Underground solutions ? : Integral approach.

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Why integral approach?

- Until now the **costs** aspect played a **dominating** roll and as a result the underground solutions did not get a fair chance.

- Currently the underground solutions will only be chosen under high **social pressure** or the presence of **physical obstacles.**

PARADOX of SUBSURFACE CONSTRUCTION.

Actors

- People who influence the decision process:
    - Direct users: motorists, customers of public transport
    - Indirect users: shopkeeper, pedestrians, cyclists
    - Neighbours
    - Environmental organisations

- Decision process
    - Government (National & local)

- The interested party
    - political engagement

Type of arguments.

- Economical arguments
- Ecological and rural arguments
- Environmental arguments: noise, pollution
- Safety and risks
- Social and psychological causes
- Costs
- Spatial redistribution

Arguments

- For large infrastructure projects the political decisions are decisive.
- Long term effect, strategic impact.
    - Green Hart tunnel
    - South axis Amsterdam

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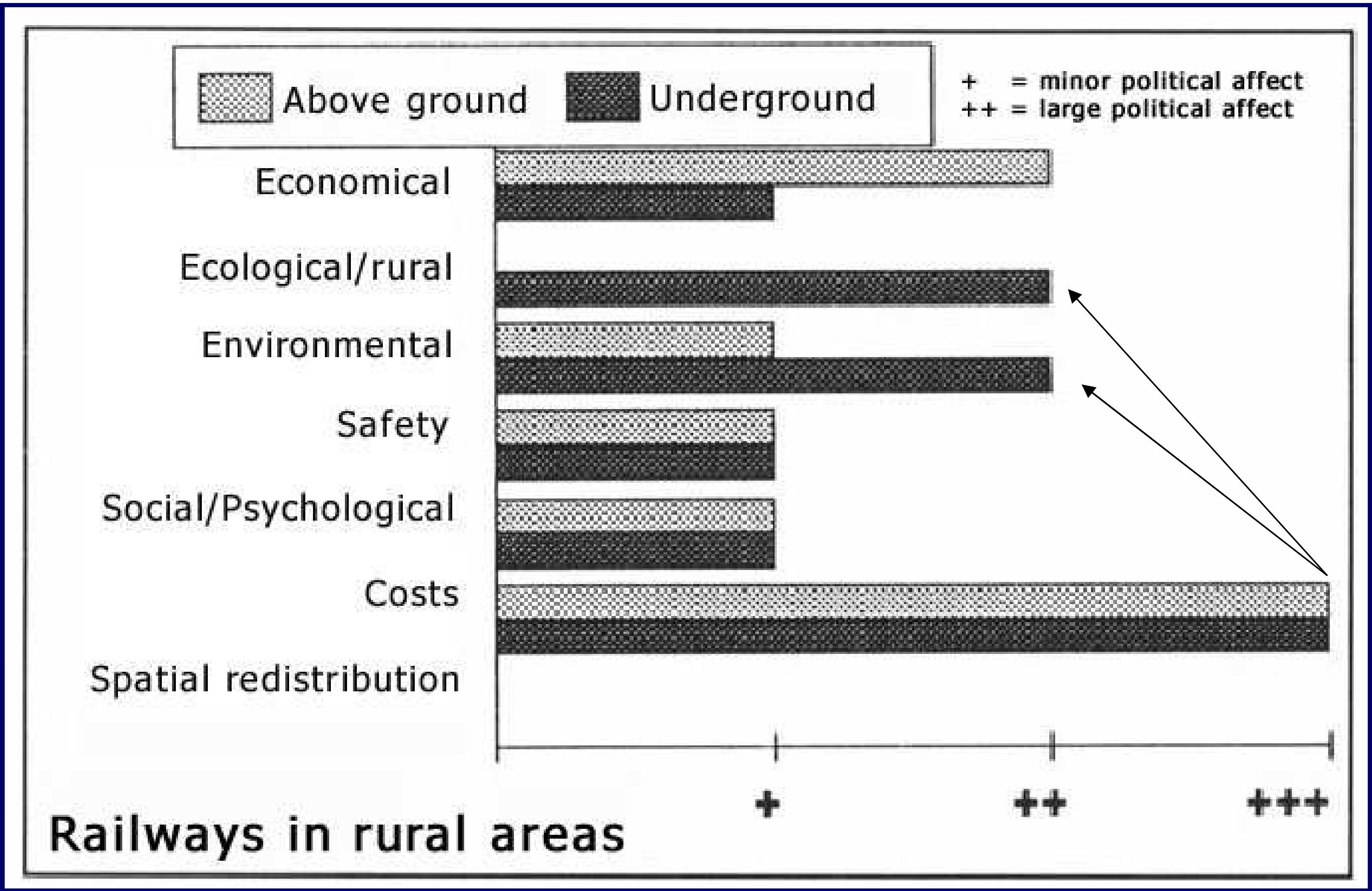

When the government is inclined to put the costs and economy to a discussion, the influence tends to move to the perception aspects.

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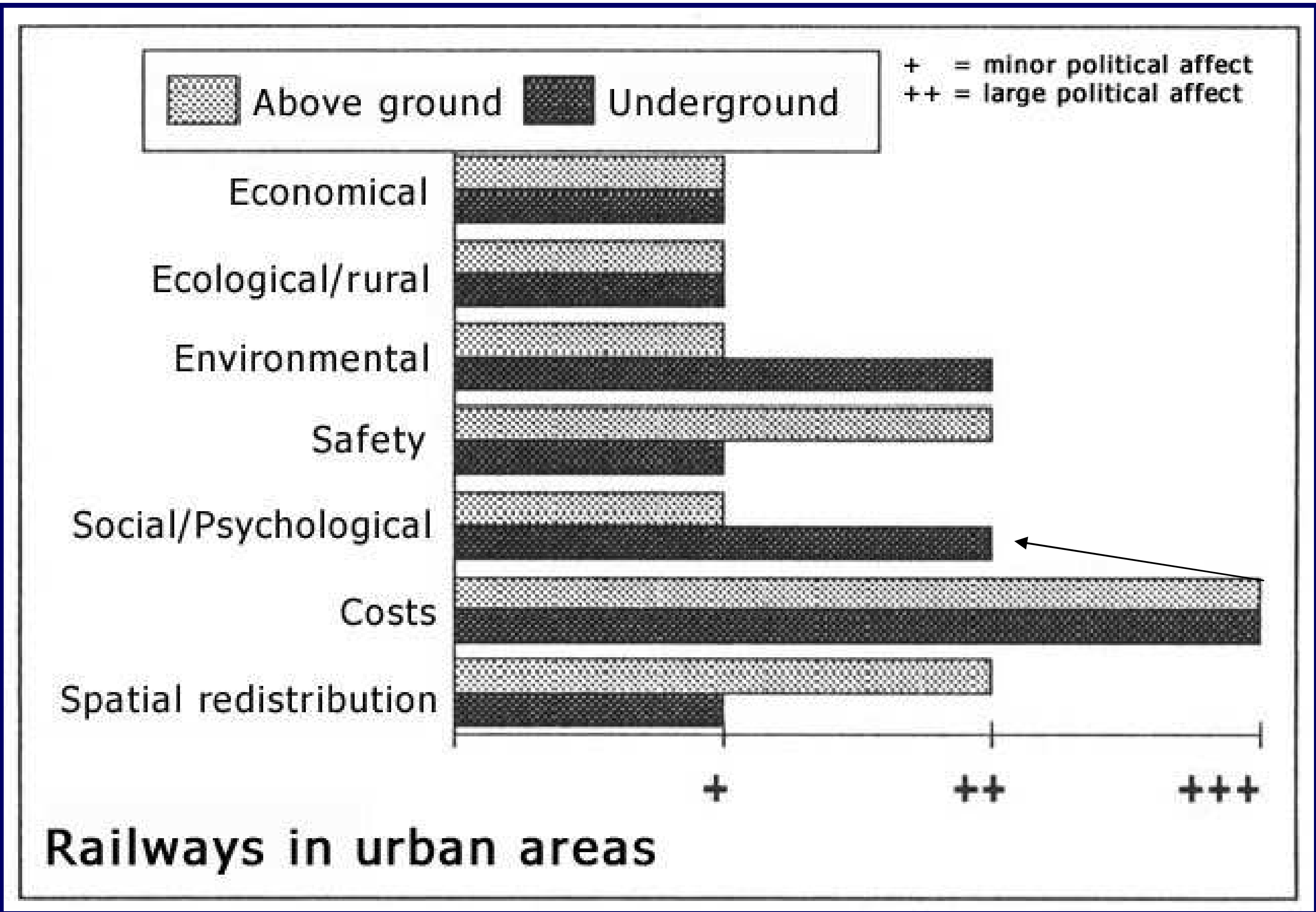

Costs are still number one but more movement to the perception aspects.

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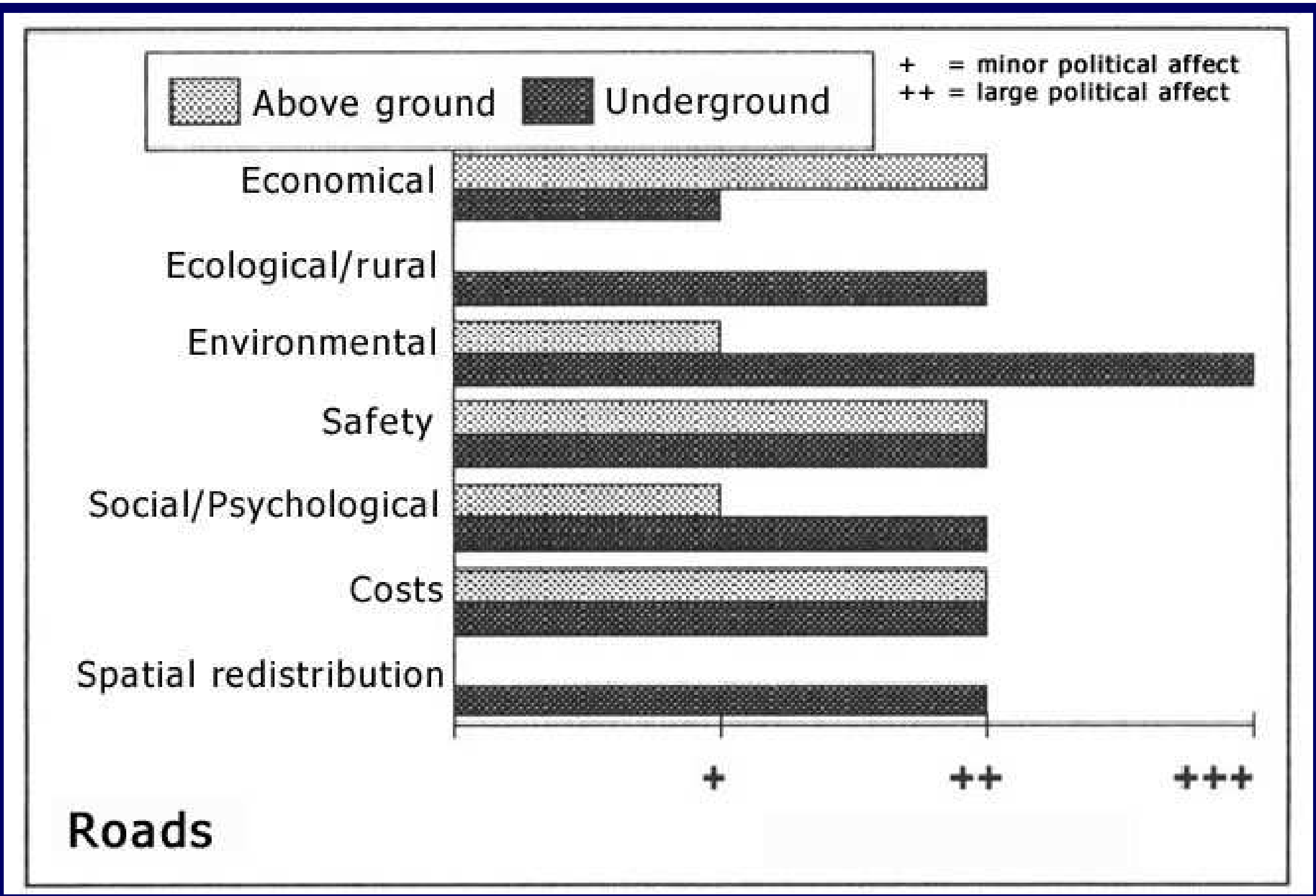

Possible expectations of the political influence of the arguments concerning roads.

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Process

- How to prevent the underground solutions to be written of as a serious alternative?
- What kind of considerations do you need to involve in a integral approach and consideration?
- How to organize an integral approach?

The method.

Balance between costs en benefits.

Costs: total costs

Benefits: unit x unit price

amount

quality

The method

- To choose the best alternative, pass through the next three phases:
  1. Arrange and select info
  2. Financial consequences
  3. Assign 'joy and burdens'

- Make the data accessible, generate tables.

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The method

Phase 1: Arrange and select info

An overall picture is needed of the various consequences in different stages, to get and to provide insight.

Step 1: on level of the subparts, the detailed information need to be reduced.

Step 2: elimination of less relevant material

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The method

Phase 2: Overall picture of the financial consequences of each alternative

Not only the consequences for the budget need to be taken into account but the **total costs**, and also the social and environmental effects.

⇨ Financial and monetary analyses

Using this analyses a price is put on the positive and negative consequences for environment and society.

Because the financial point of view doesn't cover all the consequences, the monetary analyses must emphatically be put next to the financial analyses.

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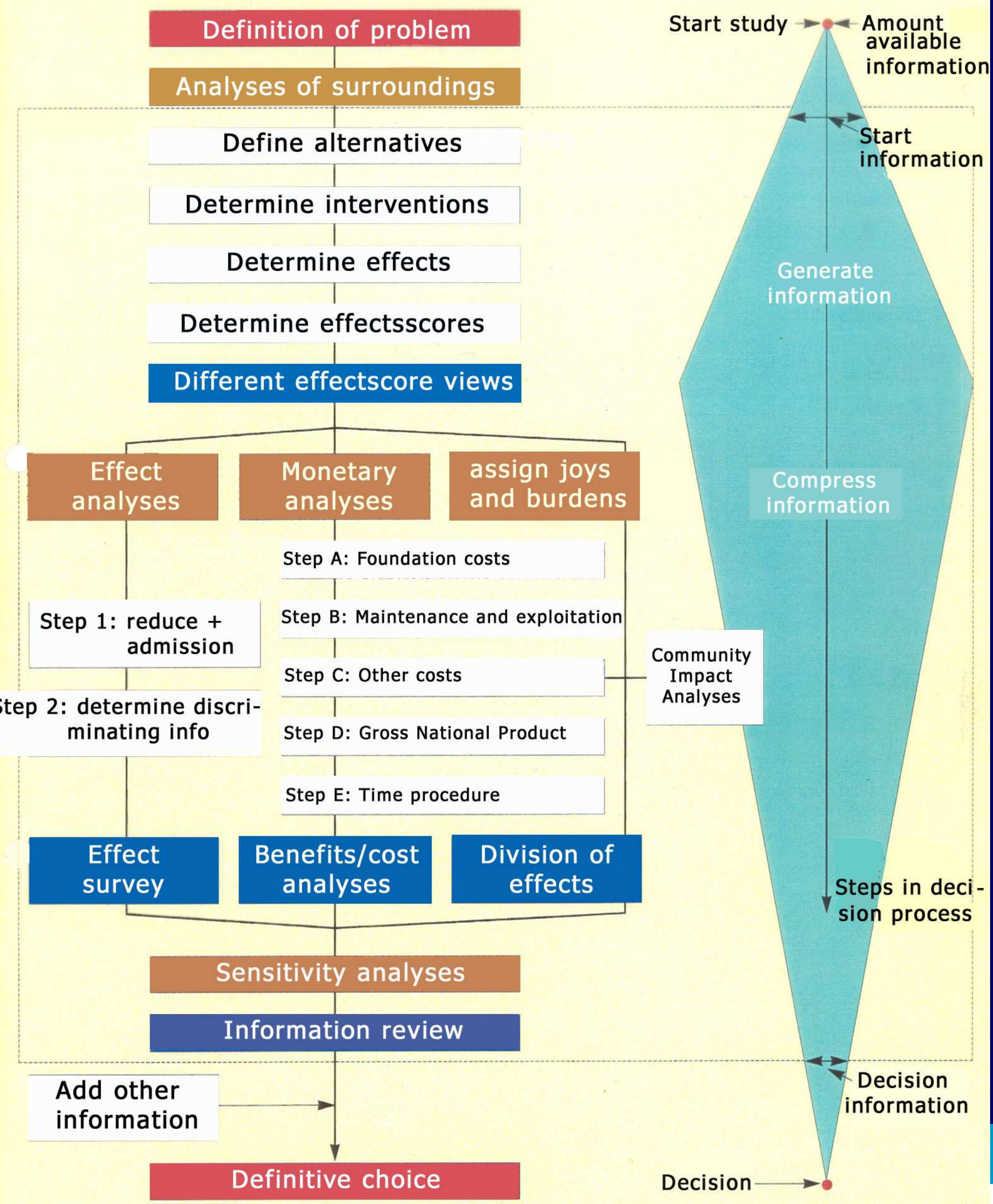
The method

Phase 3: assign joys and burdens to actors involved

Are the costs and profits equally divided among all those concerned?

This designation not only concerns the finances but also the equal division of not-financial consequences.



The process of generating and making information manageable. The amount of information is a function of the amount of considered variants and the amount of researched aspects. The recommended work method is focussed on the compression of the information into manageable decision information.

For an optimal choice, optimal alternatives are needed!

↓

Integral management demands integral design!

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Case study Delft

The Hague

Delft Station

Case study Delft

Problem

The current railway track runs through Delft on a high fly-over straight through the city. The railway line consists of two tracks which needs to be doubled.

Difficulties:

- Crossings with roads and waterways
- Gist-Brocades buildings
- Historical mill 'The Rose'
- Sound nuisance, vibrations and putting up barriers during construction and operating phase.
- The maximum achievable speed of the trains.

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Case study Delft: alternatives

1. Construct an extra fly-over besides the present one.
2. Two new tracks will be constructed underground by the wall-roof method. The present fly-over will stay at the current position.
3. Two new tracks will be constructed by using bore techniques. The present fly-over will stay at the current position.
4. Present fly-over will be demolished and four tracks will constructed by the wall-roof method.

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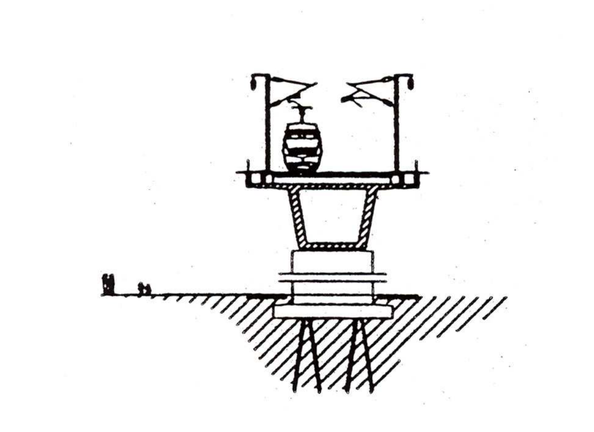
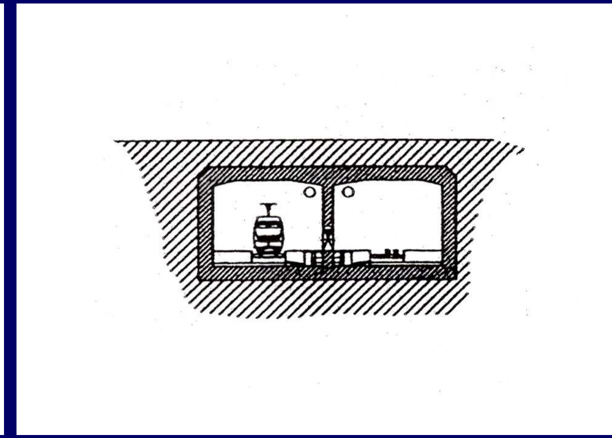
Case study Delft: alternatives

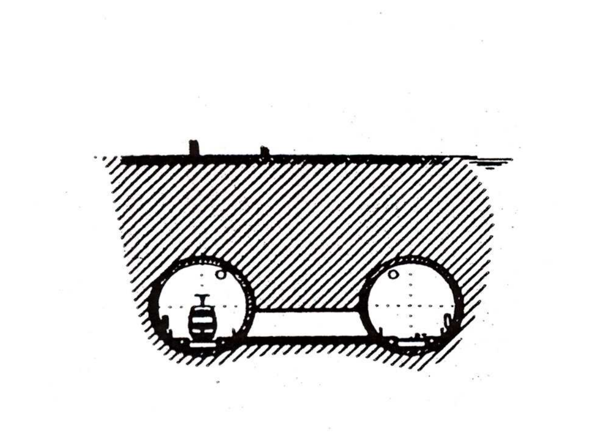
- Horizontal and vertical radius and slopes are important parameters to determine the possible solution.
- Geometrical possibilities



Alt. 1: fly-over



Alt. 2: wall-roof two track



Alt. 3: bore tunnels two track

Case study Delft: alternatives

Present situation:

Choice between long or short tunnel

Station above or underground

Case study Delft: alternatives

To choose the best alternative, pass through the next three phases:

1. Arrange and select info
   a. example detailed level (Sound nuisance)
   b. Total order of ranking
      - Technique
      - Environmental
      - Economy
      - Legal proceedings
2. Financial consequences
3. Assign ‘joy and burdens’

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Phase 1: Detailed level: Sound and vibrations nuisance(1)

Alternatives	1. Fly-over	2. Wall-roof two tracks	3. Drilling two tracks	4. Wall-roof four tracks
Sound nuisance by digging	Digging operations only near the pillars.	Excavation along the whole line.	Only three local excavations.	The same as alternative 2, but besides the first excavation a second one will be dug.
Order of ranking	1	3	2	4
Sound and vibrations nuisance by transport	In comparison with 2 and 3, relatively few material, however along the whole line.	Lots of material-transport along the line.	On the location of bore tunnel is no transport.	Same as 2, but construction time increases from 5 to 9,5 years.
Order of ranking	2	3	1	4

Phase 1: Detailed level: Sound and vibrations nuisance(2)

Alternatives	1. Fly-over	2. Wall-roof two tracks	3. Drilling two tracks	4. Wall-roof four tracks
Sound and vibrations nuisance by ramming piles	Relatively few piles compare to 2 and 3, however along the whole line.	Lots of piles along the whole line.	Fewer piles in comparison to 2, however no piles at the excavation.	Same as 2 but double amount of piles.
Order of ranking	2	3	1	4
Sound and vibrations nuisance by driving and puling of sheet pile walls	No sheet pile wall.	Along whole line sheet piles are placed.	Only at three excavations, piles are placed.	Same as 2, but double amount of piles.
Order of ranking	1	3	2	4

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Phase 1: Total order of ranking (1)

		Fly-over	Wall-roof two tracks	Drilling two tracks	Wall-roof four tracks
Technique	Technical risks construction phase	1	2/3	4	2/3
	Technical risks operating phase	1	2/3	2/3	4
Environ-mental	Landscape	4	3	2	1
	Surface/water	1	3	2	4
	Ecology	4	3	2	1
	Sound/vibrations	**4**	**3**	**2**	**1**
	Quality of air	1	2/3	2/3	4
	Surroundings????	4	3	2	1
	Extern safety	4	2/3	2/3	1
	Intern safety	1	3	2	4
	Recreation	4	3	2	1
	Living	4	2/3	2/3	1
	Working	4	2/3	2/3	1

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Phase 1: Total order of ranking (2)

		Fly-over	Wall-roof two tracks	Drilling two tracks	Wall-roof four tracks
Economy	Employment (years) Contribution GNP	8700 422	14200 735	14200 737	23900 1222
Legal proceedings	Standard time of procedure (years) Chance for raising objections and extension of time of procedure.	6 4	6 3	6 2	6 1

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Phase 2.a: Costs Calculations

Usual cost calculation:

	Fly-over	Wall-roof two tracks	Drilling two tracks	Wall-roof four tracks
Construction costs	308.7	493.8	535.6	844
Acquisition+demolition+damage costs	121.8	146	36.7	180
Total	430.5	639.8	572.3	1024
Total in terms of percentages	100%	148%	133%	238%

Phase 2.b: Cost calculations

Cost calculations including 'life cycles' costs:

	Fly-over	Wall-roof two tracks	Drilling two tracks	Wall-roof four tracks
Construction costs	308.7	493.8	535.6	844
Acquisition+demolition+damage costs	121.8	146	36.7	180
Maintenance and exploitation costs	31.4	64.0	47.0	74
Total	461.9	703.8	619.3	1098
Total in terms of percentages	100%	152%	134%	237%

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Phase 2.c: Cost calculations

Cost calculations including social effects:

	Fly-over	Wall-roof two tracks	Drilling two tracks	Wall-roof four tracks
Construction costs	308.7	493.8	535.6	844
Acquisition+demolition+damage costs	121.8	146	36.7	180
Maintenance and exploitation costs	31.4	64.0	47.0	74
Construction nuisance	112.9	163.0	-	604.4
Sound nuisance	16.6	4.3	3.7	6.8
Visual nuisance	3.4	0.9	0.7	1.4
Total	594.8	872.5	623.4	1710.6
Total in terms of percentages	100%	147%	105%	325%

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Phase 3: assign effects

Equally division of the benefits and costs to those concerned but also the division of the non financial disadvantages and advantages

Delft :	money & environment
Central Government:	money
Railways:	capacity

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Strategic Study

Why a strategic study?

- It'll focus on long term policy development
- Multidisciplinary approach

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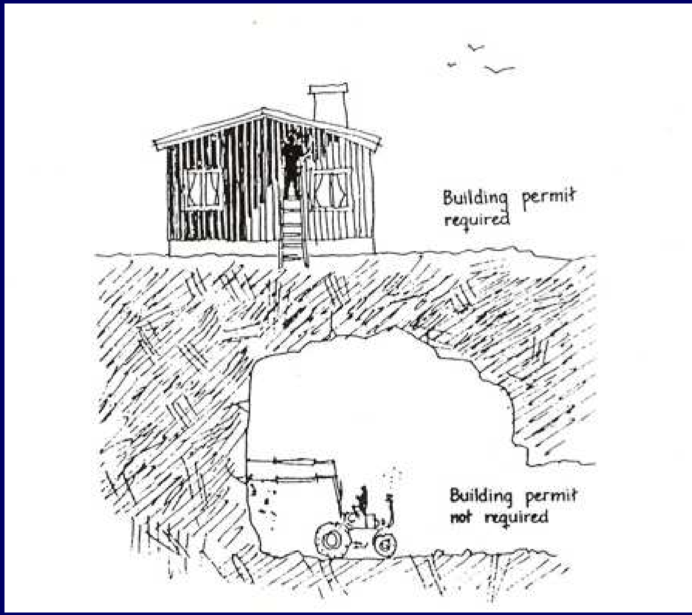
Limitations underground space technology

- Potential limitations
  - Costs
  - Perception of the environment
  - Uncertainties applying the technology, safety aspects.
  - Nuisance and damage during and after construction
  - Geological circumstances.

Limitations underground space technology



- Legal limitations:
  - Legal aspects
  - Planning aspects
  - Lack of integral considerations
  - Lack of integral decision process
  - Little knowledge about the possibilities of underground constructions

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Limitations of underground space must be recorded in the zoning plan, accompanied with a long term vision.

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Environmental planning and urban development aspects

Development of **compact** inner cities, multiple space use can play an important role to ad or maintain quality. Two different directions:

1. Utilize the free space in the inner city, for example an underground car parking underneath a town square (e.g. Museumplein Amsterdam)
2. Compact or change the function of existing urban areas (for example Delft station area)

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Motives for underground constructions	**A**	**B**	**C**	**D**
Underground construction only alternative	X	X		X
Larger functionality	X	X		
	X	X		
Energy saving		X		X
Durability and maintenance		X		X
Larger building density		X	x	X
Better accessibility	X		X	
Multiple space use		X	X	X
Combination with other facilities	x	X		
‘ugly’ constructions underground		X	X	
Limitations of nuisance for surroundings		X	X	
Limitation of environmental nuisance				X
Maintain functions of value			X	X
Increase of extern safety			X	X
Economy and export		x		X

A = users

B = investors and developers

C = neighbours

D = Society

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Economic growth	strong	high quality	growth
	average	high quality	quality
		average quality	trend
	weak	low quality	stagnation

Most of the motives for going underground concern increasing quality of life. This request goes together with the economic growth.

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Other relevant factors

- Economic development
- Quality awareness
- Mobility
- Invention
- International development
- Rate and direction of technological prospects
- Division of labor in different sectors
- Role of government

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Normative criteria for Underground Space Technology

- Costs
- External safety
- Social environment
- Internal safety
- Demands of users
- Space use
- Effect on environment

Different types of location

- Urban inner cities
- Historic city center
- Living areas
- Industrial areas (offices and small industry)
- Large-industrial complexes
- Infrastructure and transfer locations
- Valuable rural areas
- Market gardening and agriculture areas

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Larger demand for underground constructions if there's:

- Increase of quality awareness
- Growing pressure available space
- Increasing mobility
- Strong economic growth
- Technological progress
- Active role of government

Conclusions strategic considerations

- Transport of goods, transport without vehicles and deposits of oil, gas etc. are suitable to go underground. A-priori living is not suitable.
- Criteria against: costs, intern safety and user aspects. Criteria pro: extern safety, social environment and space use.

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