Are cities “smart” enough to allow AVM everywhere?

Are AVM enough to allow PT quality monitoring and service validation?

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Urban Mobility: Main Trends

- Sustainable Urban Mobility Planning - SUMP
- ITS and ICT infrastructures
- Qualification and diversification of PT services
- "Green" emerging services: ridesharing schemes, … (bike/car sharing, vans sharing, car pooling, etc.)
- Urban logistics services (last mile distribution, UCC, etc.)
- Coordination/cooperation among the involved actors
- Integration of different modalities and service interoperability
- Data integration, info and booking services,…

One Approach or Model doesn’t fit all cities…..
21 cities with more than 1 million inhabitants
180 cities between 200,000 inh. and 1 Ml
1400 under 200,000 inh.

In any case “Smart Mobility” is based on an efficient and extended Public Transport

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Public Transport Main Intervention Axes

Control of Service Reliability and Quality

- BRT-PT Corridor
- Integration
- Interoperability
- Accessibility

Within an adequate institutional framework and Public Transport service contract

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AVM Key role in PT services (not only)

Controlling and acting on regularity, reliability, headway, … service quality and performances

“Ancillary” to other systems specially for e-Ticketing
User Information and Traffic Light Priority

Fundamental for service contract monitoring allowing performances collection and reporting

Relevant role in Urban Mobility Governance and MaaS

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Some considerations:

- AVM and others PT systems (e-Ticketing, User information) are the base systems for **any Urban Mobility Governance approach**
- High role in the data **provision, interoperability** and new emerging mobile/app services
- The role of PT Operators is therefore fundamental in terms of data (quality) provider and system responsibilities
- Any **“Mobility as a Service”** initiative should involve strongly the PT Operator and Authority
- It is necessary to consider these emerging “external” aspects in the AVM procurement process

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Integrated and multimodal services

**Guarantee of:**
- **Reliability** of each system
- **Data quality**
- **Clear operation procedures**

**DATA INTEGRATION**

**Data at Regional/Urban Level**
- Journey Planner Multimodal Regional
- MIIC
- In-Time Data/Service Server for each Pilot site
- Operator for efficient distribution

**Data at Local Level**
- Time Table and real time info PT AVM
- Parking Data
- Traffic Data and other systems UTC
- DATA from Other Services Car and Bike sharing,

**Open Data**
- Commonly agreed Standardised interface (contract, term-of-use)
ITS and AVM

- Availability of a large set of ITS systems with different architectures and functions
- There is no “ICT platform” but many services, systems to be choose with respect to Towns objectives and requirements
- ITS systems usually are integrated with “a bottom-up approach” and using customized solutions which are not fully transferable
- It is necessary to adopt an ITS plan as part of the SUMP and in relation with PT services

- **AVM don’t depend directly** on the “smartness” of the city but on the service operation and stakeholders’ cooperation
- **AVM system is set up and operated** under responsibility of PT Operator or Authority (or mixed)
- AVM must planned with “network-oriented approach” for an “unitary and shared” control of the different PT services
- The **relations with the ITS level** should interest among the others:
  - User information services and devices for investment and maintenance
  - Data provision and maintenance for the upper level (supervisor) and MaaS
  - Bus priority devices, data flow and control room interaction
  - Communication Network infrastructure sharing and contracting
  - Regulation of integration aspects in the service contract (provision of fleet data, etc)
## Costs vs Benefits

<table>
<thead>
<tr>
<th>Feasibility, Design, Procurement and Contracting</th>
<th>Reduction of on street operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment, Maintenance, support services and system evolution</td>
<td>More regularity of the line (less bus insertion)</td>
</tr>
<tr>
<td>Interfacing and maintenance internal data flow and devices with the other company departments</td>
<td>Increase of service reliability and quality with impacts on users and revenue</td>
</tr>
<tr>
<td>Internal costs for system implementation, operation, training and management: control room, depots, reporting, info devices, planning</td>
<td>More efficiency for on line interventions</td>
</tr>
<tr>
<td>Data provision and interfacing external ITS systems</td>
<td>More security, less cost insurance and driver control activity</td>
</tr>
<tr>
<td></td>
<td>More transparence in contract management and more efficient planning</td>
</tr>
</tbody>
</table>

To be evaluated vs the town context and services scenario
Depending on PT service quality!!!
Depending on real-time control and day by day management

Depending on the competition among BUS and cars for the same available road space!!!!

What necessary?

Development of SUMP with priority to the PT services and identification of the suitable technologies

Sustainable Urban Mobility Plan
Clear idea of COMPLEXITY in terms of Objectives, Requirements, Organization, Operation and ..... first step--® an effective feasibility study

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Different requirements → Different functionalities

- Fleet location and monitoring
- Service regulation and interventions
- On-board security and emergencies
- Real-time information on Panels, Web, Apps

Imply different operation scenarios and technology choices

Data collection and performances reporting
Quality assurance and service validation
Tracking

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Different architecture...some indications

Full AVM
Metropolitan areas, large urban areas, BRT and main corridors

- Difference in:
  - Investment and maintenance costs
  - Installation (wiring)
  - Support services and organization
  - But also in objectives and targets

Able to guarantee:
- Service reporting
- Data for info services (partially location info)
- Relevant role of driver, high operational procedures, etc

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Some considerations at PTO/PTA level

PTA/PTO must fully understand the operational objectives of the system that will be brought into their organisation.

Operational requirements and organization structure must lead the process and influence the technology solutions and choices.

At least attention needs to be paid:

• to define functionalities and overall system cost (investment and management)
• how to manage the implementation phase and needed profiles
• to guarantee the transition to new AVM management and staff training
• to define performances indicators and system sign-off procedures
• how to extract knowledge from the huge AVM data and taking decisions

The relevance of the quality in AVM data

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Relevance of AVM data and quality

Contract/Planning Quality

AVM

High performances of AVM system is the basic condition for guaranteeing the service performances

But not sufficient!!

Service Validation & Contract Management

Feedbacks for re-scheduling

SERVIC E REPORTING

Real time info

E-ticketing

Security

PT Priority

Supervisor

Operation Quality

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...Real Time Information (Web, Smartphone or Tablet)

- bus monitored rate
- reliability of time estimation of bus stop
- accuracy of bus location
- availability rate of bus stop devices
- availability rate of on board system

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• Definition of target value for each index
• Definition of data collection procedures for the compliance with the target values

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Service reporting and validation

**Technical Problems**
- Failure blocking on-board system running
- Failure in communication board-control centre, etc

**Operational Problems**
- Vehicle assignment;
- Change of vehicle assignment for failure, etc

**System performances**
- Bus monitored rate
- Rides monitoring rate
- Availability rate of on-board device etc

**Service reliability indicators**: availability of buses in service, travelled vs planned km, performed vs planned trips, delays at terminal or stops, etc

GPRS/UMTS/HSDPA

Control Room

Server Room

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### APM Provider Control Centre

<table>
<thead>
<tr>
<th>Category of generating factor</th>
<th>Generating factor</th>
<th>Problem occurring</th>
<th>Required Actions on AVM reported data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>Failure blocking on-board system running</td>
<td>Lack of data</td>
<td>Use planned data</td>
</tr>
<tr>
<td>Technical</td>
<td>Temporary failure of communication with central system</td>
<td>Lack of real-time data</td>
<td>Use of off-line data collected by the onboard T Ex-post certification of positioning and delay</td>
</tr>
<tr>
<td>Technical</td>
<td>AVM failure in identification of bus on the service</td>
<td>Lack of on-board data on vehicle positioning and delay at timing points</td>
<td>Use of off-line data collected by the onboard T Ex-post certification of positioning and delay</td>
</tr>
<tr>
<td>Technical</td>
<td>Inconsistent geo-located data of network nodes (in service programming)</td>
<td>Lack of on-board data on transits at network nodes</td>
<td>Use of off-line data</td>
</tr>
<tr>
<td>Operational</td>
<td>Failure assignment of bus to next service</td>
<td>Lack of on-board localization data on operated service</td>
<td>Use off line data Reporting of positioning data</td>
</tr>
</tbody>
</table>
Is AVM smart enough for service validation?

Collected data set itself is not sufficient to comply the contract

- Incongruence in different data reported tables (related to the same event) “single DB source of truth”
- **Poor flexibility** and customization of “standard” reporting tool
- **Lack of standardized** methodologies for data mining and analysis (definition of validation criteria)
- **Poor compliance** to usability requirements

But in any case **operational events** affecting data quality are out of the responsibility of AVM system performances

Validation process:
- Activity partially manual performed
- Activity performed on “sample”
- Use of significant company resources and timing

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Steps forward !!!

- **Verifying** system performances in realization stage and after for sign-off the system
- **Monitoring** system performances during the day by day operation and maintenance
- **Validation** performances respect the system contract and payment steps

A specific Validation Module should be defined and requested in the procurement!!

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PT services and integration with the overall urban mobility plan (SUMP)

Data Certification and Service Validation

SERVICE CONTRACT
(competitive tender or direct award)

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Some considerations

- AVM are already **consolidated** for the main area of security, info, control, but **must be enhanced** for reporting functionalities
- AVM **feasibility study** it necessary for defining the most suitable solutions vs real service requirements
- AVM procurement should define clearly **system and quality indicators** and related target values. Guideline are necessary
- AVM **should not be ancillary** to the acquisition e-ticketing or other ITS
- AVM “**data and responsibility” level** should be defined in the service contract between PTA and PTO (specially for info services)
- Common **tool** for contract/service quality monitoring and **validation**:
  - PT Operator and PT Authority **may use the same tool**?
  - Providing a certain level of transparency between the contract actors in order to reduce **conflicts** and increase benefits
  - Guarantee the quality of data for the **integration level and info services**

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More information on the validation module at http://www.memexitaly.it/en/certinfomobilita-2/

Recent technical paper “The role and potential of an automatic certification to improve validation of operated AVM Public Transport services” soon at http://www.memexitaly.it

THANKS FOR THE ATTENTION
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