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Urban Public Transportation Systems Design and Prosperity of Regions

Institut für Eisenbahn- und Verkehrswesen

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2. Cost-Benefit-Analyses in Public Transportation

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Introduction

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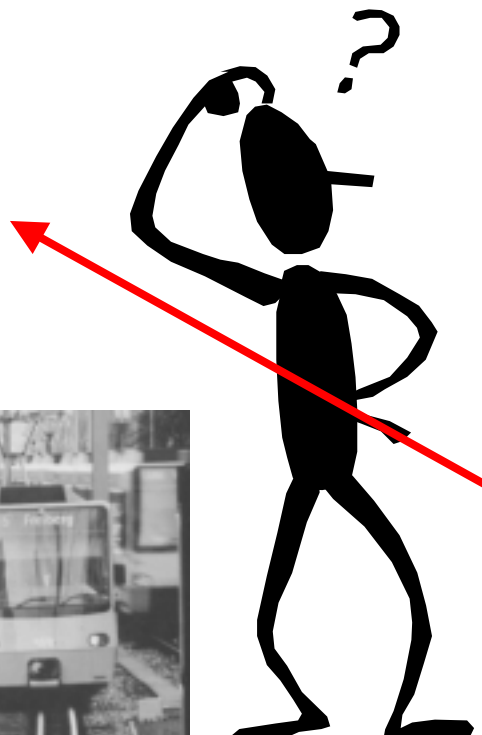
2. CBA
3. New method
4. Examples

urban public transportation design



prosperity of regions

Arguments for Combined Discussion

requests of companies

fast, cheap, reliable access of employees

fast, cheap, reliable access of customers, materials and required services

fast, cheap, reliable distribution of products and services

access to qualified potential employees

requests of citizens / public

good income

nice, affordable housing conditions

security (criminal, social)

good, affordable education

good, affordable health system

fast, cheap, reliable access to potential free time activities and social contacts

safety, as much as possible and affordable

healthy environment

fast, cheap, reliable access to potential companies

- transportation systems design strongly influences most factors which are a prerequisite for prosperity
- key locational factor
- measure for social integration

Cost-Benefit-Analyses in Public Transportation I

1. Introduction
⇨ 2. CBA
3. New method
4. Examples

business administration ⇨

- individual benefit / profit
- only internal effects considered
- actions with expected sufficient internal benefit undertaken
- external effects (i.e. environment, other persons) primarily irrelevant

economics ⇨

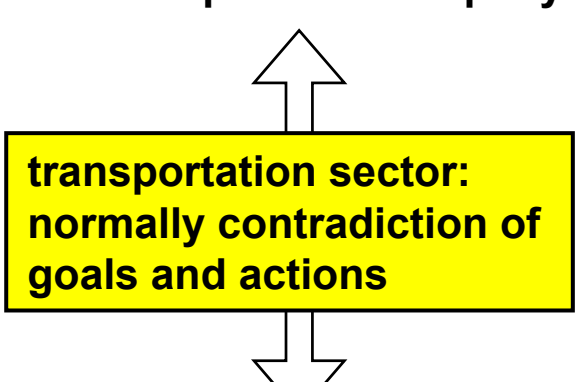
- public benefit to achieve sound / sustainable and social acceptable development
- external effects considered
- individual effects only one part
- adjustment of legislation to reach goals
- subsidies
- direct operation of (public) companies

1. Introduction
⇨ 2. CBA
3. New method
4. Examples

Who is interested in these methods?

1. Private companies ⇒ business management investigations

   ⇒ maximise profit of company



2. Public authorities ⇒ economic investigations (Cost-Benefit-Analyses)

   ⇒ prosperity

   ⇒ sound and sustainable development

Possible Results of the CBA I

1. Introduction
⇨ 2. CBA
3. New method
4. Examples

1. expected commercial profit from construction a. / o. operation is insufficient
+
public prosperity, sound / sustainable economic development are not supported

⇨ no interest at all

2. expected commercial profit from construction a. / o. operation is sufficient

⇨ private sector will carry out the measures

/ a. in conflict with public prosperity, sound / sustainable development

⇨ possibly adjust legal back-ground to reach economic goals

\ b. public prosperity, sound / sustainable economic development are supported

⇨ fine, everybody is going to be happy

Possible Results of the CBA II

1. Introduction
⇨ 2. CBA
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4. Examples

3. expected commercial profit from construction a. / o. operation is insufficient

+

prosperity, sound / sustainable development are supported

⇨ big problem with difficult solution

contradiction of interests between individuum (company) and society

reason: positive external effects do not or insufficiently contribute to commercial profit

Unfortunately case 3 is standard in urban public transportation!

Case 3 - Transportation Politics I

1. Introduction
⇨ 2. CBA
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4. Examples

Goal: directing the commercial interests of the private sector towards sound economic actions ⇒ transportation politics

⇨ **internalisation of the external effects (costs and benefits)**

⇨ **public funding**

Instruments:

taxes, charges, tolls (i. e. dependend from emissions, time, route)

bans, rules (i. e. exhaust rules, obligation to use safety-belts, acceptance of tarifs in public transport)

direct / indirect subsidies, investments by public funds (i. e. infrastructure, vehicles, operation)

Case 3 - Transportation Politics II

1. Introduction
⇨ 2. CBA
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4. Examples

Problems with the implementation of these instruments

tax / toll increases unpopular (so far no tolls for cars on motorways in Germany)

taxes generally not dedicated to special purposes (to pay more for fuel will not necessarily lead to better roads or better public transportation)

controls of the obedience to bans, rules etc. necessary (but: costs, popularity, ...)

social effects (grant a certain level of mobility to everybody)

shortening of public funds / competition with other goals (better spend money on transportation system or social housing, health care, education, culture, ... alternatively ?)

Case 3 - Transportation Politics III

1. Introduction
⇨ 2. CBA
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quantification of external effects

- **which effects?**
- **in general no market prices**
- **external costs (agreement to include environment, congestion, accidents but disagreement about the rates/ monetary units ⇒ start with lowest?)**
- **external benefits (disagreement if there are any)**

extrem long life of transportation infrastructure

- **20 to >100 years**
- **high prognosis risk (economic situation, fuel prices, security, fashion of equipment and usage ...)**
- **high risk of investment (traffic decreases, sunk costs)**

Methods in Germany

Bundesverkehrswegeplan (BVWP) [Federal Transportation Infrasturcture Plan]

- evaluation of long distance infrastructure projects (road, railway, inland waterways, airports, maritime harbours)
- environmental risk estimation
- analysis of spatial effects (improvement of reachability)

Standardisierte Bewertung [Standardised Evaluation of Infrastructure Investments for Urban Public Transport]

- evaluation of urban public transportation projects only
- effects of accidents and emissions transformed to monetary units
- travel time savings counted as benefits

New Method I

1. Introduction
2. CBA
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4. Examples

Developed in cooperation:

- Institute of Regional Development Planning (Stuttgart University)
- Jiangsu Development Planning Commission
- Institute of Railway and Transportation Engineering (Stuttgart University)

Infrastructure Development Model to enhance Prosperity (IDeMoP)

... for urban / regional public transportation system planning

... as one part of regional and urban development planning

⇒ applicable especially

- **in countries with dynamically growing economy / developing nations**
- **when large amounts should be spent for infrastructure in the near future**
- **if system decisions have to be made and there is a possibility of decision**
  - **future transportation systems design will be fixed for long term**
  - **future urban development and prosperity will strongly be influenced**

New Method II

1. Introduction
2. CBA
⇨ 3. New method
4. Examples

Content

consideration of external effects from the beginning on

evaluation of the contribution of investments in e.g.

- **housing projects**
- **health system**
- **education system**
- **water/ electricity/ gas supply**
- **purification of sewage**
- **public transportation system**
- **road construction**

to prosperity and economic development

New Method III

1. Introduction
2. CBA
⇨ 3. New method
4. Examples

Results for public transportation

1. chance for comparison and optimisation

   - with / without high capacity public transportation systems
   - public transportation systems with / without public funding
   - alternative use of public funds

2. tax income indirectly generated by the measures (e.g. public transportation system) can be used
   - for construction
   - operation

   Example: tax for houses dependent on their value

   ⇒ better infrastructure ⇒ increased value ⇒ increased tax income

Example Stuttgart - Germany

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Stuttgart 21 - an ambitious integrated project in the framework of the German and European Railway High Speed Network

present situation:

stub end terminal on ground level with 16 platforms

Ideas of Stuttgart 21

1. Introduction
2. CBA
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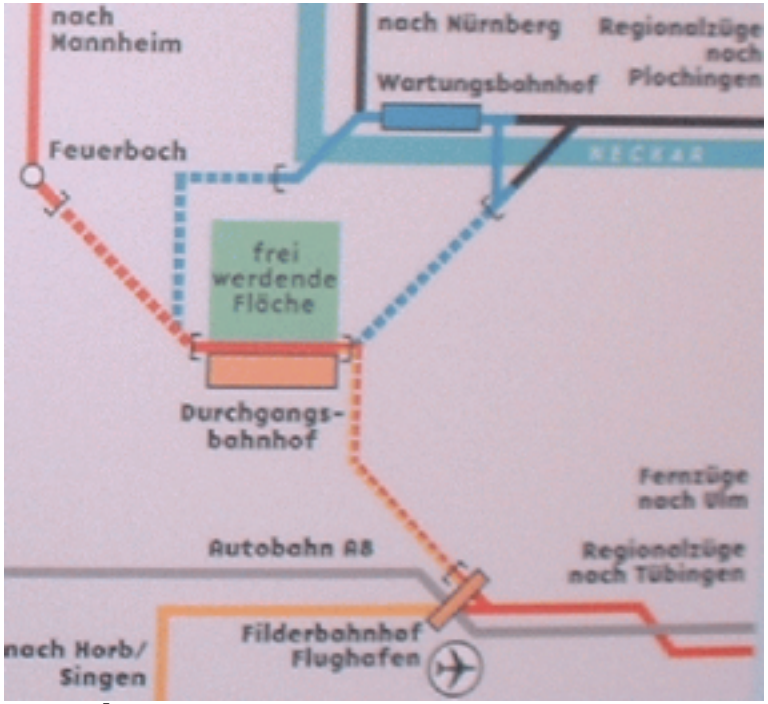
Stuttgart Main Station remains in the city centre but change direction and goes into underground

present situation:

stub end terminal on ground level with 16 platforms in north - south direction



project:

underground through station crosswise to present station in east - west direction with 8 platforms and significant increasing capacity

Impressions of Stuttgart 21 I

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

source: www.stuttgart21.de

the new area in the centre of the city with through station beneath

Impressions of Stuttgart 21 II

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

cross-section of the new through station

source: www.stuttgart21.de

Impressions of Stuttgart 21 III

1. Introduction
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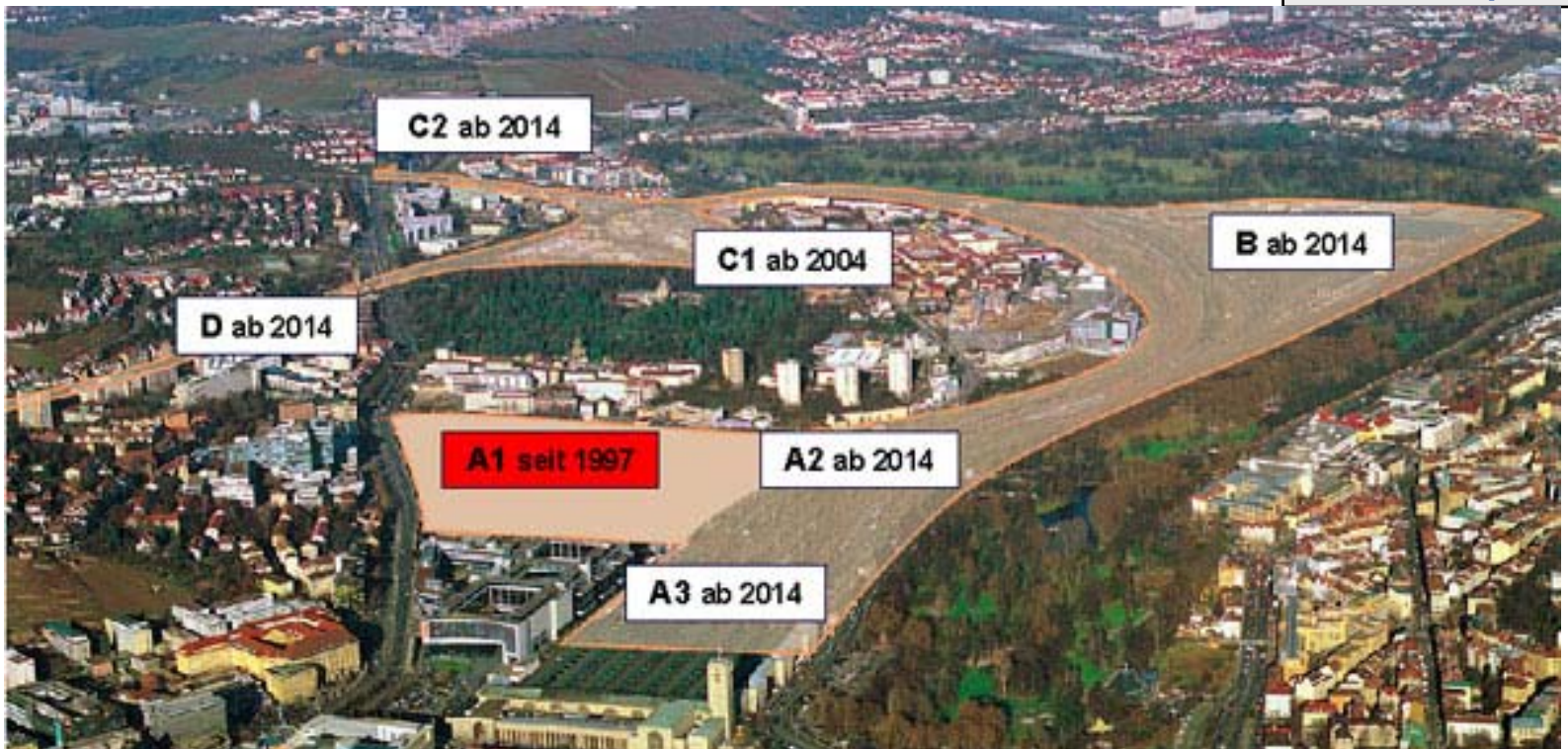
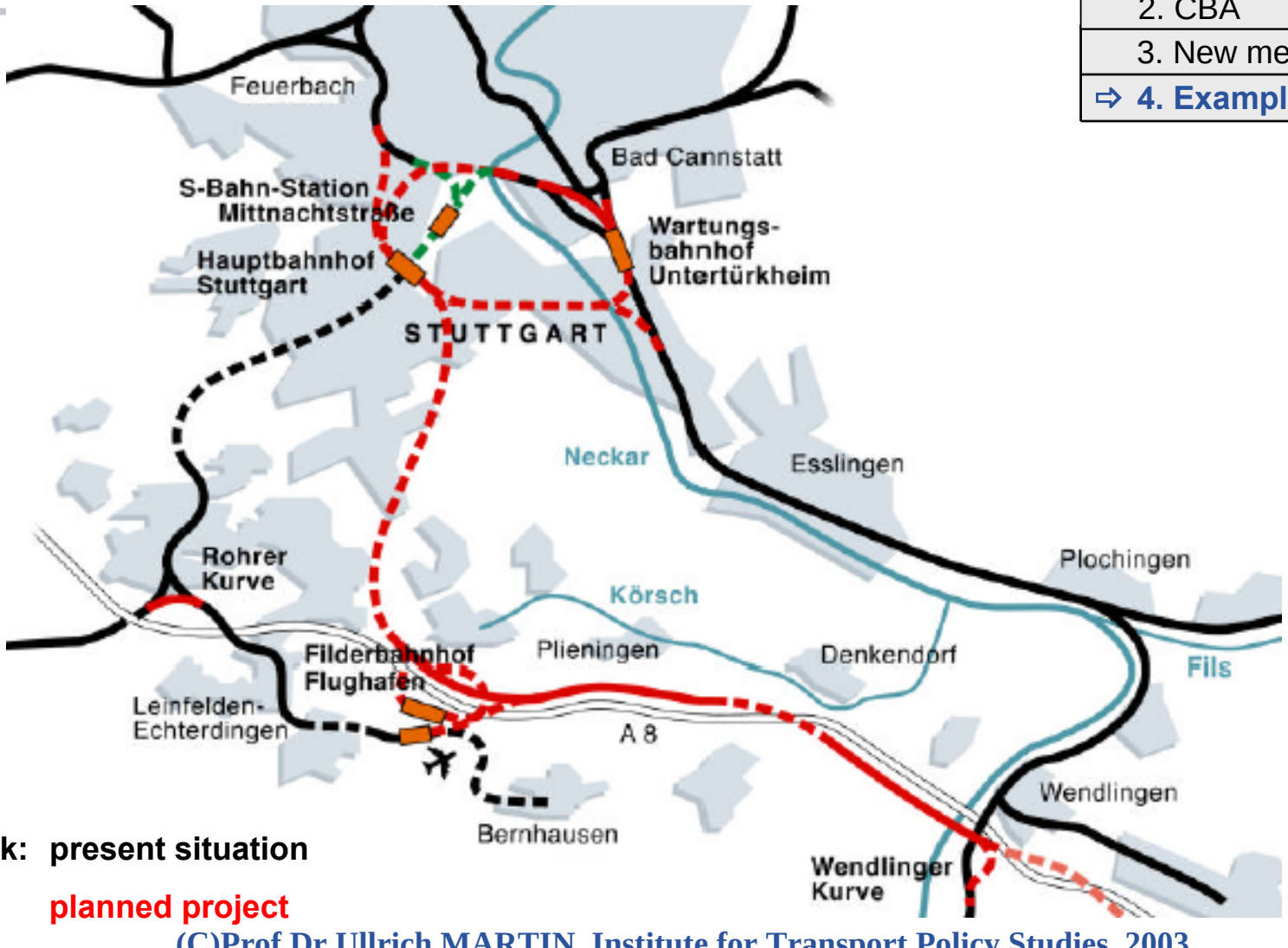
new area in the centre of the city gained by the project



chronological development of the differnt parts

Stuttgart 21 - Overview

1. Introduction
2. CBA
3. New method
⇨ 4. Examples



black: present situation

red: planned project

Stuttgart 21 - Overview

1. Introduction
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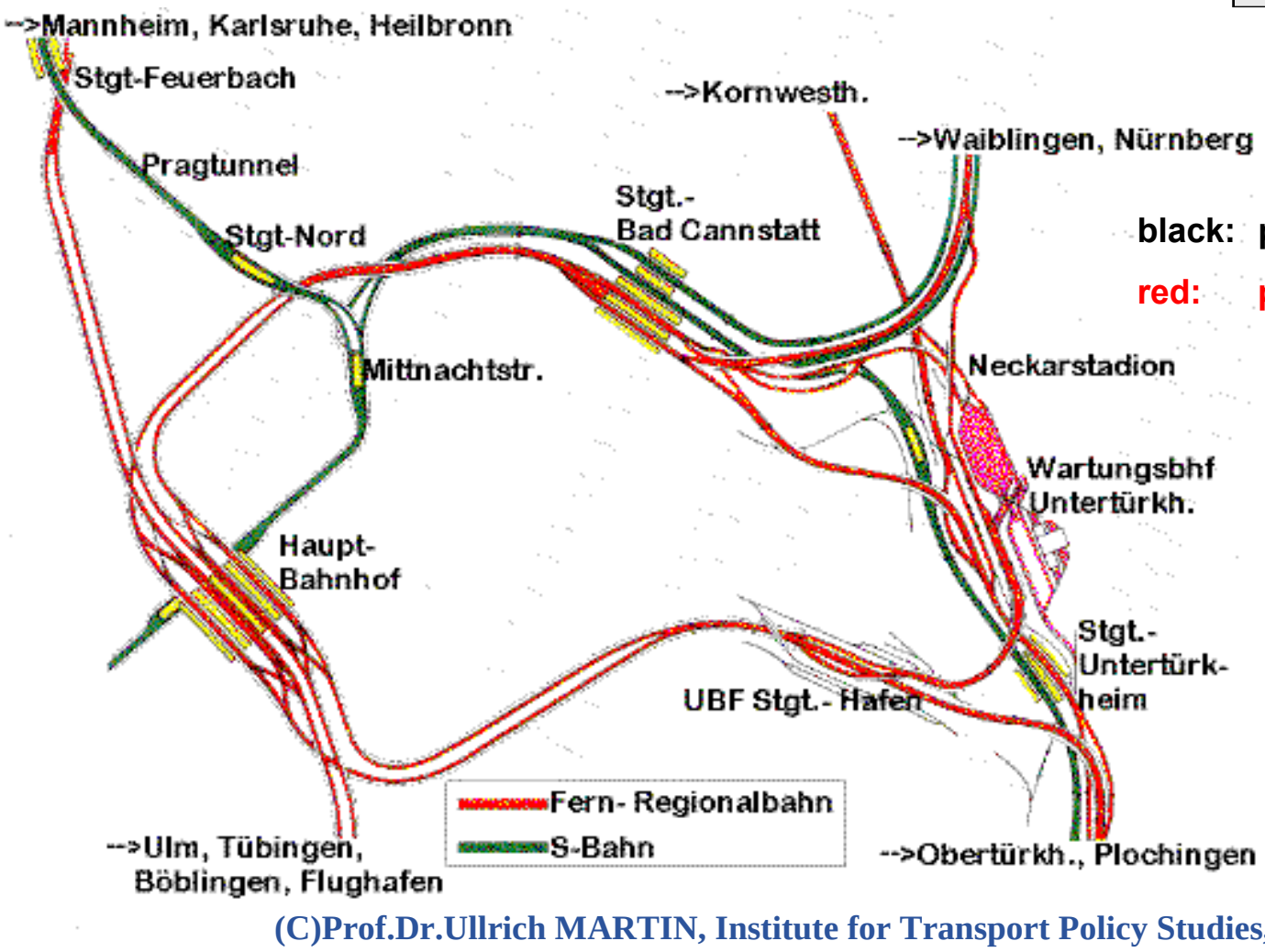
› 4. Examples



black: present situation

red: planned project

Stuttgart 21 - an Integrated Project I

1. Introduction
2. CBA
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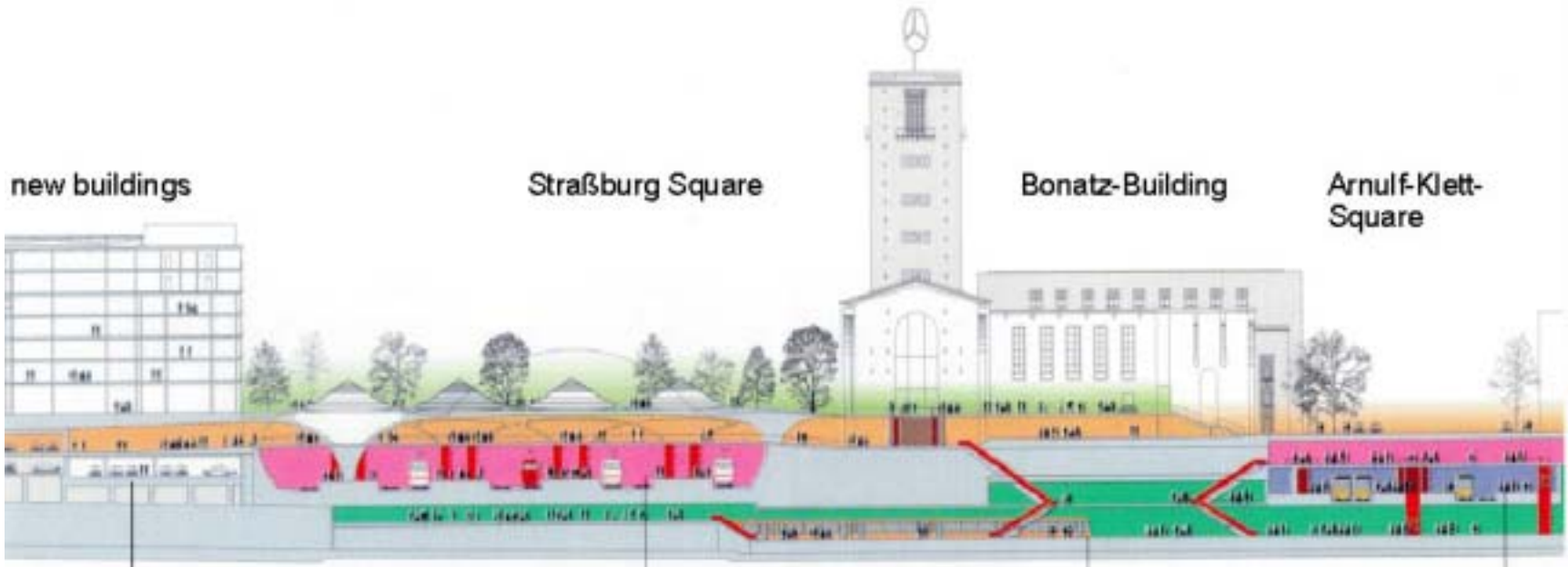
⇨ 4. Examples

Connection of long distance, urban public and individual traffic as well as integration of pedestrians

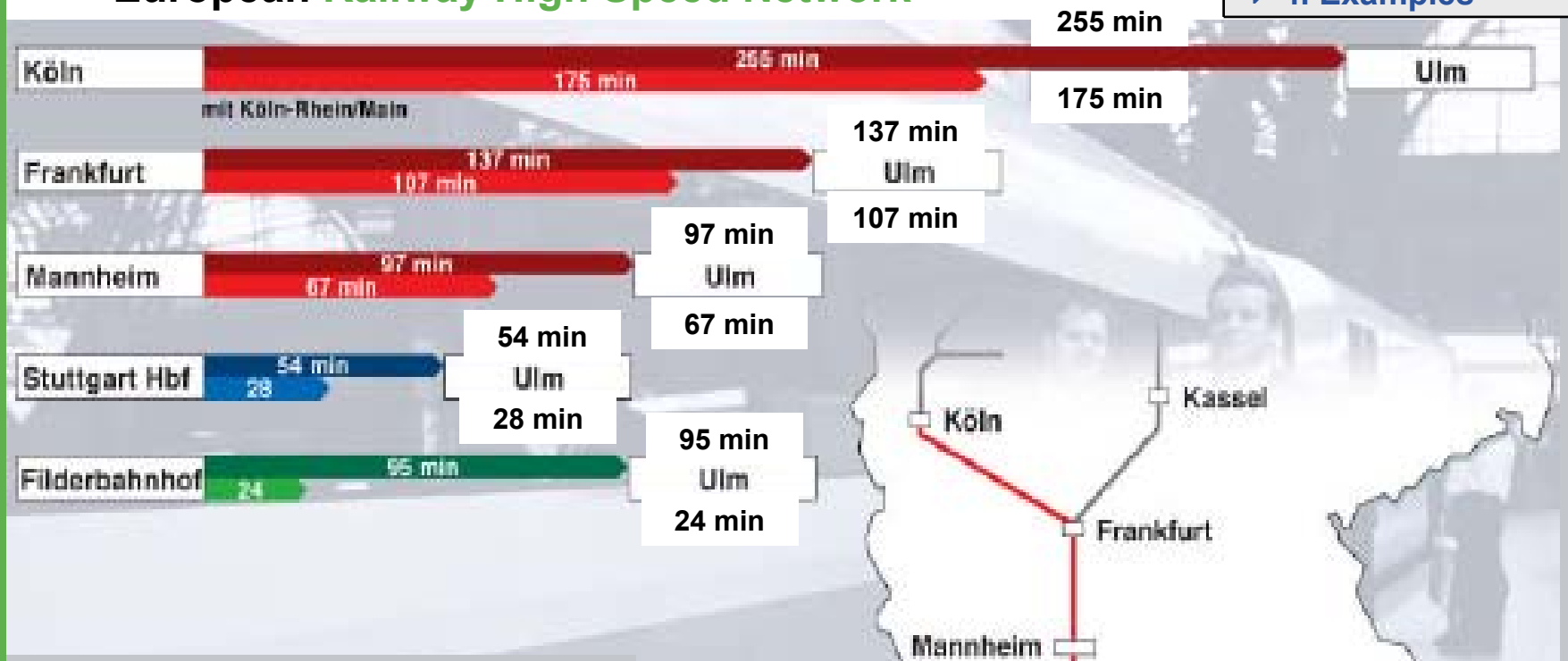


source: Turm-Forum Stuttgart 21, Katalog 11/98, S. 32)

Stuttgart 21 - an Integrated Project II

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Stuttgart 21 - as a part of the German and European Railway High Speed Network



Stuttgart 21 - an Integrated Project II

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Stuttgart 21 - as a part of the German and European Railway High Speed Network

travel time [h:min]	at present	Stuttgart 21
Stuttgart - Hamburg	5:07	4:30
Stuttgart - Berlin Zoo	5:20	4:30
Stuttgart - Köln	3:15	2:30
Stuttgart - Brüssel Nord	6:08	4:15
Stuttgart - Paris	6:05	3:30
Stuttgart – Frankfurt (M)	1:20	1:15
Stuttgart - München	2:10	1:30
Stuttgart - Wien	7:10	4:45
Stuttgart - Bern	4:09	3:30
Stuttgart - Mailand	6:43	4:30

Stuttgart 21 - Increasing Capacity

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

	present stub end terminal	new through station
number of trains per day (on average weekday)	120 (long distance) 176 (regional)	192 (long distance) 277 (regional)

Δ 173 trains

difference of new through station versus present stub end terminal	million passengers per year	million passenger kilometres per year
local and regional public transport	**18.1**	**200**
long distance rail traffic	**1.4**	**570**
total public transport	**19.5**	**770**

Stuttgart 21 - Change of Modal Split

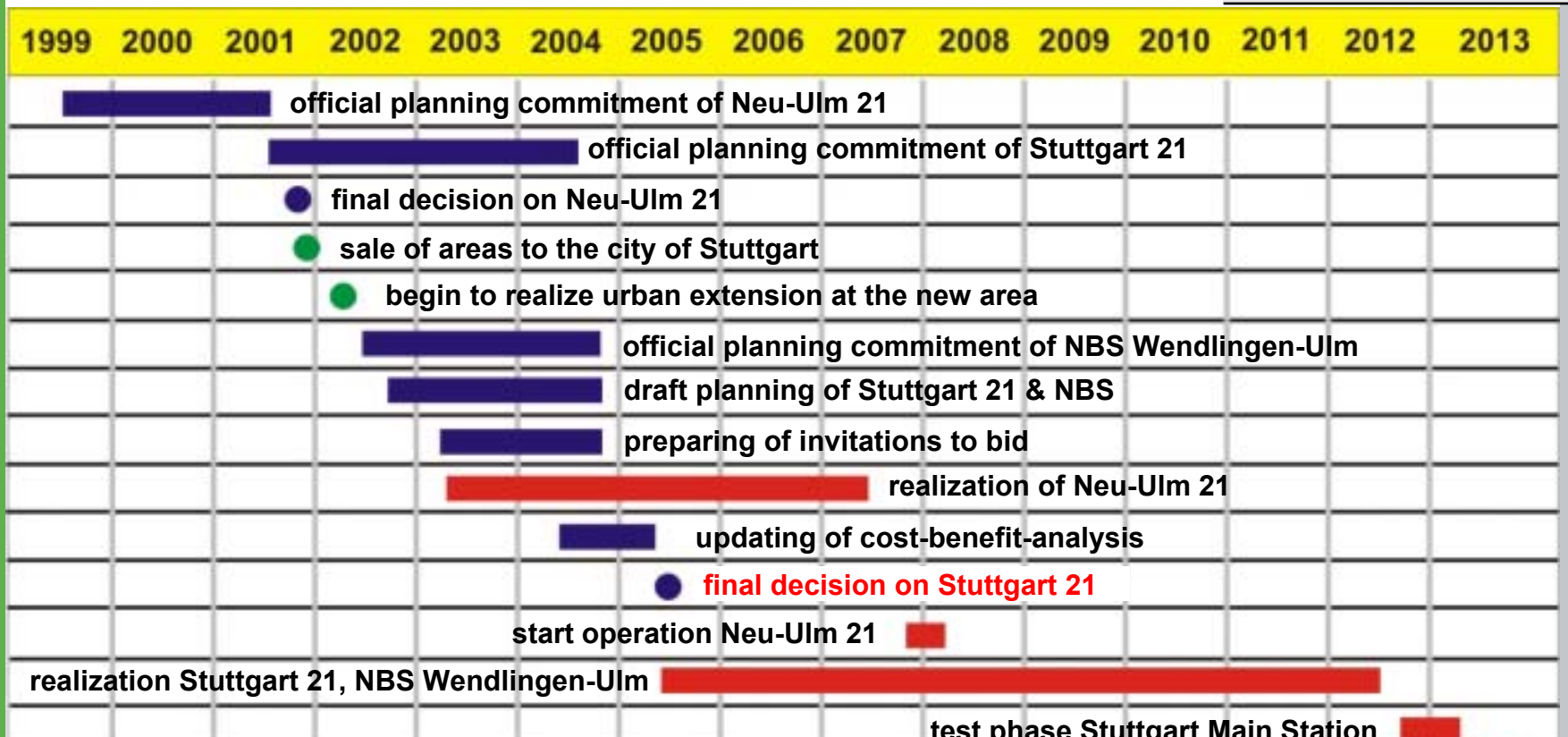
1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Impact of Stuttgart 21 on Stuttgart airport

	present stub end terminal		Stuttgart 21	
passengers at the airport in milion	9.9		11.0	
public transport from and to the airport	million passengers per year	modal split	million passengers per year	modal split
local and regional public transport	1.6	29 %	2.1	39 %
long distance public transport	0.7	16 %	2.5	44 %

Stuttgart 21 - Schedule

1. Introduction
2. CBA
3. New method
⇨ 4. Examples



source: www.stuttgart21.de

Stuttgart 21 - Costs and Benefit

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overall economic benefits:

difference of Stuttgart 21 versus stub end terminal	**benefits [million EURO/year]**
benefits from infrastructure	**48.0**
benefits from local and regional transport	**31.5**
benefits from long distance transport	**172.5**
total of benfits	**252.0**

overall economic result (difference of Stuttgart 21 versus stub end terminal)**:**

benefits [million EURO/year]	**costs [million EURO/year]**	**benefit-cost-difference [million EURO/year]**	**benefit-cost-ratio [-]**
252	**95**	**157**	**2.6**

Stuttgart 21 - Social Framework

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Some aspects of industrialized countries:

- **GDP increase slowly on high level**
- **overall infrastructure network has already been developed**
- **less degrees of freedom only**
- **high share of private car ownership**
- **economy depends on production of cars (more or less)**

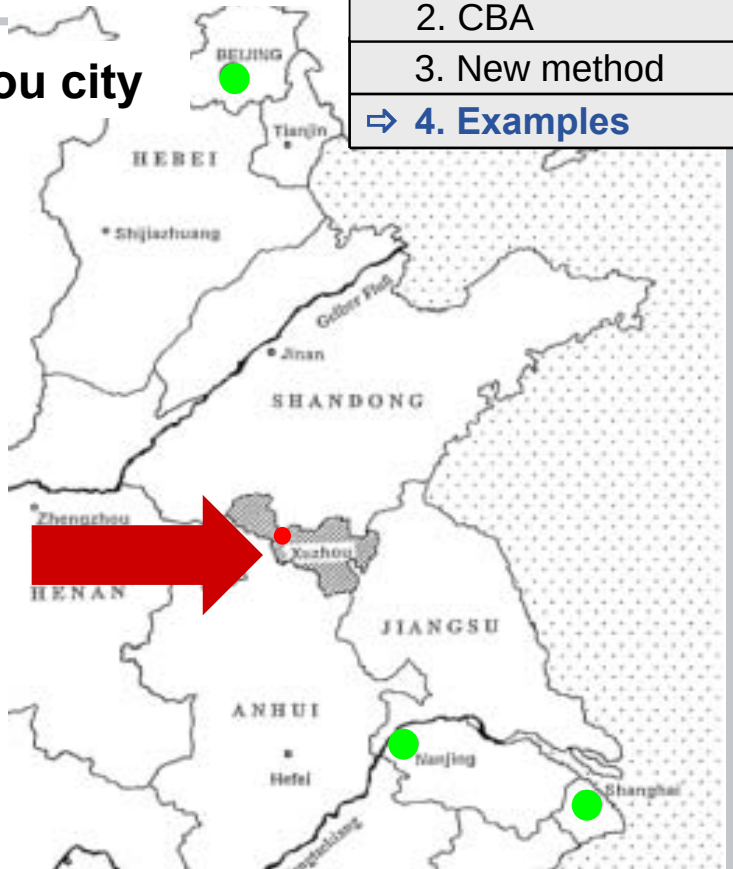
Because of the different conditions we can not use the same models in emergent or developing countries!

Example Xuzhou - China

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Some facts about the regarded area: Xuzhou city

- traffic node between Beijing, Shanghai, and Nanjing
- located on the boarder of four provinces
- population about 9,000,000 people
- GDP +11.5 % p. a. for the last 20 years
- use of motorized vehicles will become a serious problem



⇒ **introduction of a regional rail based public transportation system**

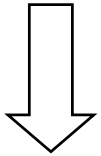
- reduction / avoidance of transportation and traffic problems
- increment of the attractiveness of region (city)

strengthening of the economy

Objectives of Xuzhou Project

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Distributed economic growth as basis for the prosperity of the whole region



development of a feasible long term regional planning and development concept with IDeMoP

- **for years 2006 to 2020**
- **115 spatial units**

minimisation of negative environmental effects of settlements, economic growth, transportation (road, rail) and other infrastructure facilities

integration of investment proposals in transportation and other infrastructure in the next three Five Year Plans as result of the project

Methodology of Xuzhou Project

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

population model
- natural growth
- migration

economic model
- investment, employment, production
- 15 economic branches

infrastructure evaluation model
- social welfare
- environment
- mobility

public transportation model
- rail based public transportation
- airport function

infrastructure investment project selection model
- selection of projects by random within by Chinese government given limits for each Spatial Unit

objective analysis model
- Calculation of effects for each project investment combination

1. Introduction
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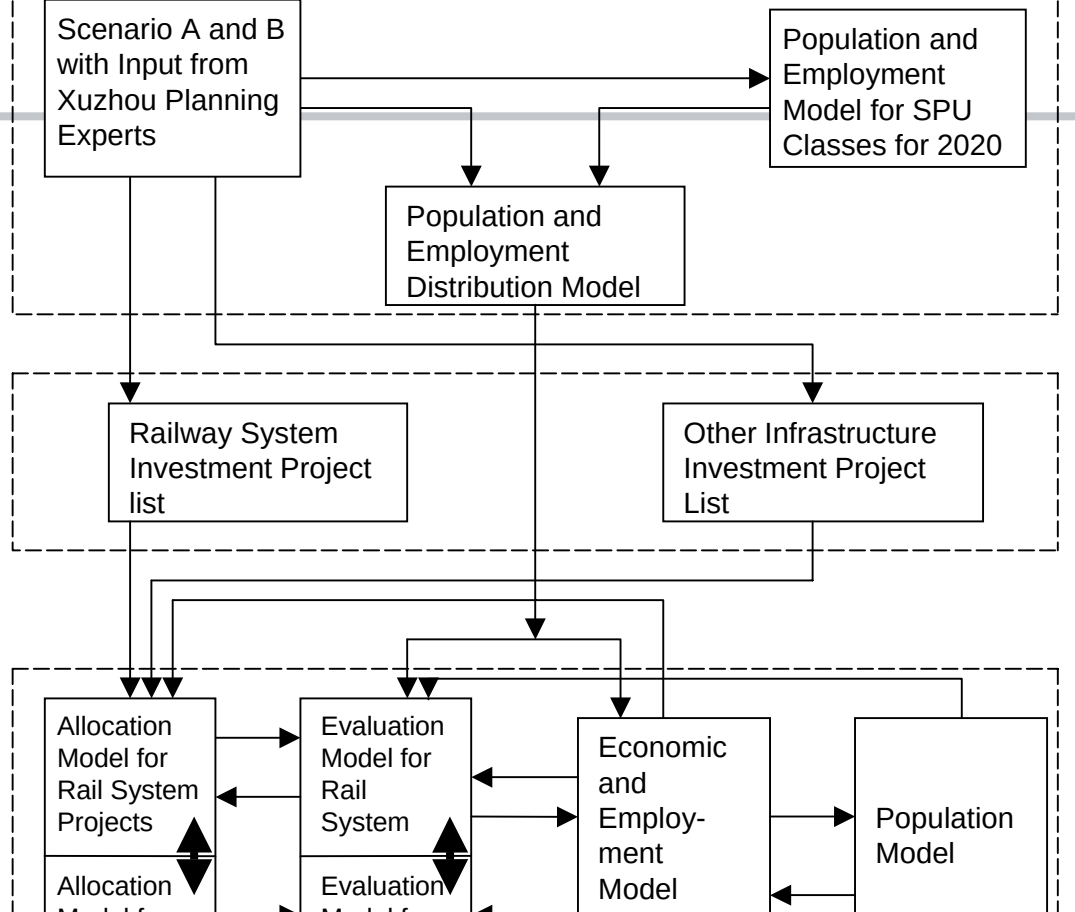


Simplified Overall Model

simplified version of linkages among different models

Leadership of economic part:
Institute of Regional Development Planning

(C)Prof.Dr.Ullrich MARTIN,
Institute for Transport Policy Studies, 2003

Results of Xuzhou Project I

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Allocation of the investments on spatial units and economic branches (103 variants of railway projects)

⇒ model gives plausible results by evaluation of the variants

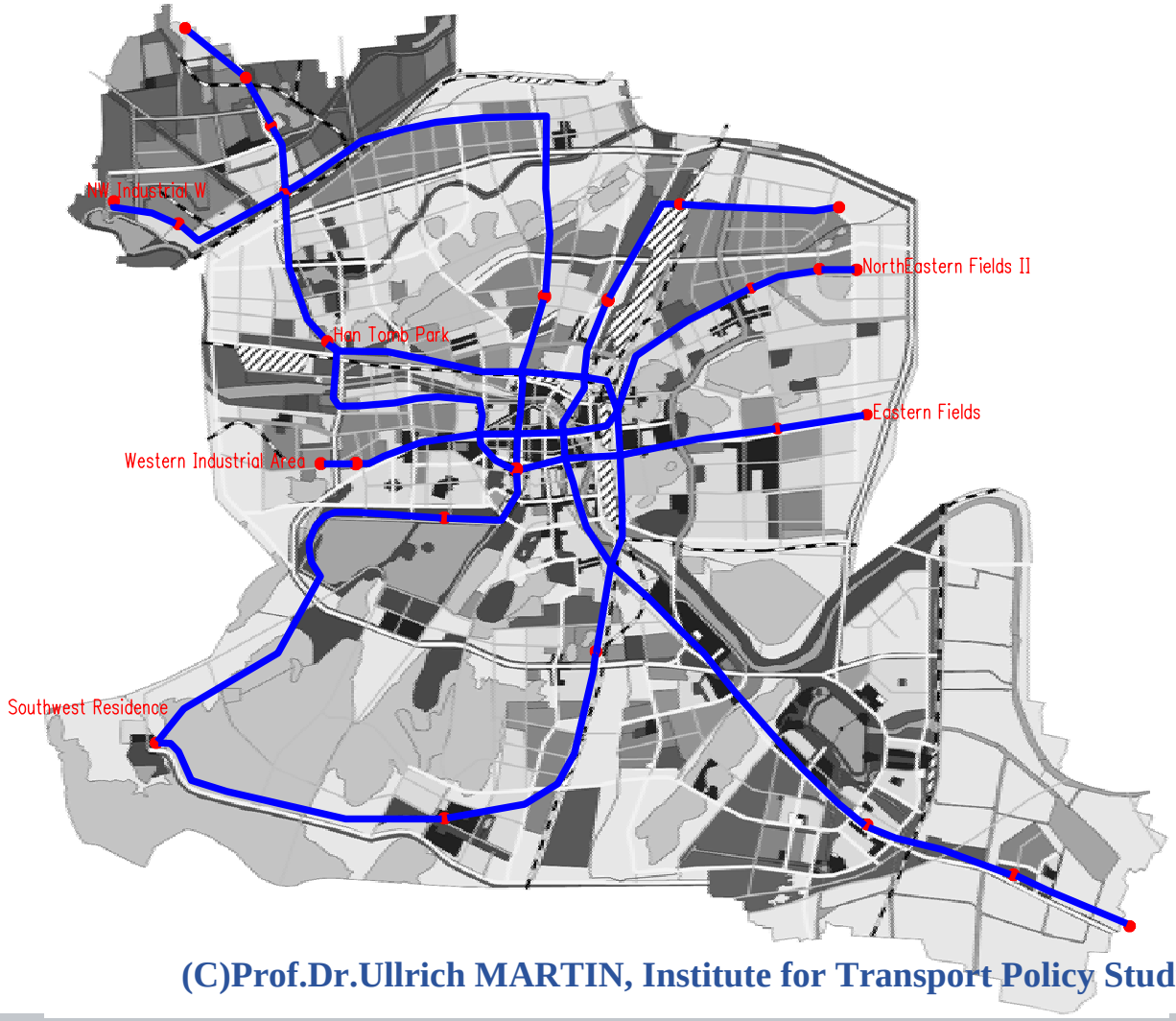
⇒ result of the model is the identification of the optimal variant / investment in branches and spatial units depending on time

⇒ recommended investment ratings available for each Spatial Unit and each branch for every Five-Year-Plan-Period

Results of Xuzhou Project II

1. Introduction
2. CBA
3. New method
⇨ 4. Examples

Scenario A



Results of Xuzhou Project II

1. Introduction
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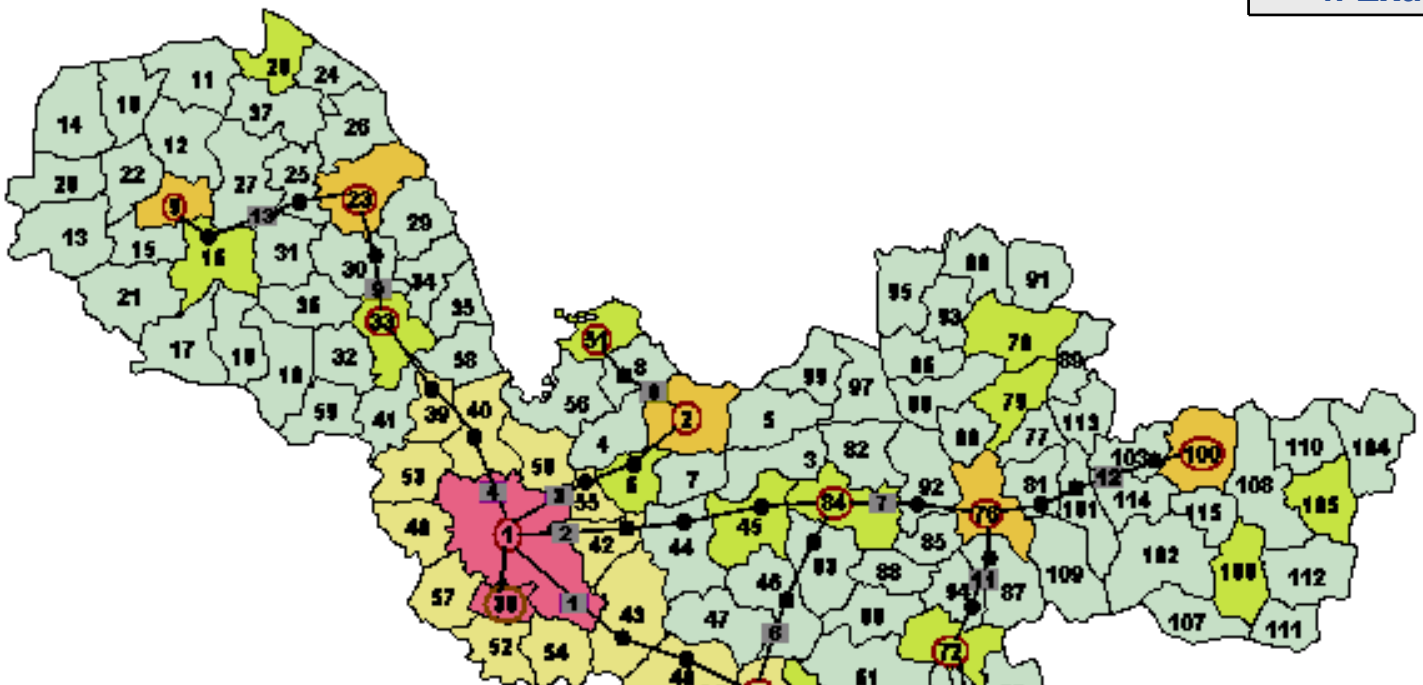
Scenario B



Results of Xuzhou Project III

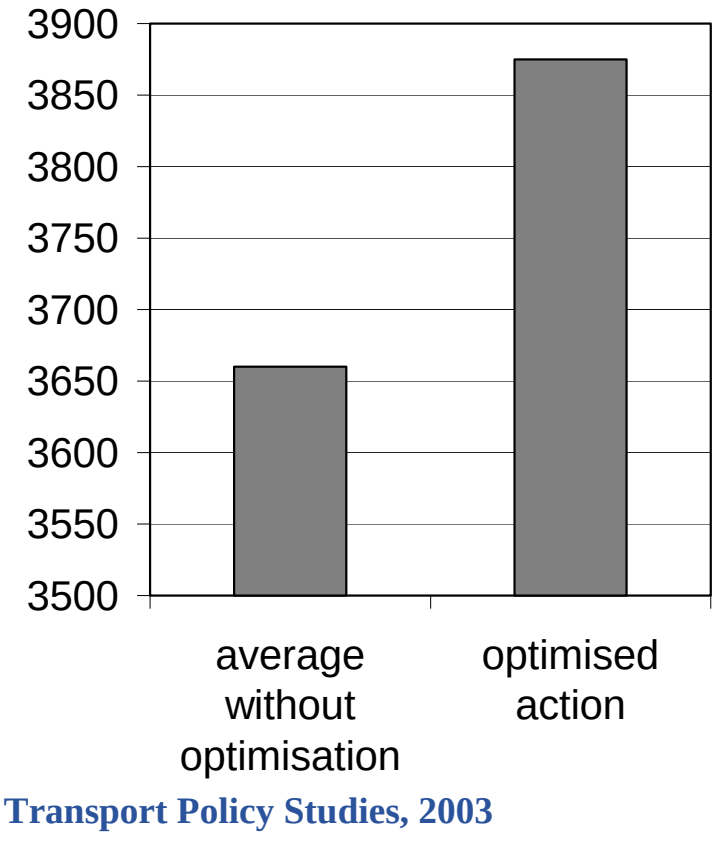
1. Introduction
2. CBA
3. New method
⇨ 4. Examples

future

realisation of the investment plan

- Difference (means profit) that is possible by application of the new developed model is **200 billion ¥ RMB**, that is about 20 billion US $, this means a rise of GDP compared with the haphazard allotment of money of **more than 5 %**

GDP (total 2006 - 2020) in billion RMB
(equal hight of investments)



Results of Xuzhou Project IV

1. Introduction
2. CBA
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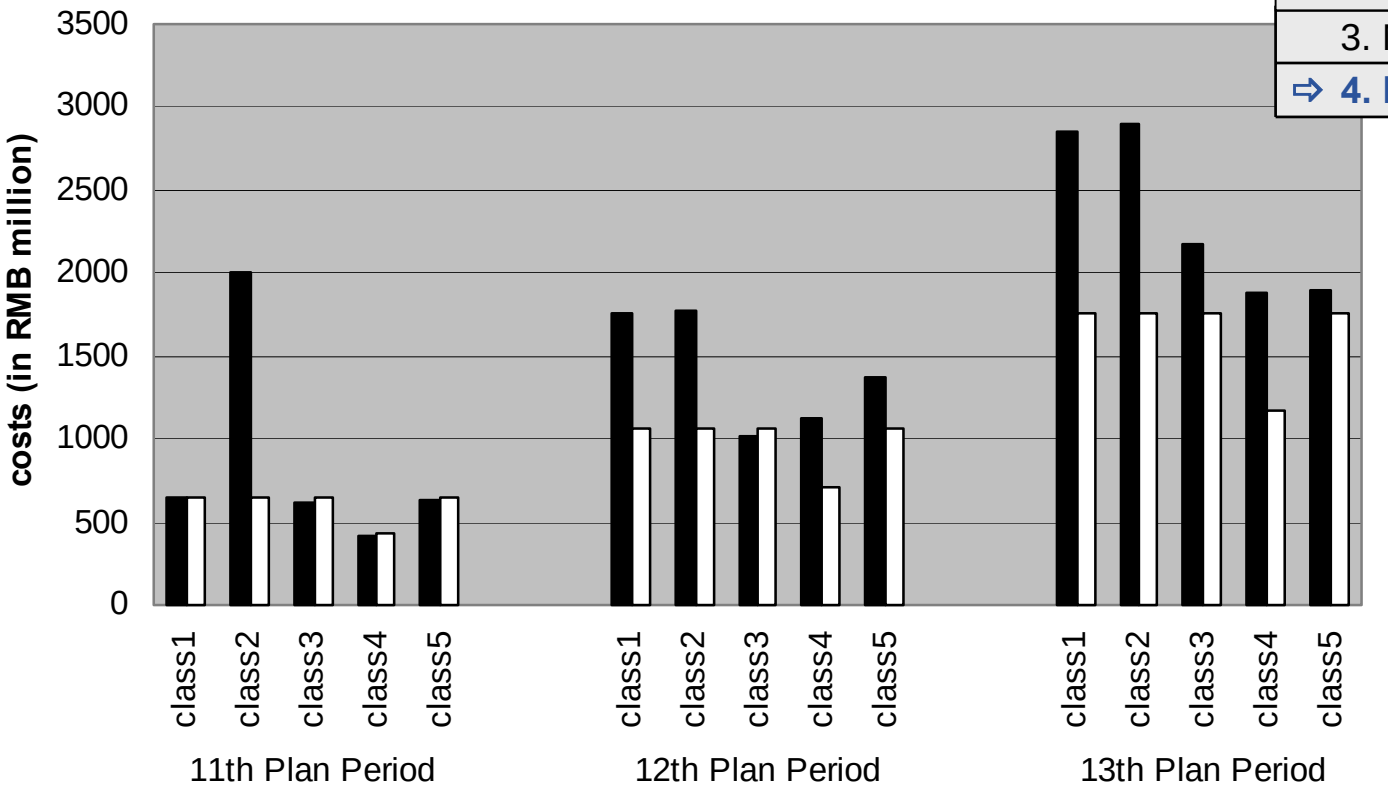
⇨ 4. Examples



Class 1: Core Area Class 3:Core Expansion Area Class 5: Rural Area

Class 2: County towns Class 4: Key towns

Thank you for your attention.