

Estimation of Benefits for an Approximation Approach on Cost-Benefit Analyses for an Underground Railroad System – Case Study in the Greater Reykjavik Area

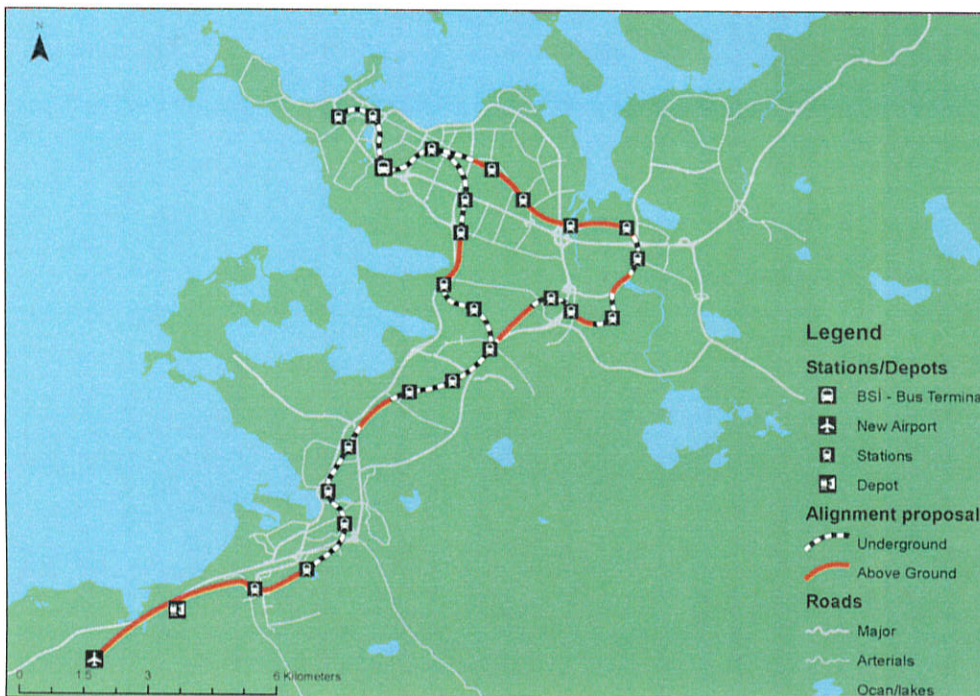
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Geographical analyses were done on population density, area of retail/office, and area of industry to locate the most optimum locations for underground railroad stations. Locations within 2-300 metres were merged to form a single station. The stations were linked to form routes, optimising the length of the system and network coverage.

An interview with the mayor of Reykjavik revealed that two stations had to be a pre-condition for the project, one in the city centre, BSI, and other at the location where it is proposed to move the current city airport to. The current city airport is located near the city centre and serves as a hub for all domestic flights; however, the runways are not long enough to accommodate for larger aircrafts and thus, a new airport might attract international flight traffic.

Subjective analysis on geographical conditions and plot prices was done to decide between under- and above ground services.

Total length of the system is 33.7 km, of which 18.7 km are underground.

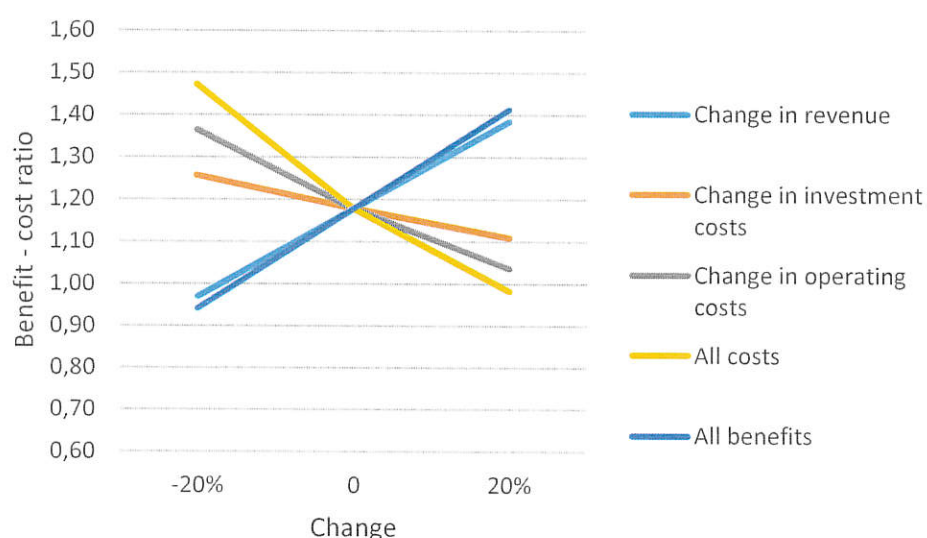
Benefits such as reduced travel time, emissions and accidents were monetised and both investment and running/operating costs were estimated. The initial construction costs were estimated to be 1,090 million Euros; when accounting for the system lifetime, the annual depreciation was 21 million Euros. Operating and maintenance costs were estimated 46 million Euros and social costs, such as noise and pollution, were estimated 188 thousand Euros.

Three scenarios were considered, an investor from the private sector, public sector and a cooperation of residents. The latter was investigated since it is not a common practice to include the users' benefits in analyses on public investments in Iceland.

Only revenue was considered as benefits and social costs were excluded for an investor from the private sector, but direct benefits and all costs were included for the public sector. All benefits and costs were considered for a cooperation of residents.

Type of benefits	Category	Estimated benefits
Annual revenue	Ticketing revenue	€ 64 million
	Lease of retail area	€ 0.75 million
	Advertisements	€ 5.3 million
Direct benefits	Accident reduction	€ 6.5 million
	Emission reduction	€ 0.62 million
	Road maintenance reduction	€ 2.5 million
Indirect benefits	Travel time	€ 68 million
	Vehicle operation/maintenance	€ 170 million

Sensitivity analysis – public sector



The cost-benefit analysis showed that such a project would be profitable for investors in the private sector, with a benefit-cost ratio of 1.04. Taking into account all costs and benefits, the scenario where a cooperation of residents would invest in such a system, the benefit-cost ratio is 4.7.

The most likely scenario, with an investor from the public sector, the benefit-cost ratio is 1.17. Sensitivity analysis shows that the project is most sensitive to changes in revenue and operating costs. Would the investment costs be underestimated by 20%, the benefit-cost ratio would still remain above 1, but if the benefits are overestimated by 20%, the benefit-cost ratio would be 0.96. Overestimation of benefits and underestimation of costs by 20% would reduce the benefit-cost ratio to 3.13 when all costs and benefits are considered.

The aforementioned results show that there is a solid basis for further studies on costs and benefits of such a system for the Greater Reykjavik Area.