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# Bridge administration and management in Latvia

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## Annotation

The report gives an overview on the experience of the Latvian Road Administration experience in bridge administration and management in Latvia, their historical development, current situation and development possibilities. The Latvian Road Administration is responsible for 929 bridges in state road network and for 740 large dimension (l ≥2 m) culverts. Additionally the Latvian Road Administration monitors approximately 1500 bridges and large culverts of municipalities. The major part of bridges is in bad technical condition and their lifetime is close to the end.

In the same time the traffic loading and the amount of freight transport grows rapidly. Fully understanding and analysing the present situation and its development in future the Latvian Road Administration has established a computerized Bridge Management System.

## 1. Introduction

In Latvia as in other countries different bridge management systems have always existed. The question was only about their quality and use efficiency.

Improvement of bridge database and system had to be considered as the number of monitored bridges and the amount of processed information rapidly grow. Such a possibility was provided by computers and software.

In year 1995 as an interim solution, the Latvian Road Administration introduced a simplified Bridge inventory and inspection form, as well as, determined types of inspection and their sequence. With 200 bridge inventories and inspections per year the Latvian Road Administration monitored all bridges under its responsibility. The results were compiled in MS Access database.

However, the initially used collection of bridge main data in MS Access database was incomplete and served as an interim solution. Practise and experience of other countries showed that it was necessary and possible to establish a more perfect Bridge Management System.

In the year 1997 a specialist work group from Norway and Latvia was established, which defined the tasks of the work to be implemented, its staging and execution

schedule. The work was finished in 2002 when the Bridge Management System LatBrutus was introduced.

## 2. Historical overview on bridge and Bridge Management System development in Latvia.

In Latvia the bridge development historically passed through all stages of technical solutions beginning with stone masonry and timber until modern reinforced concrete, steel and bridge structures, as well as modern timer structures.

During the World War II more than 80% of bridges on state roads were completely or partly destroyed.

After the war bridges were repaired, but in the place of destroyed ones mostly bridge structures from timber were built. Several bridges from cast-in-situ reinforced concrete were built. According to governmental directives from the year 1955 only reinforced concrete bridge type structures from pre-cast elements were built.

At present more than a half of bridges in state road network are older than 30 years (Figure1) and their structures are seriously damaged in the operation time.

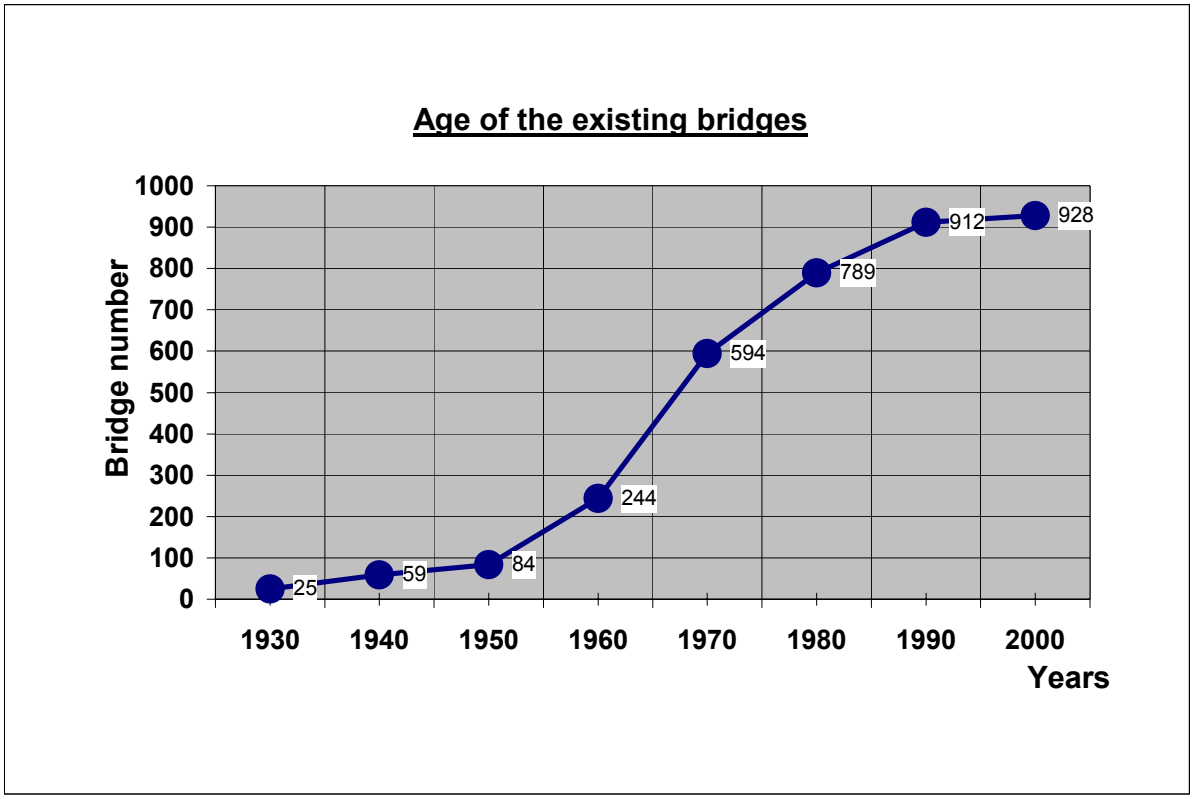


Figure 1. Existing road age profile.

In former times, according to the technical possibilities, the bridge database existed in the form of a bridge list and its maintenance was performed according to the existing Instructions.

Bridge Management System passed a long way of development starting from lists and punch cards up to modern computer systems.

## 3. Bridge management

The bridge management includes actions from bridge construction until demolition. Bridge Management System takes care of bridge technical condition and their use, and is closely tied to the rest of processes in the bridge sector (Figure 2).

Analysing the previous experience the Latvian Road Administration defined the main conditions to diminish the maintenance expenditures in the period of bridge service:

- Good bridge maintenance starts with a good design, where a lot of attention has to be paid to diminish maintenance problems during operation.
- Special attention has to be paid to quality control during bridge construction or reconstruction.
- During operation time it is important to maintain qualitative inspection programme that is made up by experienced bridge engineers.
- Maintain preventive maintenance programme, before serious defects in construction arise.
- Establish a modern Bridge Management System.

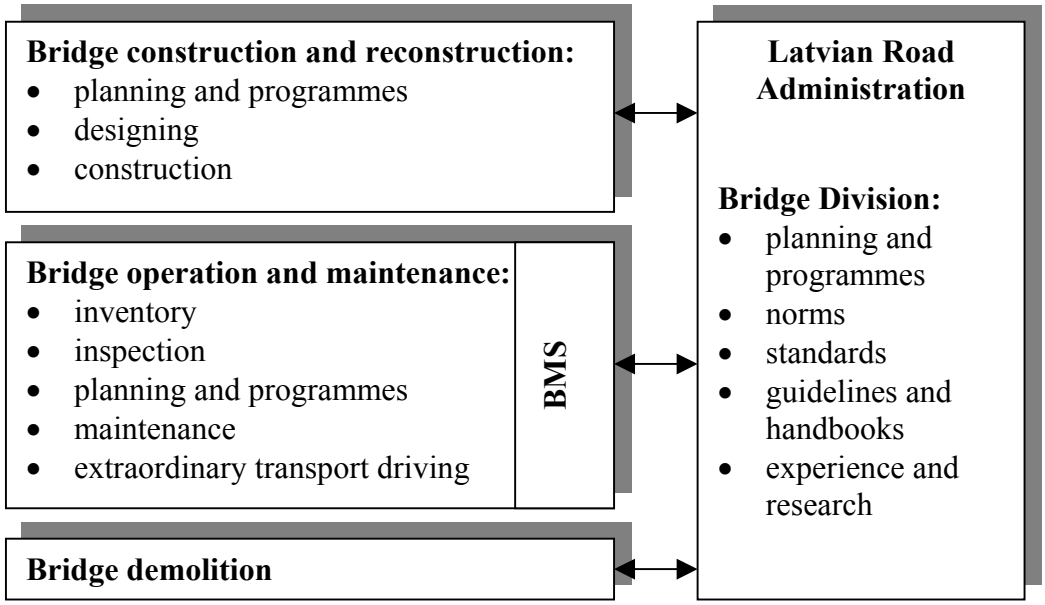


Figure 2. Processes in bridge lifetime.

## 4. BMS LatBrutus

Analysing the experience of other countries in the establishment of Bridge Management System and evaluating own financial and technical possibilities the Latvian Road Administration made an agreement with the Norwegian Public Road sAdministration about the establishing of such a system for the needs of Latvia.

In the year 1997 a Latvian - Norwegian bridge specialist group and programme was established for the establishment of Bridge Management System for the needs of

Latvia and its practical introduction in the Latvian Road Administration. Computerized Bridge Management System LatBrutus was established with the support of and in cooperation with the Norwegian Public Road Administration. The programme was finished in the year 2002.

Bridge Management System LatBrutus was formed in conformity with the mentioned programme and consists of:

Handbook:

- Guidelines of bridge management;
- Handbook of bridge inventory;
- Handbook of bridge inspection;
- Handbook of bridge maintenance;
- Handbook of LatBrutus user.

Software:

- Module of inventory;
- Module of inspection;
- Module of maintenance;
- Codes and system administration.

Training programme:

- Use of computer programs;
- Bridge inventory;
- Inspection of bridges;
- Bridge maintenance.

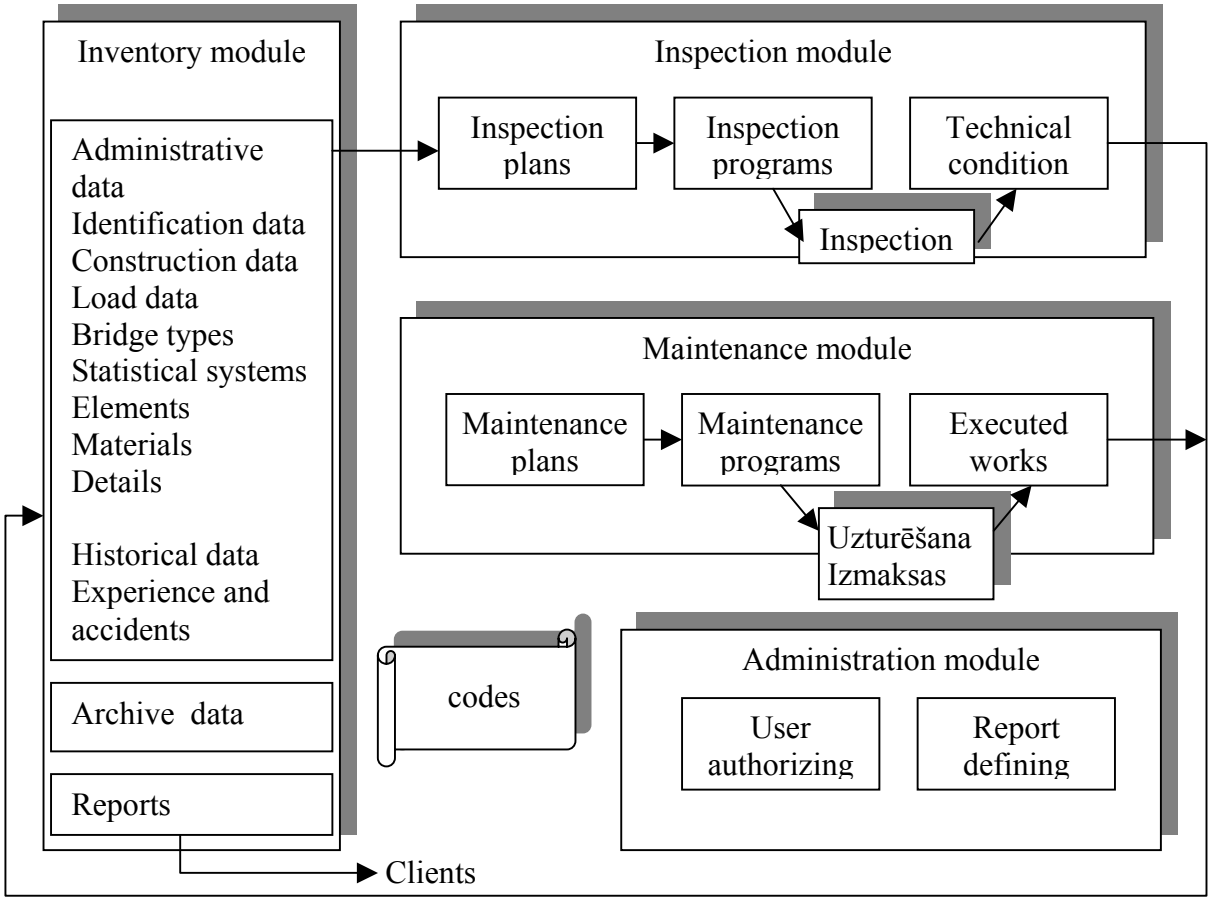


Figure 3. Structure and information flow block scheme of Bridge Management System LatBrutus

LatBrutus is a modular computerized Bridge Management System. It allows operational control and managing of bridge management and bridges included in the maintenance system. System includes necessary handbooks to ensure a transparent and systematic data collection and system use. .

**4.1.Inventory module**

Module is formed for the collection of necessary data about all bridges in road network to obtain the necessary technical information. Module includes base data for inspections and maintenance.

**4.2. Inspection module**

Module includes inspection planning and data registration about bridge technical condition over their service time. Every bridge has an individual inspection plan with inspection intervals. An inspection programme based on bridge individual inspection plans is established every year.

The division of bridge inspection and execution time is as following:

- commissioning inspection – transfer of the structure to maintenance;

- guarantee inspections –at the end of guarantee period;
- general inspections - annually;
- main inspections – at least once in five years;
- special inspections – depending on necessity.

**Description of damages and assessment of technical condition**

During the inspection the visual survey of every element has to be performed and defects or damages have to be described. It has to be assessed how the discovered defect or damage influences the element, bridge, environment or bridge user, establishing the degree of damages and their consequences. The degree of damages is assessed in digital format, which is used for the evaluation of condition and for the planning of maintenance actions.

For the evaluation of damage degree the following codes are used:
1 minimal damage/defect – actions are not necessary;
2 average damage/defect – actions are necessary in time of 4- 10 years
3 serious damages/defects – actions are necessary in time of 1 – 3 years;
4 critical damages/defects – actions are necessary in time of 1/2 year;
9 is not supervised.

The consequences of damages are able to influence bridges, their users and the environment. To define the possible consequences the following codes are used:
C damage endangers the load carrying capacity;
T damage endangers the safety of traffic;
M damage can increase the costs of maintenance and traffic;
E damage can influence the environment/ aesthetics.

The main and special inspections establish the cause of damage. They have an important role in making the decision about actions to be performed. To define the damage cause two digit figure codes are used.

The index of bridge quality (BCI).
The bridge quality index gives a notion about the technical condition of bridge and it changes.
The quality index BCI is calculated from the following factors: damage degree, damage consequences and damage type. Calculation is performed in two methods. At the beginning the damage index (DI) of every damage is calculated. Then on the basis of all damages the index BCI is calculated.
BCI determines the bridge quality in the given time and the deviations in service time.
$BCI = \sum(DI_1 \bullet F_1 + DI_2 \bullet F_2 + \ldots + DI_n \bullet F_n)$

**4.3. Maintenance module**

The module is established to help to perform the duties of maintenance planning, prioritisation and execution with accordant financing.

In Latvia the Bridge Management System is divided as following:
- routine maintenance;
- periodic maintenance;

- rehabilitation.

The purpose of routine maintenance is the following: to ensure the same traffic safety and driving conditions as on road where the bridge is situated and to preserve visually pleasant appearance of the structure; to ensure bridge functioning as it is planed in the design.
Works are executed by road maintenance companies.

The routine maintenance works include:
- cleaning of bridge elements;
- cleaning of area under the bridge;
- elimination of soil scours;
- temporary elimination of accident consequences;
- prevention of small amount structure damage.

Aim of periodic maintenance is to prevent damages, which can influence traffic and the bridge load carrying capacity, traffic safety, environment and lifetime of bridge. Maintenance works have to be executed in time that causes smaller costs. Works are executed by specialised construction companies according to the specific Bills of Quantities.

Periodic maintenance works include:
- renewal of steel structure surface coating;
- renewal of concrete structure surface coating;
- renewal of wood structure surface coating;
- works at wearing parts of carriageway structure and insulation layer.

Aim of rehabilitation works is to renew the functionality of bridge defective element by not replacing it and not reducing traffic possibilities, traffic safety and bridge lifetime.
Works are executed by specialised construction companies according to construction designs developed for this purpose.

Rehabilitation works include:
- repair of supports and concrete foundation damages above and under the water;
- repair of under structure or superstructure damages of steel, stone, wood or other materials;
- change of structures damaged elements.

**Distribution of finances**
The distribution of finances is performed according to the following (Figure 4)

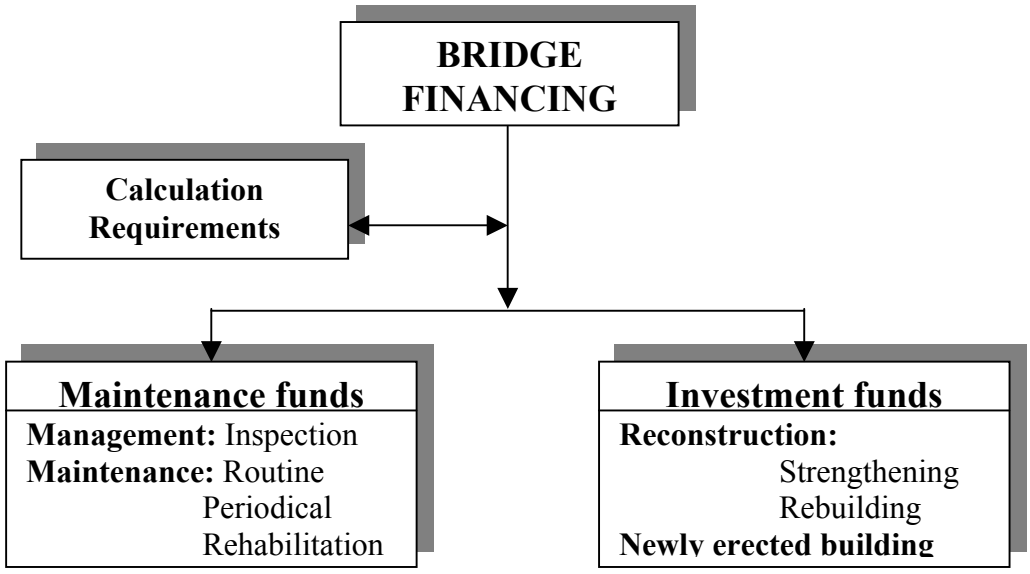


Figure 4. Financing distribution to bridges.

**5. Bridge Management System development in the future**
The Bridge Management System used in Latvia cannot be estimated as completed. Work shall be continued in all sections of the System:

- complete guidelines and handbooks;
- development of computer programmes and a entire use of information technology (IT);
- use of modern construction materials and technologies;
- training of specialists involved in the process.

**6.Conclusion**

As a unit the bridge demands greater investments as any other road network element. Bridge use deterioration or absolute failing causes a greater potential of negative impact on traffic and endangering of traffic safety.
To ensure the necessary bridge carrying capacity and traffic safety requirements in restricted financing conditions the bridge specialists have to balance between the persevering of old bridges and reconstruction. The Bridge Management System introduced in Latvia is a modern instrument to solve bridge problems. However ,the system is not a replacement of engineers. Competence of engineers is the preparation of bridge programmes and monitoring of their implementation. Bridge Management System is a good instrument for the bridge supervisor and it has to be used by specialists that have an experience in bridge engineering.

Bridge maintenance historically has passed all development stages from the wrong point view that reinforced concrete structures are everlasting without maintenance until planned and preventive maintenance works of today.