PROinfra

Digitale Wartung und Instandhaltung

PROinfra for bridge structures

Digital maintenance and repair

Table of contents

PROinfra
Digitale Wartung und Instandhaltung

What is PROinfra for bridge structures?

PROinfra is a predictive maintenance solution for the maintenance of structures. A specific implementation exists for **bridge structures**.

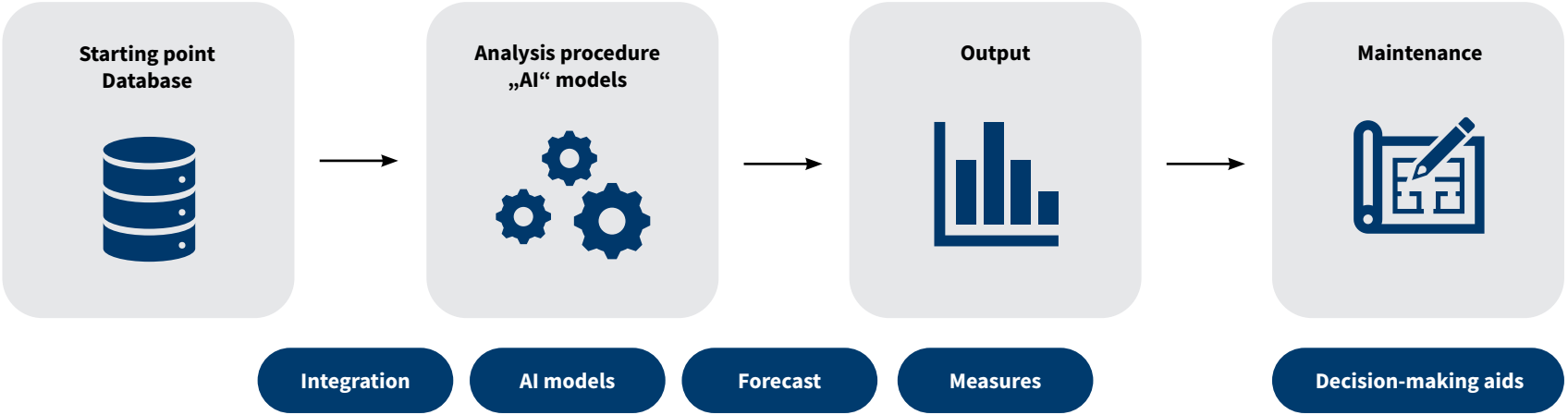
PROinfra serves as a **digitalized foundation for data management**, effectively combining structured and unstructured data from internal and external sources into a unified data platform.

PROinfra is an application for the integration and analysis of **infrastructure, structure, and maintenance data**. At its core, the solution consists of a data management system that is used for comprehensive forecasting processes.

PROinfra is a solution for the digitalization of maintenance using modern **AI methods**.

What is the goal of PROinfra for bridges?

The goal is to improve data management in maintenance and operational decision-making, to structure data and influencing factors, and to calculate condition development forecasts. Based on this, measures are derived from a cost-effective perspective, thus providing valuable decision-making support for the optimization of measures.



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Which bridge types are processed?

PROinfra can process any bridge type and its substructures. The **classification of bridge structures** is flexible and can be configured by the user.

Intelligent algorithms allow comparisons of bridge types to be made, taking into account any environmental data. This allows **comparative analyses** to be carried out prior to new bridge construction projects.

In addition to bridges, other infrastructure objects can also be recorded and analyzed, for example, to support the maintenance of entire routes or connections

Which data is used?

PROinfra processes all data relevant for **creating condition forecasts and analyses**. In addition to all historical maintenance data, it can also process **sensor data, traffic data, and weather data**.

Technically, data interfaces based on XML, CSV, SIB structures, and others are available as standard. Geological data, vegetation data, and ground movement data can also be processed. PROinfra can process data collected by drones or modern ultrasound measurements. BIM-based models are processed.

What factors and data influence the condition of bridges?

- Damage and measure history
- Traffic
- Weather/climate data
- Vegetation, geological hazards, ground movement
- Object master data (construction information, dimensions, responsibilities)
- Additional information from experts and much more.

What does data management optimization mean?

Data from different sources is transferred into a **common database**. Gaps in the data history are closed, e.g., by integrating old data backups or through interpolation. This creates a data history that facilitates the derivation of forecasts from the building‘s history.

Data from other departments, such as traffic count data, is integrated. External data, such as weather data or data on soil conditions, is automatically imported. Information on construction measures can supplement the inventory. Missing 3D models for visualizing existing damage can be generated schematically by PROinfra from the existing database.

This **unified database** can now be used for all types of analyses, even across topics.

What are the use cases?

The current version implements the following basic use cases:

- Support for determining the optimal bridge type for each location
- Comparison of bridge types under specific environmental conditions
- Forecasting condition changes depending on traffic volumes
- Forecasting the condition rating and calculating the deterioration index of bridges
- Optimizing maintenance measures based on forecasts and analyses

Further cases are currently being implemented or will be developed individually.

Use cases based on analyses of large numbers of structures can be implemented, as well as individual analyses for a small number of bridges or even individual structures.

Which forecast variants are implemented?

Examples:

- **Forecast of condition rating changes, derived from the S-shape function:** On average, structures deteriorate according to an S-curve: At the beginning and end of their service life, the decline in rating is steeper, flattening in the middle. We link the S-curve with the individual development of individual structures and groups of structures and thus forecast the further development of condition.
- **Forecast depending on external influences:** By comparing with similar structures that differ in individual influencing factors, e.g., traffic load, forecasts can be made for the impact of these influences on condition development.
- **Impact of individual damage on the overall picture:** The development of condition can be simulated by showing/hiding individual damage or groups of damage.

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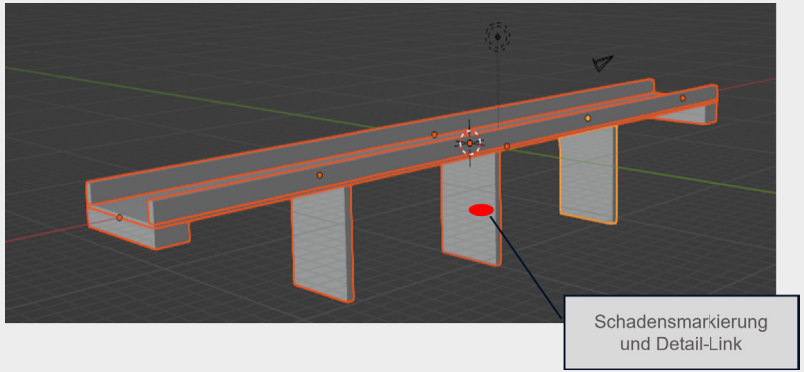
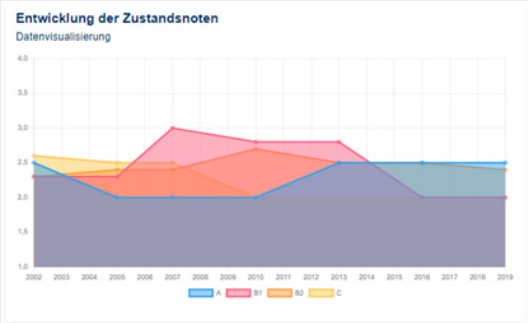
How is the optimal bridge system evaluated?

Evaluate the optimal bridge system at the respective location and compare bridge types under specific environmental conditions:

The most suitable structure type is determined for a specific location for a new (replacement) construction. This involves comparing the actual construction and maintenance costs incurred in the past for various structure types that meet the same constraints (e.g., bridge area, bridge length, weather data). For this purpose, the actual costs incurred per structure are evaluated. The planning of a new bridge is supported by obtaining a quick overview of how costs have developed for different structures in the past.





How is damage visualized?

Damage can be visualized in a variety of ways:

- List views
- Graphical representations
- Photos
- BIM models

All display methods are included in PROinfra. In addition, all **historical data** is prepared graphically and displayed in a list view.

BIM models can be imported from existing IFC files or **generated schematically based on the building data.**

The various data views are configurable, interconnected, and enable easy context navigation for the user.

Why is PROinfra modular?

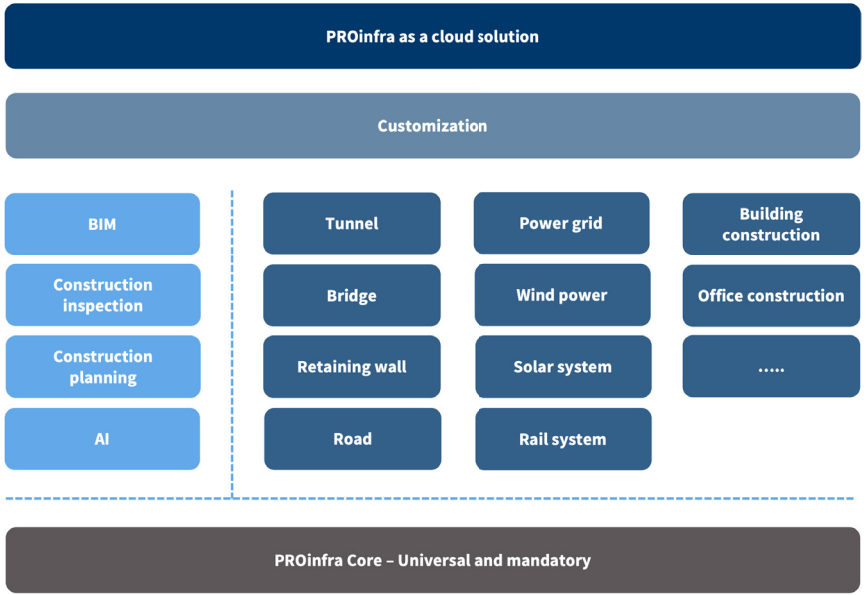
PROinfra can be **used specifically for specific structures**, so that only the corresponding specialist modules, for example, the „Bridge“ specialist module, are required. This allows PROinfra to grow gradually and ultimately map digital twins.

An example demonstrating the benefits of modularity:

1. You start with the „PROinfra Basis“ and, in the first step, digitize your database for bridges, roads, tunnels, and retaining structures. You can also divide this step and, for example, start only with bridge structures.

2. In the second step, you can use the „Bridge“ specialist module to implement analysis methods and condition forecasts.

3. You gradually expand the analyses and condition forecasts for other structures and use additional modules (BIM, AI models, sensor technology) in combination to increase the efficiency of action planning.



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Digitale Wartung und Instandhaltung

First steps for implementation

Depending on your initial situation, we will work together to determine how the database should initially be built. In an initial, non-binding, and free analysis workshop, we will discuss your current situation, clarify the effort and approach to building the database, and answer, for example, the following questions:

- What maintenance data and historical data are available, and in what form, and how can they be digitized immediately?
- What other data is available, and which should be integrated?
- Which existing systems need to be connected?

The first goal is to obtain a **uniform database** so that appropriate analysis methods can be used in the next steps.

If you already have a digitized database, it can be used for PROinfra forecasting and AI.

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Let us talk about your bridges and the future of maintenance.

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