Vedlegg C

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Preliminary construction costs:

Construction conditions were translated into cost factors:

- 1.0 for flat paths
- 1.5 for hilly paths or routes requiring staircases
- 2.0 for bridges or routes with high construction complexity

These factors are used in the cost calculation to reflect different construction conditions.

They were estimated based on Google Maps imagery and site inspections in Buvika and Børsa.

An additional land ownership factor was included:

- Factor 1.0 if at least 50 percent of the shortcut is on municipal land
- Factor 1.2 if less than 50 percent is on municipal land

This factor was calculated using spatial property data. The final adjusted cost factor combines construction costs and land ownership.

*Adjusted cost factor = construction cost factor * property factor*

Network-level potential usage:

A demand proxy approach was used to estimate potential usage of each shortcut.

All existing and proposed shortcuts were included in the pedestrian network model.

Origins were defined as a 250 × 250 m grid of centroids. Each centroid was weighted by the number of inhabitants in 2022.

From each origin, network distances were calculated to:

- The three closest major destinations within a maximum walking distance of 2.5 km
- The closest relevant public transport stop along the E39 corridor and the seaside within a maximum distance of 600 m were included

Destination weights were applied:

- Major destinations: factor 1.0
- Public transport stops: factor 0.3, reflecting a secondary role

Origin to destination routes were then assigned to the pedestrian network. The cumulative demand passing through each shortcut was calculated.

Based on total demand, shortcuts were classified into four categories:

- Low: <100 potential trips, score 0.25
- Medium: <500 potential trips, score 0.5
- High: <1000 potential trips, score 0.75
- Very high: ≥1000 potential trips, score 1.0

These categories represent the estimated level of use of each shortcut.

Local-level benefit score:

In order to assess the local-level walking needs, we adapted the Norwegian planning principles for walking infrastructure (Nistov and Farner, 1973) with the theory of the hierarchy of walking needs (Alfonzo, 2005). Therefore, we focused on four dimensions (accessibility, safety, attractiveness, comfort) to assess the local-level walking needs. These four dimensions form the basis for evaluating the performance of individual shortcuts.

1. Identifying and calculating attributes

Walkability factors can differ between urban and semi-rural contexts. Based on the literature (Basu et al., 2022; Scanlin et al., 2014), we identified the following key attributes for each dimension:

Dimension	**Sub-Attribute**	**Description / Calculation**
Accessibility	Detour gain	Ratio of route length with shortcut to alternative route without shortcut (m)
Accessibility	Opportunity index	Composite measure of access within 300 m walking distance
	Access to major destinations within 300 m	Number of major destinations (grocery, pharmacy, school, kindergarten, specific PT stops) reachable within 300 m
	Access to minor activities within 300 m	Number of minor destinations (playground, sports hall, library, most PT stops) reachable within 300 m

	Access of inhabitants within 300 m	Number of inhabitants within 300 m walking distance
Comfort	Average slope	Average gradient of shortcut and alternative route, classified into ≤3%, 3–6%, >6% and weighted
Comfort	Surface type	Paved vs unpaved surface, calculated as length-weighted average
Safety	Number of crossings with motorized traffic	Number of crossings derived from FKB data and visual checks, normalized to a score from 1 (few) to 0 (many)
Safety	Weighted average traffic speed segments	Speed exposure based on FKB speed limits (no traffic, ≤40 km/h, >40 km/h), weighted by segment length
Safety	Weighted average route length with/without sidewalk	Degree of separation (fully separated, sidewalk, no separation), weighted by segment length
Attractiveness	Public space quality score	Three-level rating based on environmental quality: high (green, low traffic, pleasant public space), medium (residential or mixed), low (traffic exposure, back-of-house, low visual quality). Converted to weights (1.0, 0.7, 0.3) and applied as length-weighted score along the route

Table 1: Description of attributes

These attributes were operationalized by using OSM and geodata sets provided by the municipality. The attributes were calculated for each shortcut and for the existing route without a shortcut (see Figure 2).

Figure 2: Local Level Assessment

2. Calculating scores and the local level score

The score is derived from the difference between before and after values for each sub-attribute. Since most sub-attributes are already defined on 0–1 scales, no further normalization was required. Only the accessibility dimension was normalized because its sub-attributes (route ratio and distance to the nearest point of interest) produce values outside the 0–1 range. Within the comfort and safety score, the sub-attributes were weighted equally. For the accessibility score, we assigned a weight of 60% to route directness and 40% to the change in proximity to the nearest destination. This reflects that greater distances and lower network connectivity make direct routes particularly valuable.

Finally, the overall score for each shortcut was calculated as a weighted sum of the four scores:

$$Local\ level\ Score\ =\ w_{acc} * AC + w_{comf} * C + w_{safe} * S + w_{attr} * AT$$

where **AC** = accessibility score, **C** = comfort score, **S** = safety score and **AT** = attractiveness score

Base-case weights were set to w_{acc} = 0.35, w_{comf} = 0.25, w_{safe} = 0.25, and w_{attr} = 0.15. Accessibility received the highest weight due to its critical role in route choice, while safety and comfort were balanced equally, and attractiveness was given lower importance, as it tends to play a secondary role in utilitarian walking (López-Lambas et al., 2021). To test robustness, two alternative weighting schemes were applied: an equal weight across all dimensions, and an access-focused scheme (wacc = 0.45, wcomf = 0.15, wsafe = 0.30, wattr = 0.10). Both produced minimal changes in shortcut rankings, indicating stable results.

3. Total local level score

Total local benefit score includes the local level score and the taxi avoidance factor. The taxi avoidance factor represents whether the shortcut is expected to reduce the need for taxi transport for school children. The assessment is based on the document 'Innspill'. It increases the local level score by 0.1 points.

References:

Alfonzo, M.A., 2005. To Walk or Not to Walk? The Hierarchy of Walking Needs. Environ. Behav. 37, 808–836. https://doi.org/10.1177/0013916504274016

Basu, N., Haque, Md.M., King, M., Kamruzzaman, Md., Oviedo-Trespalacios, O., 2022. A systematic review of the factors associated with pedestrian route choice. Transp. Rev. 42, 672–694. https://doi.org/10.1080/01441647.2021.2000064

Nistov, S., Farner, A., 1973. Til fots : planlegging med hensyn til fotgjengeren (NIBR rapport No. 29). Norsk institutt for by- og regionforskning, Oslo.

Scanlin, K., Haardoerfer, R., Kegler, M.C., Glanz, K., 2014. Development of a Pedestrian Audit Tool to Assess Rural Neighborhood Walkability. https://doi.org/10.1123/jpah.2012-0224

Prioritization of shortcuts:

The final prioritization score combines benefits and adjusted costs factor. It is calculated by dividing the composite benefit score by the square root of the adjusted cost factor.

The composite benefit score includes:

- Network level benefit
- Local level benefit
- Taxi avoidance factor

Weights were applied as follows:

- wlocal=0.6
- wnetwork=0.4

The higher weight for the local level reflects a policy choice. The aim is to support qualitative improvements and ensure a balanced distribution of measures across the entire area. This places more emphasis on rural and less dense areas, not only town centers.

The square root of the cost factor reduces the impact of high costs. High cost projects are penalized but not excluded from consideration.

Length was not included in the calculation. Earlier tests showed that including length favored very short shortcuts and disadvantaged longer connections, which are important in rural contexts.

The resulting score is used to rank all shortcuts and support municipal decision making.

$$Cost - Effectivness \;= \frac{w_{networklevel} * \;Network\;score\; + \;w_{locallevel} * \;Total\;local\;level\;score}{\sqrt{adjusted\;cost\;factor}}$$

Weights to calculate …

the speed score

	Speedlimit	Weight
	0	1
<=	40	0,7
>	40	0,3

the seperation from car traffic score

	Weight	
1	1	physical seperation from car traffic
0,7	0,7	build seperation from car traffic (for example sidewalk)
0	0	no seperation from car traffic

the surface score

Surface	Weight	
1	1	paved surface
0	0,5	unpaved surface

the slope score

	Average slope in %	Weight	
<=	3	1	flat
3	6,00	0,7	inbetween
6	6	0,4	steep

the attractivity score

Attractivity		
2	1	2 means an attractive environment along the shortcut, for example green surroundings, no traffic, pleasant public space.
1	0,7	1 means a neutral or mixed environment for example residential neighborhood
0	0,3	0 means a less attractive environment, for example proximity to traffic, back-of-house areas, or limited visual quality

the safety index

Weighting safety	Weight
Seperated from car traffic index	0,5
Speed index	0,3
Crossingsindex	0,2

the comfort index

Parameters	Weight
Surface	0,75
Slope	0,25

the opportunity score

Parameters	Weight
Inhabitants score	0,5
Major activity score	0,35
Minor activity score	0,15

the accessibility index

Parameters	Weight

Opportunity score	0,4
Detour gain	0,6

the local level benefit score

Local dimension	Weight
w_Accessibility	0,35
w_safety	0,25
w_attractivity	0,15
w_comfort	0,25

the network-level score

Usage potential	Weight	
low	0,25	<100
medium	0,5	<500
high	0,75	<1000
very high	1	>1000

the costfactor

Cost estimate	Weight	
low	1	flat path
medium	1,5	hilly path, staircases
high	2	bridge

the total score

Scores	Weight
Local-level score	0,6
Network-levelscore	0,4

		Weight
Municipal land	50 %	1
Non-municpal land	<50%	1,2