PROSE

Securing the Future on Rails: Strategies and Measures for Fleet Modernization

PROSE WHITE PAPER

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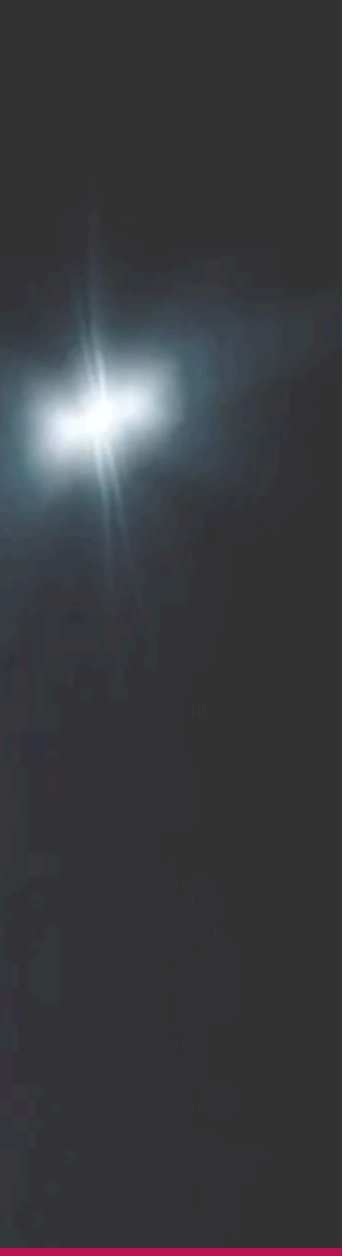


Modernisation is necessary due to technical ageing, regulatory changes and operational requirements.

Individual modernisation strategies are developed using a detailed evaluation matrix.

The planning of modernisations integrates environmental and cost efficiency.

Modernisations require specialised expertis and careful planning due to technical and operational challenges.

The decision to modernise rolling stock depends on a variety of technical, operational and economic factors. This white paper discusses the various reasons for a refit, including trains reaching the end of their service life, technological obsolescence, market and regulatory requirements and the need to improve comfort and reliability.

MODERNISATION OF RAILWAY VEHICLES

A long-term fleet strategy is crucial. Around 10 years after commissioning a fleet, the important question must be asked: What is the future of the vehicles?

1 SUSTAINABLE FLEET STRATEGIES

The decision as to whether and what type of modernisation measures are appropriate depends heavily on the vehicle, system or component in question. It is important to carry out a thorough assessment to determine which modernisation measures are economically and technically viable. These can be implemented either on a large scale or in stages. The optimal timing for a modernisation measure depends on various factors, including current system performance and future requirements. An important aspect that must be considered when developing a fleet strategy is sustainability. A sustainable strategy should take into account the entire life cycle of the vehicles, from procurement to operation to disposal. This helps to minimise environmental impact and maximise resource efficiency. The principles of circular economy can be applied to reuse and recycle materials and components, reducing the need for new raw materials and minimising waste. When deciding on a modernisation measure, the energy efficiency of the vehicles should also be taken into account, as this contributes significantly to operating costs. The use of environmentally friendly materials can further increase the sustainability of rolling stock by favouring materials that are less harmful to the environment and have a longer service life. The question of how the financial resources for a modernisation measure are spent is also of great importance. There are two main approaches: spending the funds all at once by taking the vehicles out of service one after the other, or spreading the expenditure and carrying out the modernisation measures during ongoing operations, at scheduled maintenance intervals. Each method has its own advantages and disadvantages, which must be carefully weighed up. PROSE has developed a special methodology for defining, evaluating and monetising fleet strategies. This methodology helps to make informed decisions and ensure the long-term profitability and efficiency of rolling stock. By integrating sustainability aspects into this methodology, long-term ecological and economic benefits can be achieved.

Terms relating to modernisation measures:
There are various terms used in connection with the modernisation of rail vehicles. We use the following terms in this white paper:

Modernisation:
Generic term for the renewal and refurbishment of vehicles, often includes several of the measures described below.

Refit:
Comprehensive, needs-based restoration and refreshing of all components in order to restore the vehicle to its original condition as far as possible. A refit may already be planned when the vehicle is manufactured (e.g. as a mid-life refurbishment). However, it can also be decided at a later date (usually carried out in the last third of the original service life) with the aim of extending the service life and increasing efficiency (can also be referred to as service life extension).

Retrofit:
Improvement and updating of vehicles by replacing components or systems with new technologies that were not originally (economically) available.
Example: New customer information system

Upgrades:
Installation of completely new systems or components in existing vehicles to extend their functionality.
Example: ETCS (specifications for network access), ATO (decision of the transport operator to introduce this). Carried out as required, but ideally as part of a refit or a general retrofit.

Redesign:
Redesign and comprehensive overhaul of the interior and, if necessary, the colour scheme to improve comfort and appearance. Carried out as required, but ideally as part of a refit or general retrofit.

One of the main reasons is that a train has reached the end of its life, which means that the vehicles have reached their planned service life and require a comprehensive overhaul in order to continue operating.

2 BACKGROUND INFORMATION

There can be numerous reasons for an upcoming modernisation.

There can be numerous reasons for upcoming modernisation measures. One of the main reasons is that a train has reached the end of its service life, which means that the vehicles have reached their planned useful life and require a comprehensive refit in order to continue to be operated efficiently.

When determining the service life to be achieved, the future procurement strategy should be taken into account. For example, the possibility of a subsequent joint procurement project can be a trigger for modernisation measures in order to synchronise the procurement cycle with another vehicle owner.

Obsolescence and technological progress can be the reason for a retrofit. For example, it may be economical to modernise obsolete systems or it may be necessary to replace complete components and systems because they are no longer available due to obsolescence. The desire or requirement, by the contracting authority or the customers, to integrate new technologies, can also be a trigger.

Market-related factors, such as changes in demand or competitive situations (with other modes of transport or as part of a new tender for transport services), can also make measures necessary. A redesign is usually implemented for this purpose. Depending on requirements, this can range from a simple change of colour to a completely new interior layout that allows for improvements in comfort and enhanced functionality (e.g. multi-functional compartments).

Operational changes, such as new deployment plans, changed operating requirements, changed network access conditions, the introduction of new processes (regulatory requirement) or digital maintenance (internal requirement) as well as new technologies such as ATO, may require upgrades. If a retrofit is planned that revokes the grandfathering clauses, new safety or environmental regulations may be another reason for upgrades.

Finally, measures to increase the reliability and availability of the train can also justify various modernisation measures.

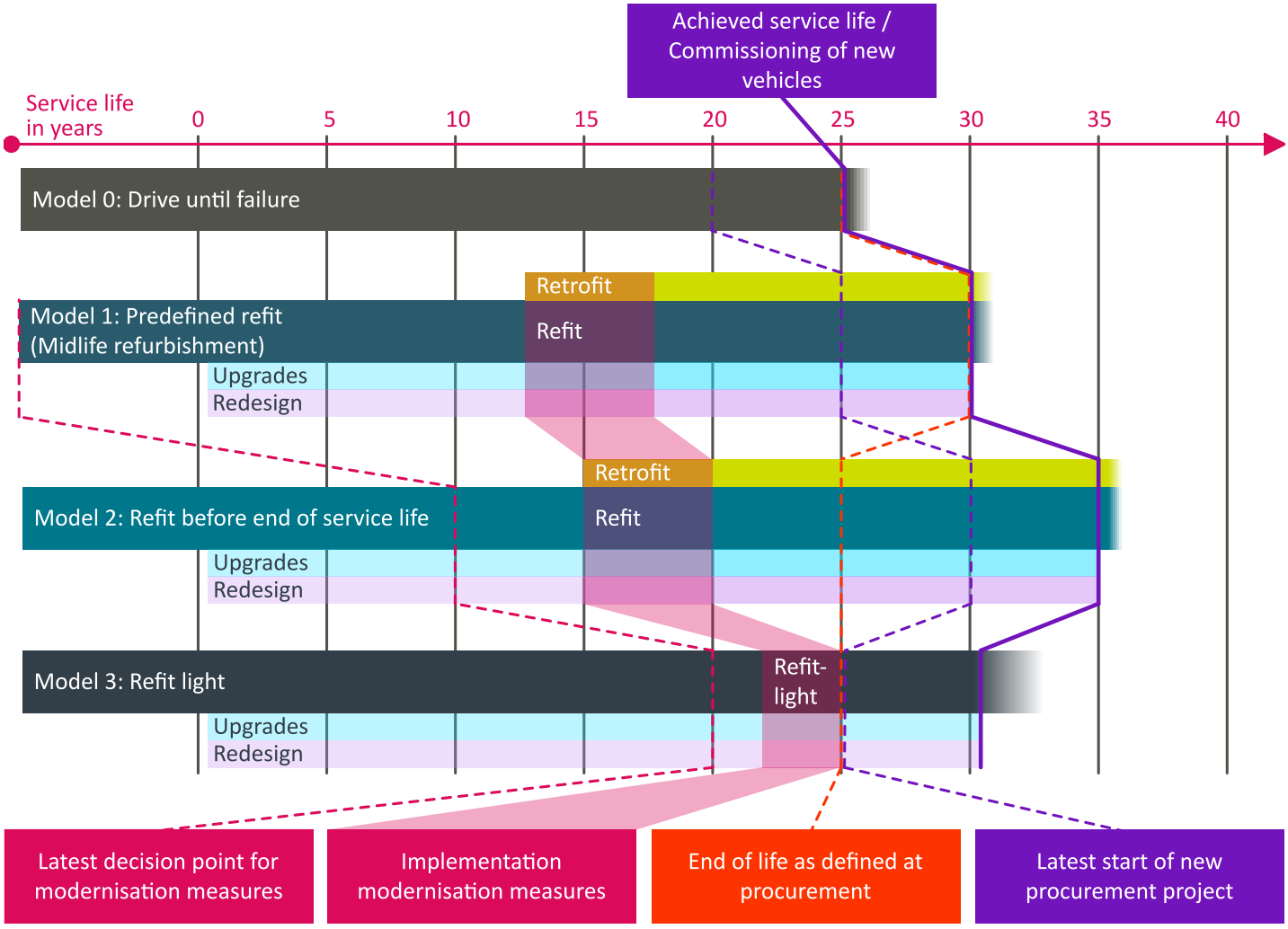
Modernisation usually involves different measures, which in turn are taken for different reasons. All factors and options must be carefully weighed up in order to make the most economical decision in the long term (for the operator, customer, vehicle owner, etc.). Based on the simplified illustration (see next page) of the rolling stock life cycle, different considerations can be made regarding modernisation measures. On one hand, life-extending measures that enable an extended service life of up to 15 years can be carried out. These measures would take place in parallel with the regular overhauls due during this period. On the other hand, it is possible to carry out a so-called refit light. This comprises bridging measures aimed at making the existing vehicle fleet usable for a period of additional 5-10 years. During this period, the aim is to procure a new vehicle fleet (if possible together with another vehicle owner).

The long-term total costs should not be forgotten in the fleet strategy - a new procurement is associated with great effort and high investment costs. Modernisation measures enable adaptation to current requirements and a reduction in operating and maintenance costs at significantly lower investment costs. Even if the running costs after modernisation are higher than these of a new vehicle, the significantly lower investment costs mean that it is generally a much more economical solution overall.

3 CHALLENGES FACING OPERATORS AND OWNERS

Operators and owners of rolling stock face several challenges when planning modernisation measures for their rolling stock. Modernisation measures can be very cost-intensive, especially when it comes to modernising older vehicles, and are associated with risks. The costs include not only the materials and labour, but also the downtime of the vehicles during the implementation. The integration of new technologies, such as zero-emission drives or advanced driver assistance systems, can be complex. This often requires specialised knowledge and can lead to compatibility issues with existing systems.

Operators and owners must ensure that their vehicles comply with current legal regulations. This may require additional adjustments and certifications and may result in new approval processes, which further complicates the process and can lead to delays. Finally, the rising costs of energy and maintenance place an additional burden on the budgets of operators.
These challenges require careful and early planning and often external support in order to be successfully mastered.



4 PROBLEM SOLVING: PROSE METHODOLOGY

PROSE has developed a methodology that is customised in close cooperation with the operator and owner in order to define the fleet strategy with regard to modernisation measures. While PROSE contributes the methodological and project management skills as well as technical expertise, the operator and owner provide the concrete figures and data relating to its vehicles and future requirements. This combination makes it possible to develop customised solutions that meet both the technical requirements and the specific operational circumstances. This co-operation ensures that the strategies and measures developed are optimally adapted to the needs and conditions of the respective case.

In the first step, PROSE begins with the development of a detailed evaluation matrix based on the specific vehicle structure of the operator or owner. This matrix is used to identify and evaluate the various measures to be implemented as part of the upcoming modernisation measures. The evaluation matrix comprises a series of criteria, which are defined with the operator and are relevant for the evaluation of the measures. These criteria can include technical aspects, economic factors, regulatory requirements and operational necessities.

Once the criteria have been defined, each potential measure is assessed against these criteria and an evaluation is prepared. This evaluation helps to prioritise the measures and make well-founded decisions.

PROSE also develops a project manual for the upcoming modernisation measures that is specifically tailored to the project in question. This manual serves as a comprehensive guide for the implementation of the project and defines the various phases that the project will go through. Each phase is described in detail, including the objectives, planned duration and specific content.

The project manual also explains which project participants and stakeholders should be involved in the project, when and how. Clear responsibilities are defined to ensure that everyone involved understands their tasks and roles. This promotes smooth communication and collaboration throughout the project.

Case studies:

Assessment of the remaining useful life of the Zillertaler Verkehrsbetriebe (ZVB) fleet:
Various modernisation measures were analysed and evaluated as part of the assessment of the old fleet of the Zillertaler Verkehrsbetriebe. The report takes into account both the economic and technical aspects of extending the service life and demonstrates the need for a comprehensive overhaul of the vehicles. Particular attention is paid to the improvement of system performance and the fulfilment of future requirements. By applying the PROSE methodology, it was possible to make well-founded decisions and ensure the long-term profitability and efficiency of the rolling stock. The analysis highlights the importance of thorough assessment and early planning when implementing modernisation measures.

Modernisation measures at the Verkehrsbetriebe Zürich (VBZ):
As part of the support measures for VBZ, a detailed analysis of the fleet strategy was carried out. The study focused on the technical requirements and the economic advantages of various modernisation options that could be implemented as part of Revision 3 of the Cobra trams. Aspects such as the improvement of system performance and the fulfilment of future requirements were taken into account. PROSE's evaluation matrix was used to make informed decisions and ensure the long-term viability and efficiency of the fleet. The results underline the importance of careful evaluation and planning when implementing modernisation projects.

5 CONCLUSION

To summarise, the decision as to which modernisation measure should be carried out and when, depends on various factors. Early consideration in the life cycle of the rolling stock is important as a first step, just as a thorough assessment of the economic and technical aspects is essential. The current system performance, future requirements and the type of vehicle play a decisive role here. There are different approaches to modernisation measures, such as a refit, retrofit or refit-light, each of which has its own advantages and disadvantages. PROSE offers a methodology to define, evaluate and monetise the fleet strategy. This helps transport operators to make informed decisions and ensure the long-term profitability and efficiency of rolling stock. Ultimately, all relevant factors must be carefully considered in order to implement the best possible modernisation measures.

"A thorough assessment of the economic and technical aspects is essential to determine whether a refit makes sense."

PROSE was founded in 1982 and is a globally active, independent engineering and consulting service provider in the mobility solutions sector with a clear focus on the rail vehicle sector. PROSE is active along the entire mobility life cycle: from planning, procurement, development, production, approval, operation and maintenance through to modernisation.

An independent, proven partner

As PROSE is largely owned by its employees, we can guarantee neutral and independent engineering services and advice. Our customers - manufacturers, operators, authorities and workshops - trust us to deliver complete solutions for complex requirements, often involving more than one of our wide range of services. Based on a deep understanding of our customers' business, we offer high quality and cost-effective solutions from A to Z.

9 offices in 6 countries, more than 200 employees, over 5,000 projects worldwide

PROSE has a total of nine offices in Germany, Austria, France, Italy, Sweden and Switzerland. With more than 200 dedicated and experienced employees and more than 5,000 successfully completed projects worldwide, we solve our customers' challenges wherever we are needed.