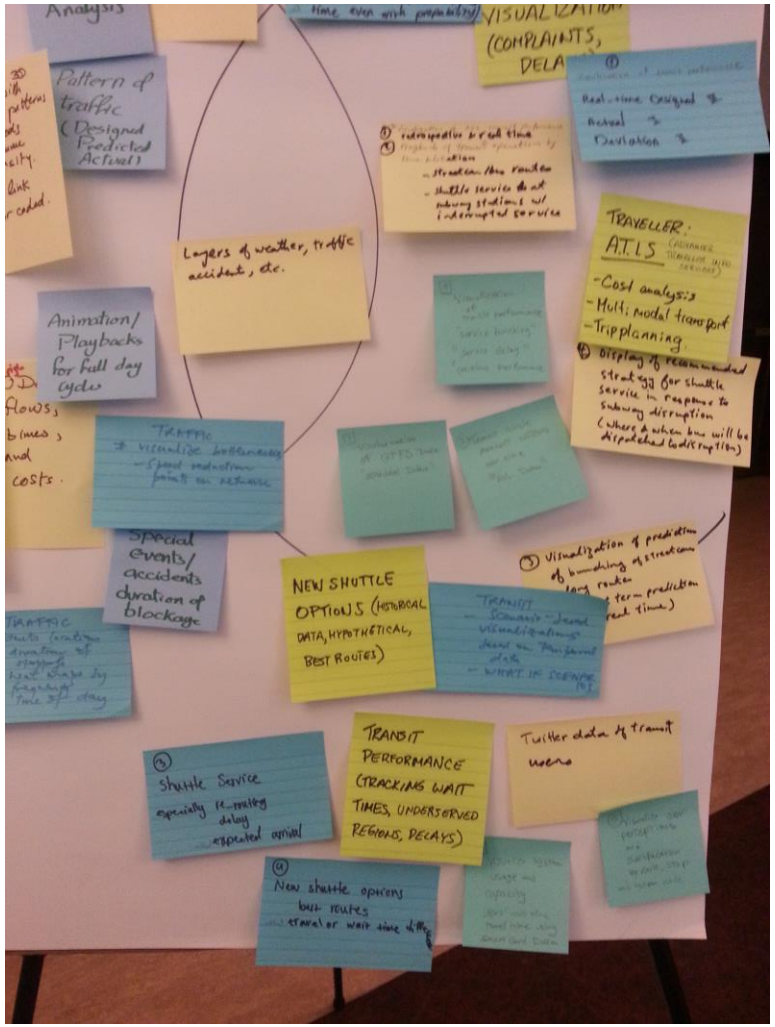
- BRAINSTORMING
- PRIORITY MAPPING
- USE CASE MAPPING: IDEATE + PROTOTYPE SOLUTIONS



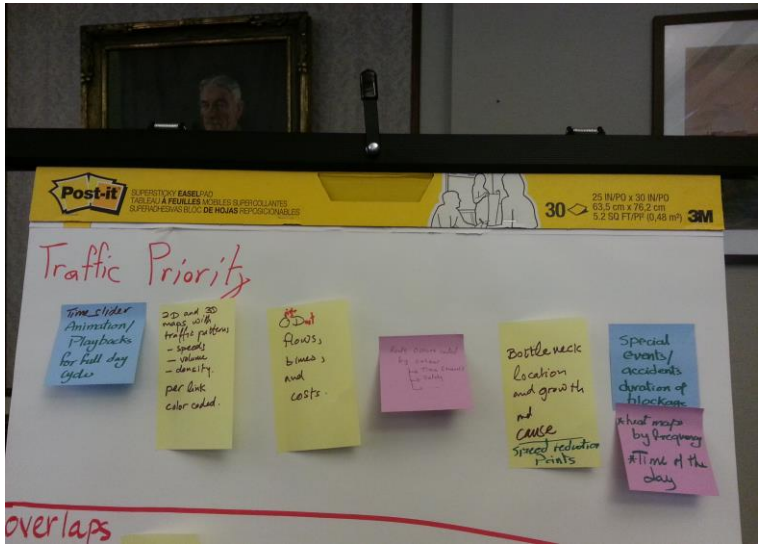
# 1. BRAINSTORMING (List of Data-Viz Requirements)

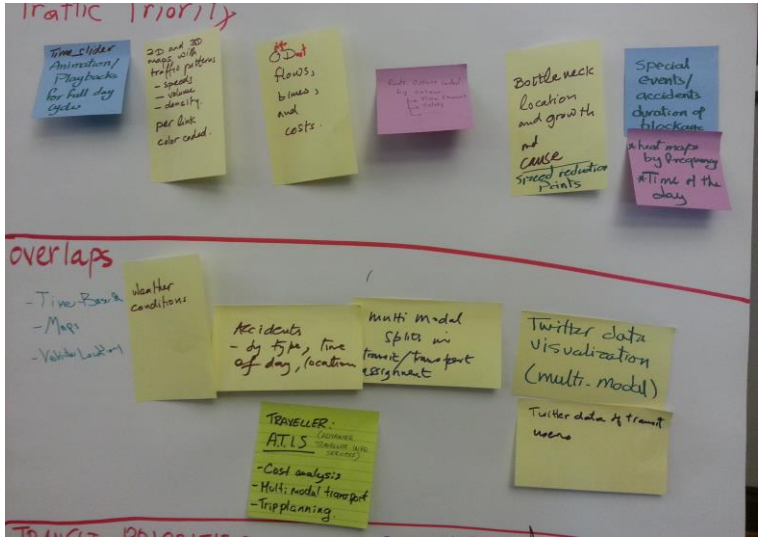


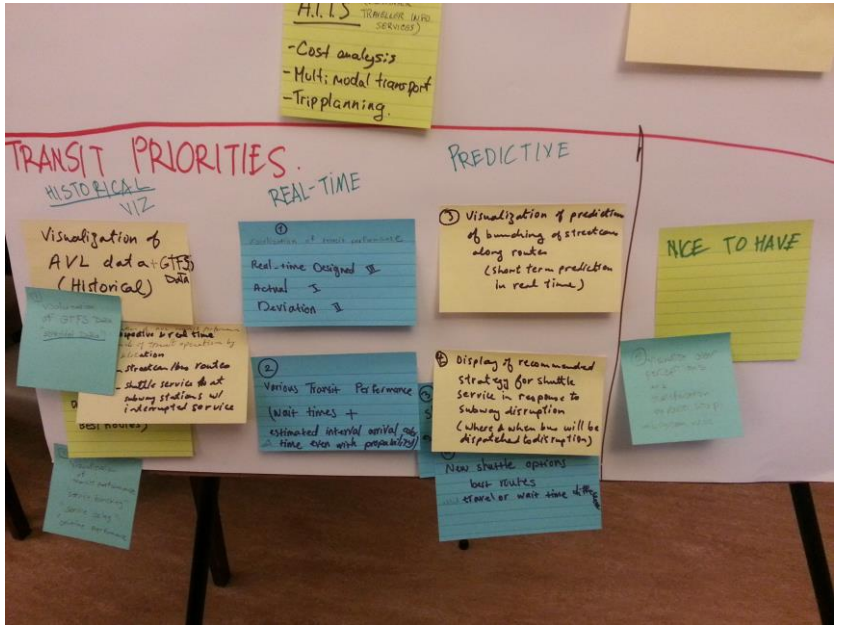



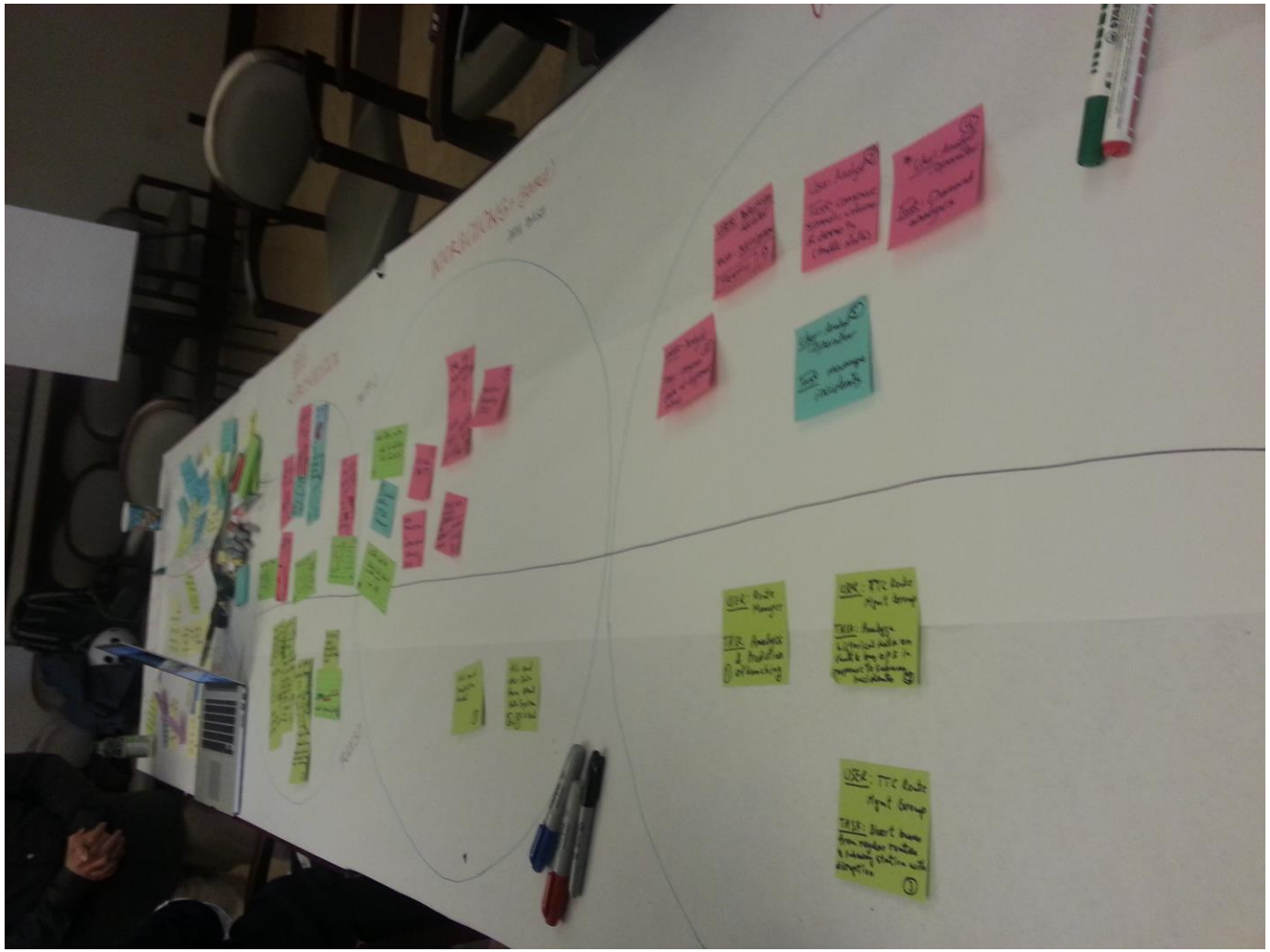



# 2. PRIORITY MAPPING

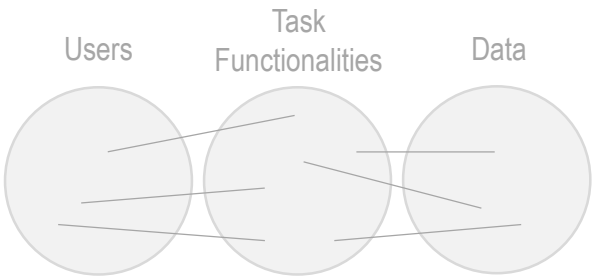



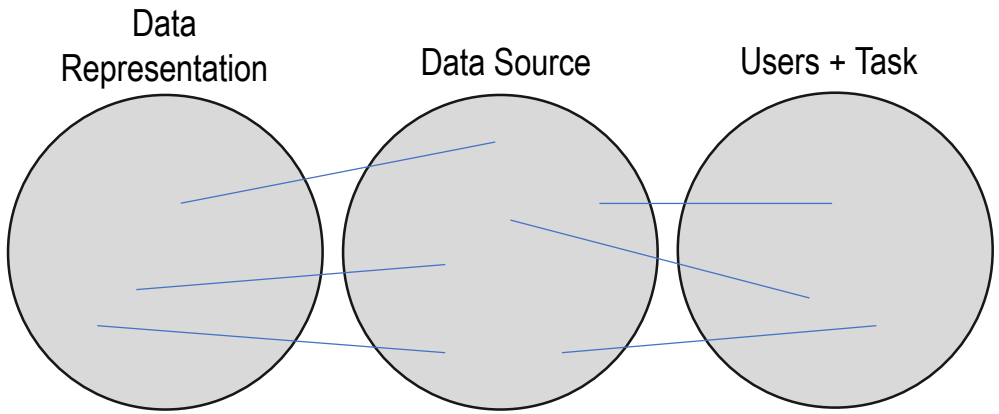





## 3. IDEATE + PROTOTYPE

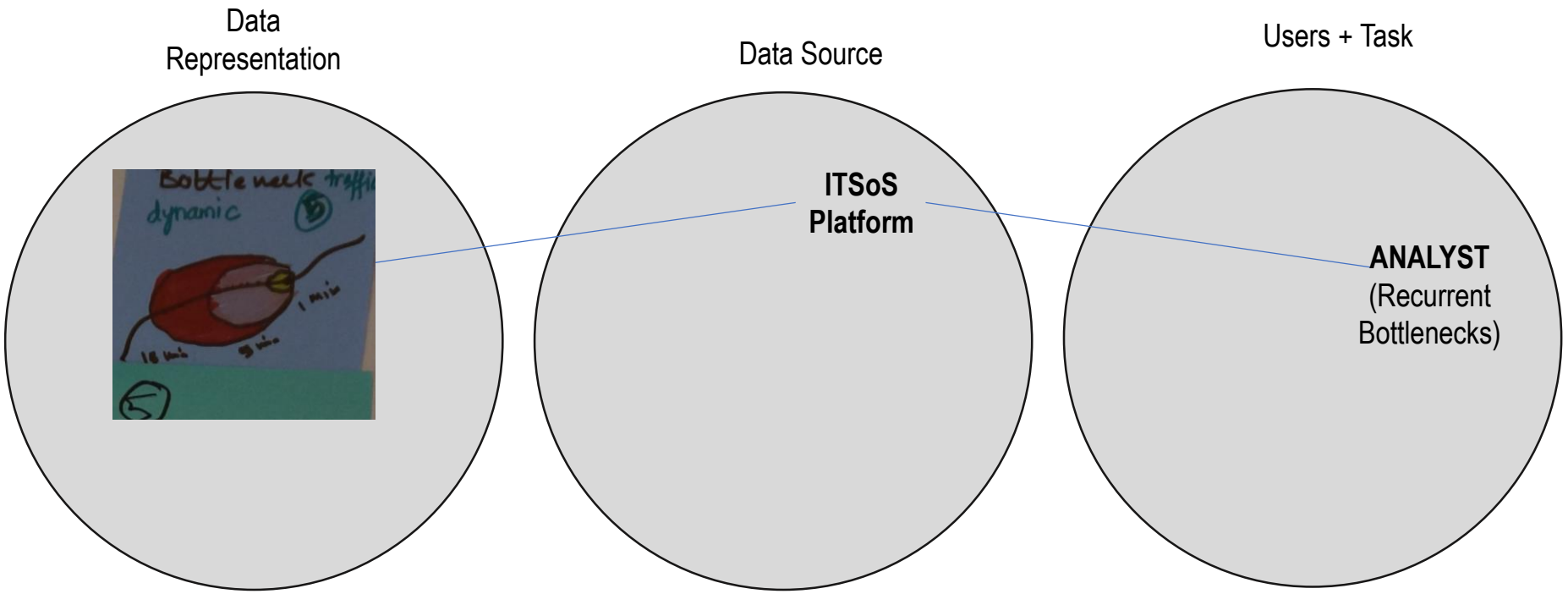



*(From Literature Review)*



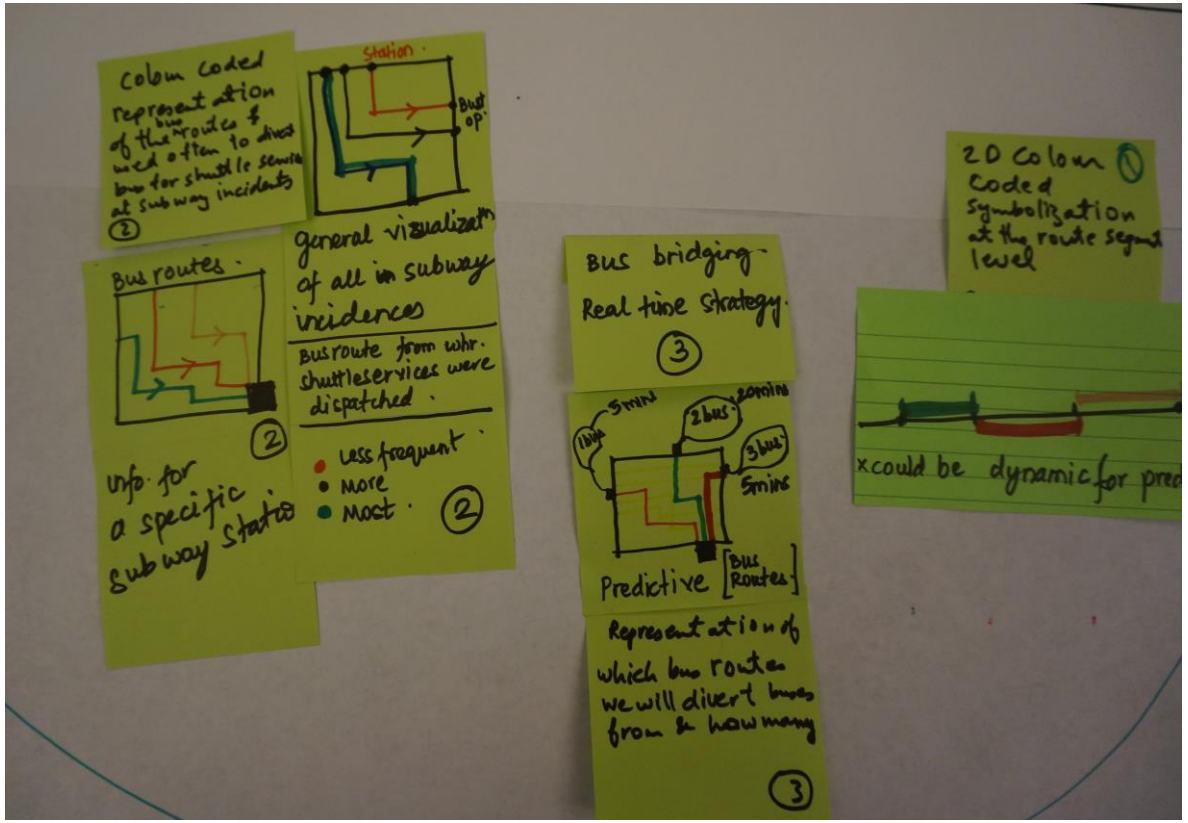

*(Data management format modified at the Charrette)*

## Example:
### Traffic Management Priority 1. : Data Viz for Recurrent Bottle Necks




*(Data management format modified at the Charrette)*


TRAFFIC MANAGEMENT PROTOTYPE SKETCHES



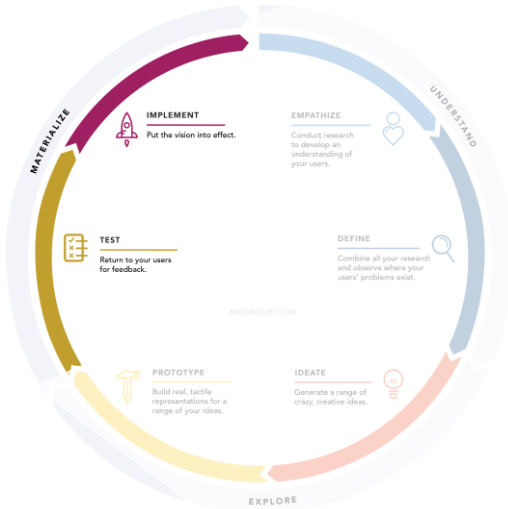

TRANSIT MANAGEMENT PROTOTYPE SKETCHES

# next steps

MATERIALIZE – TEST
IMPLEMENT

**Test:**
Work with industry partners to develop working prototypes
Plan user tests for feedback

**Implement:**
Integrating the Prototypes/ Apps into a framework for dashboard



# THANK YOU