Process Steps in Busfleet Renewal Projects

A collection of examples

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1. Introduction

Project managers of bus fleet modernization programs need a structured plan that breaks down the program into manageable components and phases. Project elements like activities, outputs, timeframes and monitoring measures should be included in such a plan.

The aim of this document is to provide a diverse set of examples of how countries and cities have designed the management process of bus fleet modernization projects. The examples have been selected because they exhibit different ways of structuring a management process and because they differ on their scope and thematic issues: the country examples (Philippines and Costa Rica) deal with more comprehensive attempts to modernize Public Transport at a national level, while the city examples (Gdynia, Monza and Aachen) present the management process of specific activities, such as the introduction and testing of bus technologies.

There is no one-size-fits-all approach for managing bus fleet modernization projects. Alignment with the city or country context is always necessary. However, the good practices of others should be taken into as a source of inspiration.

2. Public Transport Reform in the Philippines

The main goal of the project is to modernize public transport on a national level by replacing old jeepneys, improving regulation and fostering industry consolidation. The project therefore aims at establishing a formalized, high quality public transport system inducing ongoing fleet renewal, a transition towards higher capacity vehicles, higher operational efficiency while significantly reducing GHG emissions. Further information about the project can be found here.

General overview

Status quo 2015	Long Term Vision
Database and Network Planning Cycle	
▪ Network and vehicle data is incomplete and outdated. ▪ Many 'colorum'. ▪ No passenger or revenue data. ▪ Operator-led evolution of network over decades but not optimum. ▪ No systematic network or service planning.	▪ An annual cycle of network and service planning that adjusts the network to changes in demand and maintains a 3-year horizon.
Industry structure	
▪ Fragmented, in individual ownership, loosely organized in cooperatives.	▪ A manageable number (less than 50) corporate operators.
Regulatory regime	
▪ Current permissive franchises do not include service obligations. ▪ All routes are shared. ▪ Franchise applications are considered in isolation.	▪ All main routes on main corridors operated by large buses under performance contracts.
Vehicle specification	
▪ Most Jeepneys over-age. Jeepneys should be replaced by more efficient vehicles. ▪ Jeepneys are assembled in informal workshops. ▪ Vehicle inspection is ineffective.	▪ All main city routes operated by large purpose-built buses of at least 10 meters. ▪ Specifications progressively increased to phase out old, small, and low-quality vehicles.
Fare & revenue	
▪ Fares set by LTFRB balancing viability and affordability. ▪ Manual cash fare collection.	▪ Recovery of operating costs from revenue to be maintained. ▪ Common electronic fare collection system covering all modes.
Infrastructure	
▪ Few depots. ▪ PUV maintenance and parking mainly on-street. ▪ Jeepneys stop on demand, few designated stops.	

Detailed project outline

Phase 1 (2015 - 2017)	Phase 2 (2018 - 2020)	Phase 3 (2020 - 2025)
Database and Network Planning Cycle		
Objectives		
▪ Understand the structure, composition and performance of the jeepney industry in order to plan interventions.	▪ Operators to report trips, passengers, revenue. ▪ Set up network computer model for analysis and planning. ▪ Establish team of network planners.	▪ Complete the first annual planning cycle.
Measures		
▪ Compile a database of PUV routes, vehicles, owners, ridership, revenue. ▪ Identify routes that can recover costs. ▪ Complete the first network review. ▪ Plan the initial 'rational' route network.	▪ Electronic ticketing system to produce route loadings, passenger O & D data, revenue. ▪ Electronic data to be supplemented by surveys. ▪ Select computer model, input data and calibrate model. ▪ Use model and other measures to develop network.	▪ Input data measures how far services meet demand. Network and service adjustments are drafted. Operators are selected, contracts awarded.
Output		
▪ List of data to be complied by DOTC and date of completion.	▪ A fully commissioned model capable of measuring demand and evaluating alternative network development scenarios. ▪ A capable planning team to conduct the planning process.	▪ An annual route development plan is produced with 3 – 5 year horizon, containing route network, fleet size, industry composition, infrastructure, costs and fares.

Phase 1 (2015 - 2017)	Phase 2 (2018 - 2020)	Phase 3 (2020 - 2025)
Industry structure		
Objectives		
▪ Make the cooperatives accountable for the management of their routes as a first stage of consolidation. ▪ Shift demand from jeepneys towards big buses.	▪ Give 5-year notice that franchises on main routes will only be issued to corporate bodies operating large buses.	▪ Provide incentives to encourage a process of amalgamation and takeovers of bus operators to form larger fleets.
Measures		
▪ Cooperatives to hold contract and be accountable for route performance. ▪ Create incentives to form companies. ▪ Encourage new corporate investment in urban bus fleets.	▪ Vehicle owners under main-route franchise to be notified that there is no right of renewal and that on next expiry, renewal of the franchise may be refused or extended for a shorter term. ▪ Franchises with a corporate structure, committing to invest in larger vehicles may be eligible for a performance-based franchise contract.	▪ Government will augment the normal consolidation process in the bus industry through direct incentives, so the stronger operators take over weaker operators. ▪ Greater economies of scale realized with larger fleets of full-sized buses.
Output		
▪ Draft cooperative statute, specifying management functions. ▪ Scheme of incentives to attract investment in urban buses.	▪ Some main routes to be operated by larger buses under franchise contracts that contain service obligations.	▪ Move towards target industry structure of less than 50 corporate operators of large buses. ▪ Jeepneys organised into cooperatives remain on minor routes.
Regulatory regime		
Objectives		
▪ Provide a basis for DOTC to control jeepney and bus services, and to realize its network and service plans.	▪ First, award commercial contracts to viable routes. ▪ Later, award gross cost contracts to routes needing subsidy.	▪ All main routes governed by new franchise contracts with performance obligations.

Phase 1 (2015 - 2017)	Phase 2 (2018 - 2020)	Phase 3 (2020 - 2025)
Measures		
▪ Announce transition to a single limited-term, franchise contract for each route, with service obligations. ▪ Franchises to be awarded by quality competition.	▪ The first route contracts will be commercial contracts for major routes identified as cost recovering. ▪ Later, as capability strengthens, gross cost ('pay by km') contracts will be offered by competitive processes.	▪ A 5-year transition program is completed whereby main route franchises are replaced on expiry by performance contracts, and jeepneys are replaced by buses.
Output		
▪ Draft franchise contract with performance obligations. ▪ Draft amendments to regulations.	▪ Transition to large buses will parallel the transition to performance contracts.	▪ All main routes are operated by corporate operators under performance contracts.
Vehicle specification		
Objectives		
▪ Gradually improve the efficiency, accessibility, comfort and safety of jeepneys. ▪ Improve the safety and environmental impacts of jeepney vehicles.	▪ Selection criteria for award of exclusive route franchise contracts to include vehicle type and quality. ▪ All public transport vehicles to comply with road worthiness requirements. Vehicle inspection capacity to be increased, higher technical standards applied. Old and unfit vehicles de-licensed.	▪ Target promotion of main routes operated by large urban buses. ▪ Stringency of type-approval criteria and fitness tests to be progressively raised.
Measures		
▪ Give advanced notice of progressive raises of vehicle specifications over 5 years through a transition plan to phase out jeepneys on main routes. ▪ Specify progressively higher standards for type-approval, including emissions, capacity and safety = 'modernisation'.	▪ The transition to larger, purpose-build buses will be gradual while the risks of investment in urban buses are reduced. ▪ A progressive set of minimum specifications will be drafted, with emphasis on safety, accessibility and low environmental impacts. ▪ Reform of the MVIS system is in progress.	▪ Bus specifications continue to be progressively refined, with high capacity, low floors and high environmental standards. ▪ PT vehicles to have priority in limited testing capacity. ▪ Measures to ensure integrity of testing procedures.

Phase 1 (2015 - 2017)	Phase 2 (2018 - 2020)	Phase 3 (2020 - 2025)
	▪ Safety dimension and environmental standards must be progressively increased and strictly applied. ▪ Removal of sub-standard vehicles is an element of the transition process. ▪ Integrity of the inspection process to be monitored.	
Output		
▪ A progressive set of minimum specifications for public transport vehicles. ▪ A progressive set of parameters to be subject to 6-monthly inspection (MVIS)	▪ A substantial proportion of the fleet will be larger modern buses. ▪ A progressive set of parameters to be tested by regular 6-monthly inspections (MVIS). ▪ All PT vehicles to be tested.	▪ All main routes are operated by high specification large city buses. ▪ All PT vehicles to be tested twice yearly under international standards.
Fare & revenue		
Objectives		
▪ Ensure jeepney services remain commercially viable. ▪ Improve passenger convenience, enable fine-tuning of fares and to collect operating data.	▪ Electronic fare collection adopted by large corporate bus fleets. ▪ Fares continue to be set with reference to costs and affordability.	▪ Introduce more flexible, cost-related, market-sensitive fare scales. ▪ Maintain cost recovery target, preferably 100% of operating costs. ▪ Operators under commercial contracts to have some freedom to set targets.
Measures		
▪ Investigate technical and organizational options for common electronic ticketing system.	▪ DOTC takes the lead to establish an electronic fare collection system for all modes. ▪ Railways and corporate bus operators are the initial users.	▪ Fares to be used as an incentive to use buses, to avoid peak hours. ▪ Fares to be integrated between modes without interchange penalty.

Phase 1 (2015 - 2017)	Phase 2 (2018 - 2020)	Phase 3 (2020 - 2025)
	▪ Operators with commercial contracts to have some freedom to fine-tune to reflect local market conditions.	
Output		
▪ A basic technical standard for a common ticketing system.	▪ A basic technical standard, and a management agency in place for a common ticketing system.	▪ More flexible fares enable commercial operators to market services and recover costs, and minimize the need to subsidize services.
Infrastructure		
Objectives		
▪ Provide facilities for the parking and maintenance of jeepneys, thereby improving safety and reduce volume of vehicles parked on-street.	▪ Bus stops protected from obstruction established at 500m intervals along all main routes. ▪ Bus lanes to be established where bus flows exceed 100 bph.	▪ Target bus speeds to be set and monitored, remedial bus priority and other traffic management measures to be introduced where speeds fail to reach target.
Measures		
▪ Government to identify sites for depots and assist operators to acquire land. Government to review availability and capacity of urban bus terminals and provide where required.	▪ Design prominent bus stop road markings and flag poles and install at designated stops. Specify road infractions to stop other vehicles at bus stops and enforce with on-bus camera. ▪ Designate a target bus speed for main corridors and establish bus lanes where congestion reduces speeds below the target. Bus lanes demarcated with distinctive signage and physical demarcation.	▪ A target running time is set for each route in the contract. The operator is indemnified by the authority for revenue loss and additional costs due to traffic delays. ▪ The authority commits to take all reasonable measures to give priority to buses on main corridors.
Output		
▪ DOTC to identify sites for jeepney depots.	▪ DOTC to identify sites for jeepney/bus depots. ▪ Buses' capacity, productivity and reliability to be enhanced by priority used of road space.	▪ Predictable running times make services reliable, cost-effective and attractive to users.

3. E-Mobility in Costa Rica

The strategy of the MiTransporte project is to improve the legal and institutional framework for implementing the national transport and climate agenda. In cooperation with various actors, the project supports replicable and scalable measures on sustainable urban mobility and energy efficiency in the sector. The project focuses on the deployment of e-buses in Costa Rica, which also includes purchasing the units, facilitating operation and monitoring, as well as removing barriers in the transition towards electric buses.

Component 1: Analysis and mitigation of barriers & establishment of an electric mobility consortium
Justification
There are a number of risks and barriers associated with the mass deployment of e-buses. These include regulatory, commercial, financial and operational. As a result, strong inertia exists to continue with the operation of conventional and inefficient diesel buses. In order to achieve the massive upscale of e-buses, it is necessary to identify and analyze the regulatory, commercial, financial and operational barriers in order to develop mitigating measures and reduce any potential risk for their operation. Component 1 will establish a consortium of key public and private actors, through a public-private partnership (PPP), which will be the platform to empower the deployment of e-buses in Costa Rica, as well as project components. It will start by activating an ad hoc working group with relevant stakeholders to jointly define the architecture of the PPP and then launch it. The consortium will have the mandate of agreeing on the strategic measures required to accelerate the uptake of e-buses. The consortium will provide strategic guidance and oversee the successful implementation of the rest of the components of this project. It will be composed of key national ministries (i.e. Environment and Energy, Transport and Finance), business associations, and associations of bus operators, main electric utilities and technical institutions and civil society.
Activities
▪ Engage with relevant stakeholders (i.e. lead public bodies, bus operator associations, electric utilities, academia, NGO's, etc.) through an ad hoc working group to jointly establish a public-private partnership (PPP or consortium) ▪ Define the architecture of the public-private partnership (e.g. purpose, composition, distribution of roles, governance structure, communication and exit strategy, etc.) and launch of the consortium ▪ Analyze and mitigate barriers for e-buses deployment in Costa Rica (legal, regulatory, commercial, operational, capacities, political, etc.)
Timeframe
12 months
Deliverables
▪ Formal launch of a public-private consortium ▪ Comprehensive communication and awareness raising strategy to raise the profile of the project ▪ Report on analysis of barriers and development of mitigation alternatives for e-bus deployment in Costa Rica
Cost
US$ 150,000

Component 2: Evaluation of commercial operating conditions of e-buses

Justification

There are currently a number of competing technologies for e-buses and charging systems with differing performance levels for different conditions and routes. Given the novelty of e-buses in Costa Rica and the region, it becomes necessary to inform decision-making with real life examples while providing data to feed in-depth analysis. Currently, the Public Service Regulation Authority (ARESEP) is in the process of defining a tariff for e-buses. Similarly, electric utilities and academia are modelling the impact of electric mobility on the Costa Rican grid. Meanwhile, bus operators are unsure of the profitability of e-buses in Costa Rican conditions.

Component 2 will deploy a pilot project to introduce e-buses into existing commercial bus lines to evaluate their technical performance, profitability and to provide knowledge outcomes for subsequent massive deployment.

Activities

- Select most appropriate commercial bus lines for e-bus pilot testing with participation of private sector
- Identify most suitable e-bus technology and charging system options
- Design specifications for procurement of e-buses and charging infrastructure according to selected commercial bus lines
- Evaluate performance of e-buses in selected commercial bus lines
- Assess results from pilot testing, compile lessons learned and recommend considerations for subsequent deployment

Timeframe

10 months

Deliverables

- Technical report on bus line selection for pilot testing
- Specifications for procurement of e-buses and charging infrastructure
- Assessment of results, lessons learnt and provision of technical recommendations for e-bus deployment

Cost

US$ 200,000

Component 3: Capacity building of relevant stakeholders

Justification

Component 3 will focus on building capacities of local stakeholders by addressing three different audiences: (1) bus operators, who face a steep learning curve to successfully operate the new technology of e-buses and charging stations; (2) decision-makers, especially public officers who are in charge of setting and implementing policy; and (3) citizenship, being the final consumers of public transport. Component 3 will build upon the outcomes from pilot testing under Component 2 in addition to experiences from pioneering countries in Latin America in electric mobility (e.g. Chile, Finland, etc.).

Activities

- Workshops (and related materials) to provide hands-on training to bus operators and service providers, based on outcomes from pilot testing to overcome operational barriers for the adoption of electric buses.

- Provide training to decision-makers to promote upscaling of e-buses based on experiences from leading Latin American countries and abroad
- Raise citizen awareness about the positive impacts of e-buses

Timeframe

8 months

Deliverables

- Report with main outcomes of (1) workshop to bus operators and services providers and (2) training to decision makers
- Social media campaign to raise awareness about the positive impacts of e-buses

Cost

US$ 100,000

Component 4: Development of financial instruments to promote e-bus deployment

Justification

One of the important barriers to achieve the massive uptake of e-buses in public transit systems is the upfront costs associated with their purchase. Consequently, it is important to define a financial instrument to promote e-bus purchase by local bus operators. Component 4 will focus on assessing the impact and cost-effectiveness of different financial instruments (e.g. soft loans, subsidies, leasing of critical components, etc.) with the aim to select and establish the most appropriate to the Costa Rican context. Component 4 is expected to be implemented in close collaboration with financial institutions and bus operators.

Activities

- Assess impact and cost-benefit analysis to select most appropriate financial instrument based on identified barriers for e-bus deployment
- Economic assessment including a forecast cash-flow for private operators
- Design the architecture of selected financial instrument through active engagement with financial institutions and bus operators
- Define the financial instrument together with financial institutions and bus operators
- Development of potential financial proposals as required by government (e.g. Green Climate Fund)
- Develop environmental and social assessments needed to mobilize required levels of finance (linked to 4.5)

Timeframe

8 months

Deliverables

- Design of the financial instrument most appropriate in Costa Rican conditions
- Development of at least one complete financial proposal to the Green Climate Fund (including all feasibility assessments) related to e-buses in Costa Rica

Cost
US$ 200,000
Component 5: Empowerment of an e-Mobility innovation platform
Justification
Electric mobility opens up the opportunity to provide new services and products. Hence, it is important to facilitate an enabling ecosystem for business opportunities and high value jobs to flourish. This component focuses on the creation of an innovation platform to empower the uptake of electric mobility in Costa Rica.
Activities
▪ Empower an e-mobility business ecosystem through the elaboration of a strategic 5-year plan to promote electric mobility innovation and related business opportunities in Costa Rica ▪ Identify services and business opportunities to foster Costa Rican startups related to electric mobility ▪ Design a mechanism to promote innovative local startups and new ventures through the provision of support to reduce risk through testing and prototyping
Timeframe
8 months
Deliverables
▪ National plan to promote electric mobility innovation and related business opportunities in Costa Rica ▪ Design of a mechanism to promote innovative local start-ups and new ventures related to electric mobility
Cost
US$ 100,000

4. Trolleybus in Gdynia

Source:
http://civitas.eu/sites/default/files/converting_regular_buses_to_clean_buses_dynamo_brochure_web.pdf

The CIVITAS project in Gdynia focused on the conversion of conventional diesel buses into trolleybuses in order to improve the attractiveness of public transport in the city. Traditional high-floor buses therefore were manually converted into low floor trolley vehicles to provide a sufficient level of comfort for all passengers, including people with disabilities.

Phase 1: Documentation and preparation

Without preparing proper technical documentation one cannot professionally convert a bus into a trolleybus. Technical guidelines need to be followed:

- all significant decisions taken should be based on experts' opinions in the fields of: electro technology and electronics, mechanics, vehicles, marketing and communication and economics
- the type of a bus selected for conversion should be clearly specified
- the type (drive and auxiliary systems) and location (i.e. inside, on the roof) of equipment to be installed have to be defined

A schedule of the investment steps is recommended. Such a schedule is useful for companies performing the conversion in-house, as well as, in case of commissioning the conversion to an external operator.

Phase 2: Mechanical work

The first stage of the mechanical work is dismantling the obsolete elements of the combustion power transmission system in a trolleybus including the engine, gear- box, cooling system and a fuel tank (if there is one). The second phase is the modification of the engine space by removing unnecessary construction elements and dividing it into 3 parts for the new elements of electrical installation.

Some basic requirements concerning converted trolley- buses in Gdynia are that they should have three doors, at least four hopper windows and a step less floor throughout the vehicle. A coachwork used for conversion into a trolleybus should not be older than 10 years for endurance reasons.

Phase 3: Installing electrical units

After the dismantling phase, the coachwork must be prepared for incorporating the electric drive. Conversion requires building the roof with such elements of electrical machinery as: current collectors, starting and braking resistors, a lightning protector, a static converter (in case of trolleybuses with power electronic machinery), and a traction inverter (if necessary).

The next step is to assemble the main elements of 600 V installation. As trolleybuses can be fed from the contact system of a voltage rating of 600 or 750 V, it is necessary to make 600 V cable outlets. Also the new 24 V wiring control system is installed.

The last part of electrical phase is the installation of control system elements, the majority of which in PKTs case, are produced in-house. All steering elements working with a traction drive control system have to be equipped with insulation for contact system full voltage (600 V).

Phase 4: Setting the trolleybus in motion

This is the stationary and movement test phase. Before the deployment of the vehicle, numerous tests need to be conducted, including the ones concerning 600 V installation.

Phase 5: Trolleybus registration

The list of formal requirements in the process of converting a bus into a trolleybus.

- purchase a second hand bus
- re-register the bus (still as a bus) under the new ownership
- convert the bus into a trolley bus
- obtain a positive expert opinion
- obtain temporary admittance to service for the duration of the test period
- obtain positive test results at a vehicle inspection station
- register the converted vehicle as a trolleybus
- obtain a positive result of extended tests.

5. Hybrid Bus in Monza

Source: http://www.civitas.eu/sites/default/files/hybrid20bus20in20monza.pdf

The city of Monza, Italy, developed a study on the delivery and the test of a hybrid bus in the city. After the 18-month test run, the results showed that the hybrid bus had a higher mileage than a comparable diesel bus, emissions were significantly reduced, and public awareness was successfully raised. The case study of Monza is a very useful insight to especially understand arising problems when testing new bus technologies.

Analysis of market and contacts with hybrid bus producers and PT companies (M13 – M16)

Actual market has been deeply investigated through contacts with hybrid bus suppliers and Italian PT companies which have already equipped their fleet with hybrid buses in order to define which technology is more suitable at the moment.

Defining the type of hybrid bus to be purchased (M17 – M23)

A study has been conducted in order to investigate technical characteristics of different brands and models offered by producers. Exploiting outcomes of the study the most suitable bus to be procured, according to the needs of the city of Monza and to the available technology at the moment, it has been decided to test the VanHool in series hybrid bus, model A330Hyb in particular. The reason for choosing Van Hool can be summarized in the following points:

- the streets of the town of Monza and of neighboring ones are in some parts difficult to drive through because they are "historical" and show a narrow roadway, so 18 meter buses cannot be tested;
- in some areas of the town the bus has to make just one maneuvering because it cannot reverse. For this reason the turning radius declared in technical sheets of the different models proposed by retailers has been taken into consideration. Not all the buses could satisfy this need;
- the chosen vehicle should transport the highest number of passengers in comparison with diesel buses. Thus excluding 18 meter buses, which would be barely adaptable to the peculiar streets of Monza, the capacity declared by retailers became a key decision criterion.
- NET, the PT company which is actually managing the PT service in Monza, can rely on a garage located in TPM premises in Monza where the fleet running in the city is serviced; even during the demonstration phase the garage should be able to give emergency assistance and also ordinary maintenance suggested by the retailer itself. This is why it has been chosen to test an electric/diesel hybrid bus since mechanics have already experienced with such type of mechanisms.
- LPG, methane, and hydrogen buses have been rejected: it was not possible to build in TPM premises tanks suitable to contain any kind of gas (LPG or methane) in this location: the supply in service stations would not be easy because vehicles would be forced to travel for many kilometres to find one; travelling with an empty tank would be very expensive due to higher costs of time and staff.

Leasing of the hybrid bus (M24 – M31)

This stage will involve the purchase of one hybrid bus, and the completion of administrative accomplishments (registration, insurance etc.). According to the results of the study, a Van Hool A330 Hyb should have been leased, since technical characteristics and delivery times had been considered the most suitable for the city of Monza and for ARCHIMEDES timing. The delivery of the bus was scheduled by January 2011 and put into operation after administrative accomplishments in March 2011. During meetings between NET (who is supporting the demonstration stage of the measure) and Van Hool, Van Hool communicated they would have been able to deliver the bus only in September/October, so too late according to ARCHIMEDES schedule. In order to achieve the milestones scheduled for the measure, it was then decided to investigate the marketplace in order to find another suitable hybrid bus to test in replacement of the Van Hool bus: it has been identified the IVECO Citelis Hybrid bus. After being decorated with CIVITAS and ARCHIMEDES logos, the bus has been presented to the city and to the press on May 3 2011. It has also been presented during Monza Consortium Meeting in May to all delegates of the cities participating in ARCHIMEDES.

Operation of the hybrid bus (M32 – M36)

The new bus started to be operational on route Z206, one of the most frequented PT lines in Monza, which connects the eastern part of the city, densely populated, to the city centre, the Park, the hospital and the University.

The line Z206 is split into two complementary lines which share the same route for the first part of the journey, starting from hospital until Via Buonarroti towards the eastern/south- eastern area of the city: at this point the traditional Z206 (indicated in Figure 1 with the black line) connects the Hospital and the University with the eastern area of Monza (Via Borsa, Via Luca della Robbia, Viale Sicilia and Via Pompei), and Z266 (indicated in Figure 1 with the blue line) connects the Hospital and the University with the south-eastern area of Monza (Via Buonarroti and Viale delle Industrie, where the prison is also located).

Each part of the line has a frequency of 20 minutes all day long from Monday to Saturday (which means every 10 minutes for the common section, since the timetables are staggered); additionally in peak hours there are periods where the line frequency is 10 minutes (5 in the common part of the journey), whereas on Sunday it is every 30 minutes (15 in the common section).

Drivers' training (M33)

Due to the innovative equipment of the hybrid bus compared with rest of the conventional NET fleet, it has been necessary to plan training for both drivers and maintenance technicians.

The first training stage has involved the managers of the workshop and one driver who is usually employed to train new ATM/NET drivers, in order to train him about driving techniques for this particular vehicle. Staff from IVECO, supplier of the hybrid bus, was employed in this training stage, during which a general explanation of the particular characteristics of the bus and its use were presented to NET's staff. The training activities were held in May 2011 in NET's premises in Monza (former TPM depot) for a whole morning.

The second training stage involved specific training for bus drivers in order to have the hybrid bus operational on Line Z206. During this stage, which has involved 32 drivers, 12 two-hour sessions (1 hour for theory and 1 hour for practice) were held in May and June 2011. Other sessions will soon start in order to train all drivers employed at NET's Monza premises.

Technical problems during demonstration stage (M38 – M44)

After summer 2011, the hybrid bus has presented a number of technical problems. Since the hybrid bus delivered in Monza by IVECO was a prototype originally intended for the French market, some interventions have been necessary to upgrade the vehicle and make it suitable for registration under Italian law. Furthermore, some minor adjustments have been realized to make the vehicle match the ATM/NET fleet standards. First of all, the bus is not air-conditioned and it has been necessary to change windows in order to have a better ventilation of the interior of the vehicle, since in hot days the temperature was too high for the journey to be comfortable.

Interventions on the electrical system of the vehicle, aimed at both improving the performance of the bus and at adapting it to ATM/NET's standards, have been made. More specifically:

- the stop booking system resets when the bus is moving and not when doors open and close at the bus stop. This implies that, if a bus stop is booked and the bus halts before reaching it (for instance for a red traffic light) and then starts moving again, the system resets and the stop has to be re-booked;
- the plug in the battery compartment is 24 V and different from the kind installed on ATM/NET fleet;
- electric displays of booked stop are present only in the front and in the rear of the vehicle, but they are missing in the centre; moreover, their functioning is connected to the opening of the second door only;
- buzzer of booked stop is different from the kind installed on ATM/NET fleet /with three bips);
- sealing of hatches for ventilation in the vehicle is activated simultaneously when the start and stop system activates;
- doors' blocking system when the bus is moving has been activated

Other interventions have concerned:

- electric displays of booked stop have been translated from French to Italian;
- front tow hook and fuel filler have been modified according to ATM/NET's standard
- behind the driver's seat the niche dedicated to the placement of the stamping machine has been resized, since its dimensions were too small;
- the location for disabled people on a wheelchair has been equipped with seat belts and with a panel with buttons to book stops;
- labels indicating emergency exit have been positioned on side windows.

Although all these problems were solved, there were still some anomalies in the systems' management software that caused the continuous lighting of warning lights, which caused too frequent stops of the bus and consequent repairs in workshop. For this reason, in February 2012 NET wrote a very harsh letter to IVECO complaining about the frequent problems the bus was presenting, highlighting that, since May 2011, the bus had circulated only for 43 days out of 266, covering only 7.388 km. Such a situation would have involved problems with the demonstration of the measure and, more specifically, with a sound evaluation of the vehicle and of its performances.

Supply of a second generation bus (M44 – M51)

After NET complains, IVECO has immediately activated procedures to replace the prototype bus with a second generation one, which, although presenting the same technical features of the first one, has now fully entered into the production chain, so it does no longer present the manufacturing defects shown by the prototype. The new bus started to be operational in May 2012, after completing all administrative accomplishments, and will be tested until December 2012, in order to test its performances both in summer and winter conditions.

6. Hybrid Bus in Aachen

Source: http://www.civitas.eu/content/integration-hybrid-buses-towards-clean-fleet-public-transport

The CIVITAS project together with ASEAG, the mobility provider in Aachen, Germany, aims to convert the local bus fleet into environmentally friendly buses to reduce GHG emissions and noise. This project had the objective of testing and integrating hybrid buses in the city as well as introducing the first fully electric bus in Germany.

Planning and preparation

During the preparation phase the following tasks were executed:

- Revision and adaptation of current testing programme, considering better the special topographic situation in Aachen
- Definition of test phase for two further hybrid buses, one MAN and one Mercedes-Benz bus (1 solo bus and 1 articulated bus), e.g. routes, timetable, etc.
- Establishment of a database of present experiences from cities with hybrid buses covering various operational and topographical conditions
- Comparative analysis of tests: catalogue of indicators and weighting of indicators and results – establishment of a decision matrix; evaluation indicators considered the CIVITAS core indicators where possible
- Approval of leasing contracts for further hybrid buses. The rental of a EURO VI hybrid prototype bus was planned for the second half of 2013. The technical development was watched very closely. It was important to test vehicles in different variants (for example buses with capacitors or batteries as energy storage system or serial/parallel hybrid drive systems)
- Equipment of two hybrid buses and one conventional vehicle with acoustic measurement devices in order to perform specific noise and vibration measurements in the interior. In this way relevant acoustic and vibration data referring to passenger comfort was collected. The measurement campaigns pursued the time schedule of project partner ASEAG.
- Equipment of two hybrid buses with sensors and loggers for the collection of operation data (fuel consumption, driver behaviour, traffic situations, etc.).
- Rental of a Mercedes Citaro G Hybrid (articulated bus). This bus fit perfectly into the current ASEAG fleet because there was a high proportion of Mercedes-Benz vehicles. Workshop staff was very well trained in repairing this bus type and most spare parts were available in stock. Because of its technical specification the bus was very suitable for a conversion. ASEAG has been planning the upgrade into a fully electric environment so that it is possible to drive 50 km without any diesel engine.

Implementation and demonstration

In the implementation phase the following tasks were executed:

- Test operation with two hybrid buses in real conditions according to the defined test programme
- Collection (logging) of all important acoustic characteristics, regarding real bus stop arrivals and departures in scheduled operation. And limited traffic measurements in designated

areas (e.g. in traffic calm zones). In addition, reference measurements were made at the measurement noise route of the "Institut für Kraftfahrzeuge" (Institute of Automotive Engineering).

- Data acquisition of relevant acoustic characteristics regarding real bus stop arrivals and departures in scheduled operation. In addition, acoustic measurements were performed on the pass-by noise test track of the "Institute of Automotive Engineering". The major aim wasto verify the potential of hybrid urban buses in terms of an effective reduction of noise emissions. The measurement campaigns pursued the time schedule of project partner ASEAG.
- Collection (logging) of data concerning the fuel consumption and the driver behaviour (driving style) was conducted
- Conversion of a serial hybrid drive bus into a fully electric vehicle using a Fast Charging Station at the ASEAG home depot. This bus operated under real conditions from 2014 onwards.
- Procurement of four hybrid buses based on the evaluation results; the precondition for the procurement was the reduction of fuel consumption by at least 20%
- Procurement of five light weight buses based if benefit/cost-ratio was higher than 1.0 and introduction into ASEAG's bus fleet

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