RATP: 3D Multimodal stop place accessibility and indoor way finding.
Three experiments to build and use map and network with ESRI and MOBIGIS tools under standard models for disable persons.
From 2D CAD or point cloud data to 3D BIM through GIS tools.

David Lellouche RATP | 20.05.2016
Goals and use cases with GIS data, ESRI and MOBIGIS

- 2D/3D GIS map for a better view and description of complexes indoor transport sites spaces

- Improve accessibility and information for passengers and disables persons as well as safety and maintenance

- Give a view from territory to local area is similar than run a door to door travel engine to run an indoor path way finder to exit or make a connection

- Associate an accessibility and navigation standard model with map and improve transport site interoperability with GIS and as built 3D model
RATP Transport operator experiments: 2D/3D map accessibility and indoor way finding

Results, limitations and prospects

1. Central Multimodal stations in Paris. Accessibility and route finding
   - From CAD to GIS map 2D and 3D visualization => data accuracy
   - Network, route finder, multimodal identification => Navigation map database
   - IFOPT a standard for accessibility and fixed object.

2. 3D point cloud survey in AUBER/OPERA to 3D BIM visualization
   - 3D point cloud, shape recognition to BIM model. => State of art, interoperability, costs
   - Comparison between 2D CAD and 3D BIM
   - Limits

3. Sound cards. A linear sound approach of path for blind persons
   - Map for underlying model.
Video:
From 2D Map territory
to 3D underground station
A search engine with conceptual proximity on “3D BIM and interoperability” show that we are in the main stream.

Interoperable tool
3D BIM software, interoperable format, GIS

In RATP Engineering department
Standard transport model and GIS. Locate on map: vehicles, clients, disruptions, objects, stop points, route

- Open data and schedule data
- Multimodal door to door route engine
  - GTFS, NETEX
- Real and estimated times
  - SIRI SM, GM
- Situation exchange
  - SIRI SX
- Fixed object & equipment
  - Status data transfert
  - SIRI FM, Facility monitoring
- Services platform for disable persons
- Accessibility, Indoor network & geometry
  - IFOPT, TRANSMODEL
- Navigation model, users profiles & grammar
- GIS indoor database map, CAD, GIS SHP,
- BIM
  - 2D/3D
  - IFC, RVT ...
- Indoor Location
  - wifi,
  - Blue-tooth
  - Without Infra,
  - Lora,
  - LIFI

Transport operations

Passengers Information

BIM & GIS

Network infrastructure
First experiment: 
Central Multimodal stations on suburban railway mode (RER A) 
Model and indoor way finding
PROJECT PHASES AND SOFTWARE WORKFLOW

Data integration
- Stations 2D/3D
- Road database
- Transport public lines

GIS analyses
- Travels and way
- Path and way connectivity
- Flow

Software delivery
- Desktop
- Web

Multimodal Network
Disable persons way finding

Road network, public transport lines and points of interest integration

GIS 2D/3D visualization (map and station)
IFOPT attributes model definition

AutoCAD
2D to GIS automatic & manual process (levels and stairs, path link network, data accuracy)

FME

ArcGIS

MobiAnalyst
2D web and desktop visualization with level

Main central station: NATION

Isochronal time accessibility: CHÂTELET

Navigation path and stop place: CHARLES DE GAULLE
WEB VISUALIZATION

MobiGIS work: Way finding comparison: Profiles, times, distance and stairs
AUBER station

CAD visualisation
Classical emergency 3D
Levels and labels :

3D Arcscene visualization
Extruded levels and stairs.
Second experiment:
3D point cloud survey in AUBER/OPERA to 3D BIM visualization
Methodology and software workflow: From laser point cloud to BIM

1. Laser survey
   - Laser, Photo 360°, Mobile, backpack, Stop and go, handheld

2. 3D recognition
   - 3D shape recognition, fixed equipment Structure, location & point cloud comparison

3. Models
   - REVIT and RECAP. 3D light BIM Model in point cloud wired 3D with Leica software in arc-explorer

4. Uses case
   - 2D comparison in CAD and GIS tools.

• Valuation of mobile laser solution in a multimodal station: AUBER
• Valuation to extend the solution to one line or all network.
• Develop news services upon uses cases
AUBER station: Point cloud to BIM, equipment and shape recognition

Point cloud to BIM: Stop & go solutions

Kinect handheld solution: drift and deformation

Shape recognition: night survey and reduction of degrees of freedom
Video
Dynamic visualization of different 3D models
Point cloud, mesh with photo texture and BIM
Accuracy: comparison between 2D CAD database and as built 3D model projection

BIM projection (blue) and CAD reference (pink)
Only 4cm deviation with 2D referential database.

3D synthesis from 2D. The data must be treated to assign the good quay level

3D level synthesis on flow, stairs or space with 2D CAD/GIS. A new obligation and advantage of BIM project.
## Relatives costs of 3D processing: Come from CAD or export from BIM

<table>
<thead>
<tr>
<th>Relative costs</th>
<th>From laser point cloud &amp; 2D to BIM</th>
<th>From BIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIM from CAD 2D with laser point cloud</td>
<td>6,5 to 8,5 Cloud=1, data entry = + 4 à 6, quality of 2D map = 1, géolocatoin = 0,5</td>
<td></td>
</tr>
<tr>
<td>Light Wired 3D with geolocation and low attributes</td>
<td>0,5 = Export from BIM With geolocation 3 to 4 Cloud=1, data entry = 2, quality of 2D map = 1,</td>
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<tr>
<td>3D by levels.</td>
<td>2 Without geolocation</td>
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<td>3D relative extruded in SIG</td>
<td>3 Geolocation 3D synthésis</td>
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<tr>
<td>Laser or photogrammetry survey</td>
<td>1 geolocation</td>
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<tr>
<td>CAD map</td>
<td>1 Select &amp; quality</td>
<td>!! to navigate in point cloud (Geoverse)</td>
</tr>
</tbody>
</table>
# Uses case and 3D technology

<table>
<thead>
<tr>
<th>Use case</th>
<th>Work function</th>
<th>photo</th>
<th>Laser, photogrammetry</th>
<th>2D CAD</th>
<th>2D SIG</th>
<th>3D CAD levels</th>
<th>3D SIG extruded</th>
<th>3D Wired SIG</th>
<th>3D BIM</th>
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<tbody>
<tr>
<td>Shape calculation</td>
<td>Asset management</td>
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<tr>
<td>3D referential geodatabase, sites connection. Equipment and way</td>
<td>Asset &amp; equipment management</td>
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<td>Passenger map database for indoor routing</td>
<td>Commercial</td>
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<tr>
<td>Virtual visit or travel scheduling</td>
<td>Equipment management</td>
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<td>Flow simulation in space</td>
<td>Project, conception</td>
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<td>Checking templates. Near quay and trains</td>
<td>Engineer, asset management</td>
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<td>Simple site asset management</td>
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<td>Intelligent site management</td>
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<td>Safety, emergency simulations</td>
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<td>sport &amp; health in the subway. Accessibility</td>
<td>Accessibility</td>
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<tr>
<td>Ambience and environnement settings</td>
<td>Asset management</td>
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<tr>
<td>Passenger comfort (sound, radio, lighting, visual)</td>
<td>Commercial, innovation</td>
<td>+</td>
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Third experiment: Sound cards.
A linear sound approach of path, agnostic or without infrastructure for blind persons

GIS for MODELS and MAP

RATP/ACCESSIBILITY
THIM laboratory Paris 8 university
URBILOG company
Accessibility: the sound card project for blind and others persons. Goals

- A simple mobile application with one touch ergonomic, hand free, in the pocket with headsets and with a vocal description of indoor travel.

- Increase the autonomy of passengers and universal design thinking. Profiling the accessibility with users needs and extend it to foreigners and tourists.

- A pivot grammar with seven segments based on a topological modeling spaces obtained from map. A grammar which could be translate in other languages. A safety way for exchanges indoor network map?

- A multimodal station with several line connections. Indoor routing to entrances/exits, connections or other modes.

- Three stages. Audio guide without radio beacon. Mobile signature sensor track for characteristics steps (stairs) and location with radio tags.

- A low investment cost for a wide deployment.
Bastille
2D/3D level map

Passengers spaces
Passengers Flow
Stairs, services extraction
Visibility and Voronoi 3D model
Navigation Model and topological pivot language supporting segmented grammar

Mixed use of model based on both visibility (obstacles, services and equipment.) and Voronoi (middle way in space) associated with a simple seven segments navigation grammar for each path link. Mandatory Reference descriptor from, safety sound, location information, target object, direction, distance.
Conclusions:

high cost to make as build 3D BIM. We need to find an economic model, the best way to produce it and a use case with an early adopter for a 3D referential.

Upgrade the existing 2D referential?

Point cloud could be the first stage for some use.

2D map is still the cheapest and widely available for indoor way finding.

Best model and organization to manage work and renovation on sites and the associated model of indoor way finding.

GIS the necessary territorial coherence