Valorization of infrastructures in a context of sustainable development

PIARC – Seminar on URBAN PAVEMENTS – CRACOW (Poland)
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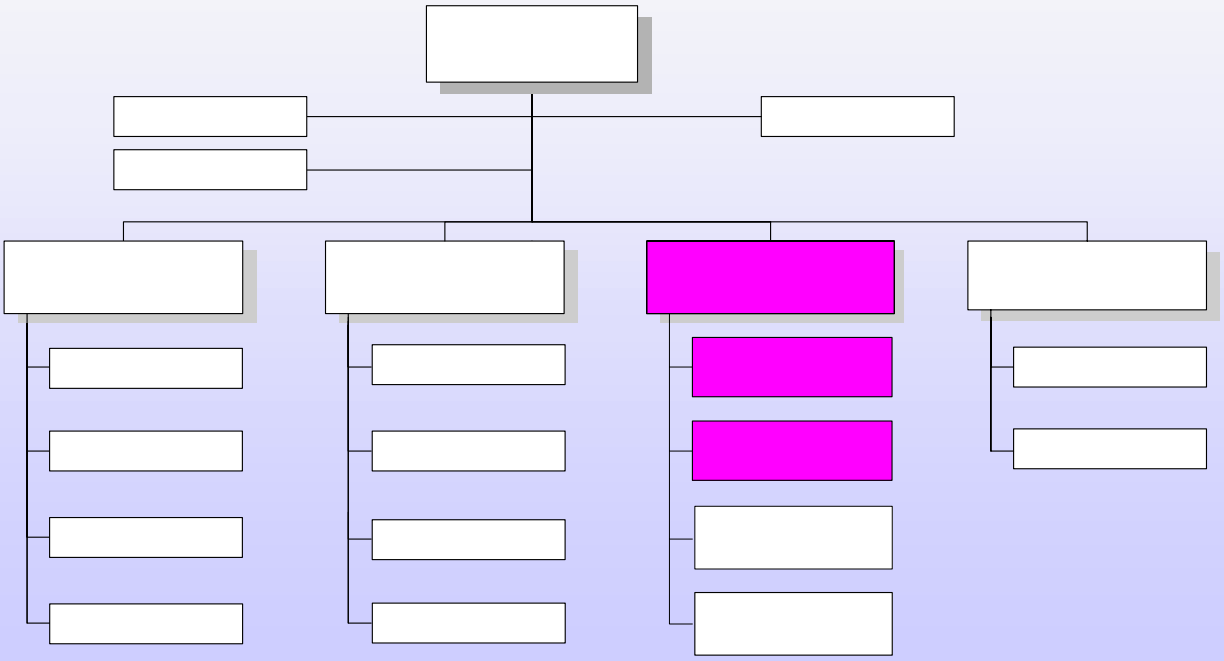
City of Zurich
Department of Civil Engineering

City of Zurich

Facts on the city of Zurich:

Population: ***340'000***
Area: ***88 km²***
Yearly budget: ***€4.5 billion***
Road length: ***737 km***

Structure of the Dep. of Civil Engineering



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Maintenance task

Warranting an adequate maintenance of the road network means performing the road manager‘s function.

Responsibility

- Economic and sustainable use of the taxpayer‘s money for the maintenance of the road infrastructure
- Ensure structural safety

Tasks

- Bookkeeping of inventories
- Inspection, condition rating and intervention planning
- Initiation of maintenance measures, representation in joint project teams (coordination)
- Support of externally executed projects
- Quality control of measures taken
- Project manager (privately executed projects)

Competences

- Determine type of measure and time of intervention

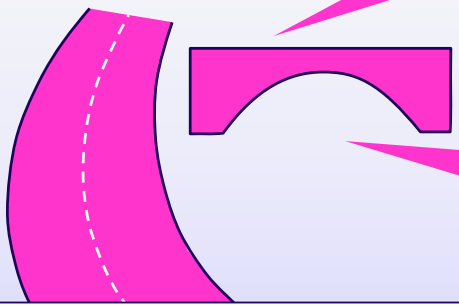
Questions regarding management

What is the condition of the road network?

What condition do we aim for?

road maintenance?

To what extent is road maintenance done?



Inventory road network Switzerland		
Legal classification	Length	Replacement value
City roads	51,400 km	€150 – 300 billion
Canton roads	18,200 km	€80 – 150 billion
National roads (motorways)	1,700 km	€120 billion
Total Switzerland	**71,300 km**	**€350 – 570 billion**

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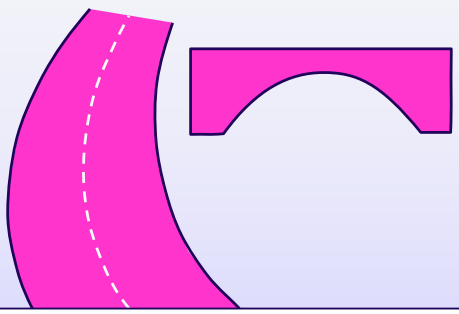
Different viewpoints



- **Engineering / Material Technology**
- **Project view**
- **Accounting view**
- **Data-oriented view**
- **Operational accounting view**

Inventory road network Switzerland		
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City roads	51,400 km	€150 – 300 billion
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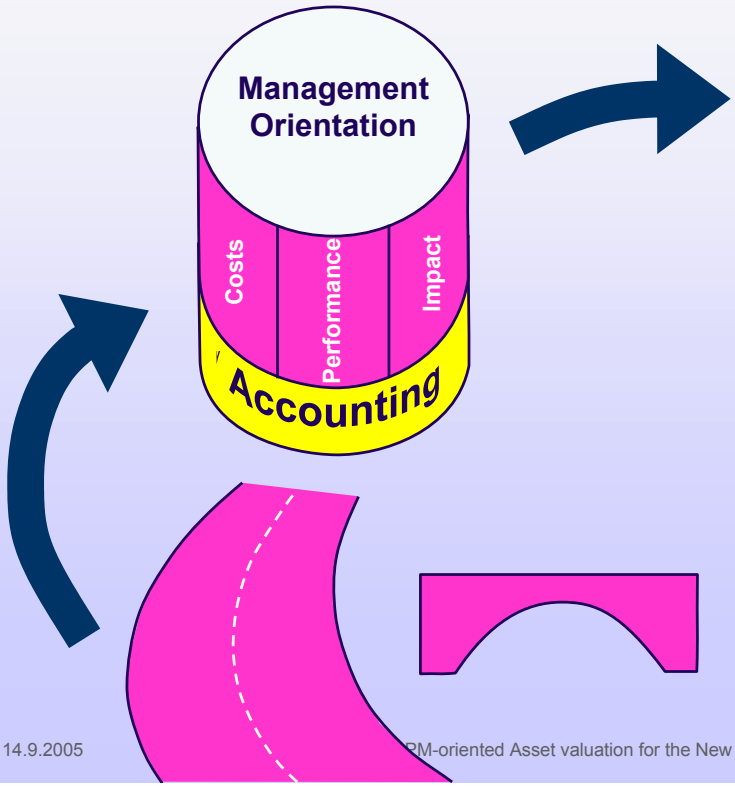
Our approach: operational viewpoint



Budget / finance plan				
Project	05	06	07	08
A				
B				
C				

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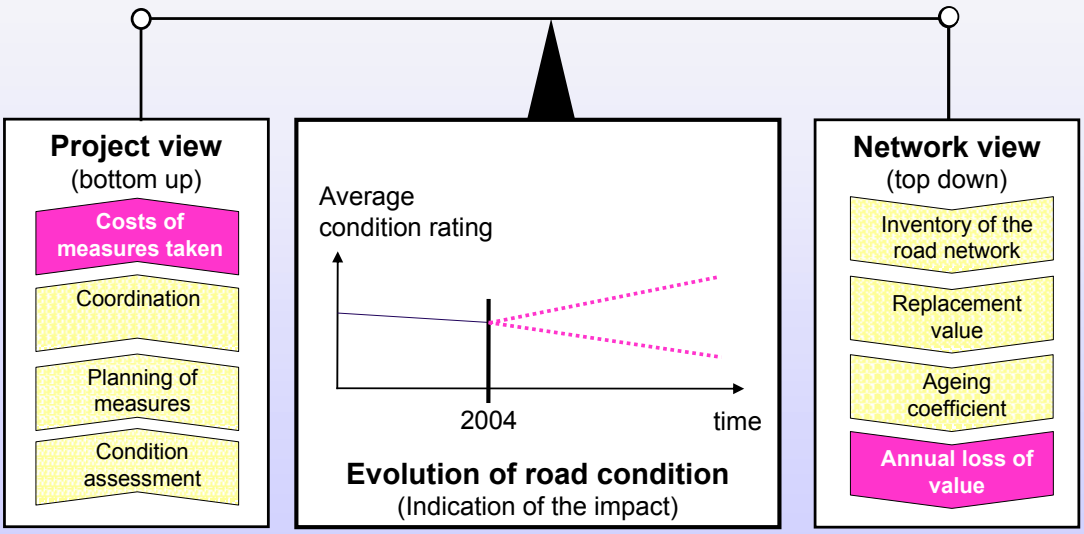
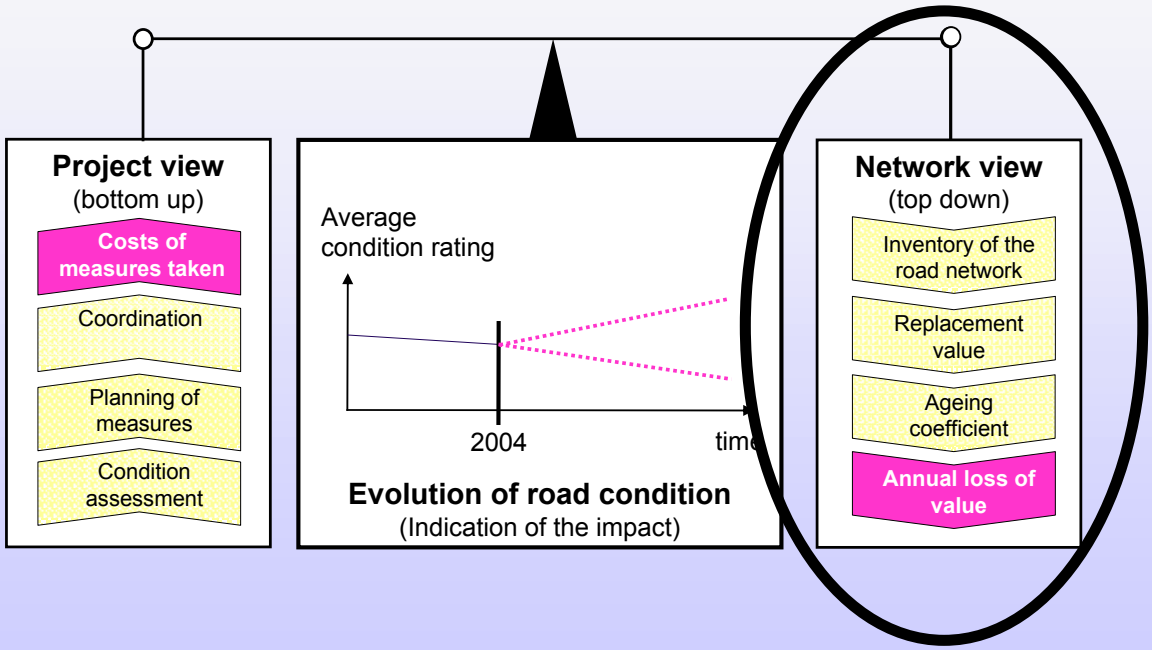
Basic model for Maintenance



The functioning and quality of the road network can be

Network view



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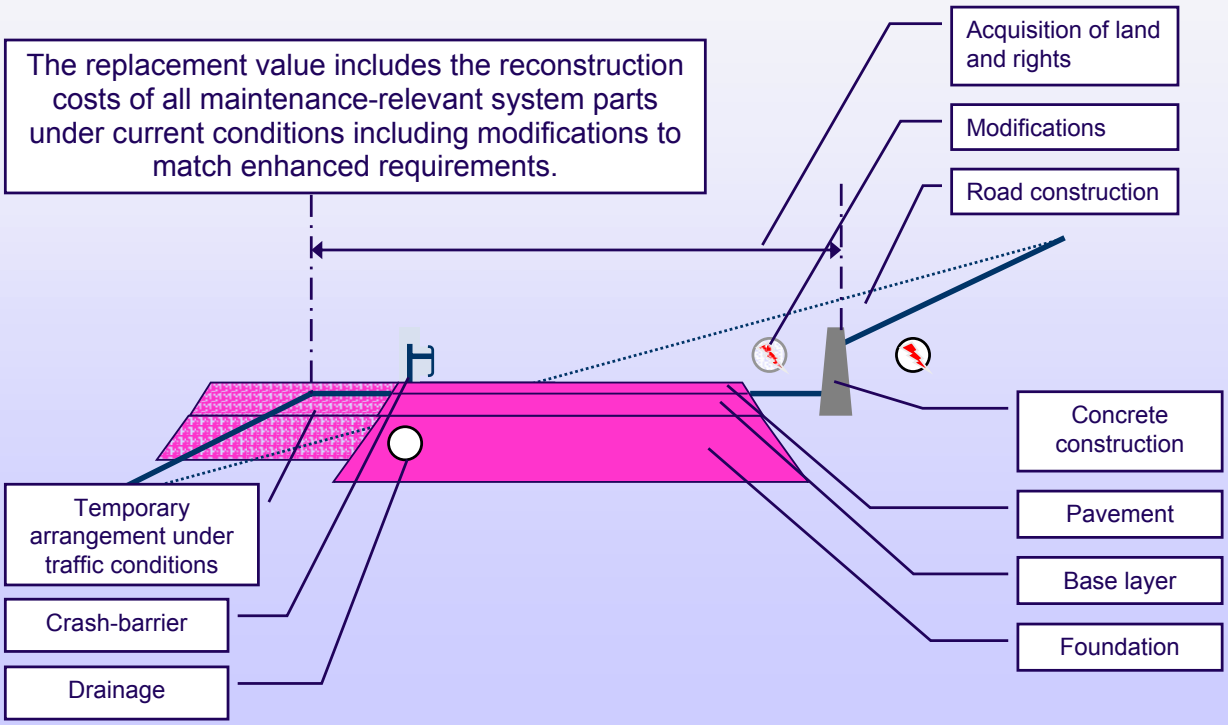
Inventory

Road network city of Zurich (Responsible: Department of civil engineering)	**Objects** km	**Objects** Number	**Area** m^2
Total Roads			**7‘761‘000**
Traffic lanes	737		5‘301‘000
Pedestrian bycicle lanes			2‘460‘000
Total Civil Engineering Structures		a) **643**	**295'278**
Bridges		113	133‘028
Overpasses		198	25‘298
Underpasses		8	12‘932
Culvets		126	5‘074
Road tunnels		4	17‘764
Utility tunnels		13	11‘347
Pedestrian subways		81	29‘287
Riverside structures	9.6	k.A.	44‘548

Replacement value

The replacement value includes the reconstruction costs of all maintenance-relevant system parts under current conditions including modifications to match enhanced requirements.



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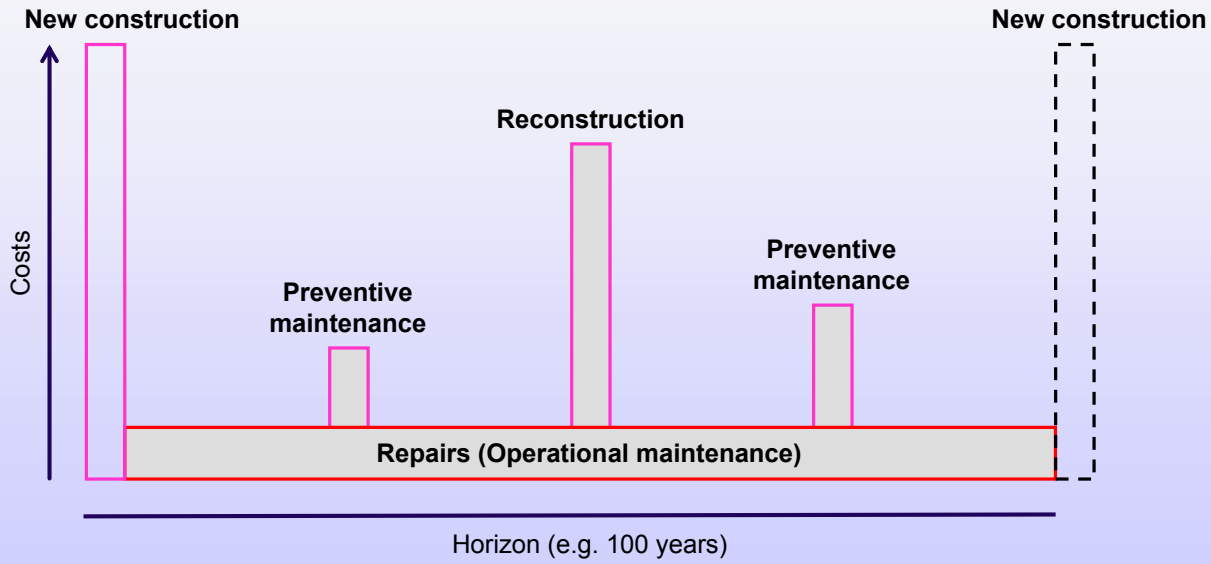
Ageing coefficient: Methodology



Annual loss of value: Roads

Roads			Area	Replacement value		Loss of value	
Traffic volume	Urbanistic requirements	km	m^2	€/m^2	Mio. €	Ageing coefficient in %	Mio. €
Total roads			**7'761'000**		**1,189**	**2.2%**	**26**
Total lanes		**737**	**5'301'000**	**200**	**1,029**	**2.2%**	**23**
> T4	normal		1'339'383	220	295	2.6%	8
T3, T2	normal		925'324	190	176	2.1%	4
T1	normal		2'129'190	170	362	1.9%	7
> T4	enhanced		426'301	230	98	2.6%	3
T3, T2	enhanced		330'798	210	69	2.1%	1
T1	enhanced		150'371	190	29	1.9%	1
Pedestrian/bicyle lanes			**2'460'000**	**65**	**160**	**1.8%**	**3**

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Annual loss of value: Civil Engineering structures

Civil Engineering Structures	Objects	Areas	Replacement Value:		Loss of value	
	Number	m^2	€/m^2	Mio. CHF	Ageing coefficient in %	Mio. €
Total Civil Engineering structures	**643**	**295'278**		**1'304**	**1.5%**	**11.5**
Bridges	113	133'028	2‘840	585	1.6%	6.1
Overpasses	198	25'298	1‘800	71	1.6%	0.7
Underpasses	8	12'932	2‘700	54	1.9%	0.6
Culvets	126	5'074	2‘840	22	1.5%	0.2
Road tunnels	4	17'764	5‘100	140	1.3%	1.2
Utility tunnels	13	11'347	1‘740	31	1.2%	0.3
Pedestrian subways	81	29'287	2‘320	105	1.8%	1.2
Riverside structures	k.A.	44'548	3‘120	216	0.9%	1.2
Retaining walls[a)]	100	16'000	3‘230	80	?	?

Management-oriented asset valuation

Advantages of the valuation of the existing assets (and hence the replacement value):

1. Discounting can be omitted
   (Determination of the present value ist time consuming and difficult for roads)

2. The annual loss of value, derived from the replacement value, can directly be compared to the costs of the annually implemented measures

3. Asset value (loss of value) and implemented measures are on the same (actual) cost level

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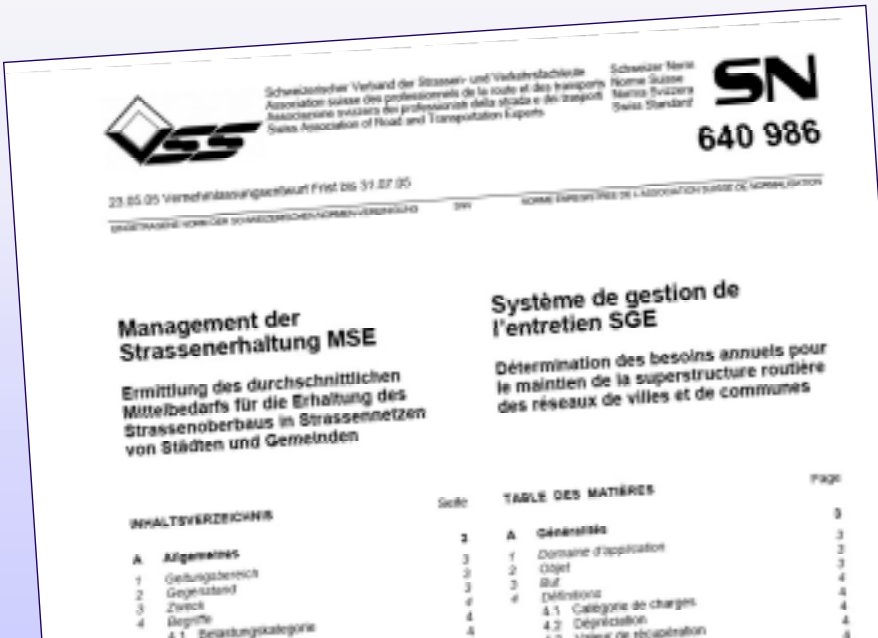
Standards in preparation



VSS

Schweizerischer Verband der Strassen- und Verkehrsfachleute
Association suisse des professionnels de la route et des transports
Associazione svizzera dei professionisti della strada e dei trasporti
Swiss Association of Road and Transportation Experts

Schweizer Norm
Norme Suisse
Norma Svizzera
Swiss Standard

SN
640 986

23.05.05 Vernehmlassungsentwurf Frist bis 31.07.05

Management der Strassenerhaltung MSE

Ermittlung des durchschnittlichen Mittelbedarfs für die Erhaltung des Strassenoberbaus in Strassennetzen von Städten und Gemeinden

Système de gestion de l'entretien SGE

Détermination des besoins annuels pour le maintien de la superstructure routière des réseaux de villes et de communes

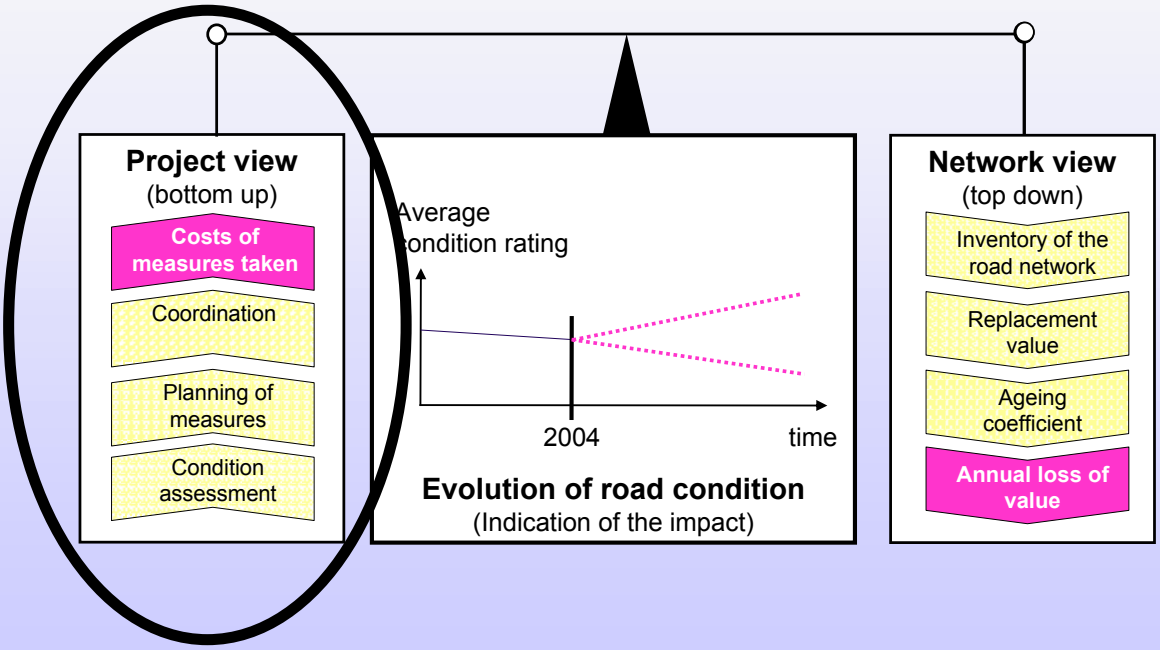
INHALTSVERZEICHNIS Seite

A Allgemeines 3
1 Geltungsbereich 3
2 Gegenstand 3
3 Zweck 4
4 Begriffe 4
4.1 Belastungskategorie 4

TABLE DES MATIÈRES Page

A Généralités 3
1 Domaine d'application 3
2 Objet 3
3 But 4
4 Définitions 4
4.1 Catégorie de charges 4
4.2 Dépréciation 4

Object view



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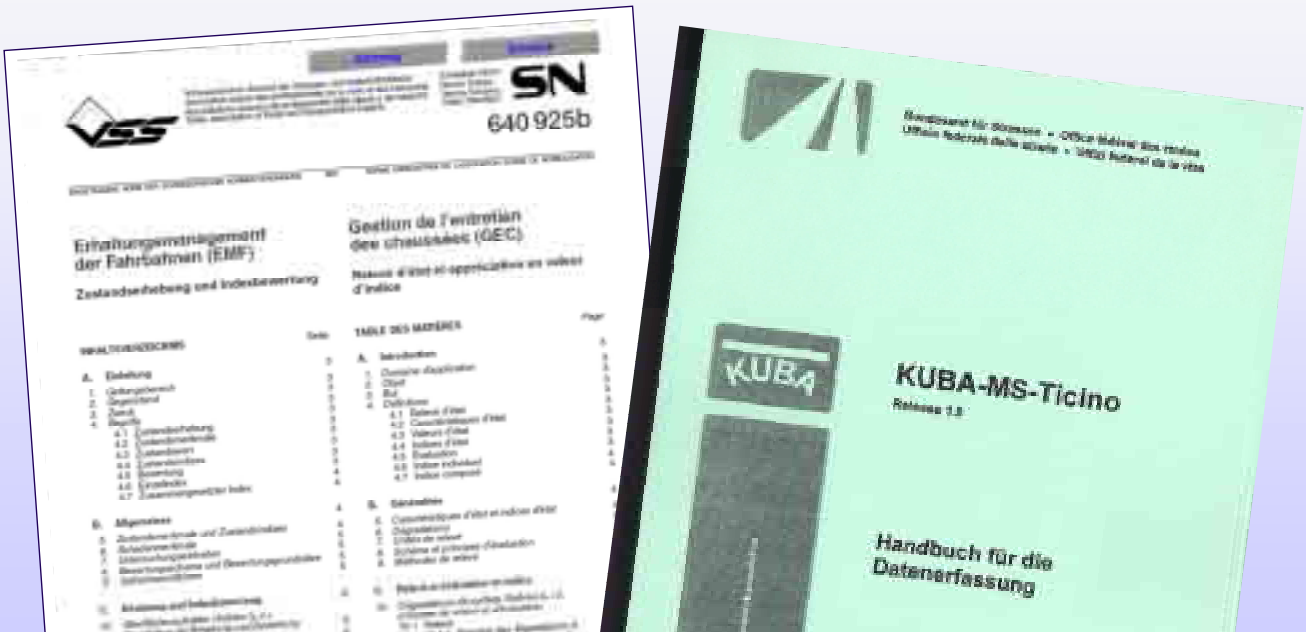
Condition assessment



Inspection, condition rating (PMS)

Basics	• Swiss standard 640 925b for visual inspection
Scope	• Only traffic lanes (sidewalks excluded) • Only measures for maintenance (no repairs)
Structure	• Legal classification, traffic volume and district
Sections	• Generation of sections on site in line with measures to be proposed
Geometry	• Basic geographical data (GIS) from City surveying office (AV 93): Area instead of axes
Implementation	• Inspection and rating by own employees • Tri-annual complementation. A third of the network per year • No updating at the moment (just current assessment) • No administration tasks by experts

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Condition overview with GIS

Intervention planning (PMS)

Proposal of measures

- Defined for each section
- According to damage pattern and trends (surface, structure) on site

Four options

- Detailed planning in line with coordination (sampling, pavement design, different intervention options)

Maintenance	Surface dressing	€10 / m²	
	New surface	€50 / m²	
Reconstruction and rehabilitation	Resurfacing with partial enhancement	€100 / m²	
	Reconstruction	€200 / m²	

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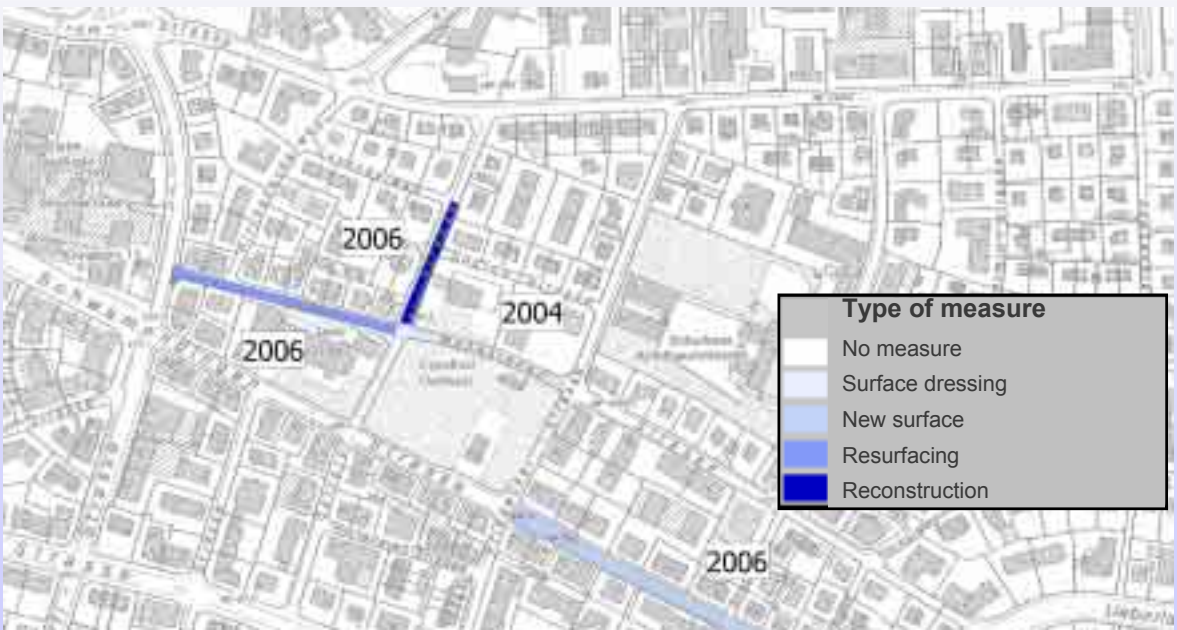
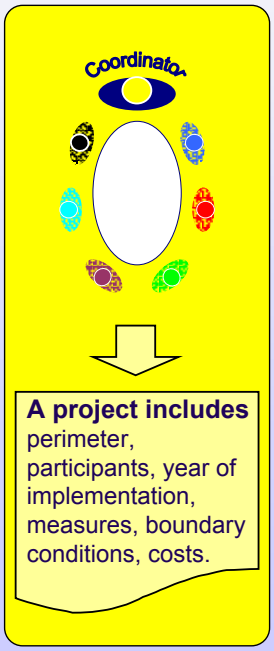
Intervention plan (PMS)



Coordination

Management of subsystem | **Coordination** | **Planning and construction process**

- Planning **Construction/extensions**
- Planning of measures of **roads**
- Planning of measures of **civil engineering struct.**
- Maintenance planning for **sewage**
- Maintenance planning for **tramway**
- Maintenance planning for **water supply**
- Maintenance planning for **power supply**
- Maintenance planning for **....**



A project includes perimeter, participants, year of implementation, measures, boundary conditions, costs.

Total reconstruction
(joint projects)

Planning / Design / Implementation

- ➔ **Reduction of total costs for the city**
- ➔ **Reduction of obstruction of traffic**
- ➔ **Reduction of nuisance for residents**

Non-joint projects

Planning / Implementation

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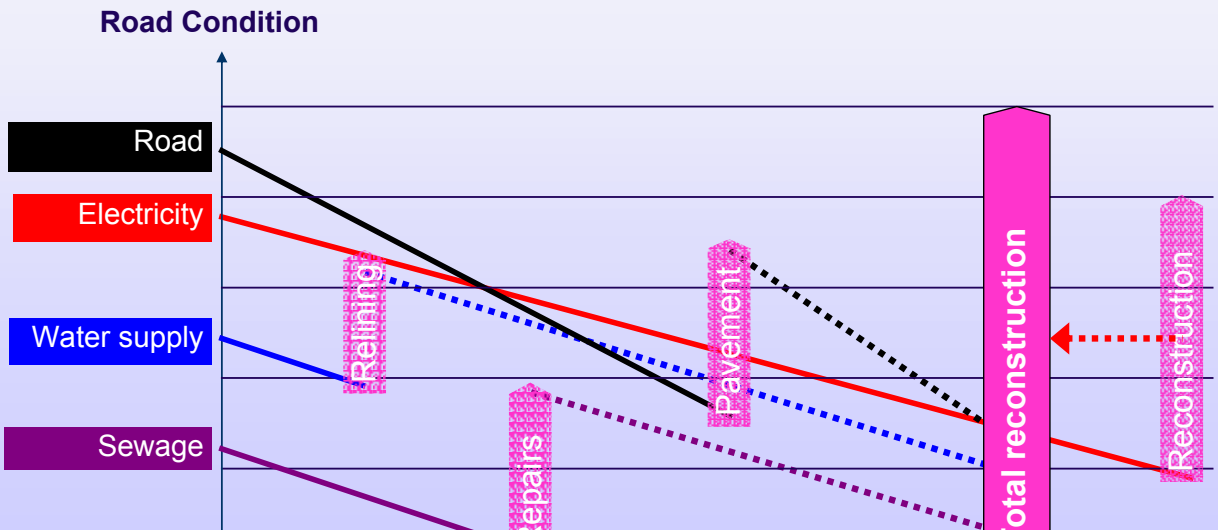
Coordination: as good as necessary, instead of as good as possible



Costs of measures taken

Maintenance
- Which measures are effective within the Basic model for Maintenance?

Costs
- How do we share the costs of joint projects?
- At what time do we evaluate costs (annual reporting or at the completion of the project)?
- How do we define costs? (tender or actual costs)

Performance
- What is the performance?
- How to we quantify it?

Effects
- What is the impact of the measures?
- How do we measure the impact?
- How does it relate to the New Public Management (NPM)?

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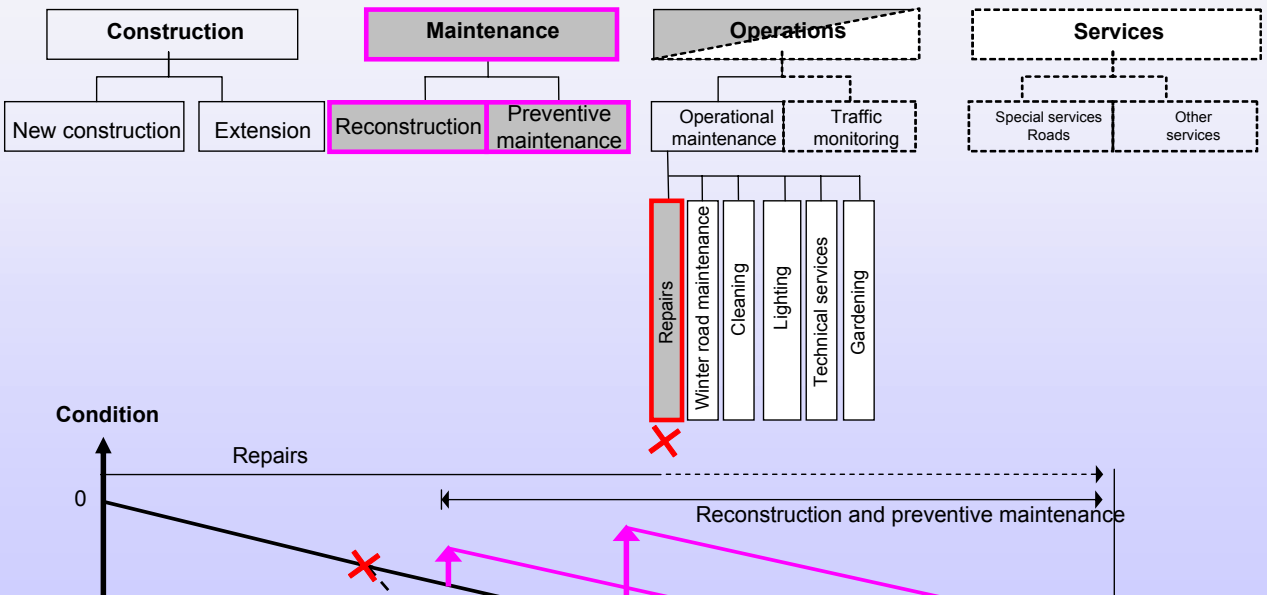
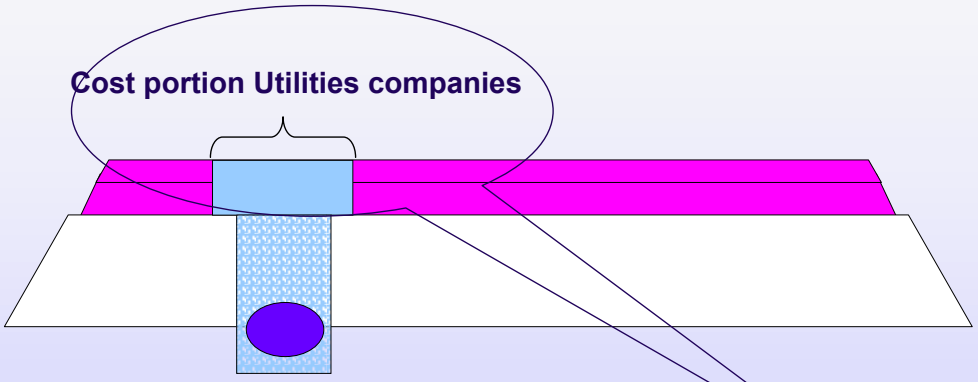
Evaluation of implemented measures



Quantify costs: Total costs



Sum of the implemented measures (invoice Dept. of Civil Engineering)	
+ cost portion of joint projects at the expense of Utilities companies	
Total costs implemented measures on road network of the City of Zurich	.....

Costs and performance (m2) are quantified once at completion of project

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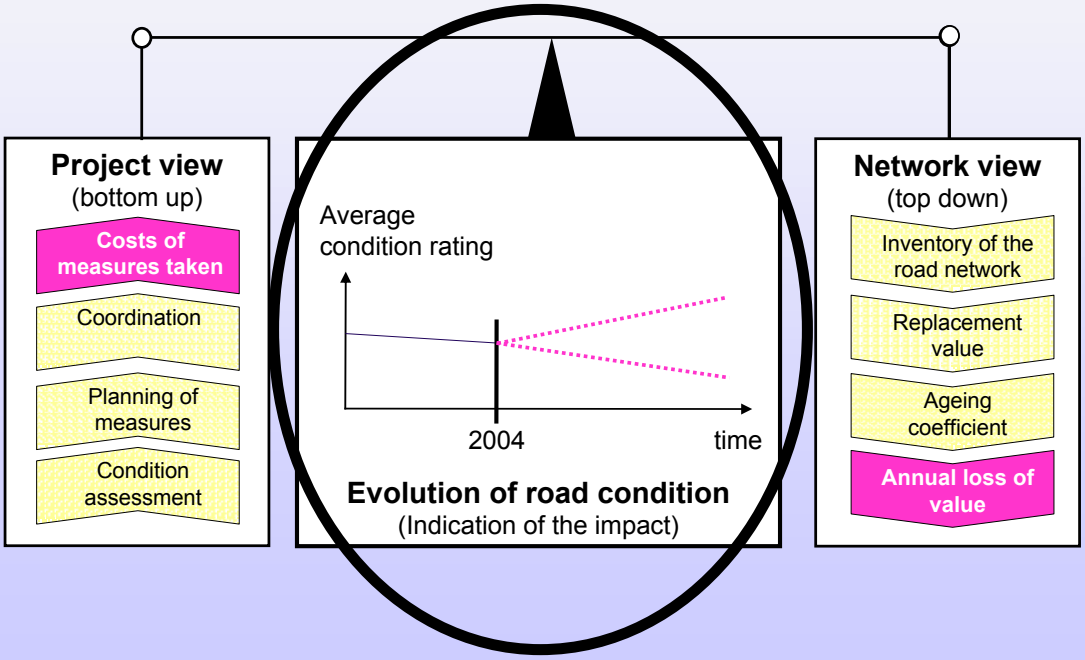
Quantify costs and performance Project view

Budget / Finance plan	2003	2004	2005	2006	Σ
Project A	10,000	40,000	30,000	20,000	100,000
Accounting view	10,000	40,000	30,000	20,000	
Project view (at completion)					
• Total costs				**100,000**	EURO
• Total performance				**330**	m^2

In the project view the costs and performance are quantified at the completion of

Evolution of road condition



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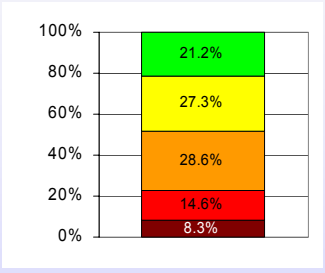
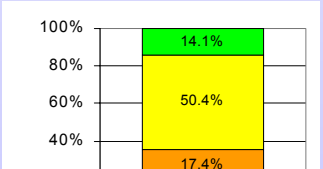
Current condition ratings (2004)

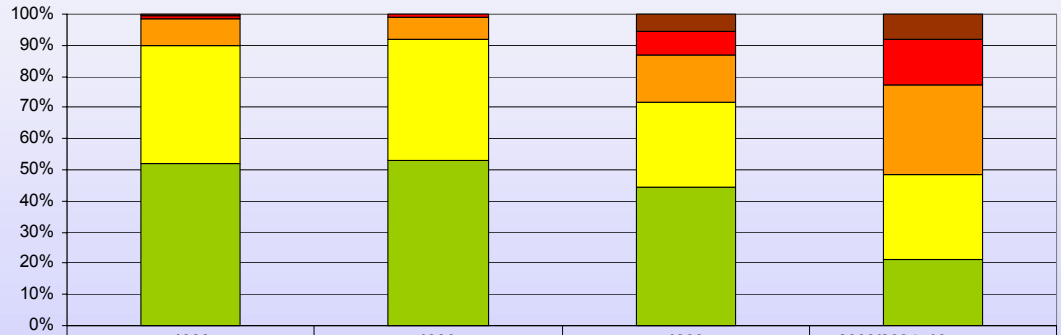
Roads mean value: 2.07 (weighted according to traffic lane area)



Civil Engineering structures mean value: 2.39 (weighted according to bridge area)



Condition ratings from 1993 to 2004
(Example roads)



	1993 (average: 1.1)	1996 (1.0)	1999 (1.4)	2003/2004, 16 quarters (2.1)
4.0 - 5.0: alarming	0.004	0.002	0.057	0.082689979
3.0 - 3.9: critical	0.012	0.008	0.076	0.14628762
2.0 - 2.9: acceptable	0.084	0.073	0.151	0.28587173
1.0 - 1.9: average	0.38	0.385	0.273	0.273226247
0.0 - 0.9: good	0.52	0.532	0.443	0.211924425

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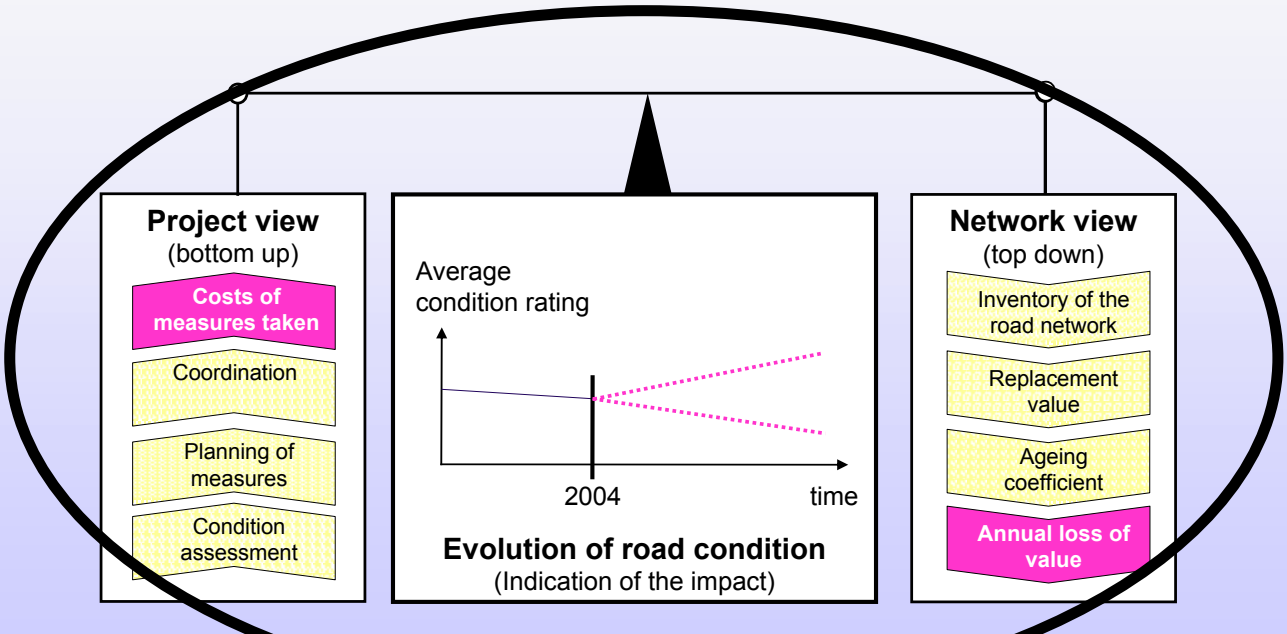
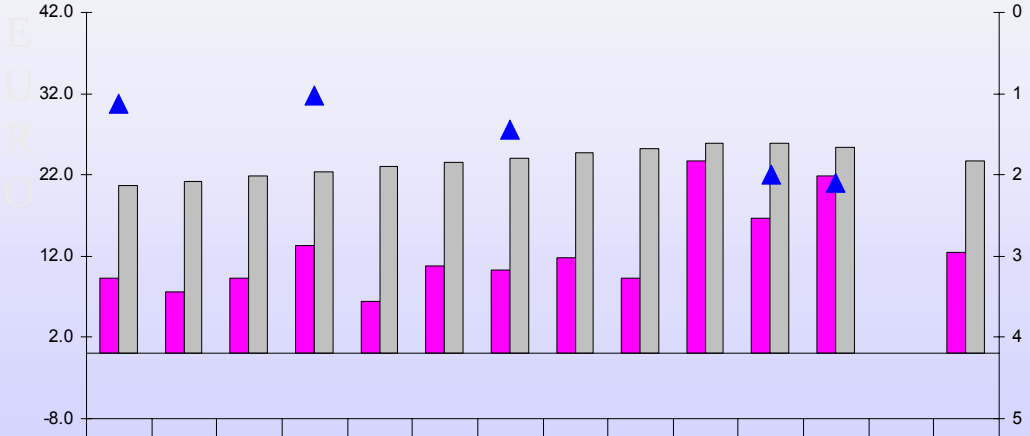
Maintenance management



Look back: Balance?
(Example roads in €)



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		average
Implemented measures	9.3	7.7	9.4	13.3	6.4	10.7	10.3	11.8	9.4	23.7	16.7	21.9		12.5
Loss of value (e.g. indize rise in price TAZ)	21	21	22	22	23	24	24	25	25	26	26	25		23.7
Mean index of road condition I1	1.12			1.02			1.44				2.00	2.10		

without Repairs

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Look forward: Maintenance scenarios

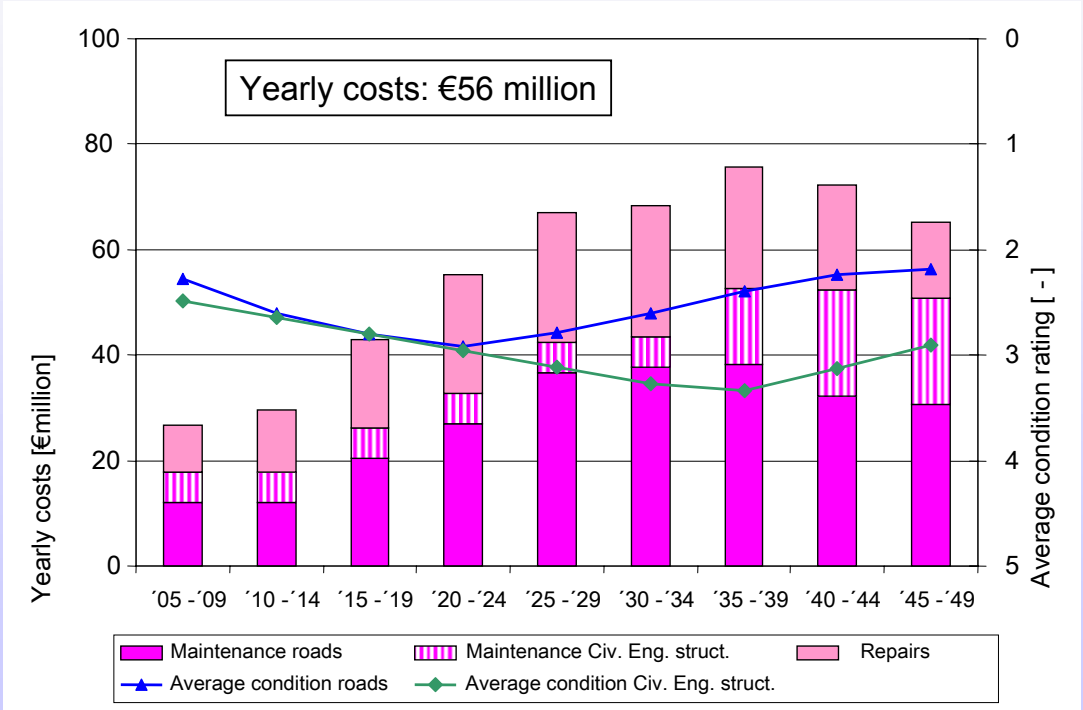
To demonstrate the evolution of the financial needs and the road network condition of the City of Zurich for the coming 45 years:

1. with limited financial means over the next 10 years
   (Scenario „Threshold on maintenance expenses“)

2. with a sustainable maintenance strategy
   (Scenario „Sustainable maintenance“)

3. with a 25%-reduction of the financial means over the next 10 years
   (Scenario „Decrease of the maintenance expenses“)

„Threshold on maintenance expenses “: Results



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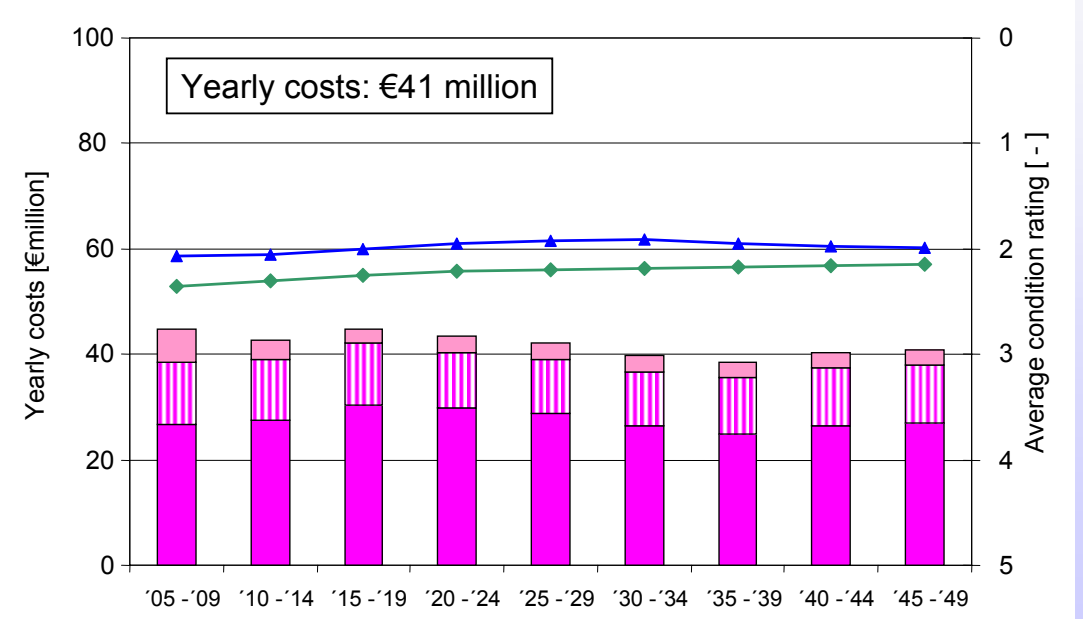
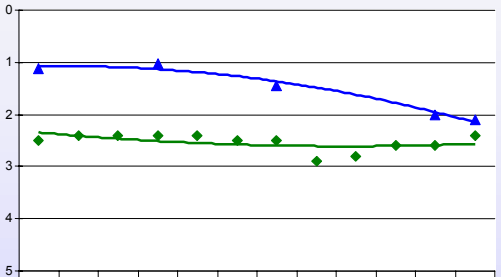
„Sustainable maintenance“: Results



Basis for political decision-making



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
▲ Condition Roads	1,1			1,0			1,4				2,0	2,1
◆ Condition Civ. Eng. struct.	2,5	2,4	2,4	2,4	2,4	2,5	2,5	2,9	2,8	2,6	2,6	2,4

> €41 million/year

€41 million/year

< €41 million/year

Sustainable maintenance of the Zurich road network means:

Gradual increase of the maintenance expenses from today €26 million/year to €41 million/year.

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Management oriented road maintenance is

Lack of cost transparency lead the (short-period oriented) politics into temptation to burden maintenance investments onto the next generation

- New combination of technology, organisation, public administration accounting, new public management and data management for the management of maintenance from the network point of view
- Easy, plausible, transparent, economical due to few key data and industrial standards
- Political options for a sustainable road maintenance with positive cost

Guide for the implementation

www.chgemeinden.ch