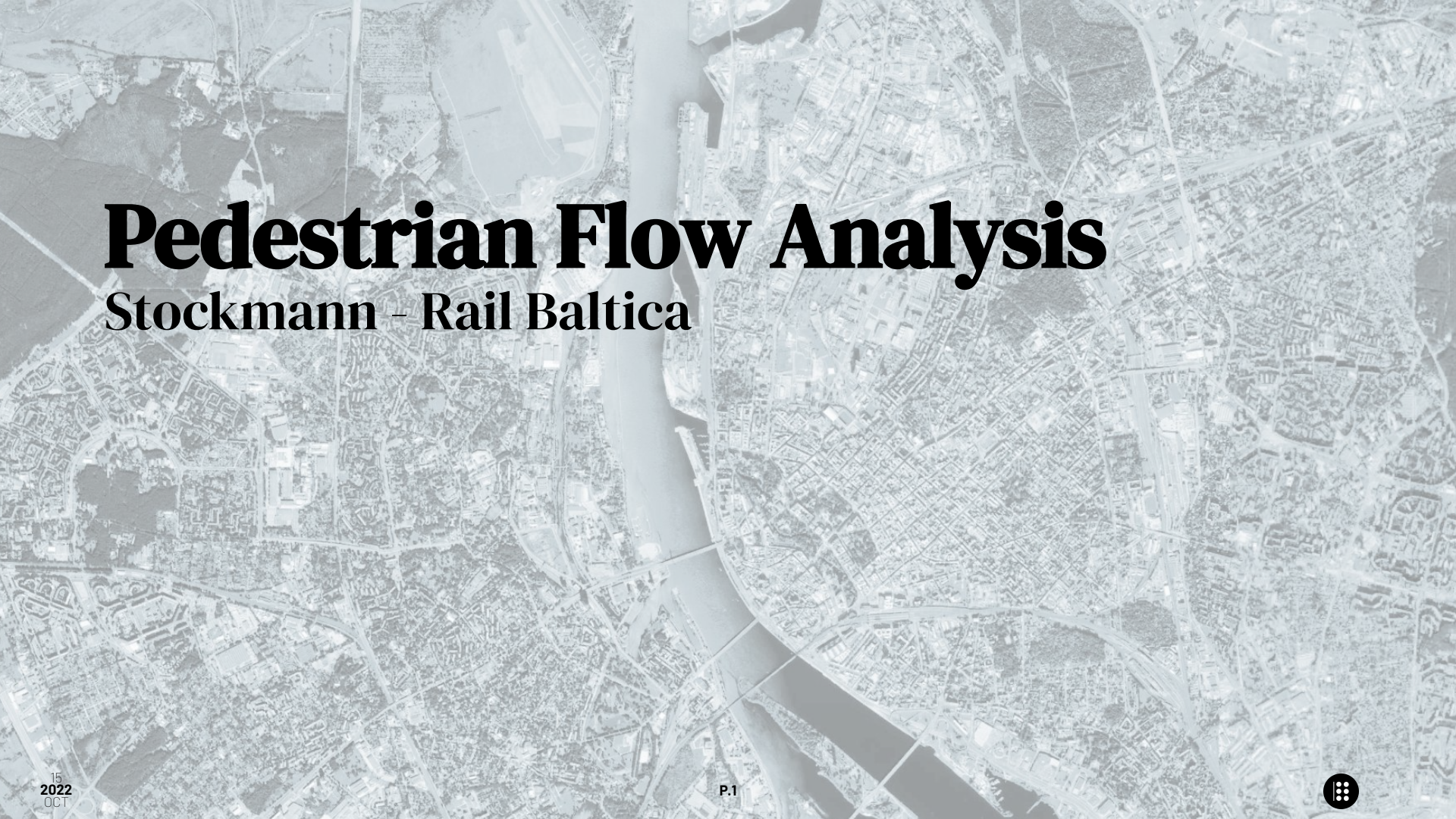




Pedestrian Flow Analysis

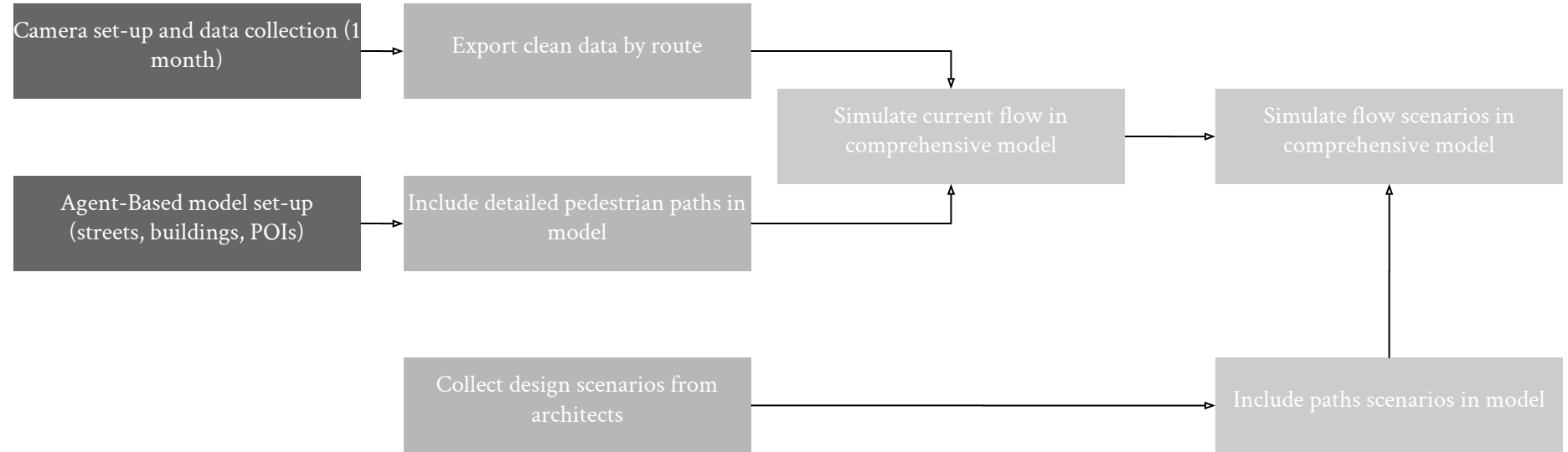
Stockmann - Rail Baltica

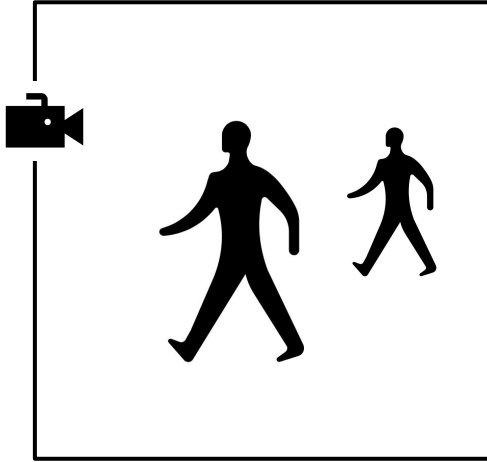


Project Plan

Week 36

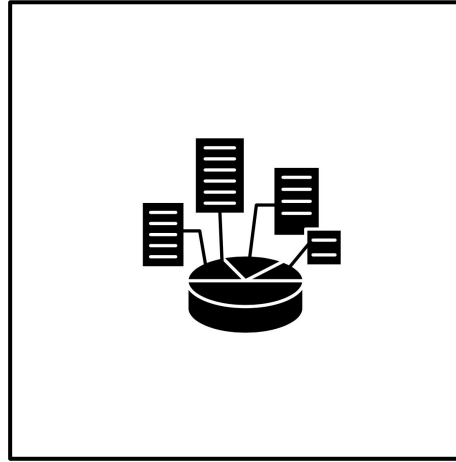
Week 37-39





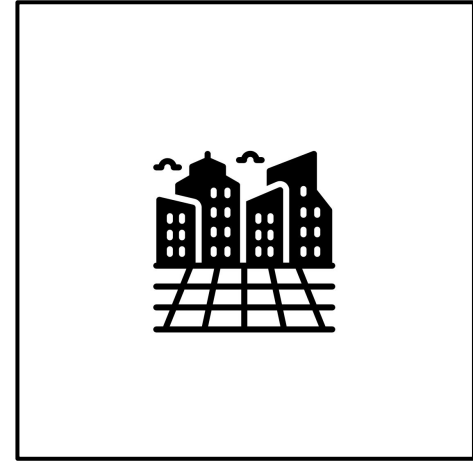
MONITORING

Using Artificial Intelligence on the existing CCTV to detect the number of people passing by each spot.



DATA ANALYSIS

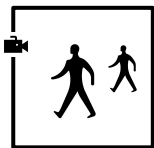
Defining the characteristics of the flow of people, their origin and destination.



SIMULATION

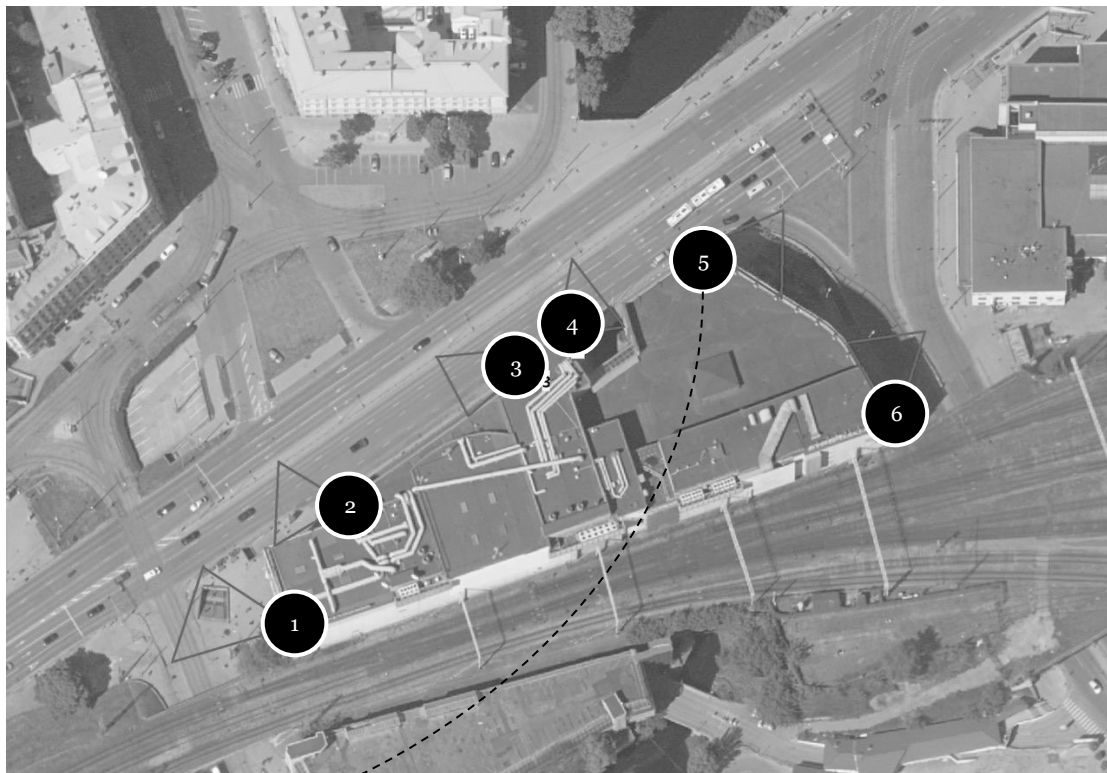
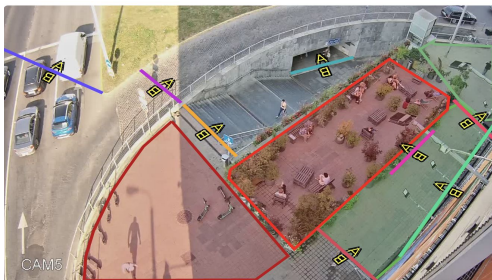
Using the calculated flows to predict the movement of people in future scenarios

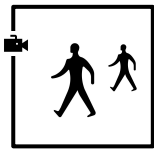




MONITORING

Using Artificial Intelligence on the existing CCTV to detect the number of objects passing by the areas covered by cameras. AI detects presence of people, in count lines and areas, including their direction, and time. The output of the monitoring phase is the activity level of each spot.





DATA COLLECTED

Number of elements per minute
(flow per timestamp)

Type of element
(person, bike, e-scooter, ...)

Direction
(origin-destination)

Time staying in the area
(dwell time)

How many people come in and go out?

When are the peak hours?

Where do they come from and go to?

Which areas are the most comfortable to wait / stay in?

What are the most common paths?



Which paths should be emphasized by the new design?

What additional paths do we need?



Which path configuration works better / as desired?





DATA ANALYSIS

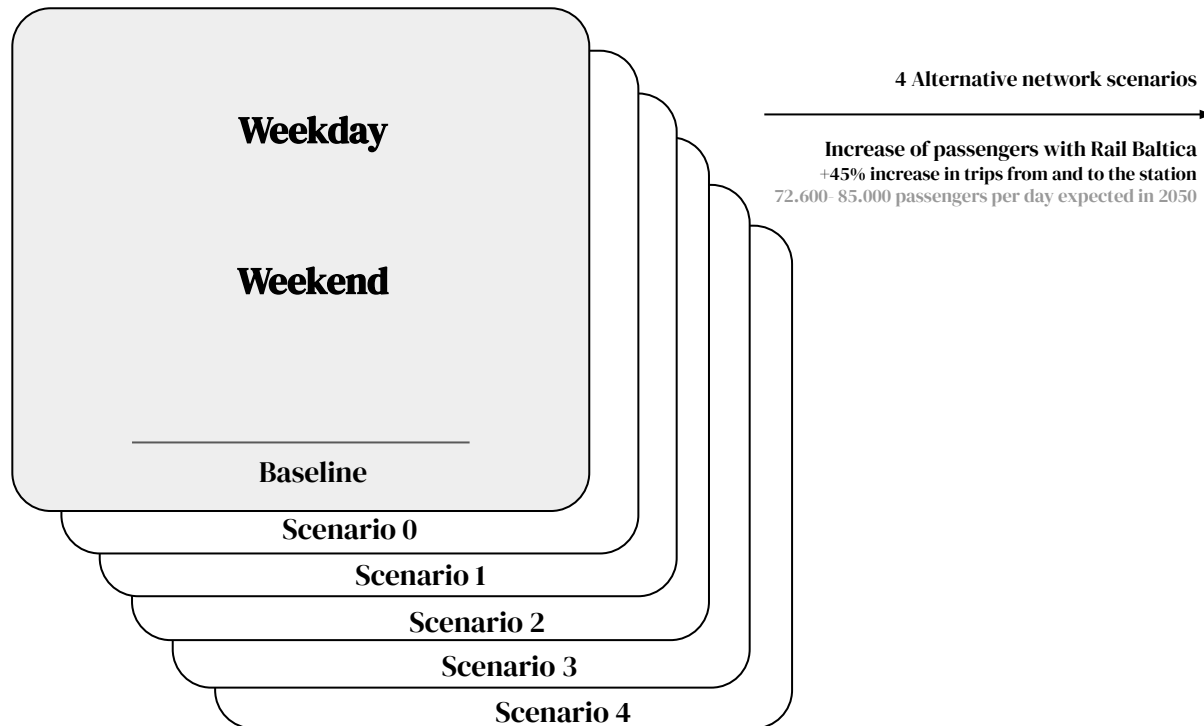
Data monitored by the cameras can be plotted into locations by transforming the activity data into directional flow. Each camera line is estimated into a number of people passing by in one direction. By doing so and scaling up all count lines in every camera, we are able to estimate the characteristics of the movement of people, their origin and destination.



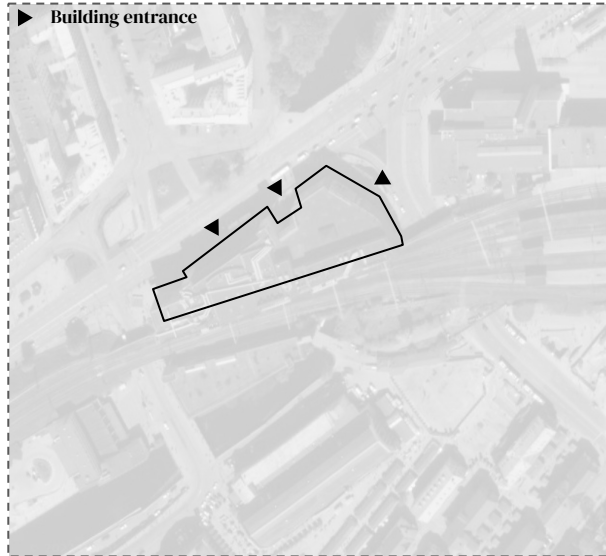


SIMULATION

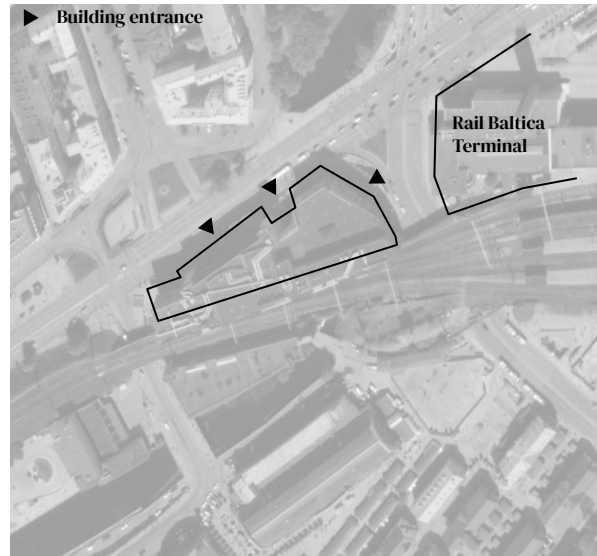
Using the origins and destinations calculated in the analysis phase, we use them to predict the movement of people in future scenarios. In order to do so, we utilize Agent-Based Models, a technique in which general rules of walking are defined for each pedestrian, and then scaled up to every pedestrian counted by the monitoring cameras. The input data of the ABM are the origins and destinations of the trips, the street network, and the number of people going from each origin to each destination at every minute. When we change the street network, it is possible to predict how pedestrians would walk along new streets.



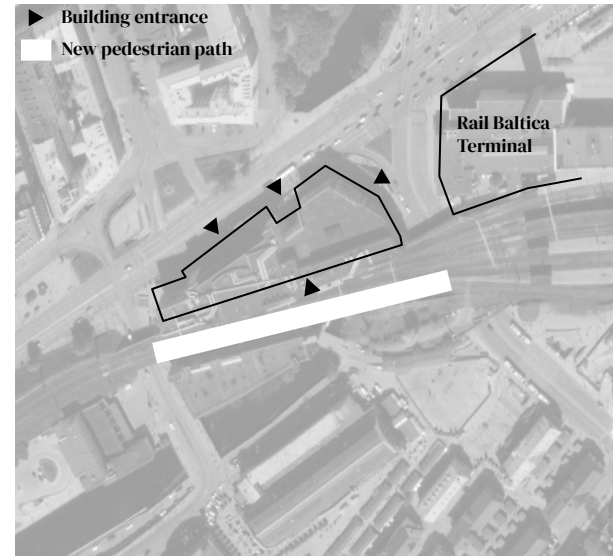
Scenario Planning



Baseline
Current situation



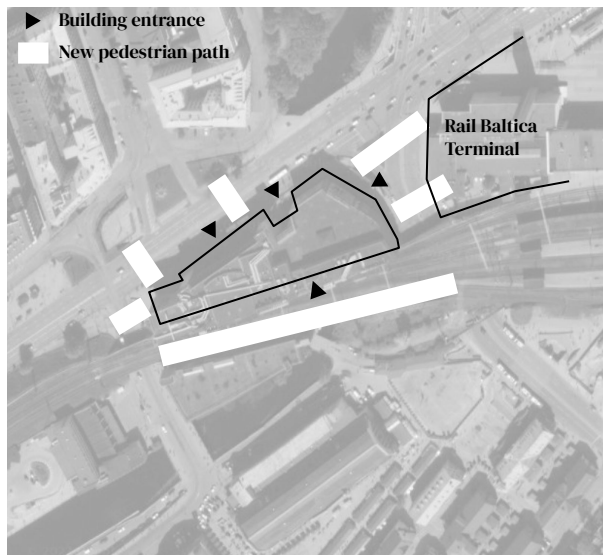
Scenario 0
Rail Baltica is built
No further interventions are considered



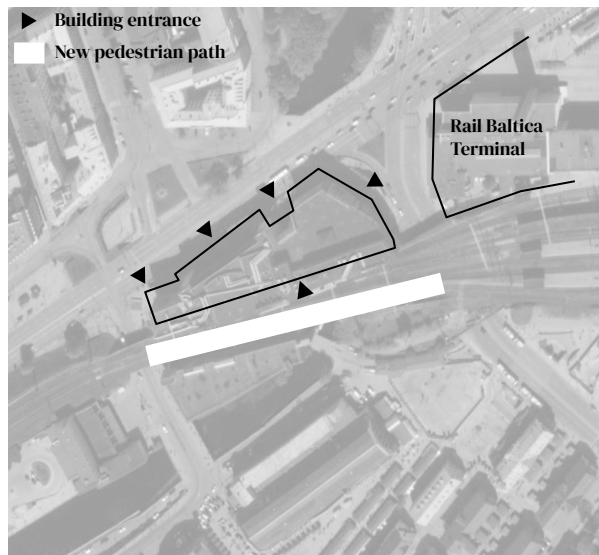
Scenario 1
Rail Baltica is built
New Promenade
New South pedestrian entrance



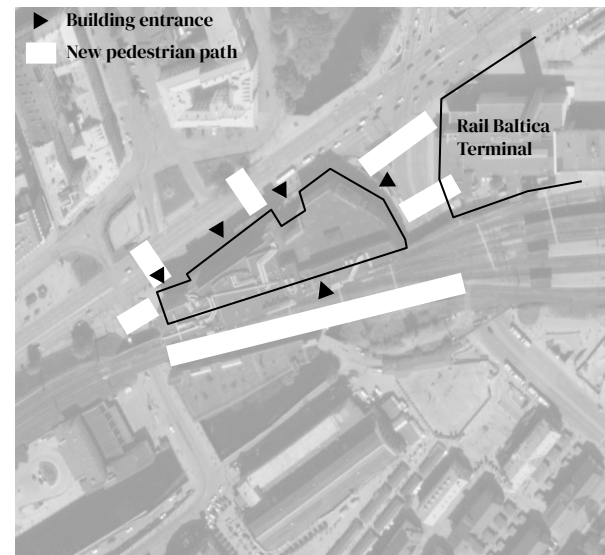
Scenario Planning



Scenario 2
 Rail Baltica is built
 New Promenade
 New South pedestrian entrance
 Urban redesign of pedestrian crossings



Scenario 3
 Rail Baltica is built
 New Promenade
 New South pedestrian entrance
 New East entrance
 New customer-friendly façade (without café)



Scenario 4
 Rail Baltica is built
 New Promenade
 New South pedestrian entrance
 Urban redesign of pedestrian crossings
 New East entrance



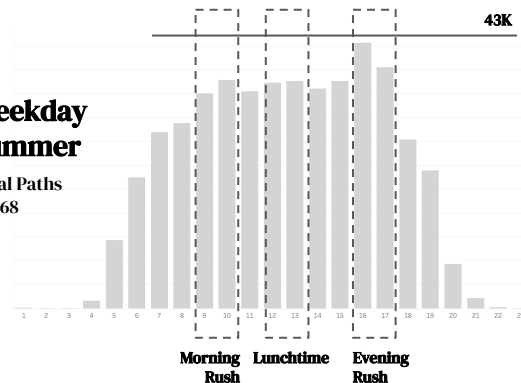
TEMPORAL DISTRIBUTION

A 20% decrease is predicted for winter time. The decrease is proportional to the measurements taken in August and therefore, is subject to summer social dynamics (maximizing outdoor exposure time). In winter, a different spatial distribution of flow is expected. It is recommended that further field measurements are taken in winter.

The temporal distribution is an input to the model so it is shared across all simulation scenarios.

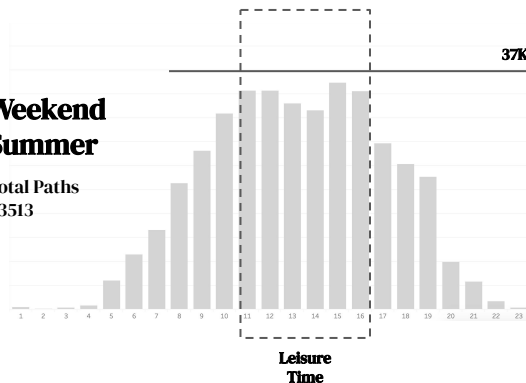
Weekday Summer

Total Paths
40968



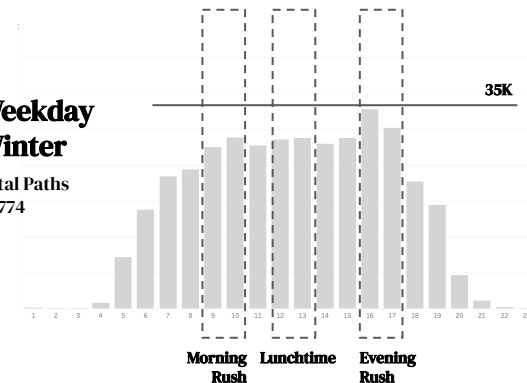
Weekend Summer

Total Paths
33513



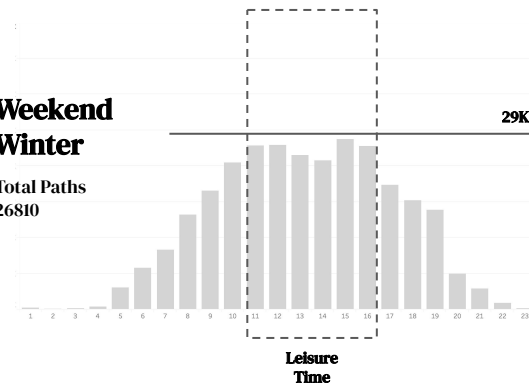
Weekday Winter

Total Paths
32774



Weekend Winter

Total Paths
26810



FOOTFALL METRICS

In our model, we calculate four types of pedestrian flow data: FROM, TO, THROUGH, and AROUND.

FROM: People using Stockmann building as a destination.

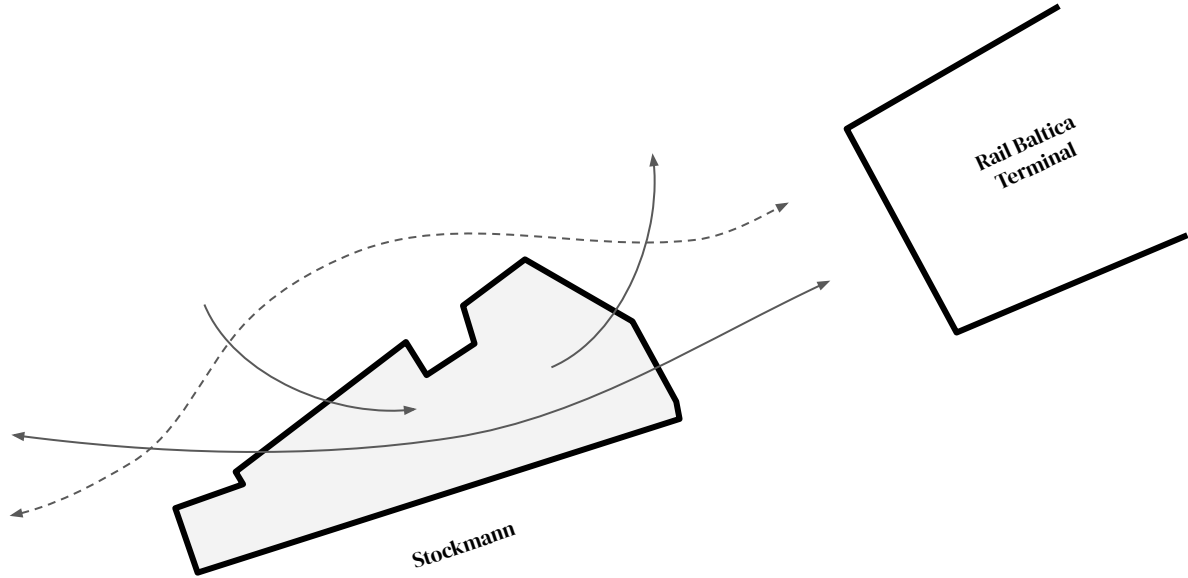
TO: People traveling from the inside of Stockmann out.

THROUGH: People going from one side of Stockmann to the other, and traveling through the building.

AROUND: People traveling with origin and destination outside of the building.

Paths In/Out

Total Paths



Weekday Baseline

Total Paths
40968

12865 Paths inside the building

10397 Origins+Destinations in the building

2268 Paths through the building

23870
44.5%

3586
8.8%

2907
7.1%

6372
15.6%

Flow distribution in
this scenario
(% of total paths)

Weekend Baseline

Total Paths
33513

12545 Paths inside the building

10130 Origins+Destinations in the building

2415 Paths through the building

20670
45.9%

3804
11.4%

2450
7.3%

6291
18.7%

Flow distribution in
this scenario
(% of total paths)



Weekday Baseline

Total Paths
40968



Intensity of people in the area

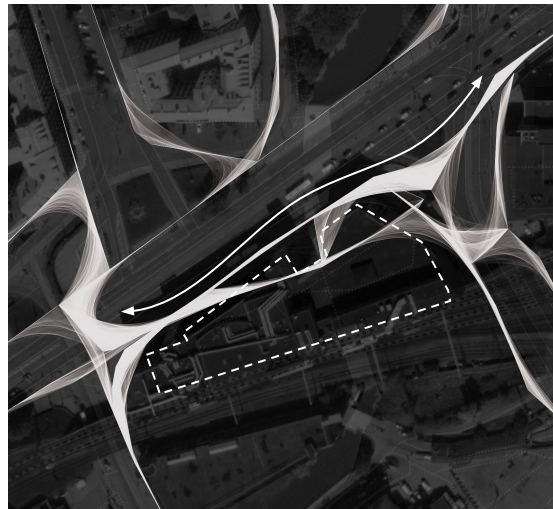
Weekend Baseline

Total Paths
33513



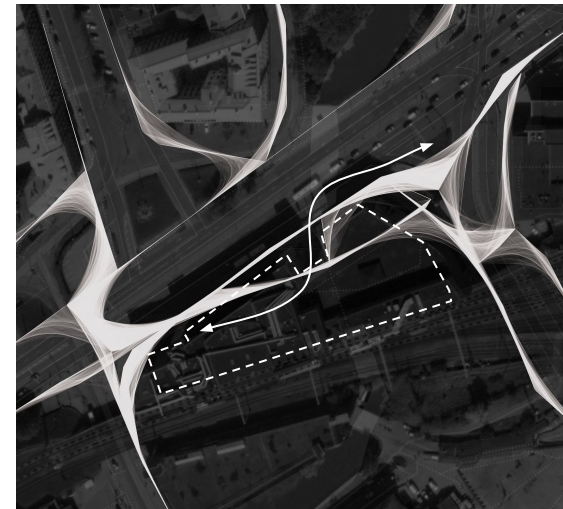
Weekday Baseline

Total Paths
40968



Weekend Baseline

Total Paths
33513



BASELINE

In weekdays, the main flow northeast to southwest emphasizes the street at the north side of Stockmann. During the weekends, it is observable how the flow deviates from the shortest route to include the interior of the building, specially at leisure times. The most used entrance is the existing south-west entrance, followed by the main central entrance.



Weekday Scenario 0

Total Paths
53533

15811 Paths inside the building

12851 Origins+Destinations in the building

2960 Paths through the building

+22.9%

+17.3%

+55.1%

Increase relative to
baseline scenario

26485
49.5%

2295
4.3%

7092
13.2%

6424
12.0%

Flow distribution in
this scenario
(% of total paths)

Weekend Scenario 0

Total Paths
45018

13512 Paths inside the building

10667 Origins+Destinations in the building

2845 Paths through the building

+7.7%

+5.3%

+17.8%

Increase relative to
baseline scenario

21333
47.4%

5639
12.5%

2135
4.7%

5738
12.7%

Flow distribution in
this scenario
(% of total paths)



Weekday Scenario 0

Total Paths
53533



Intensity of people in the area

Weekend Scenario 0

Total Paths
45018

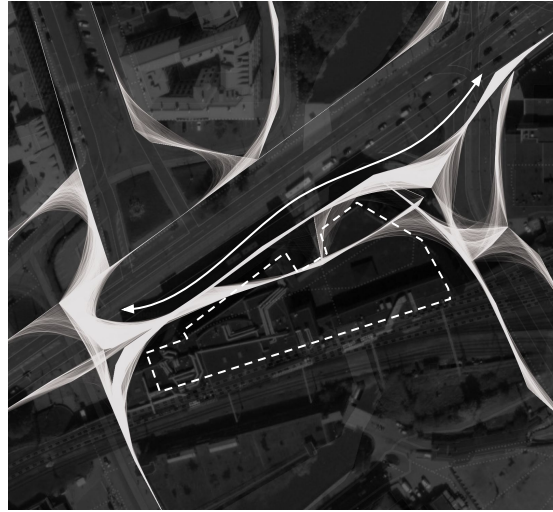


Scenario 0

Similarly to the Baseline scenario, in weekdays, the main flow northeast to southwest emphasizes the street at the north side of Stockmann. During the weekends, it is observable how the flow deviates from the shortest route to include the interior of the building, specially at leisure times. The most used entrance is the existing north-east entrance during weekdays, and south-west in the weekends followed by the main central entrance.

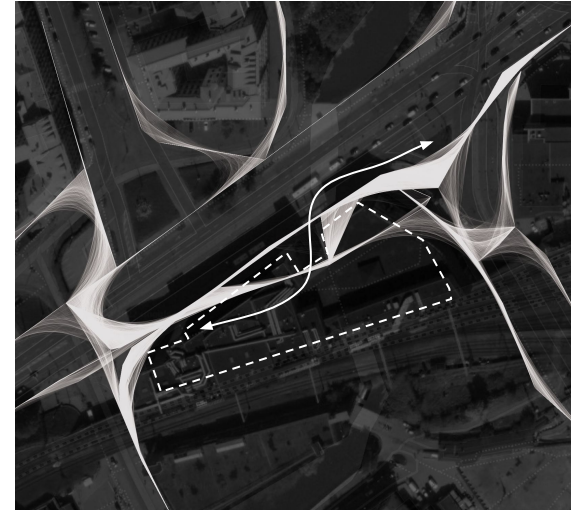
Weekday Scenario 0

Total Paths
53533



Weekend Scenario 0

Total Paths
45018



Weekday Scenario 1

Total Paths
53533

16615 Paths inside the building

12923 Origins+Destinations in the building

3692 Paths through the building

+29.1%

+17.9%

+93.5%

Increase relative to
baseline scenario

20648
38.6%

2319
4.33%

7630
14.25%

2690
5.02%

3976
7.43%

Flow distribution in
this scenario
(% of total paths)

Weekend Scenario 1

Total Paths
45018

13894 Paths inside the building

10368 Origins+Destinations in the building

3526 Paths through the building

+10.8%

+2.3%

+46.0%

Increase relative to
baseline scenario

20153
44.8%

3734
8.29%

2381
5.29%

3651
8.11%

4128
9.17%

Flow distribution in
this scenario
(% of total paths)



Weekday Scenario 1

Total Paths
53533



Intensity of people in the area

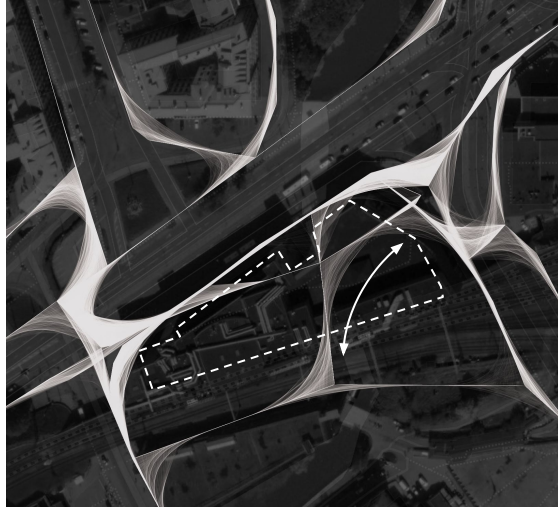
Weekend Scenario 1

Total Paths
45018



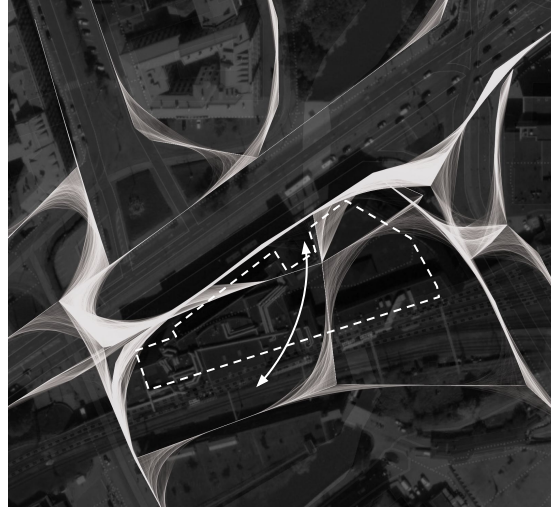
Weekday Scenario 1

Total Paths
53533



Weekend Scenario 1

Total Paths
45018



SCENARIO 1

Compared to the baseline, Scenario 1 shows a noticeable increase in the flow that connects the Railway station towards and the south-west area of Stockmann. These route is taken by people connecting the East entrance to the new South gate.

During the weekend, the flow that connects North and South increases notably, and the connections North-South and North-West is emphasized.



Weekday Scenario 2

Total Paths
53533

14782 Paths inside the building

12956 Origins+Destinations in the building

1826 Paths through the building

+14.9%

+18.2%

-4.3%

Increase relative to
baseline scenario

13258
24.8%

2659
4.97%

1904
3.56%

7170
13.39%

3049
5.70%

Flow distribution in
this scenario
(% of total paths)

Weekend Scenario 2

Total Paths
45018

12177 Paths inside the building

10409 Origins+Destinations in the building

1768 Paths through the building

-3.4%

+2.8%

-29.3%

Increase relative to
baseline scenario

15975
35.5%

3118
6.93%

2548
5.66%

3264
7.25%

3247
7.21%

Flow distribution in
this scenario
(% of total paths)



Weekday Scenario 2

Total Paths
53533



Intensity of people in the area

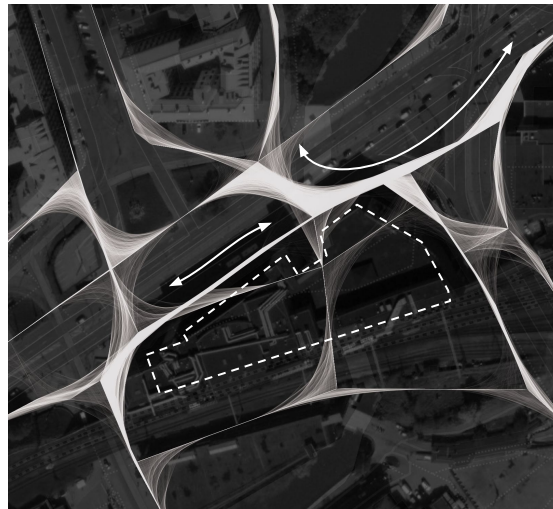
Weekend Scenario 2

Total Paths
45018



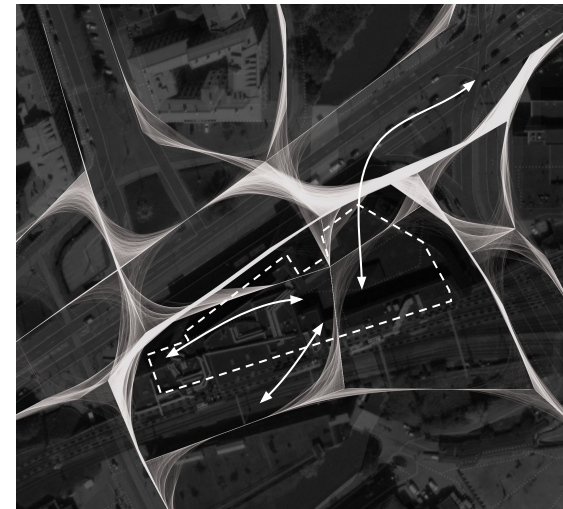
Weekday Scenario 2

Total Paths
53533



Weekend Scenario 2

Total Paths
45018



SCENARIO 2

Compared to Baseline and Scenario 1, the presence of a same-level crossing connecting to the other side of the street drives pedestrian flow from the train station towards the northern areas, instead of attracting people towards the inside of Stockmann at the south-west. It is observed that the activity levels at the south-west intersection and entrance decreases considerably.

Similarly to Scenario 1, weekend dynamics decrease at the north-east entrance and increase at the three others.



Weekday Scenario 3

Total Paths
53533

17116 Paths inside the building

13405 Origins+Destinations in the building

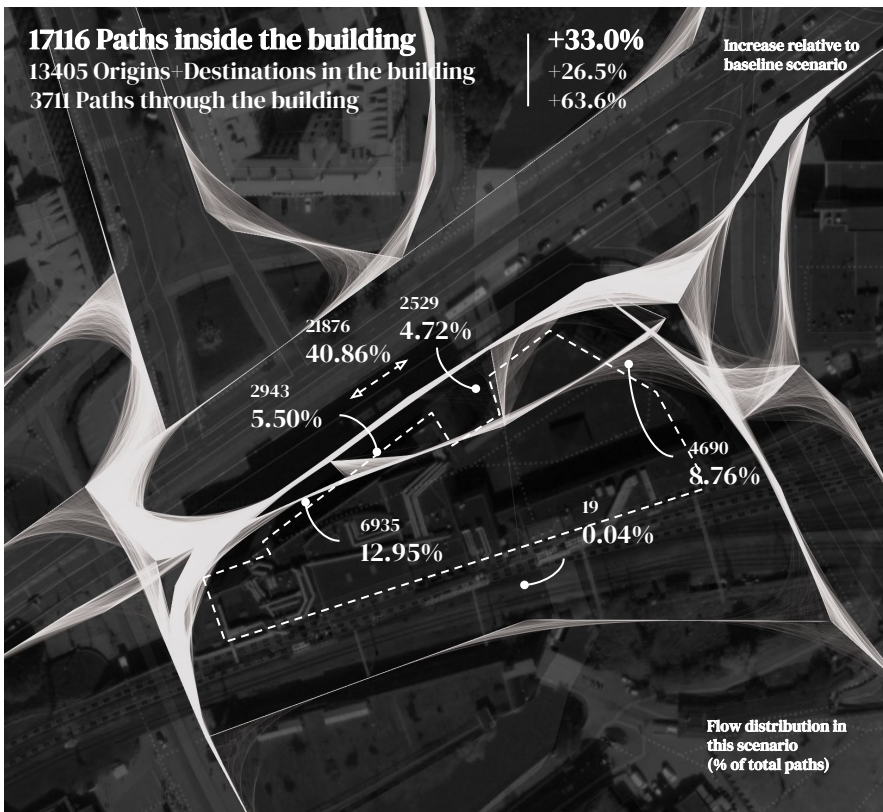
3711 Paths through the building

+33.0%

+26.5%

+63.6%

Increase relative to
baseline scenario



Weekend Scenario 3

Total Paths
45018

13967 Paths inside the building

10286 Origins+Destinations in the building

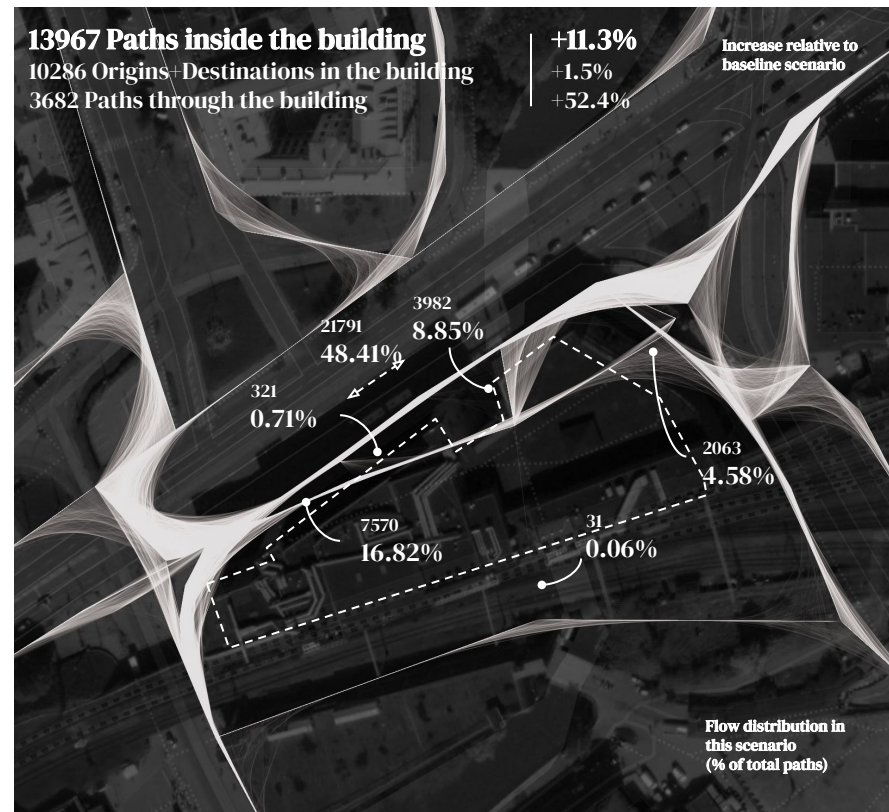
3682 Paths through the building

+11.3%

+1.5%

+52.4%

Increase relative to
baseline scenario



Weekday Scenario 3

Total Paths
53533



Intensity of people in the area

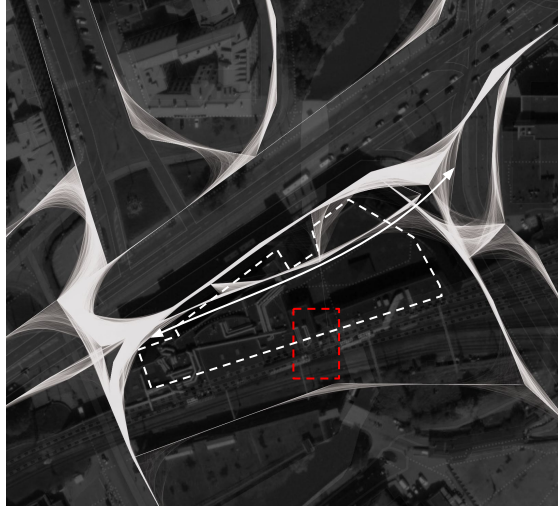
Weekend Scenario 3

Total Paths
45018



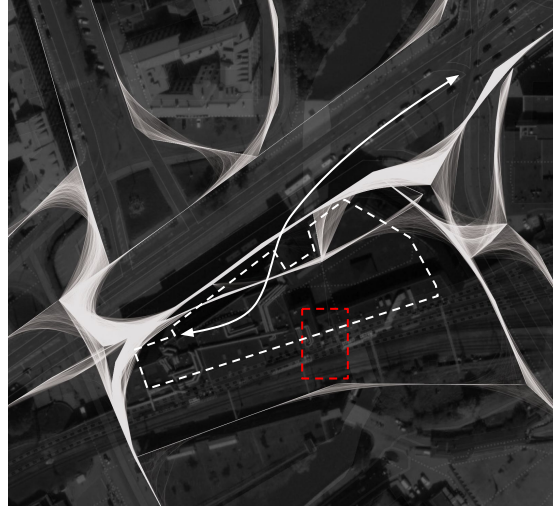
Weekday Scenario 3

Total Paths
53533



Weekend Scenario 3

Total Paths
45018



SCENARIO 3

The new South entrance appears to be unused, because the additional West entrance offers a shorter path when walking from and to the south-west area. The main flow is observed through the inside of Stockmann, using the new West entrance and connecting it to the north-eastern side. In both weekdays and weekends, the new West entrance is the most used.



Weekday Scenario 4

Total Paths
53533

14734 Paths inside the building

12938 Origins+Destinations in the building

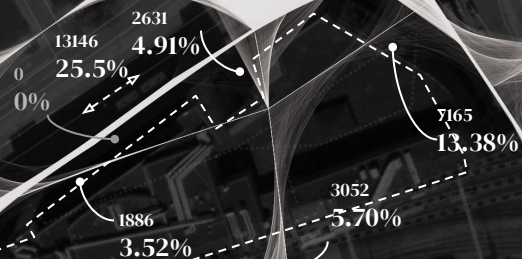
1796 Paths through the building

+14.5%

+18.1%

-5.9%

Increase relative to
baseline scenario



Flow distribution in
this scenario
(% of total paths)

Weekend Scenario 4

Total Paths
45018

12119 Paths inside the building

10319 Origins+Destinations in the building

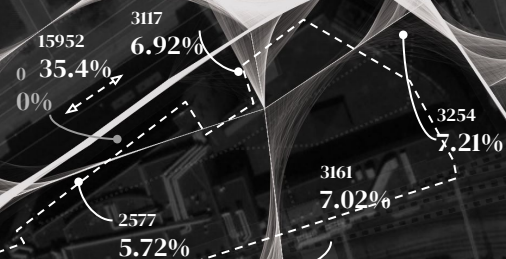
1800 Paths through the building

-3.4%

+1.9%

-25.5%

Increase relative to
baseline scenario



Flow distribution in
this scenario
(% of total paths)



Weekday Scenario 4

Total Paths
53533



Intensity of people in the area

Weekend Scenario 4

Total Paths
45018



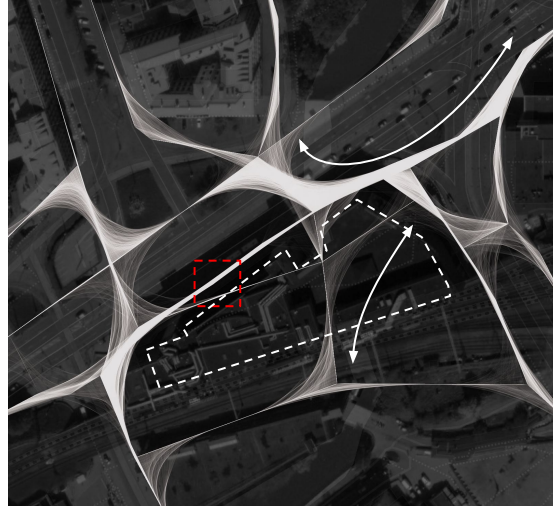
Weekday Scenario 4

Total Paths
53533

SCENARIO 4

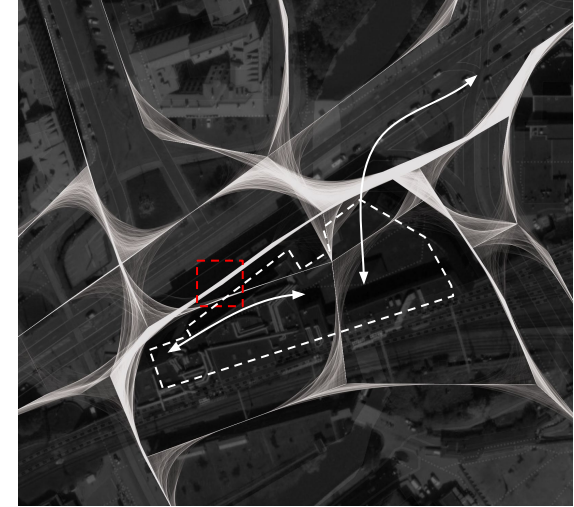
The existing entrance at the south-west is unused, and all the flow towards that direction flows through the new entrance, because it is aligned with the new pedestrian intersection and offers a more convenient route.

The general trend is directly comparable to Scenario 2, with the addition of the new entrance.

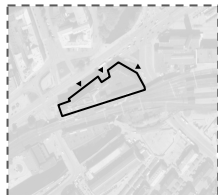


Weekend Scenario 4

Total Paths
45018



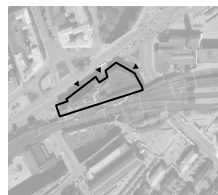
Scenario Summary



Baseline

12865-12545 trips per day

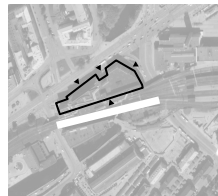
The south-west entrance is the most used. In the weekend, people flow through the building, while in weekdays they flow around the building along the north sidewalk.



Scenario 0

15811-13512 trips per day.

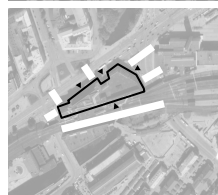
The north-east entrance is the most used. In the weekend, people flow through the building, while in weekdays they flow around the building along the north sidewalk. There is an increase of pedestrians coming from/to the terminal.



Scenario 1

16615-13894 trips per day.

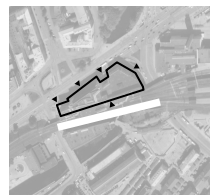
The north-east entrance is the most used in weekdays, and the new south entrance is the most used in the weekends. Both in weekends and weekdays, people flow through the inside of the building in north-south and east-west trips.



Scenario 2

14782-12177 trips per day.

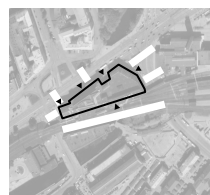
The relative use of the entrances is comparable to Scenario 1, with a slight decrease in all gates except the new south entrance. Flow through the north street is more convenient for east-west trips, while flow through the building is more convenient for north-south trips.



Scenario 3

17116-13967 trips per day.

In weekdays, people traveling east-west flow through the inside of the building. The new West entrance is the most used in both cases. The new amenities at the north influence an increase in the flow of visitors through the Main entrance, especially during weekends. The new south entrance is unused, being more convenient to use the new west gate.



Scenario 4

14734-12119 trips per day.

The relative use of the entrances is also comparable to Scenarios 1 and 2, and the absolute numbers are similar to Scenario 2. The new west entrance works when aligned to the new pedestrian intersections, being a more convenient path than the existing entrance at that side - which becomes unused.

Learnings

- Scenarios 1 and 2 include the south entrance and the flow to/from the inside of the building is more balanced between the four gates.
- Scenario 1 and 3 maximize the footfall inside Stockman.
- Scenario 1 and 2 optimize the use of all the entrances.
- Scenario 3 offers a convenient connection to the public transport network
- Rail Baltica passengers produce a flow increase that is more notable on weekdays and therefore, there is a directional difference between weekend and weekdays: For East-west flow to/from the Station to be driven through the inside of Stockman and maximize foot traffic, Scenario 1 offers the best solution.

