Implementing ITS for BRT: considerations and recommendations

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Overall objective of the webinar

What this webinar is going to address today
Contents of the webinar

- ITS market: approach from provider/demand side
- ITS supporting BRT operation: wide range of solutions
- BMS/AVL (Fleet Monitoring) system and e-ticketing
- Approach to ITS design and key choices
- Relevance of the feasibility study
- Process complexity: contract, implementation and operation
- Some conclusions / remarks
The actors in PT service chain

**PT AUTHORITY**  
**PT Service**  
**PT OPERATOR**

- **Planning**
  - Service KPI assessment
  - Service Integration

- **Scheduling**
  - Reporting
  - Data analysis and mining

- **Operation**
  - Improve reliability
  - Improve accessibility
  - Information
  - Service Interoperability

**ITS**

**SYSTEM PROVIDER/OFFER**
Lack of **understanding/in-depth analysis** of PTA/PTO needs

Poor “problem solving” approach

**Offer of many products** without complete awareness to local requirements customization

**Underestimation of costs** and timing of the realization

**Difficulty in integration** of third-party systems, etc.

**Poor coordination** of sub-contractors
OVERESTIMATING THE ROLE AND BENEFITS OF **ITS**:

"... ITS can immediately **support new services** for end-users and stakeholder"

"... ITS will **increase performances, decreasing, resources/investments resulting in cost savings**

"... ITS **allows plug&play** solution for data/services integration"

"... fast to realise and easy to manage with “light” organization and operation"

- **Expected** **ITS performance** and **benefits** sometime **are partially achieved**
- **Time** for implementation is often **longer** than planned and **costs higher**
- **ITS need an appropriate feasibility study** accompanied by the necessary organizational and operational measures
ITS for BRT

Many SOLUTIONS and CONSOLIDATED PRODUCTS

- Fleet monitoring and management systems (BMS/AVL, etc.)
- Fare Collection System and Integrated Payment
- Customers information systems pre/on trips on various channels (panels, audio, SMS, web portal and smartphone)
- Surveillance Systems, Safety and Security solutions
- Priority Systems
- Back-office / Management Systems

ONE SYSTEM DOESN’T FIT ALL SERVICES AND REFERENCE CONTEXTS

FUNCTIONALITIES TO BE ADAPTED TO LOCAL OBJECTIVES AND OPERATIONAL PROCEDURES
Fleet Monitoring = AVL ↔ AVM ↔ BMS
Fare Collection Systems

Stockholm  Paris  Las Vegas  Rio

Yancheng  Chengdu  Bogotà
On-road / on-board infosystem

Infotainment

Rio de Janiero

Next stop / Line direction

Jonkoping

Rouen
System for improving security and comfort

CCTV

Video-Monitoring Control Centre in Rio de Janeiro

Fastract bus: plug and WIFI
Bus Priority systems

Nantes

Johannesburg
Design principles

AVL and e-Ticketing even more crucial for effectiveness of BRT Quality → Reliability/Regularity/Accessibility

ITS for BRT is seldom the first ITS deployed in the city but ...

they are sometimes deployed specifically for BRT with no relations with the others PT services

Key considerations from technology point of view:

- AVL, Fare Collection and User Information should be planned with “network-oriented approach”
- “Unitary and shared” Control among the overall PT services and BRT operator
Controlling and acting on regularity, reliability, headway, ... Service Quality and Performance

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

Fundamental for service contract monitoring allowing performances collection and reporting
Complexity of AVL system long deployment process

- Design phase
- Contracting process
- System implementation
- Organization and operational impacts
Design of AVL system specifications
Different requirements → Different functionalities

- Fleet location and monitoring
- Service regulation
- Real-time Users info: Panels, Web, Apps, etc
- On-board safety and emergencies
- Data collection

- CONTINUOUS CONTROL (BRT CORRIDOR)
- TIME SHARING CONTROL (URBAN BUS LINE)
- CONTROL ON EVENTS (FEEDER)

- Data consolidation and performances reporting
- Quality assurance and service validation
- Feedbacks vs planning

Imply different Organization Scenarios, Operation Procedures, Technology Choices, Costs
Key points for AVL design and functional options

- **Import of scheduled service from planning sw:**
  - Definition of data format, exchange protocol and procedures
  - Tool/procedures to check the import is complete and successful

- **Service monitoring:**
  - Procedure for vehicle assignment with planned service (Central System, drivers, Control operators) and priority rules
  - Requirements for on-board localization (polling, by events, ...)

- **Service regulation:**
  - Control Room/Events notifications
  - Management of irregular cases

- **Communication network**
  - BRT WiFi, long-range UMTS/G4/G5 as back up for BRT and primary for feeder, short range at depots

- **Reporting and data analytics**
  - For quality and KPI
  - For service contract obligations
  - For optimization of service planning
AVM design focus: the reporting functionality

Assessment of service performance

- related to the objectives of the PT Operator to improve the provided services and optimise
  - Identification/classification of data typology (i.e. reliability, vehicle diagnostics, etc.)
  - Identification of performance indicators
  - Criteria for aggregation/filtering data (i.e. per route/line, hours, days, etc.)
  - Definition of statistics elaboration
  - Data export to other back-office applications
  - Data mining (integration with data produced by other systems)

- related to contractual obligations
  - Identification of performance indicators
  - Protocol, timing and modalities data exchange to PT Authorities

- related to systems performance
Relevance of data quality produced by AVL

High performance of AVL system is the basic condition for guaranteeing the service performances

But not sufficient!
Providing PT real-time info requires efficient and reliable AVL system...

... and highly performing organization and operational procedures

**Technical Problems**
- Failure of on-board system running
- Failure in communication board-control centre
- Wrong bus location on the service
- ........

**Operational Problems**
- Vehicle assignment
- Maintenance of on-board units
- Change of vehicle for failure
- Imprecise geo-coding of bus stops
- ...
Design of Infosystem specifications
Infosystem

AVL System

Data produced by AVL

Web

Mobile

Panels
APP from PT Operator point of view
APP from PT Operator point of view

- Trip planner
- Parking info
- Ticket purchase by SMS
- Link to web site
- Mini Questionnaire
- SUMP Measures Evaluation
- PT lines info
- Bus stops info (real time/planned)
- User feedbacks
- News
- Read of Ticket
- Ride services
- Travel diary

- Pianifica viaggio
- Fermate
- Linee
- iPark Treviso
- News
- Questionario
- Biglietto
- Leggi biglietto
- Archivio biglietti
- Sito MOM
- Mini Questionnaire
- Mini Questionnaire
- Ride
- TD

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Design of e-ticketing

Focus on interoperability among different Operators
FCS: components and operational scenarios

- Smart card emission
- Selling points
- Validation
- Tickets control
- System monitoring and management
- Data collection, statistics and analysis
- Clearing

- Different organization and operational procedures among the operators
- Different systems to be integrated:
  - Accounting sw
  - Maintenance sw
  - etc.

Kindly provided by AEP/Selex Elsag
Again... more than technology

FCS system is more than choosing and specifying technologies (ITS)

ACTIONS INVOLVED:
- Revision of fare and tickets
- Definition of discounts, promotional fares/flexible prices, “new” targeted profiles
- Data for cross-related analysis with other system (O/D, improvement of PT offer, optimization of on-board control)
- Integration with AVL, background data sources and accounting procedures
- Design of promotional campaign, restructuring of marketing initiatives
- ITS maintenance
  - on-board
  - depots/terminal
  - communication network
- ...

design phase plays a key role!
FCS: the evolution over time

First e-ticketing systems
- Paper + Magnetic (multitrips) + smart cards (pass) (1980)

Cards centered systems
- MIFARE Classic, Ultralight Calypso Security keys into the devices (1990-2000)

Cloud systems

ENABLING INTEROPERABILITY

MOBILE-TICKETING
- NFC

MAGNETIC

PAPER
Spotlight on key points of the design

- Common ticket database to manage multiple vending channel
- Integration with accounting system
- Security managed by third party and outside the code (security keys). **Not in hands of IT provider**

*In particular for interoperable systems:*

- Definition of commercial rules/agreements among Operators
- Definition of processing rules
- Definition of “private” or “hared” data level
- Definition of access rights for reported data and statistics
- Definition of clearing rules and procedures
Integration with other city systems – Towards MaaS
Priority system

**Key elements:**

- **Architecture**
  - centralized/de-centralized/Mixed solution

- **Priority strategies:**
  - unconditional/conditional (based on vehicle status)

- **Technological solution:**
  - physical devices installed on the road
  - direct communication between vehicle and traffic light
  - communication between AVM and UTC Central systems
**Direct Connection**

**Priority Policy**

**Data Flow between Centers:**
- Bus identification number
- Junction Identification number
- Line
- Bus state (in orario/in anticipo/in ritardo)
- Priority for each lines
- Timing of priority request to UTC by AVL
AVL, e-Ticketing, User information are **the base systems** for any MaaS initiatives

- **The Transit data are relevant for any modes integration**
- **The role of PTO is fundamental** in terms of open data, system responsible and services provider

- MaaS must involve strongly the PT Operators/Agencies
Feasibility Study
A good practice: a detailed ITS feasibility is necessary

- **Objectives** to be achieved
- **Needs** of relevant actors, their role and responsibilities
- System’s **functionalities and use cases**
- **Architecture, technical requirements**
- Appropriate **management and maintenance procedures, Organization structure, resources, responsibilities.**
- **Business Model, estimated costs** for investment, maintenance and operation

**Pre-condition procurement process**
Costs vs Benefits

Feasibility, Procurement and Contracting
- Improve the quality of the service and the customer satisfaction

Investment, Maintenance, System evolution
- Attract new customers

Internal costs for system implementation, operation, staff training and management:
- Increased efficiency in internal procedures
- Reduction of staff (it depends case by case)

Create and maintain data flow among ITS and external systems, integrating databases and
- More transparency in contract management and more efficient planning

To be evaluated vs framework conditions and services scenario
Contracting
Approaching the procurement process

- Technical criteria more relevant than the price
- Do not underestimate the resources and time required to manage the procurement
- A must: build the required coordination/links among the involved dept/staff
Contracting model and object of the procurement

- ITS contracted as “supply” or “service (SaaS)”?

Different operational scenarios and costs impacts

- In both cases, it is recommended to detail the supporting services the Contractor should guarantee, in terms of:
  - **Activities** (maintenance, on-site presence, trainings, etc.)
  - **SLA, expected outputs**, etc.
  - **Resources** to be guaranteed (maintenance staff, tickets distribution, cash collection, etc.)
Define a “step-by-step” realization:

1<sup>st</sup> step:
- “Prototype” of the system with “reduced dimensions” but “full set of functionalities” (i.e. one corridor, etc.)
- “Prototype” of the system to be under operation (avoid “lab tests”)

Following steps:
- Extension of the “prototype” towards the full required system

Verification of “all” system functionalities from the early beginning
- Facilitate the monitoring of the implementation and the application of penalties
- Smooth launch of operation and reduced operational impacts (to be more easily controlled)
- Smoother introduction of operational procedures with opportunity to tune them
- Define time of each phase with a realistic approach
Payments can be related to each implementation step and to properly defined achievements.

Achievements should be measurable in terms of outputs and performance indicators (target values).

Penalties based on:
- Delay in achieving target outputs/performance
- Lack of compliance of the outputs/real values of performances indicators compared to target values defined in the technical specifications

......... up to Contract Termination
Implementation & Operation
On Board system installation and maintenance ...
System Testing and Acceptance

Three stages process

1. Technical and Operational Responsiveness of the installations
   - OK? (YES/NO)
   - OK? (YES/NO)
   - OK? (YES)

2. Functional Tests
   - YES
   - NO

3. Performances Tests
   - YES
   - NO

Quantitative and Technical Compliance
   - OK? (YES/NO)
   - NO

Testing/Acceptance Process

[Diagram of the three stages process with decision points and flow arrows]
Performance verification - KPI for AVL system

- Availability rate of control centre
- Availability rate of on-board device
- Rides monitoring rate
- Precision of time estimation at bus stop/terminal
- Location Accuracy
- On board event notification
- Availability of data communication
- .....
Conclusions
From decision takers: what we need

- **Clear identification** of the needs, requirements and targets
- **Awareness** of the system complexity and realization process
- **Sharing of experience, benchmarking of the current practices**, benefits, and problems encountered in similar contexts
- **Balancing the role of technology** respect the operation procedures and organization scenarios
- **Detailed feasibility analysis**, including definition of performance indicators and organizational/operational aspects
- Estimation of all the **cost categories**: investment, operation, support service for implementation, maintenance, etc
- Clear definition of **testing and commissioning procedures**
- Identification of needs in terms of know-how and competencies
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