

CORE BRIEF

Modern management and organisation of bus workshops

In the last decade, workshops of public transport companies have had to make strenuous efforts to adapt themselves to new technical, economical and sociological developments.

Although engines have become increasingly reliable and tend to need fewer interventions, overall maintenance tasks and costs have increased due to new features. Electronic and environmentally friendly equipment have emerged as priorities, along with the need for better production quality. In many companies, the “internal customer” principle has been introduced with workshops becoming financially accountable suppliers of the operation department.

This paper does not set out to draw up recommendations to members on how to design and build workshops and depots. Rather, it focus on different approaches, in order to contribute to better cost-efficiency and quality in vehicle maintenance through improved workshop and depots operation and management.

Statistical analysis will highlight the economic importance of maintenance activities and the need to streamline them as much as possible. According to local circumstances and constraints, maintenance costs, over the total life cycle of a bus, can amount to 50 to 65 % of the initial vehicle price. The organisation of maintenance is also paramount in determining the number of spare vehicles needed for full operation at peak-time. This rate can vary from 6% to 15% depending on local conditions and represents a considerable difference in capital employed.

Work planning and respect of procedures

Operating companies have to perform their services economically whilst delivering the committed quality. Consequently, they must aim at finding an optimum balance between economy and a return on capital employed. The following criteria are examples of factors to be considered.

- Reliability / costs and availability of vehicles
- Preventive (or predictive) / corrective maintenance
- Vehicle down time/ spare parts stocks

Achieving the best balance requires comprehensive overall planning of all available resources (staff, tools, infrastructure etc) and organisation of maintenance duties in relation with operation needs. This is no longer possible without using modern tools such as remote, real-time, data transmission of the technical status of each vehicle operated.

Using maintenance standards provided by manufacturers, it is necessary to establish detailed work processes with computerised support in order to allow progressive improvement of:

- On-board auto-diagnosis
- On-line transmission
- Maintenance work tracking
- Cost control



Spare Parts Management

Regular internal audits and certification support and improve such processes.

Maintenance services are unable accurately to predict vandalism or accident damage costs in this process. By their very nature, such damage occurs randomly and independent of any structured system. They are impossible to forecast.

Securing performance and quality

Increased cost-efficiency

Several strategies are available to increase productivity and thus cost-efficiency:

• Outsourcing:

Economical advantages are only achievable with strictly binding contractual commitment to vehicle availability guarantees (often expressed as the number of breakdowns in service per km). Outsourcing should preferably focus on skills available on the market and should be easy to control/monitor.

Should outsourcing be entrusted to the manufacturers, the latter can improve their own know-how and therefore also their own product.

Conversely however, close attention should be paid to the possible loss of the transport company's own skills and knowledge and to difficulties with internal staff relations.

The risk of contentious contractual cases should be recognised as these may diminish partly the advantages of outsourcing.

• Internal productivity incentive scheme

Under the right circumstances, incentive schemes can be implemented within a company. Middle management and/or workers can benefit from financial or other bonuses if yearly internal objectives are achieved. Such benefit can be granted individually or, preferably, on a team basis to foster collective improvement. These objectives need clear measurable parameters and/or quality indices such as the number of breakdowns in service etc. Incentive schemes have a limited life and effectiveness should be reviewed regularly.

• Certification

The adoption of a quality management system according ISO 9001:2000 is a strategic decision for a maintenance workshop. This International Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements. The workshop certification gives a trading advantage in competition with other workshops and where the workshop is part of a transport company it can also be a good start for the company's overall certification scheme.

Use and control of diagnostic systems

The development of computer diagnosis systems means that the operator's knowledge must be updated accordingly. In particular,

attention is drawn to on and off-line predictive diagnosis systems. The systematic application of tribological lubricant analysis is an example of an off-line system, while for on-line diagnosis, the extensive use of sensors able to register data and compare it with reference models for the vehicle is recommended.

An optimum strategy for diagnosis must be found between simple use of the driver reports and sufficient and accurate data collection for maintenance staff. Systematic recording of relevant data is very helpful provided the information to be recorded is carefully selected. The acquisition and management of too much data is counter-productive.

Control of the diagnosis system should preferably be entrusted to specialised sub-contractors with certification procedures on a cyclical basis.

Availability of spare parts

The vehicle purchase contract terms should include procedures for spare parts logistics (scaling lists, costs, delivery times etc). For spare parts related to vehicle safety, certificates of origin or the equivalent must be obtained from authorised bodies.

Request procedures for spare parts should preferably be computer-based with direct connection to the supplier.

The availability of spare parts must be consistent with an adequate rotation rate.



Access to technical documentation, drawings and graphics

The widespread distribution of maintenance documents in the appropriate language is essential and can be stipulated in the procurement contract, while respecting manufacturers' patents and industrial secrets. In particular, these should include the following:

- Description of operations
- List of necessary materials
- Maintenance deadlines
- Necessary tools and equipment
- Work and safety instructions

It is advisable to use appropriate and widely available computer backup programmes, which maintenance staff can directly consult.

Nevertheless, a simple manual structure dedicated to controlling operations, even on a sample basis, to guarantee quality and safety of operations is considered necessary.

To this aim, visual management techniques are thought to be particularly useful, with the display of tables and schematic illustrations relating to the operations to be carried out.

Staff's continuous training and safety

To be successful, a maintenance department depends a great deal

on staff quality and skill. Bus company engineering facilities must face the advent of new technologies and must organise and manage existing staff to meet the new demands.

There is no simple formula to enable maintenance departments to create high skilled and high performance workshops, but the major elements of a guideline for creating such organisations are to:

- Establish partnership between staff and management,
- Analyse the new skill demands generated by technological and regulatory changes,
- Establish the resources needed for skill development (budget),
- Prepare a maintenance training plan. It may not be possible to reach all goals in one year. A training plan can be modular and standardised,
- Create a “learning culture”. Recruit qualified instructors, collaborate with others, and create self-study packages. Increase the flow of information,
- Restructure work process and career path to give staff incentives to acquire skills and the power to use them effectively in the job,
- Publish success. Introduce a system for maintenance performance measurements. Awards and other objective recognition can increase the internal support for training programmes.

Safety has always been of paramount importance in maintenance activities:

- Workers must do only those tasks for which they are properly trained,
- All workers have to pass basic safety training,
- All workers have to use the prescribed safety equipment,
- All safety regulations and procedures have to be consistently re-examined, adjusted if necessary and respected.

Need for environmental awareness.

Fulfilment of environmental regulations is paramount in urban bus activities because:

- Relations between bus operators and public authorities are tight; be they public or private companies, they all act as a public service provider.
- Buses are running in an exposed urban environment, where under performance or failure in any environmental aspect, may be immediately detected by officials or public.
- The incentive effect that these public commitments can exert over all other users of the urban space.

Therefore, according to the particular conditions of every bus operator (existing regulations, local environmental policies or commitments, and operator’s own approach etc.), a scale of priorities emerges, such as:

- Air quality regulations (e.g. EU-Directives), requiring air quality control in urban areas and subsequent actions. Control of exhaust emissions of all buses, to ensure fulfilment of the relevant emission levels enforced at the time of every operation



Cleaning Station

starting date (clean fuels, exhaust after-treatment devices etc).

- Local noise level regulations,
- Specifications and equipment for correct environmental maintenance activities carried out in public spaces (in case of fuel, lubricants, cooling fluids leaks, tyre replacements, etc.).
- All environmental measures to be taken in workshops, such as waste and old spare parts disposal, used liquids (bus wash water, oils, coolants, etc) or handling of gases (e.g., air conditioning) and sewage disposal.
- Any other environmental requirements applicable to industrial activities, e.g. conditioning, sewage, and energy use

heating burners, air reduction, etc.

- Non-compulsory equipment, such as solar water heating cells, photovoltaic panels.

Implementing relevant norms, such as ISO 14000, imply the definition of the framework where all environmental actions to be undertaken will be specified, programmed, checked, registered and dealt with subsequently for any non-conformity that might arise.

Maintenance software

A maintenance workshop for an urban bus fleet is different from a commercial workshop open to the public

- the main goal of a dedicated workshop is to increase bus availability and reliability,
- it deals with buses along all their life cycle, and it is worthwhile to establish advanced follow-up systems that can detect failures, non reliable repairs or recurrent breakdowns which can be overcome by some analysis and further corrective actions.
- a bus workshop has to provide maintenance of a large variety of vehicles, from several manufacturers and body-builders, with a long life cycle.

Software support has to cope with these particular requirements. As invoicing is not the main goal of the software, but instead the constitution of a large data base allowing cost analysis, repairs reliability and enhancing diagnosis, a profound analysis of the fleet in charge and of the fleet management and evolution is essential.

When evaluating possibilities of adopting standard programmes, the ease with which changes and upgrades can be made now and in the future are important factors to be considered.

The amount of filed data and the file structures are also important factors, to permit simple data input and retrieval by maintenance staff with minimum computer training requirements. Therefore, screen information, available options, letter size, language clarity, key commands, etc., have to be adapted to a real workshop environment and to its regular working practices.

Development of automated input devices (bar codes, pencil



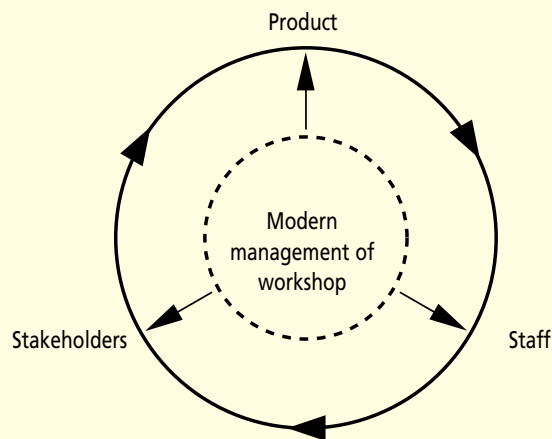
Waste Separation

markings readers, off-line recording, etc) is also important means of achieving greater speed and accuracy. When dealing with data networks, resident files have to be near their most frequent users, to reduce long distance transmission overheads.

Adapting real-time access to actual needs is also essential; batch processes in a number of activities are much simpler and completely adapted to managerial needs. They also contribute to reduction of transmission volumes.

Conclusions

- Staff management issues are paramount to reach quality maintenance performance
- ISO certification is well adapted for workshop activities and guarantee that identical actions are done exactly the same way in the whole organisation.
- Maintenance aspects have to be addressed at early vehicle design stages (maintenance-friendly vehicles)
- Maintenance aspects have also to be addressed at early stages during procurement (quality, spare parts supply, documentation etc.)
- Optimum workshop management and organisation is the best organisation balance between product (operation-ready vehicles, quality etc.), staff (work conditions, training, safety etc.) and stakeholders' concerns (costs, audits etc.). This balance is different in all organisations.



It is not possible to deal with all maintenance-related details in a Core Brief. More information can be found on a CD-ROM available from doriano.angotzi@uitp.com

Core Brief prepared by the Bus Committee.