International Bridge Forum

Bridges 2020: Management for Long Term Bridge Performance

Cambridge, UK, 13th - 16th September 2009

J. Krieger:

Safety and Security of Bridges on Federal Highways in Germany

Structure

1 Introduction

2 Bridge Management System

3 Load Bearing Capacity

4 Adaption to Climate Change

5 Security of Bridges and Tunnels

6 Conclusions

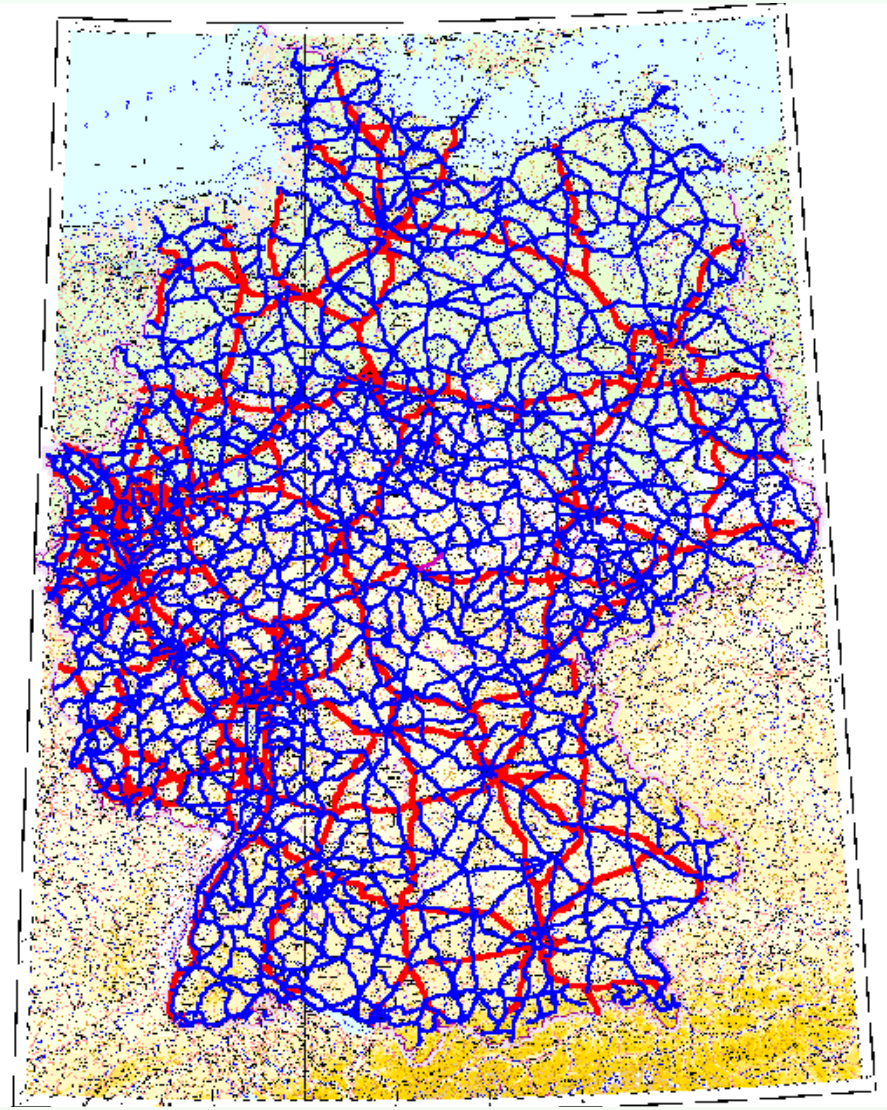
Traffic on Federal Motorways

1950

1975

Traffic on Federal Motorways

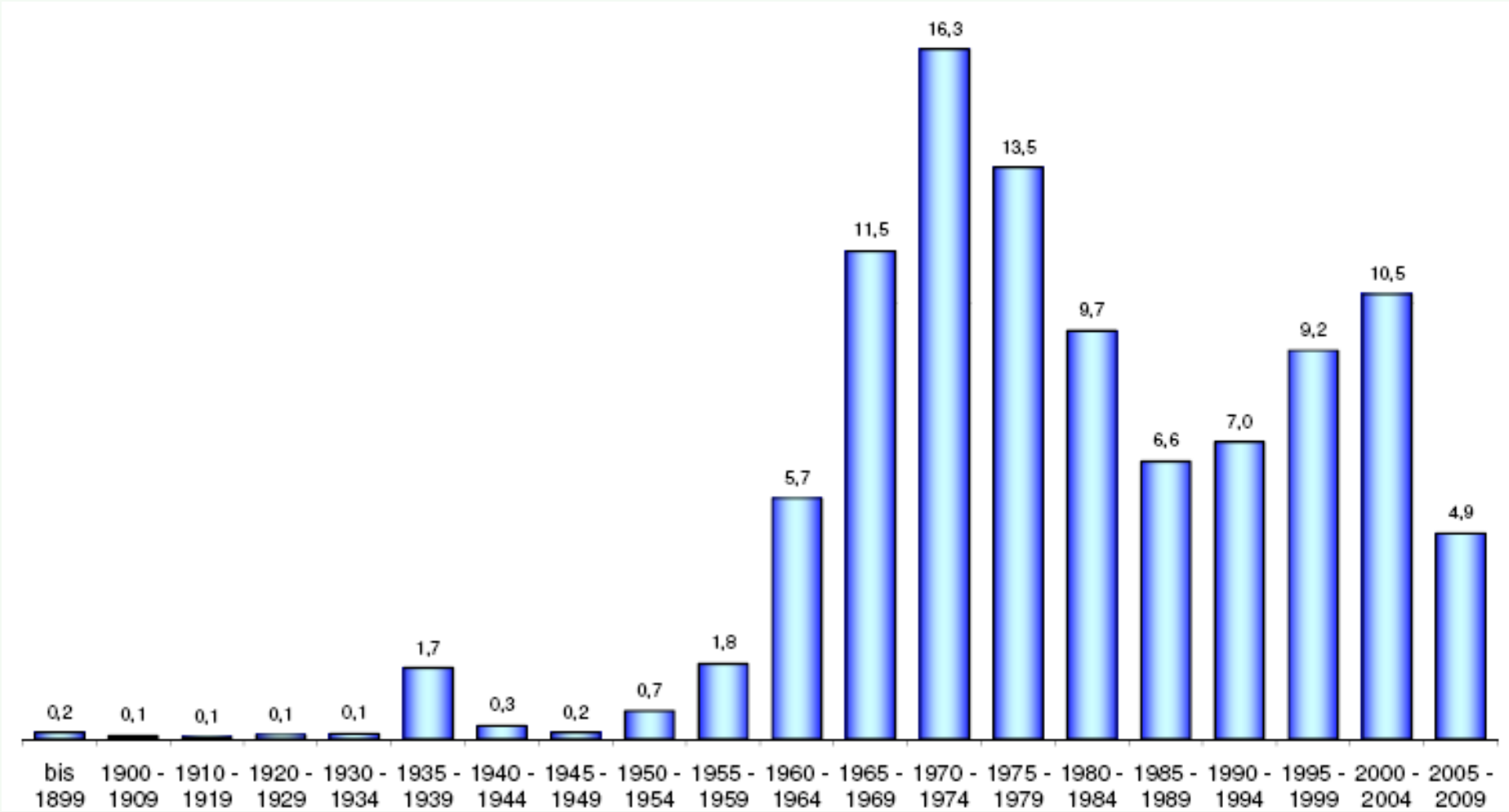
Federal Roads in Germany



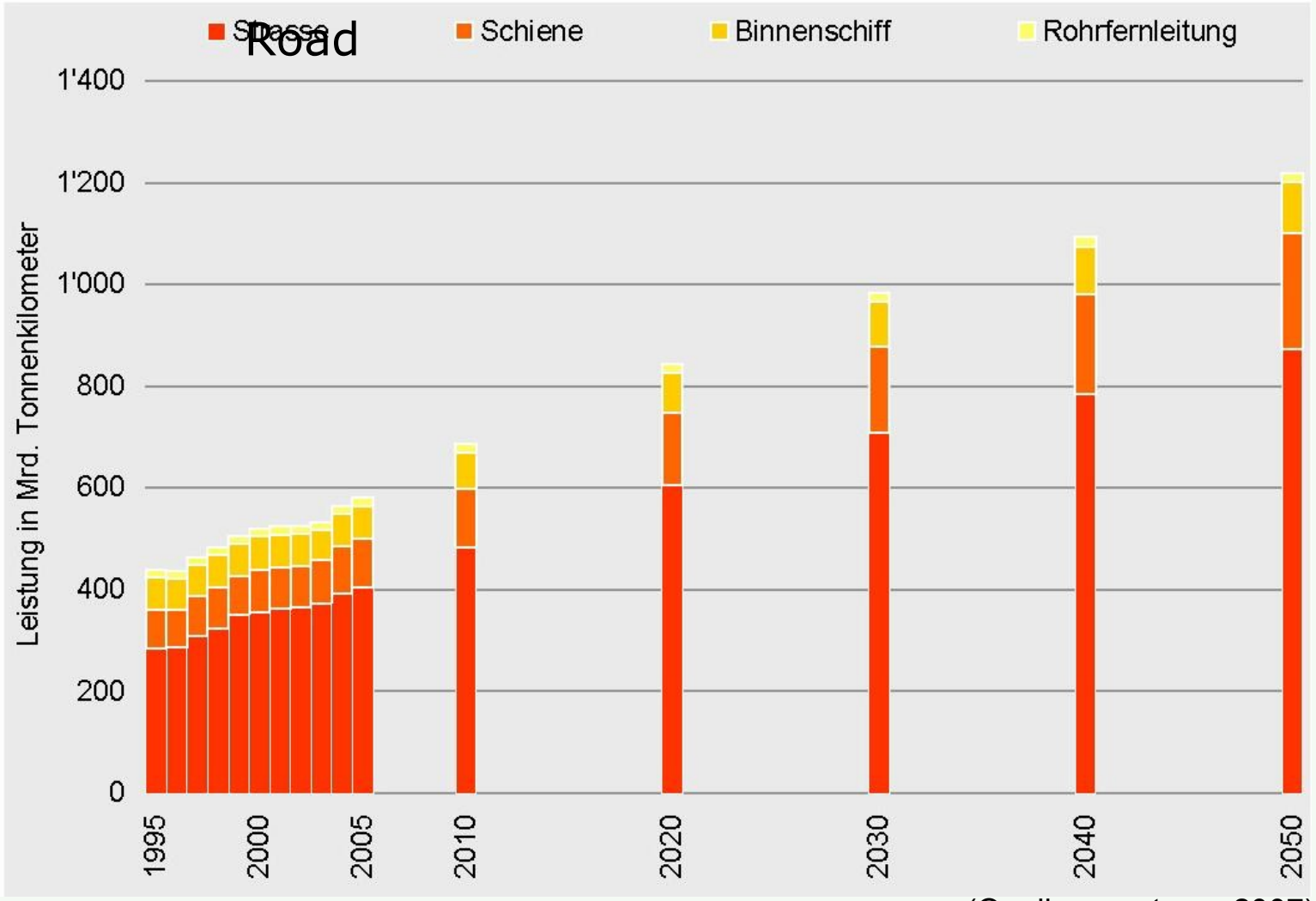
BAB:	**12.000 km**
BStr:	**41.000 km**

BfStr	**:**	**38.000 Bridges**
BfStr	**:**	**220 Tunnels**

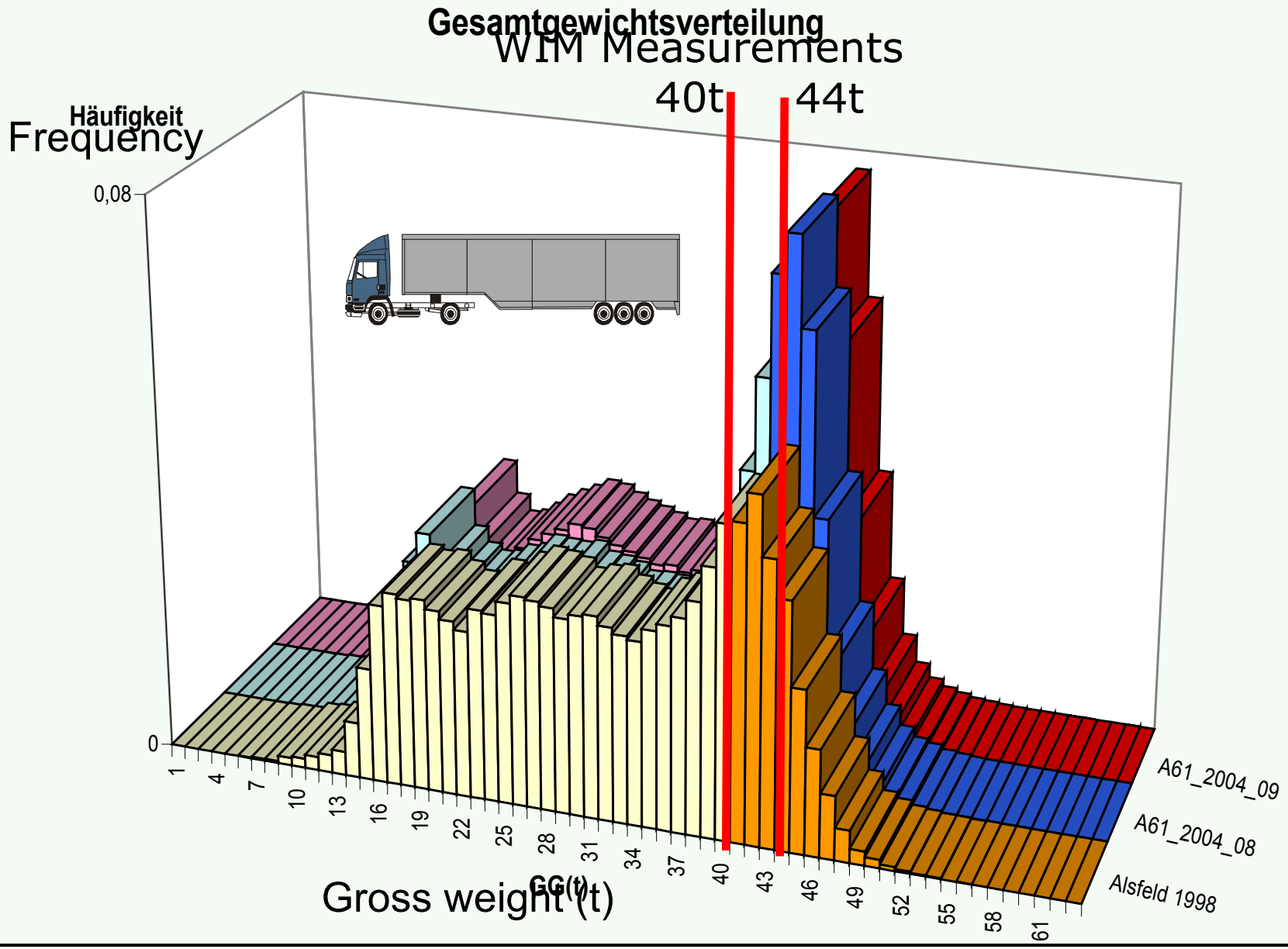
Age Distribution of Bridges on Federal Roads
(Bridge Deck Area)



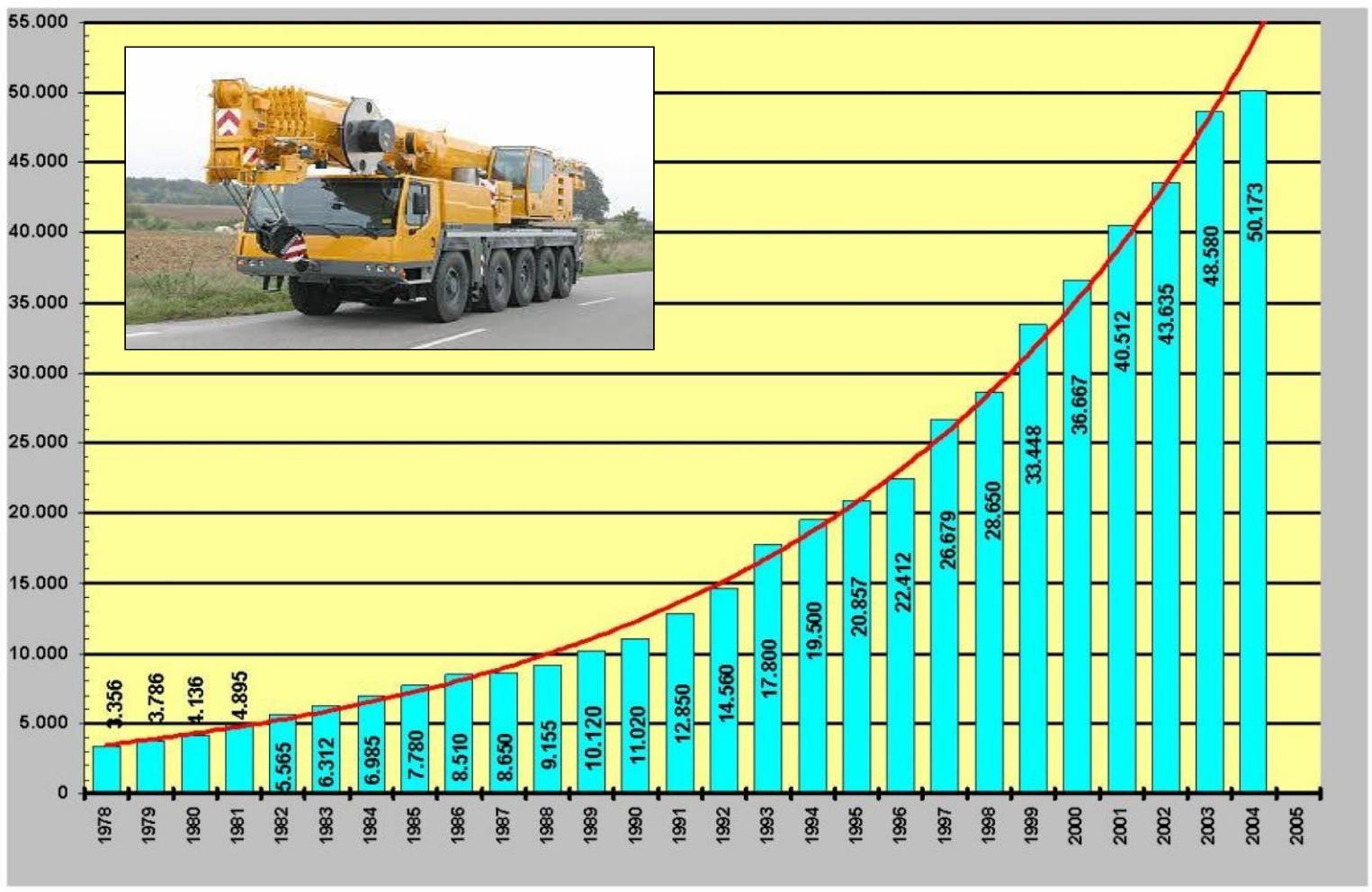
Prognosis of Freight Traffic



(Quelle: progtrans 2007)


Gesamtgewichtsverteilung
WIM Measurements
40t
44t
Häufigkeit
Frequency
0,08
0
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
GG(t)
Gross weight (t)
A61_2004_09
A61_2004_08
Alsfeld 1998

Traffic with special Permission



Possible systematic problems

Concrete bridges		Steel bridges	All materials
Reinforced Concrete	Prestressed Concrete	Steel	
Shear strength insufficient shear reinforcement	Coupling joints temperature, min. reinforcement	Cracks in orthotropic bridge decks	Traffic loads BK 60, BK 60/30
Corrosion insufficient concrete cover	Stress corrosion cracking of prestressing steel	Defects at cables	Temperatures
Cracks due to insufficient steel reinforcement	Insufficient grouting	Wind induced fatigue	Defects of bridge bearings
Other problems/ defects	……	Other problems/defects	Pavement, Sealing
			Other defects

Challenges for Bridge Owners/Operators

- The age distribution of German bridges shows a large proportion of bridges build until 1980.
- Bridges constructed before 1980 can have insufficient load bearing capacity compared to actual and future traffic on Federal Highways.
- Bridges can have systematic problems according to the used design standards.
- Bridges have deteriorated during the last years.
- Prognoses show a strong increase of freight transport.
- The percentage of vehicles with gross weights > 40t has increased.
- HGV Traffic with special permission has strongly increased.

Structure

1. Introduction

1. Bridge Management System

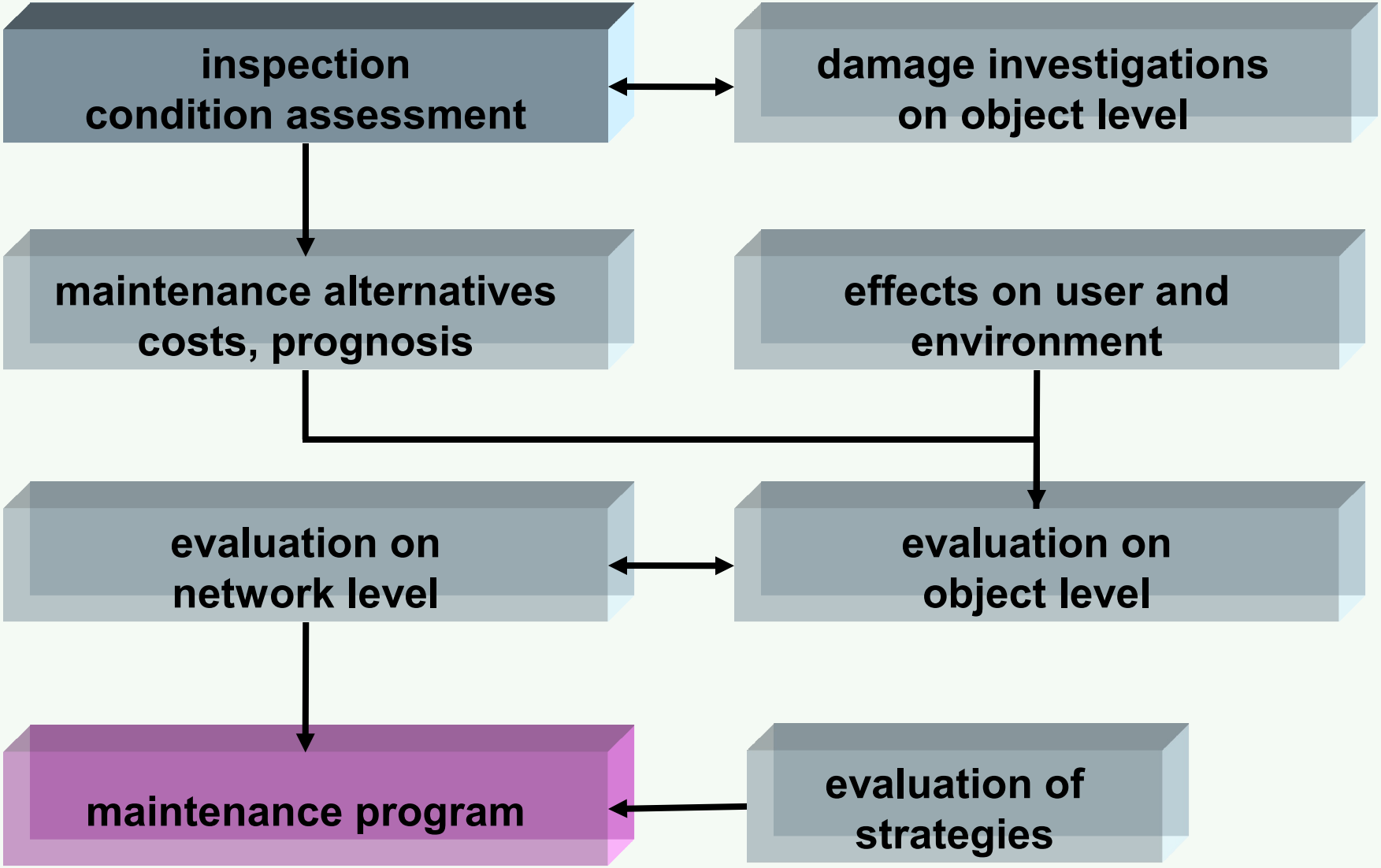
1. Load Bearing Capacity

2. Adaption to Climate Change

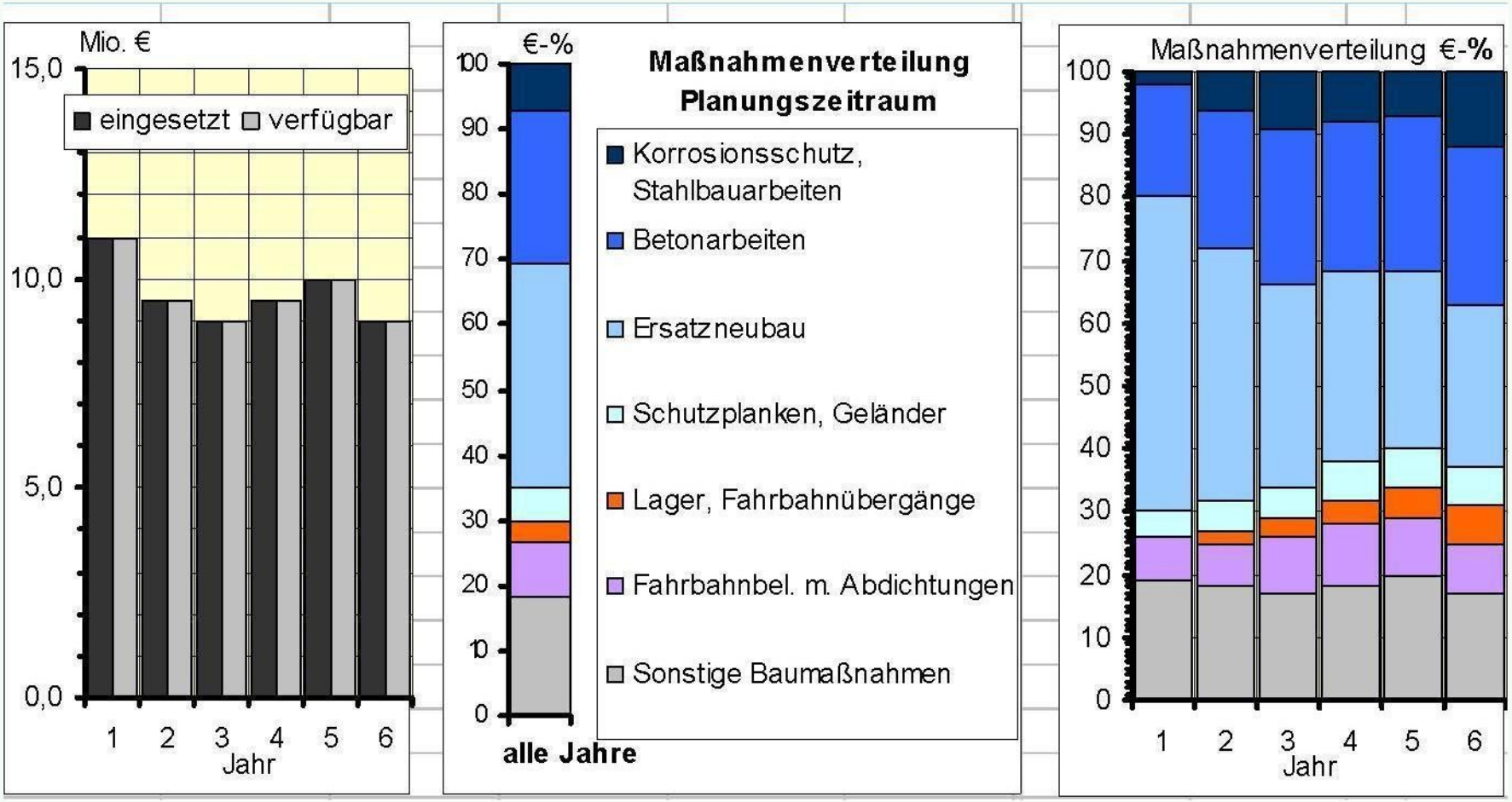
3. Security of Bridges and Tunnels

4. Conclusions

Bridge Management System



Evaluation on Network Level (Quality Scenario)



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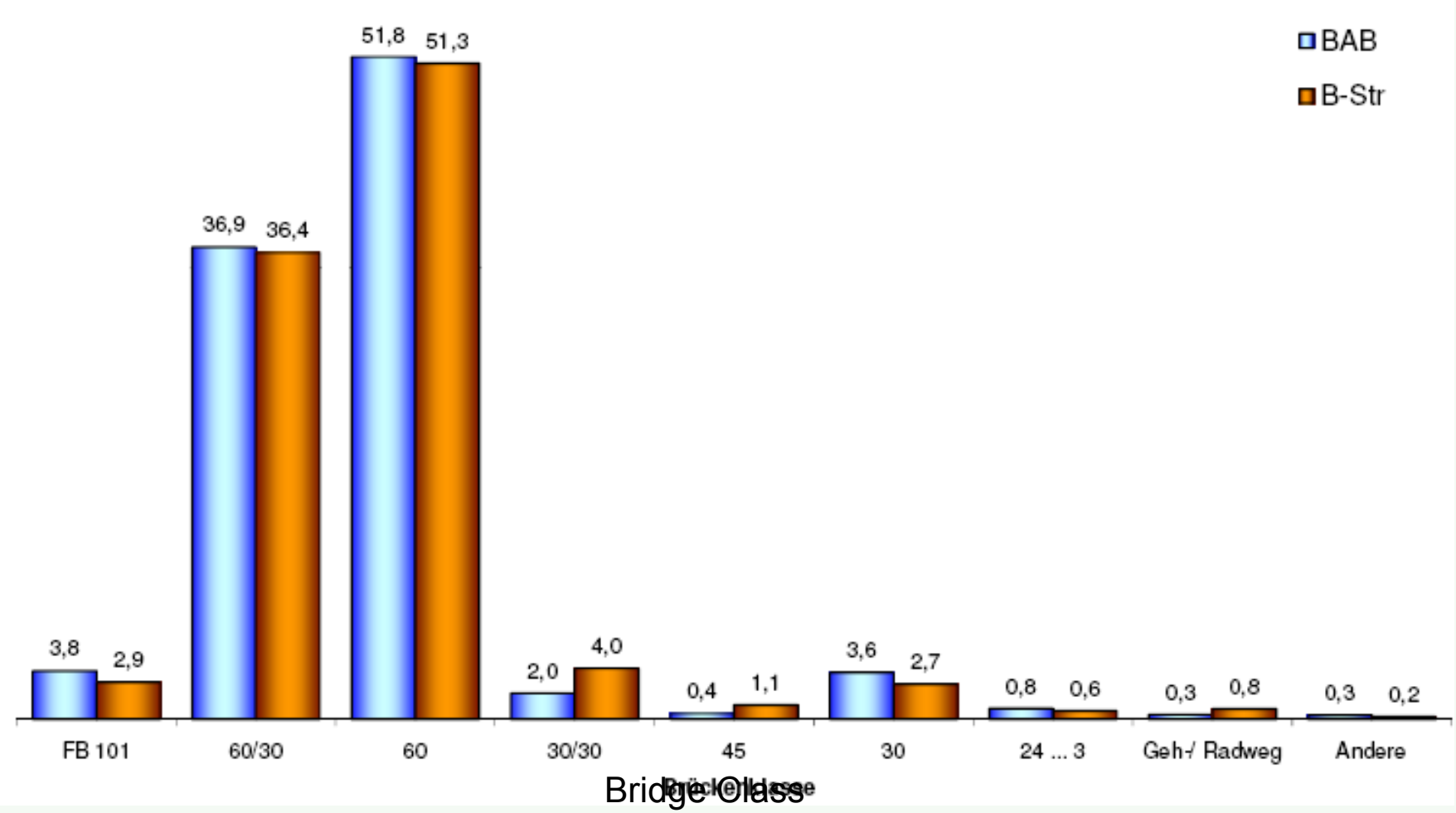
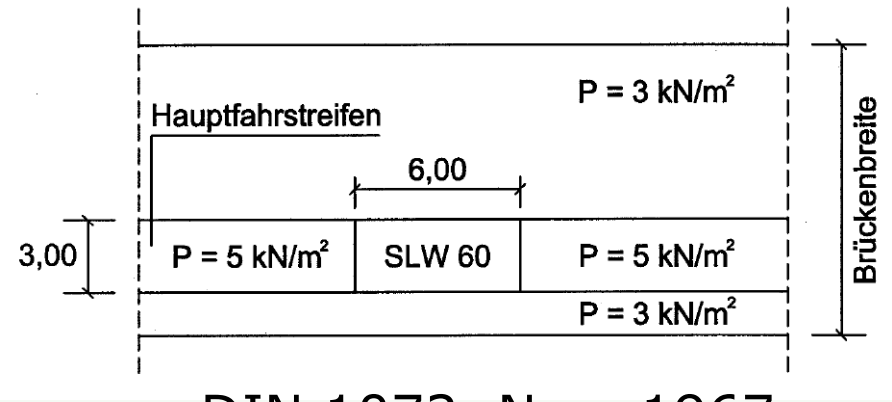
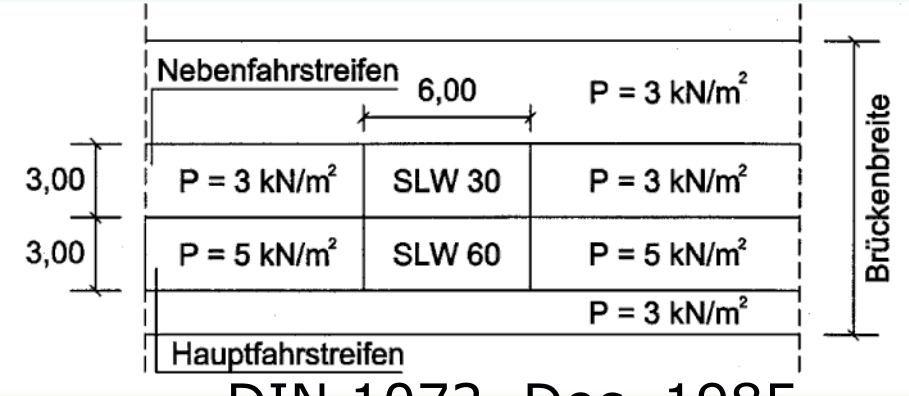
Bridge Classes of Bridges on Federal Roads
(Bridge Deck Area)



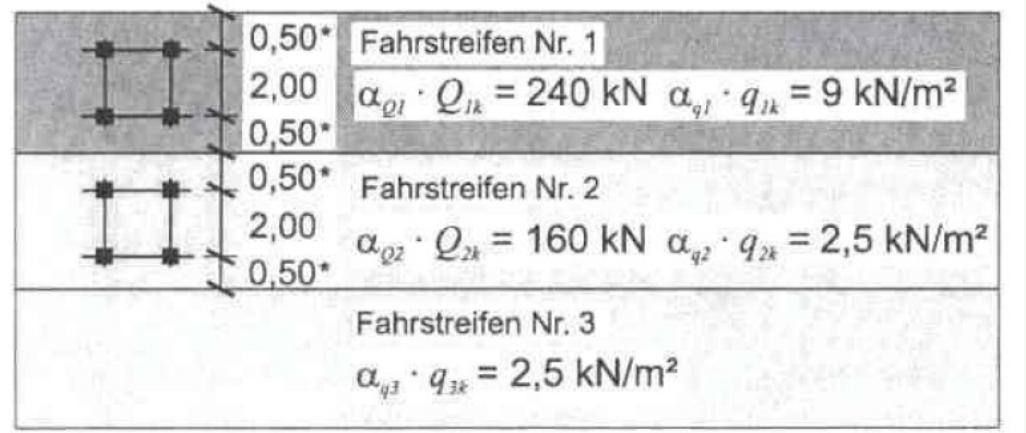
Traffic Load Models



DIN 1072, Nov. 1967

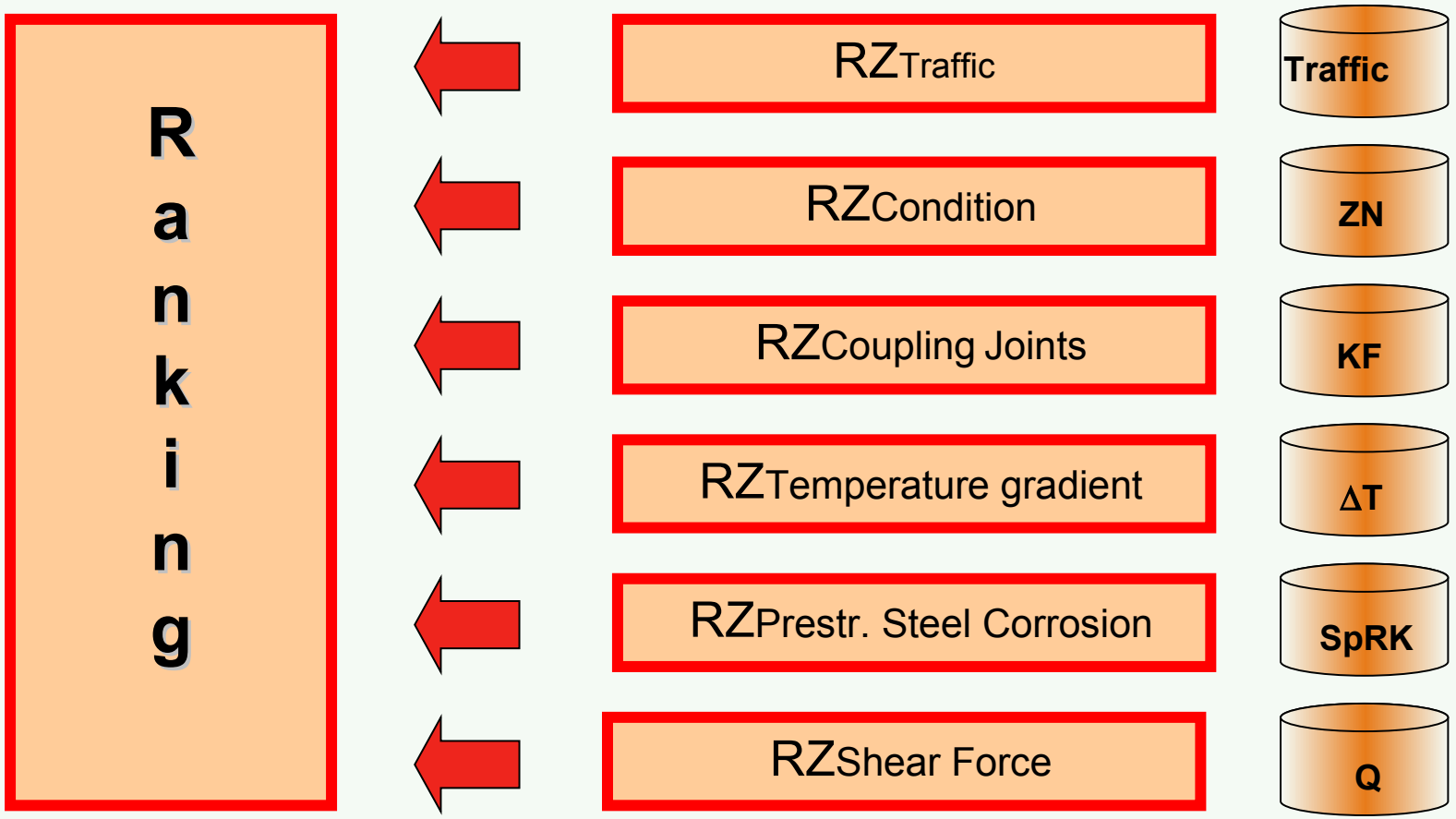


DIN 1072, Dec. 1985



DIN EN 1991

Prioritization



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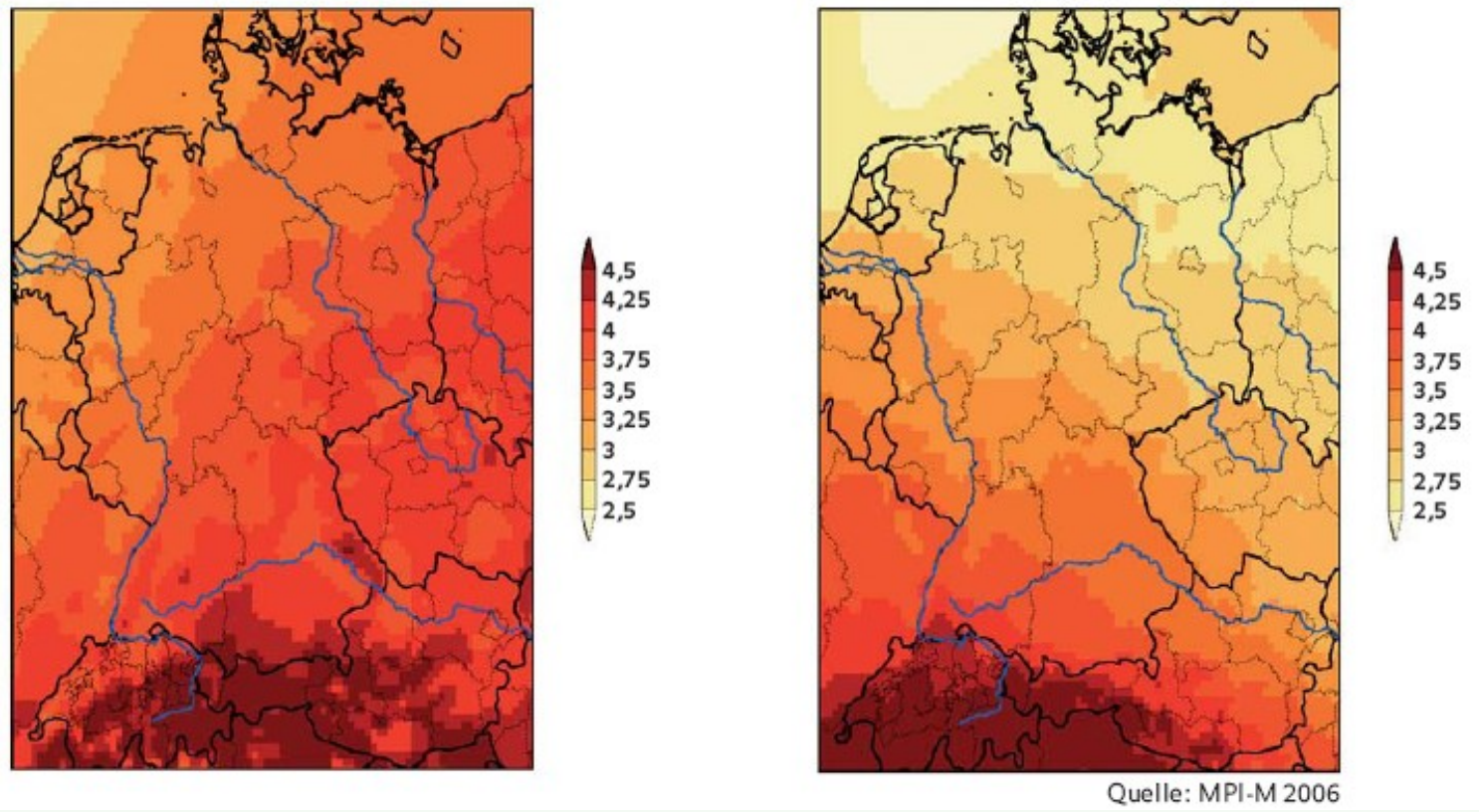
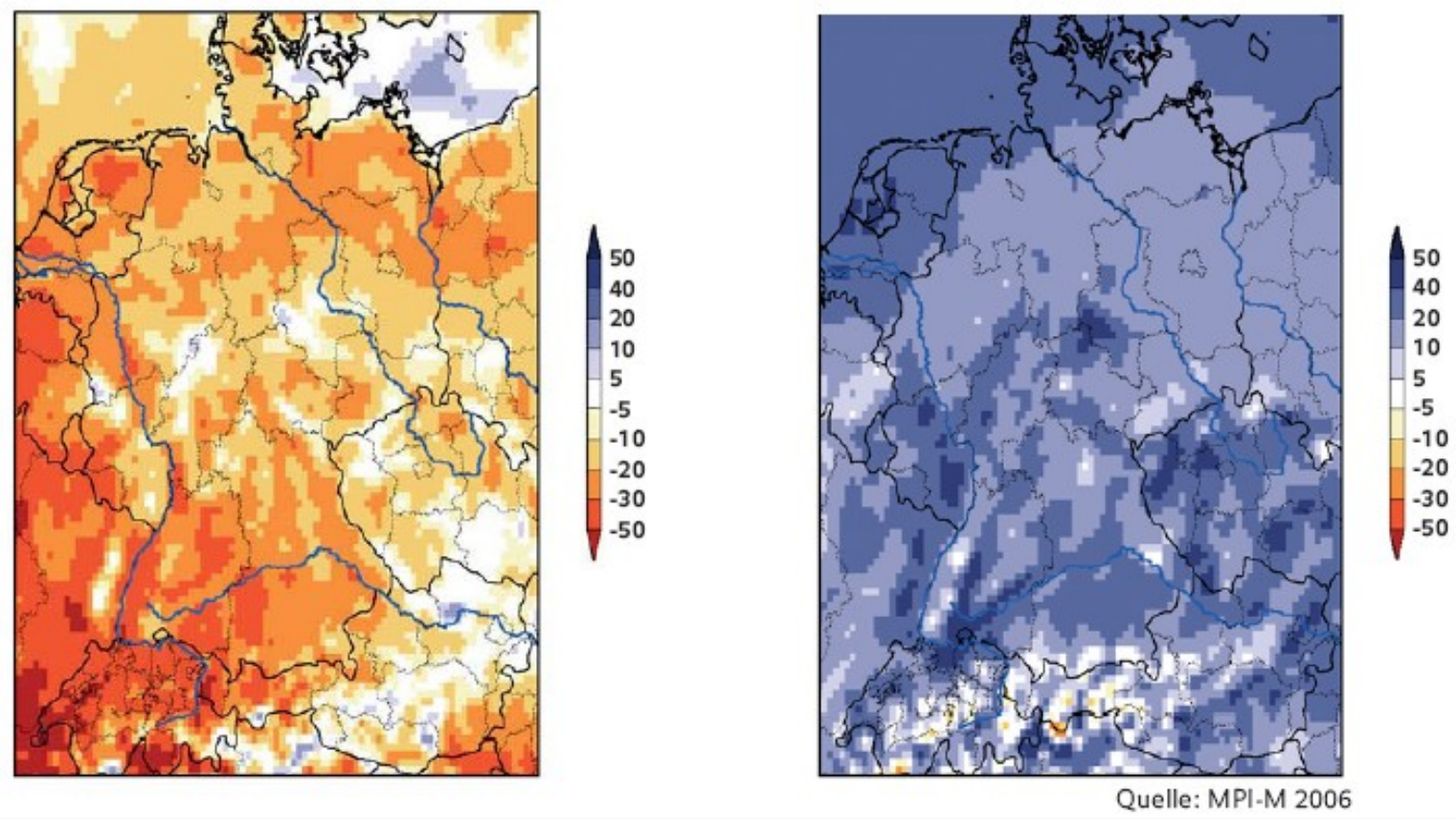
Scenarios for Climate Change in Germany
Temperature changes winter (left) and summer (right)



Mean values for the years 2071-2100 compared to the period 1961-1990, Scenario A1B

Scenarios for Climate Change in Germany
Precipitation changes winter (left) and summer (right)



Mean values for the years 2071-2100 compared to the period 1961-1990, Scenario A1B

Climate Change and Road Infrastructure

- Increasing temperatures
- Changes in precipitation

- Sea level rise
- Flooding of rivers
- Heat waves
- Extreme rain incidents
- Extreme storm incidents
- .....

Consequences for design and maintenance of road infrastructure

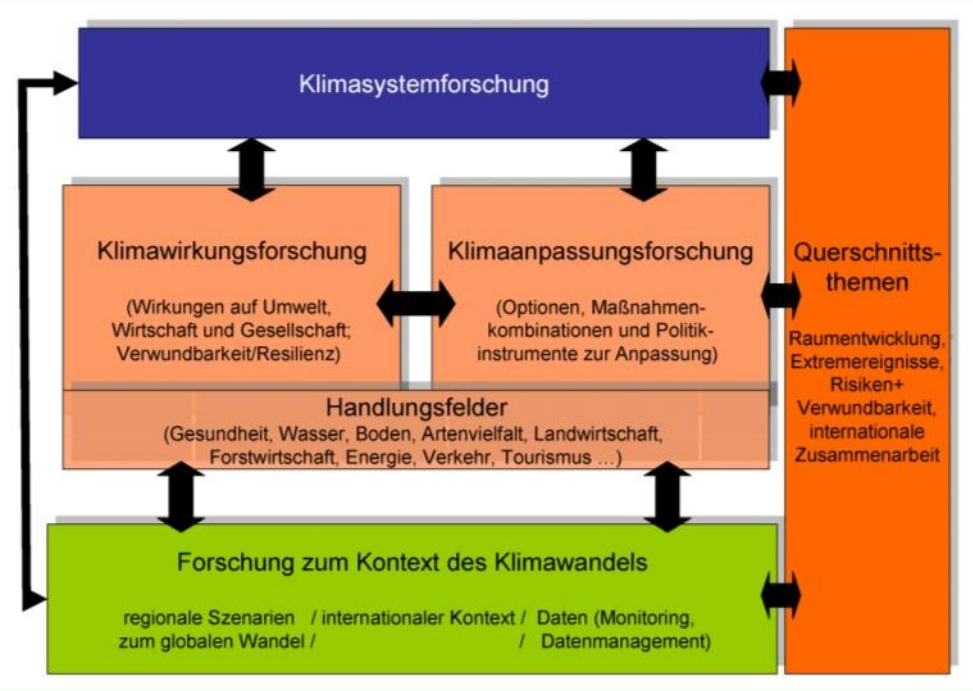
Need for Research

Deutsche Anpassungsstrategie (DAS) an den Klimawandel

Bericht zum Nationalen Symposium zur Identifizierung des Forschungsbedarfs

27./ 28. August 2008 in Leipzig
am Helmholtz-Zentrum für Umweltforschung – UFZ

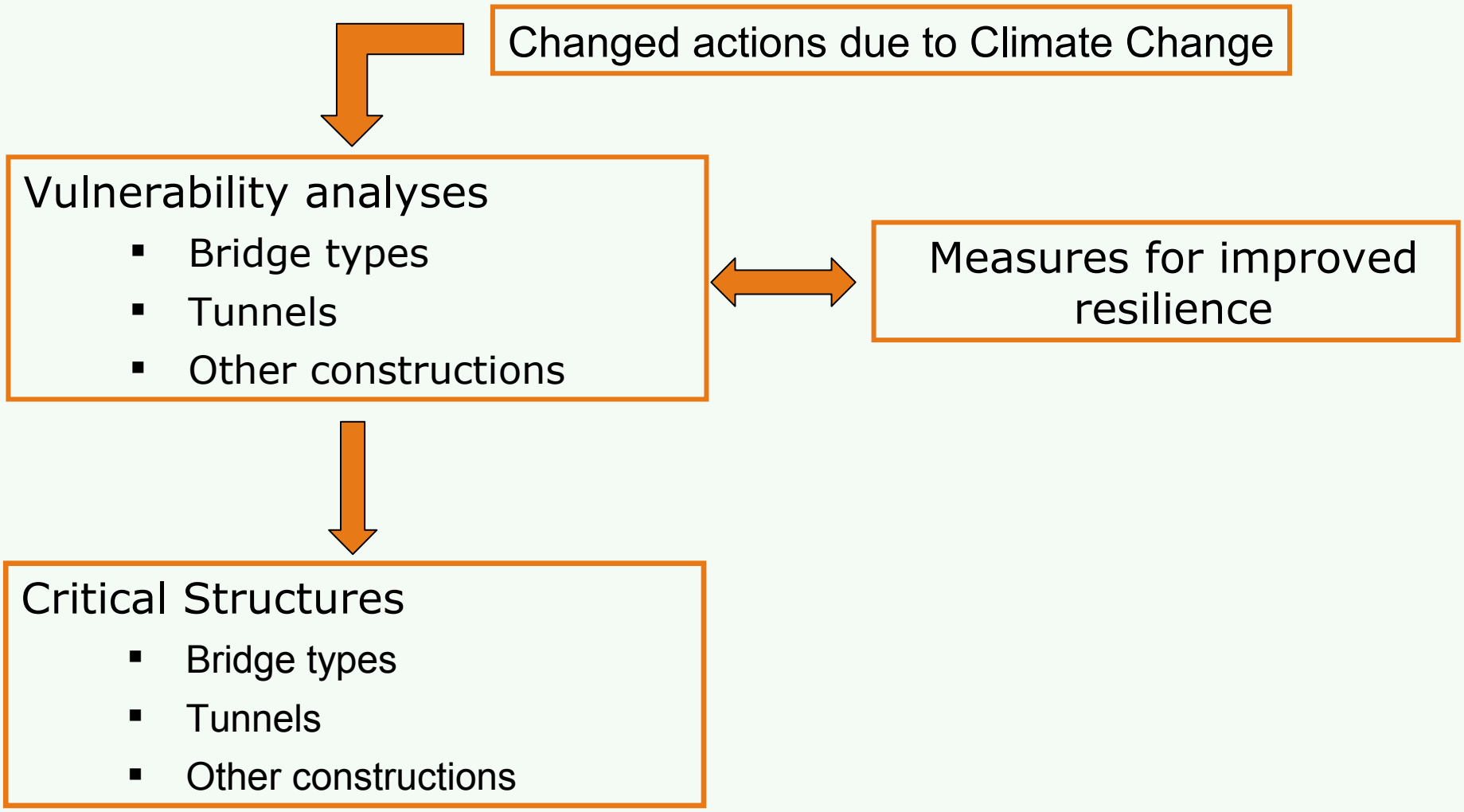
German Adaption Strategy to Climate Change



Research Categories

www.ufz.de/das

Object Level



Network level

Prioritization
- Strengthening
- Repair
- Replacement

Object level
- Vulnerability
- Measures
- Effectiveness

Program for Climate Change Adaption

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Motivation

Bridges and tunnels are key elements of the road network.
Reduced availability leads to:

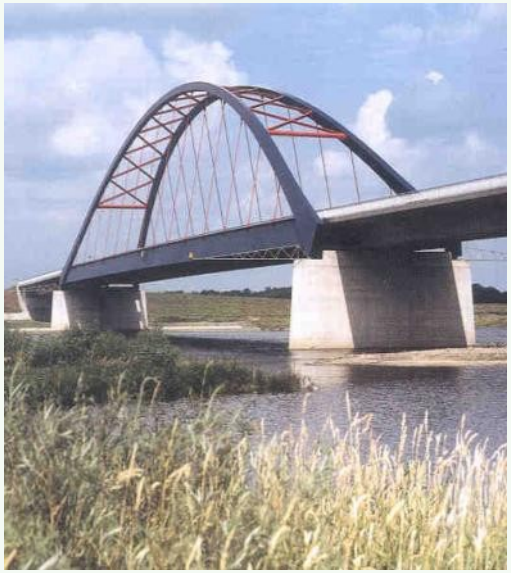
- intense traffic interferences on the surrounding road network
- negative impacts on the user,
- high economic follow-up costs,
- negative environmental impacts and
- domino effects (interdependence with other traffic modes)

Thus: **Protection of structures and users** against **threats** caused by:

- Natural disasters
- Terrorism / Sabotage
- Other man-made hazards (e.g. accidents)

Objectives

- Identification of natural and man-made hazards,
- Formation of decisive threat scenarios,
- Determination of the effects on the structures and the users,
- Investigation of the effects of possible protection measures (risk- and scenario-analyses, cost-effectivenes analyses),
- Selection of the most effective and efficient protection measures.

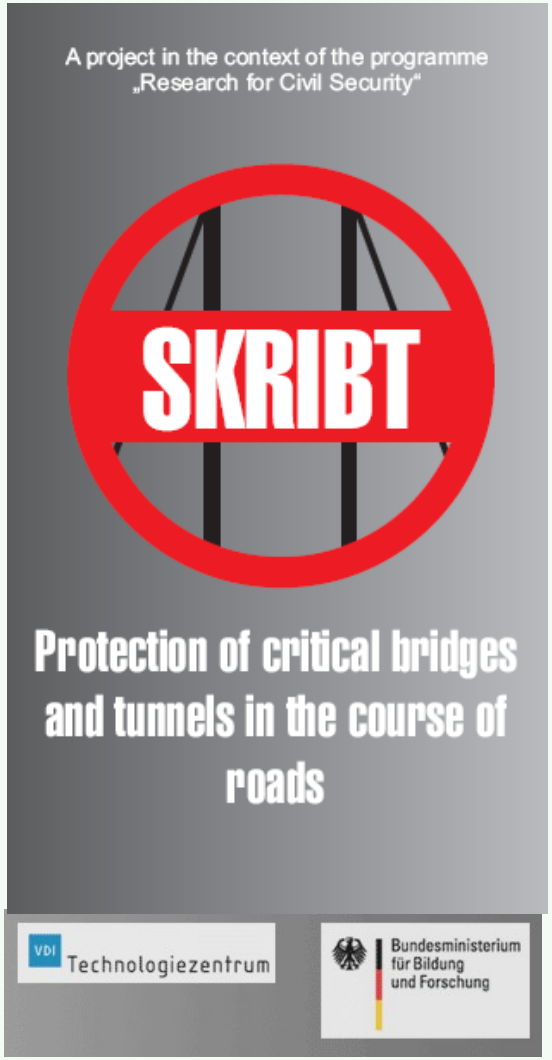


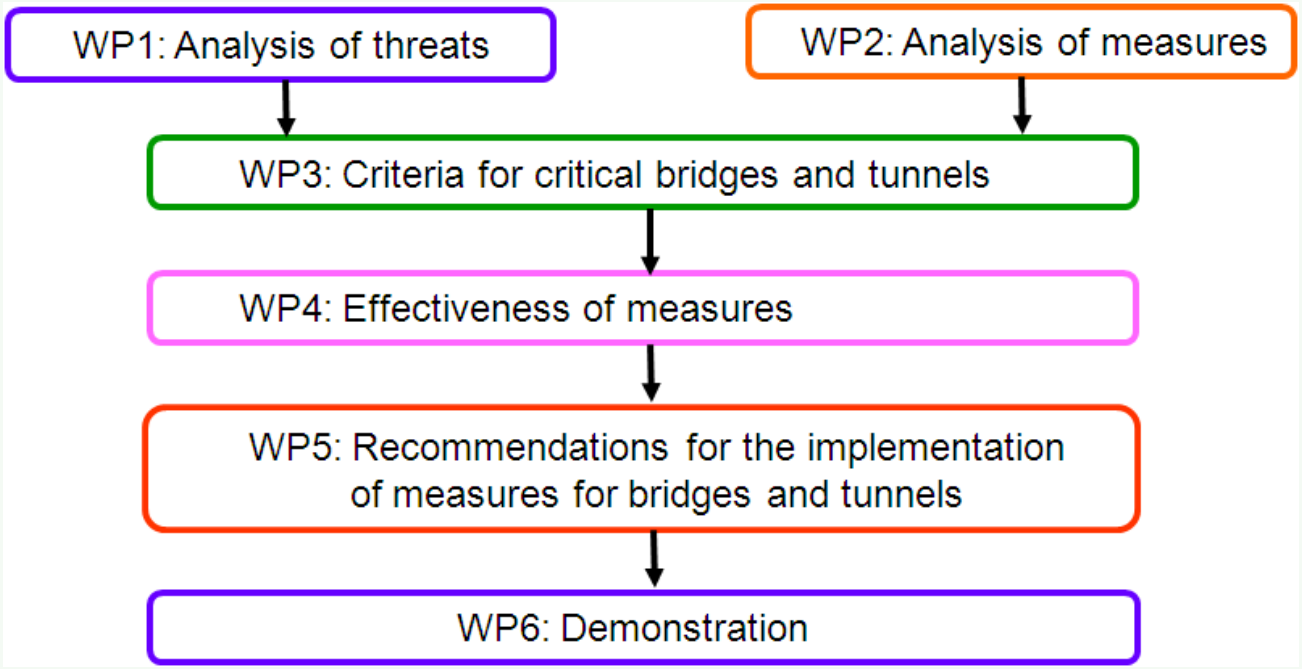
Focus on:

➢**Security of users**

➢**High availability of bridges and tunnels**

Research Activities





National Research Project

www.skribt.org

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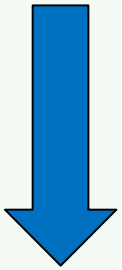
PMS
- Condition
- Climate Change
- …….
- ……

BMS
- **Condition**
- Load Bearing Capacity
- Security
- Climate Change

Other
- Traffic Management
- Traffic safety
- ……..

Asset Management



Multi-objective and harmonized Maintenance Programs