

Mapping Motion: Insights from People Movement Simulations





Ramboll is a global architecture, engineering and consultancy company with more than 17,500 experts, creating sustainable solutions for governments and companies all over the world.

We have a full-spectrum of international expertise in real estate, energy, water, transport, industrial, resource & waste, government & public, finance & investment and technology sectors.

With 300 offices across 35 countries and over 400 experts in Asia-Pacific, we bring our strong Nordic history of sustainability, expertise and multicultural insight to every project we undertake.

We contextualise our heritage to this region in the pursuit of viable and beneficial outcomes, applying systems thinking and integrated solutions to each project with sustainability at our core.

As the global economy shifts towards carbon neutrality, we are doing our part in committing to halving greenhouse gas emissions by 2030 through our Unifying Sustainability Themes:



Decarbonise for Net-zero

- Driving low-carbon initiatives and solutions by leveraging on cross-market synergies
- Industry-wide energy engagement on renewables, low-carbon technologies, transportation, net zero architecture, sustainable materials



Resilient Societies & Liveability

- Planning and creating developments that are in harmony with nature and promote sustainable living
- Building resilient infrastructure, smart mobility, environmental and natural resource protection that focuses on health, wellbeing and economic opportunity



Resource Management & Circular Economy

- Transitioning from unsustainable practices in production and consumption to a circular economy
- Applying circular principles in the protection and management of natural resources



Biodiversity & Ecosystem

- Preserving and protecting against rampant loss of environment in the region
- Restoring nature and ecosystems through planning and design as an integral component of any urban development

Our offerings

Landscape

Architecture

Resilient Cities



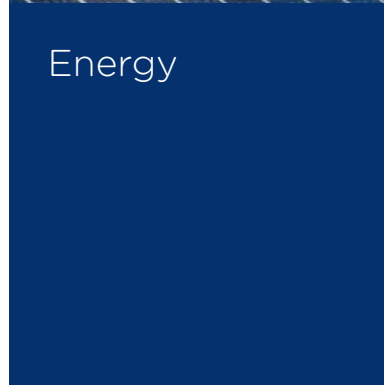
Buildings



Environment & Health



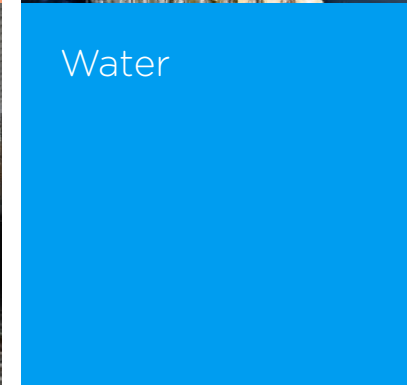
Energy



Transport



Water



Transport

The future of mobility today

By integrating urban planning with transport modes and systems, and employing digitalisation, we are **shifting the focus from the machines that move us to the freedom of mobility for all.**

Ramboll tackles the region's hardest mobility challenges through a holistic approach that combines our legacy of planning in the Nordic capitals with a high consideration of local context.

We combine technical domain know-how with **our understanding of the complicated transportation sector governance and financial structures.**

Informed by our decades of collaboration with clients and partners, we **utilise smart mobility to develop the right strategies and implementation** in cities throughout the region.

Global Group Promoting Simulations

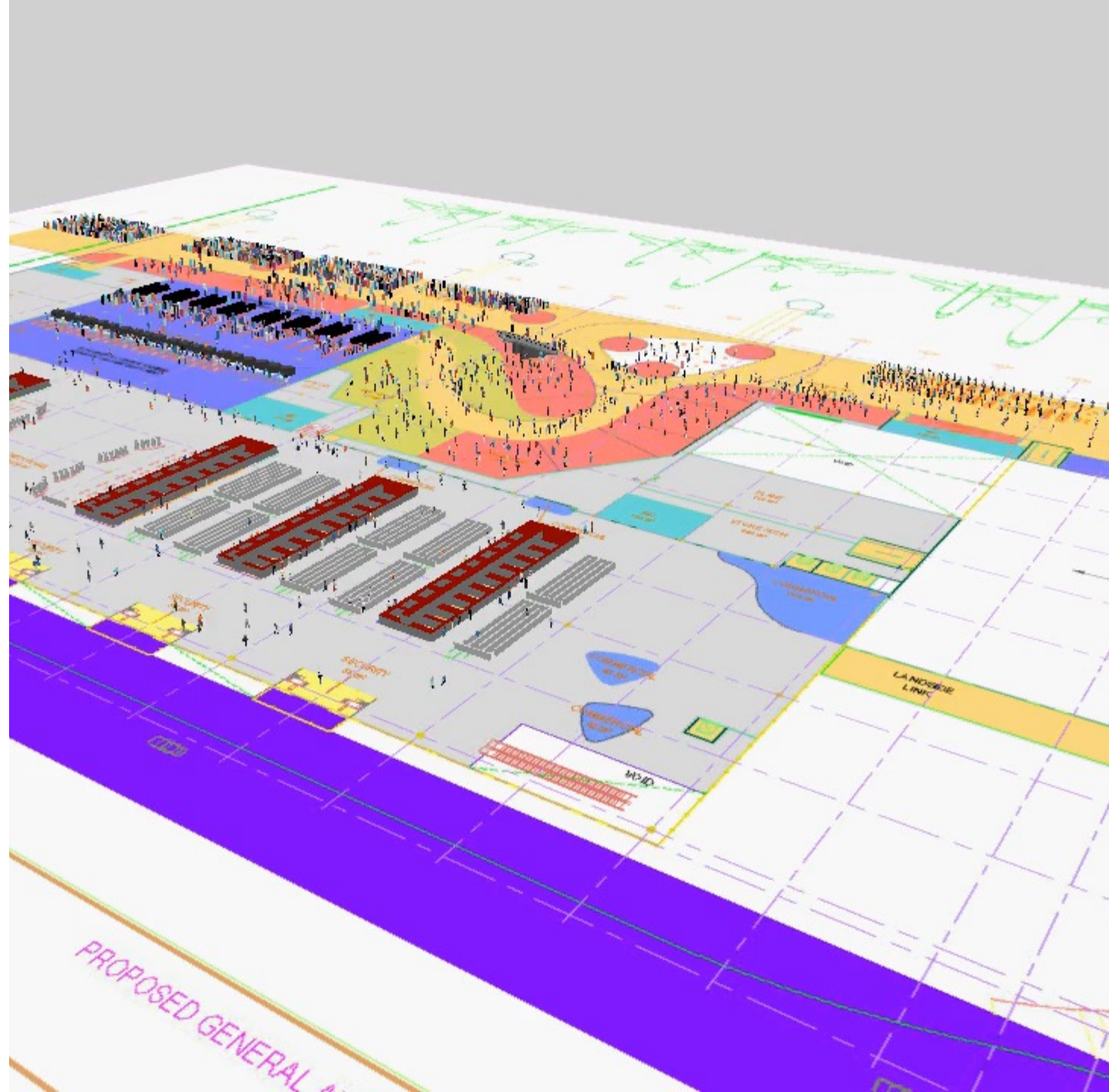
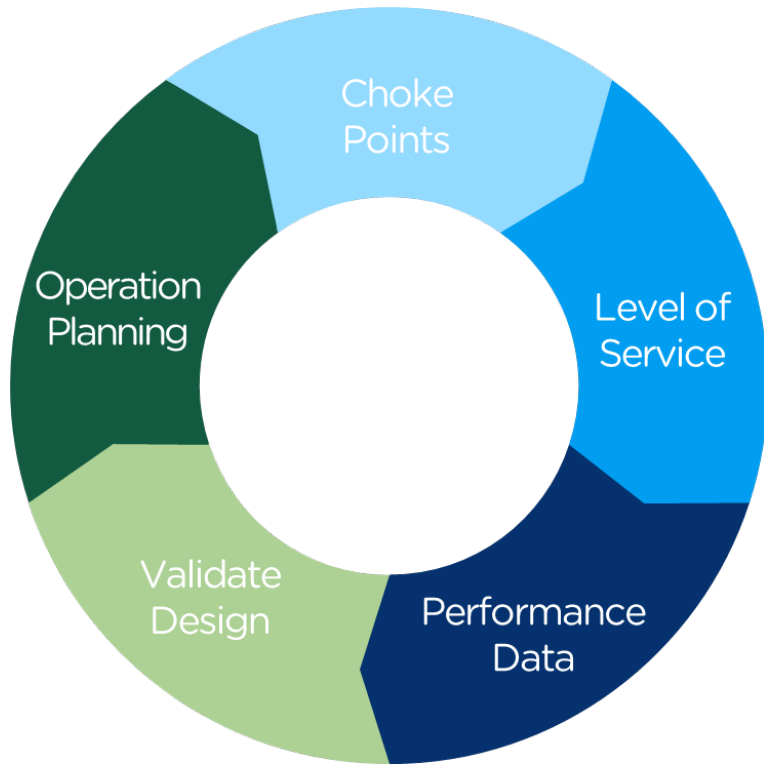
Simulations Service Line - Providing innovative solutions for transport challenges using simulations as a tool

Services include:

- Simulations technical support
- Global resourcing collaboration and coordination
- Simulations tender support
- Simulations marketing support



What is people movement simulation?



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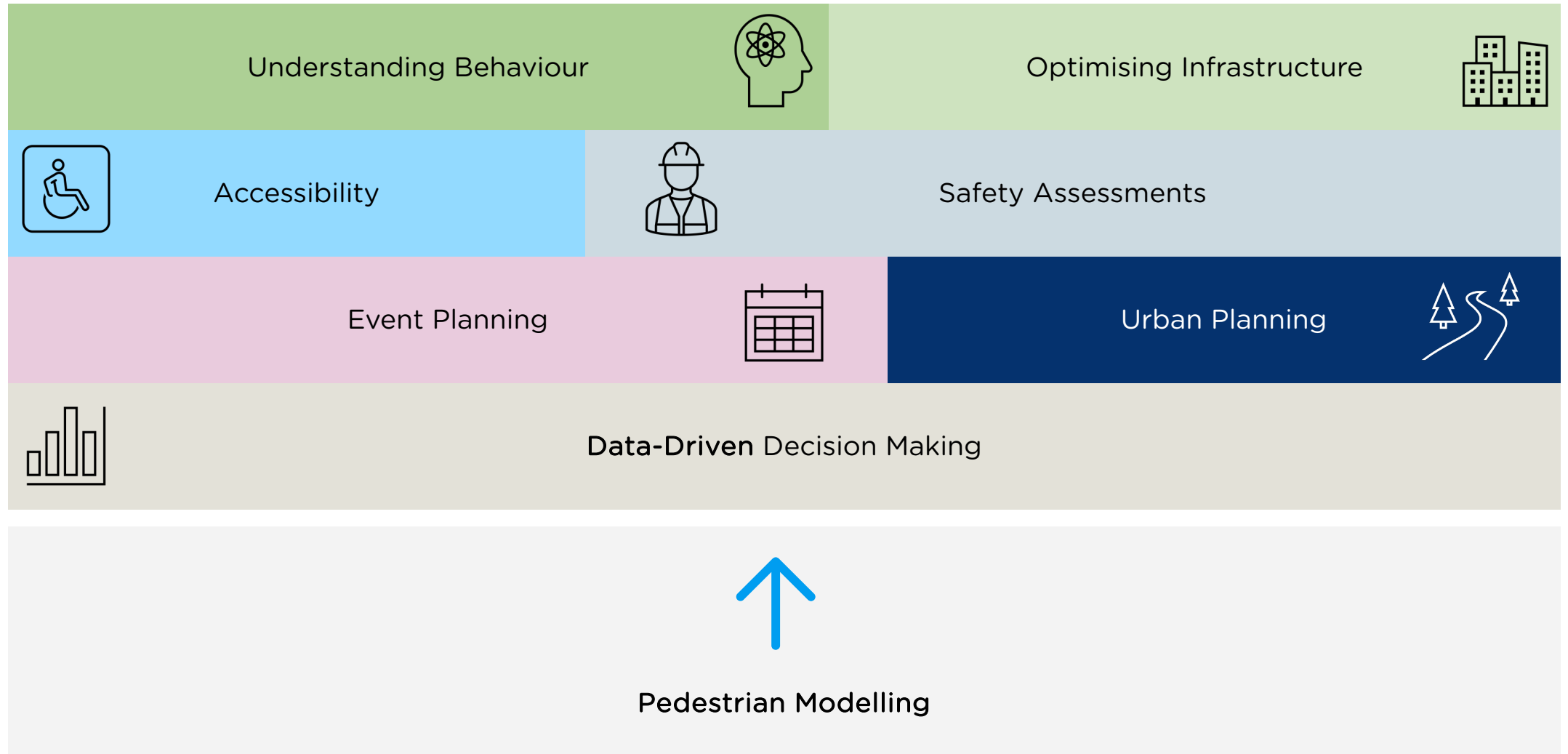
- Pedestrian Simulation - Modelling of People as they move through any built environment
- Pedestrian simulation is a **valuable tool** in designing for large crowds by providing insights into how pedestrians move and interact with their environment.



People Movement Simulation Applications

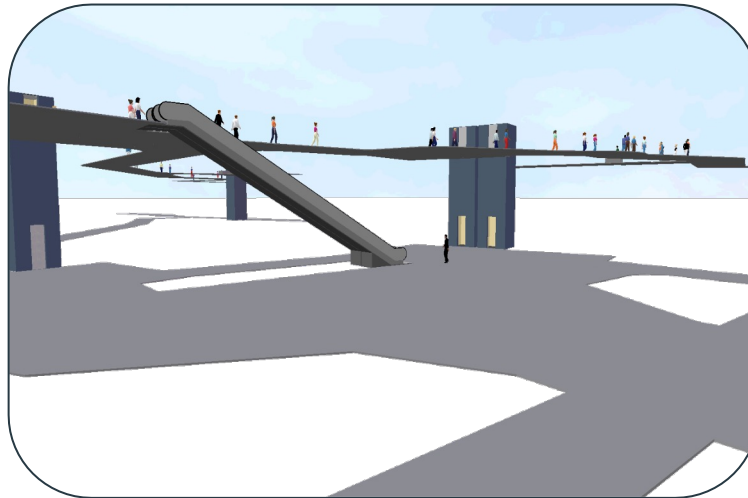
Rail Facilities	Hospitals & Medical	Large Gathering Spaces	Air Facilities	Tall Buildings	Attractions
					

Here's how it is used



Understanding Behaviour

- Pedestrian simulations help designers understand how people move through spaces, such as walkways and public areas.
- By analysing pedestrian behaviour, designers can identify potential bottlenecks, congestion points, or safety concerns that may impact active mobility



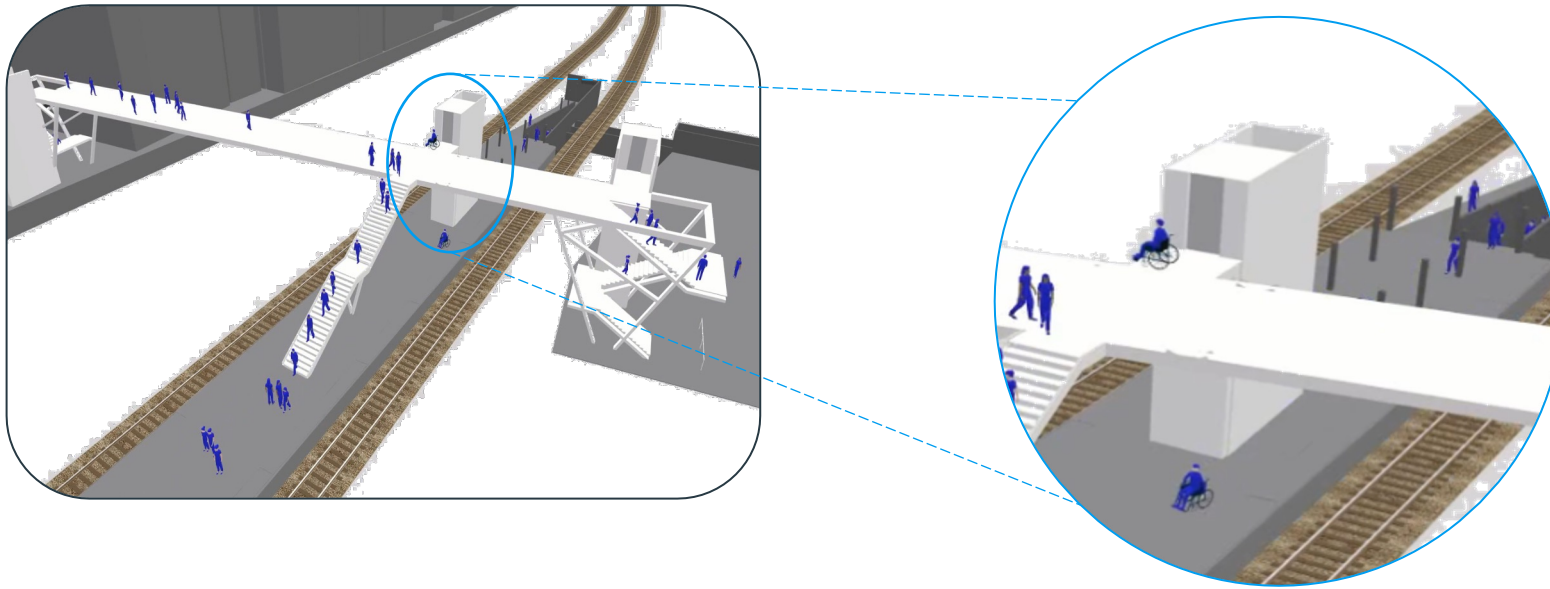
Optimising Infrastructure

- Pedestrian simulations allow designers to optimise infrastructure that can determine the ideal sizing and placement of these elements to ensure smooth and safe pedestrian flow



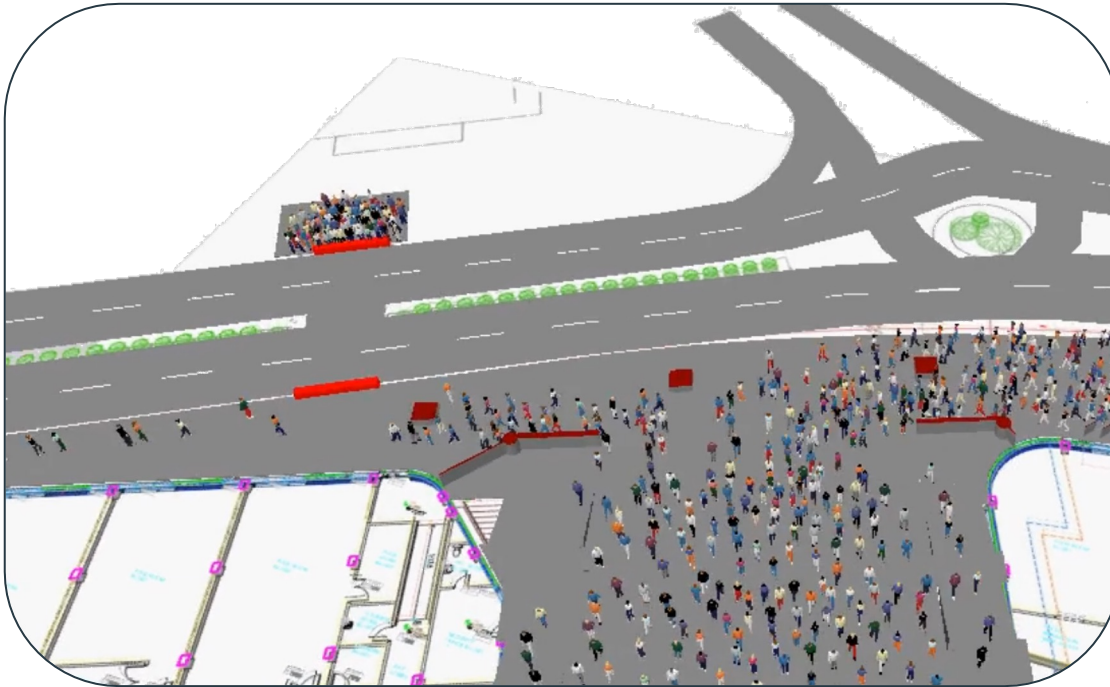
Accessibility

- Active mobility design should prioritise accessibility for all individuals i.e., all types of diversity
- Simulations can assist in evaluating the accessibility of walkways, ramps and other pedestrian facilities to ensure they meet regulatory standards



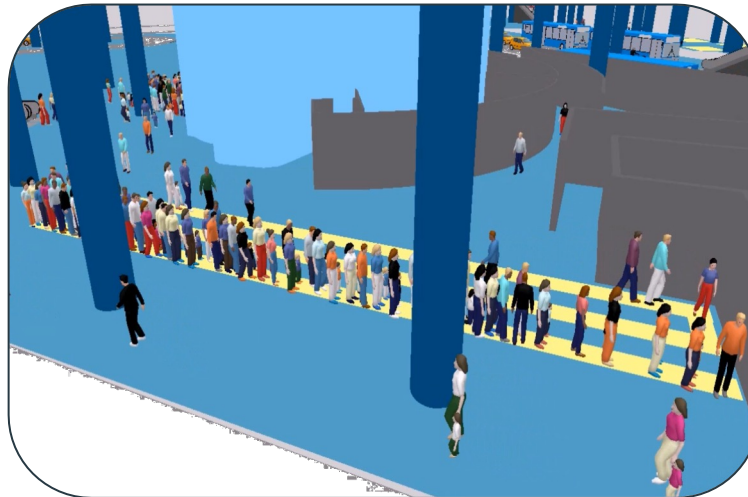
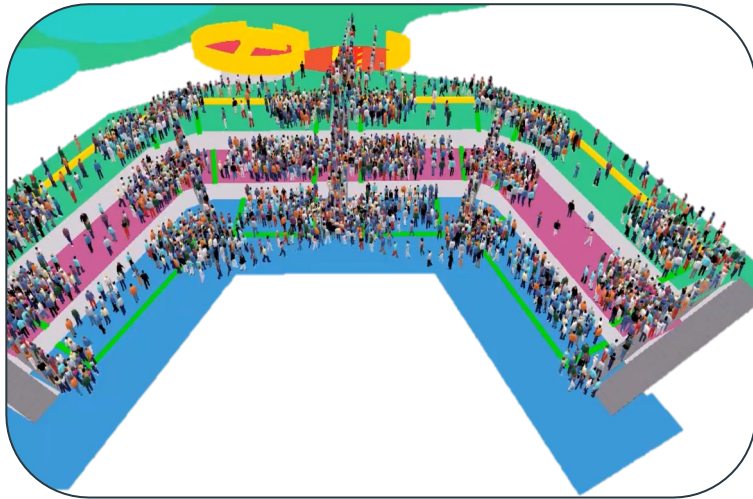
Safety Assessments

- Designers can use simulations to assess the safety of pedestrian zones.
- This includes identifying potential conflicts points in design and help to determine and analyse the impact of mitigation measures.



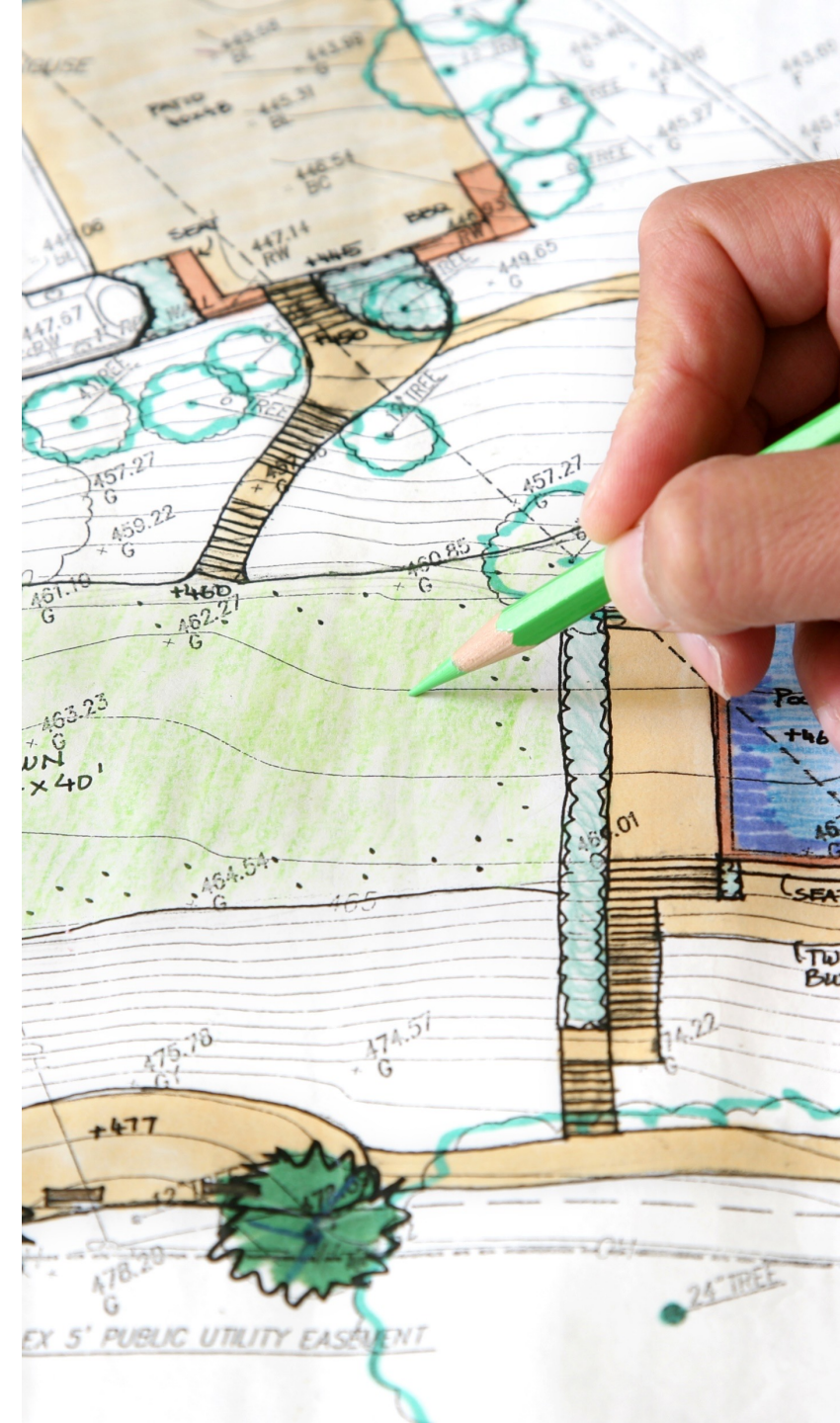
Event Planning

- For special events or gatherings, simulations can help predict pedestrian behaviour and guide event planners in optimising pedestrian flow, ensuring crowd safety, and crowd management.



Urban Planning

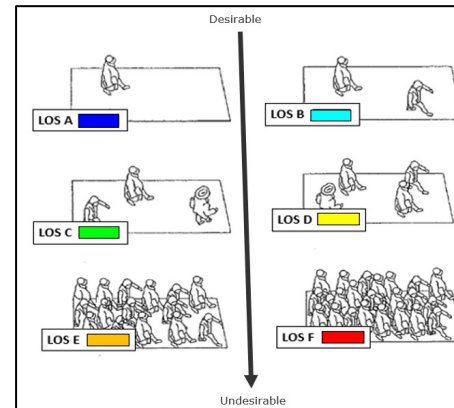
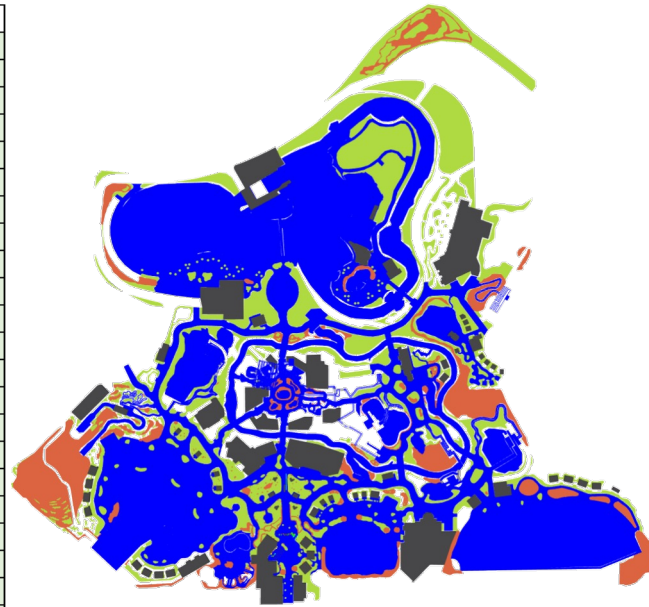
- In urban planning, pedestrian simulations can be integrated into broader city planning efforts to evaluate the effectiveness of proposed innovative, sustainable solutions and optimise designs for pedestrian safety and convenience.



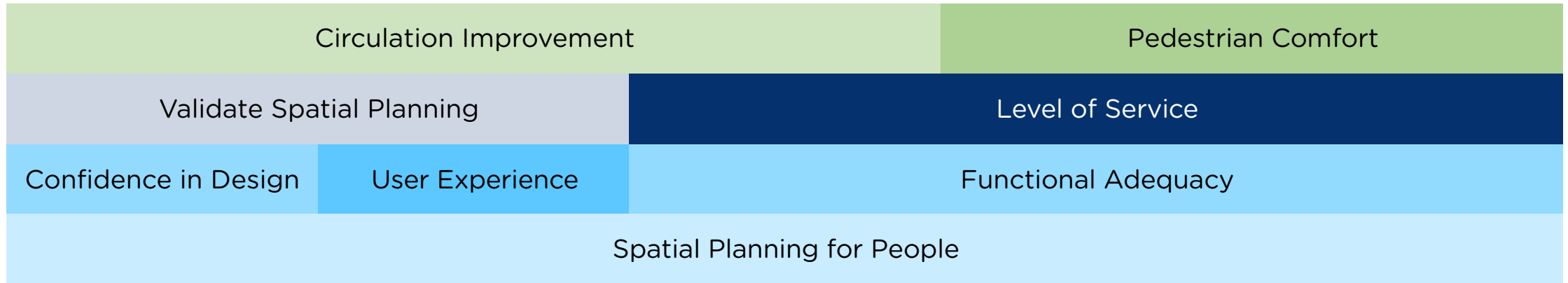
Data-Driven Decision Making

- By using data from pedestrian simulations, planners can help authorities make informed decisions about infrastructure improvements, traffic management, and urban design to enhance active mobility options.

Area	Throughput (Ped/h)	Area	Throughput (Ped/h)
67	665	9	358
30	654	8	356
64	651	71	355
65	650	47	326
62	638	70	320
55	637	66	279
69	617	11	287
57	613	1	253
56	612	2	253
42	600	23	170
33	590	60	170
19	580	58	169
24	577	59	169
50	571	21	167
35	569	15	115
37	569	25	84
45	557	6	82
29	523	31	75
36	521	7	51
38	521	17	51
32	497	43	31
34	496	63	12
16	416	48	10
61	407	22	0
52	374	68	0



Benefits of People Movement Simulation



Pedestrian Modelling for Turku Ferry Terminal, Finland

The City are planning to expand the existing ferry terminal to better optimise the process of boarding and alighting the ferries. Currently, only one ferry is allowed to berth at any one point of time. Ramboll was engaged to evaluate architectural competition bids to redesign the terminal, ultimately helping to select the winning design.

Ramboll developed simulation and assessed the arrival and departure periods of the ferry terminal to determine the highest possible level of crowding during typical conditions. The boarding situation was optimized to keep it well within the estimated time of 15 minutes and ease the alighting process with best connectivity to ramps and elevators.



Areas Studied for Optimisation:

- Escalators and staircases
- Queueing



Impact of Study:

- Provided critical design inputs to ferry terminal facility and passenger transfer connectivity

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Pedestrian Modelling for Ed Sheeran Concert in Helsinki, Finland

The study is for allowing 100,000 spectators to visit the 2-day Ed Sheeran concert in Helsinki Finland. The concert was held in Malmi airport area located in North-Eastern Helsinki.

Traffic forecasts of the concert traffic as well as micro-simulation studies including both pedestrian and vehicular traffic of the surrounding streets. In addition, we advised the client with general planning of traffic and parking arrangements.

The record-breaking concerts were carried out without major issues, minimizing the negative impacts for the surrounding traffic and transport network. The client and the city received vital information for arranging the future events



Areas Studied for Optimisation:

- Multi-modal
- Crowding
- Choke Points



Impact of Study:

- Minimised the negative impacts for surrounding traffic and transport network

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Mandai Bird Paradise and Transport Hub Pedestrian Simulation, Singapore

Ramboll used detailed simulation tools to validate the design of the Singapore Bird Park Amphitheatre that can cater for more than 2,000 spectators.

Ramboll has also studied the arrival and departure transport hub consisting of attraction and commercial space across two levels. The hub accommodates 10,000 visitors arriving and departing hourly.

The pedestrian modelling resulted in a multi-modal and environment-sensitive transport solution to cater for the demand as a world-class cluster of nature-themed attractions, as well as the wildlife and nature heritage precinct in Singapore.



Areas Studied for Optimisation:

- Queueing space
- Walkways
- Security enclosure space



Impact of Study:

- Cost saving in space optimisation
- Sufficient width for visitor circulation

An aerial simulation map of Mandai Bird Paradise and Transport Hub in Singapore. The map shows various colored zones: green for open areas, pink for paths, yellow for queues, and blue for water features. Numerous small black dots represent pedestrian density, with high concentrations in the central and lower-middle areas. A road with cars is visible at the top left, and a road with bus lanes is at the bottom left. A traffic light icon is in the top right corner.

Mandai Bird Paradise and Transport Hub Pedestrian Simulation, Singapore



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- Sufficient width for visitor circulation

Pedestrian Movement Study for Large Gathering, Central Asia

Ramboll estimated arrival rates using known transport facilities to the mosque. Build a peak arrival profile of worshippers entering the mosque. Conduct pedestrian modelling of each of the processes addressed in the mosque's design, such as ablutions, cloak storage, internal circulation, etc., with the goal of validating the design.

The pedestrian modelling revealed several opportunities to optimize and improve pedestrian circulation. The end design increased toilets, cloak room facilities, and ablutions areas, and several operational procedures were recommended to improve flow.



Areas Studied for Optimisation:

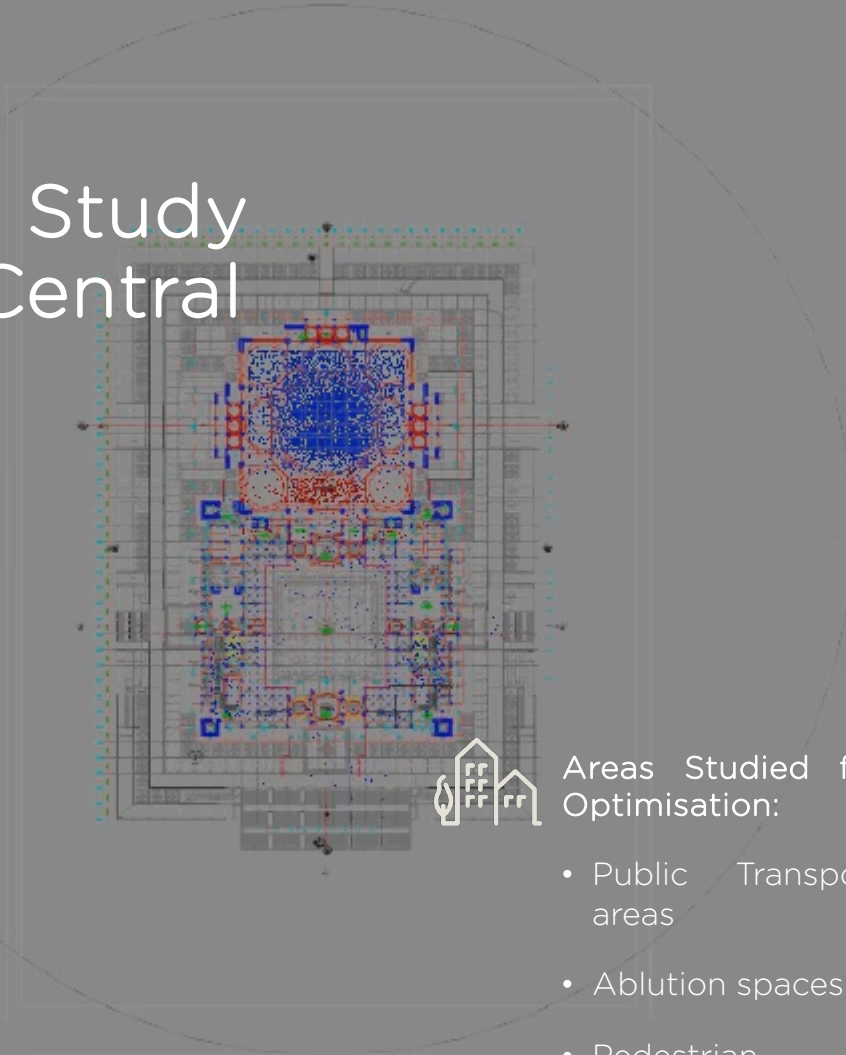
- Public Transport areas
- Ablution spaces
- Pedestrian crossings



Impact of Study:

- Validated the spatial planning for large gatherings of 30,000 worshippers

Pedestrian Movement Study for Large Gathering, Central Asia



Areas Studied for Optimisation:

- Public Transport areas
- Ablution spaces
- Pedestrian crossings



Impact of Study:

- Validated the spatial planning for large gatherings of 30,000 worshippers

Water Theme Park and Amphitheatre Pedestrian Modelling, Middle East

Ramboll have conducted a study on a large water park in the Middle East. The water park consists of an amphitheatre, 26 rides and attractions, F&B outlet and retail spaces. Various crowd simulation models and scenarios were carried out to understand the crowd situation during the scenarios and how to effectively manage it during the peak hour on a peak day.

Based on the crowd model, the waterpark is adequately designed in term of circulation space, queuing space and gantry provision to cope with the projected water park demand even during the arrival and departure peaks.



Areas Studied for Optimisation:

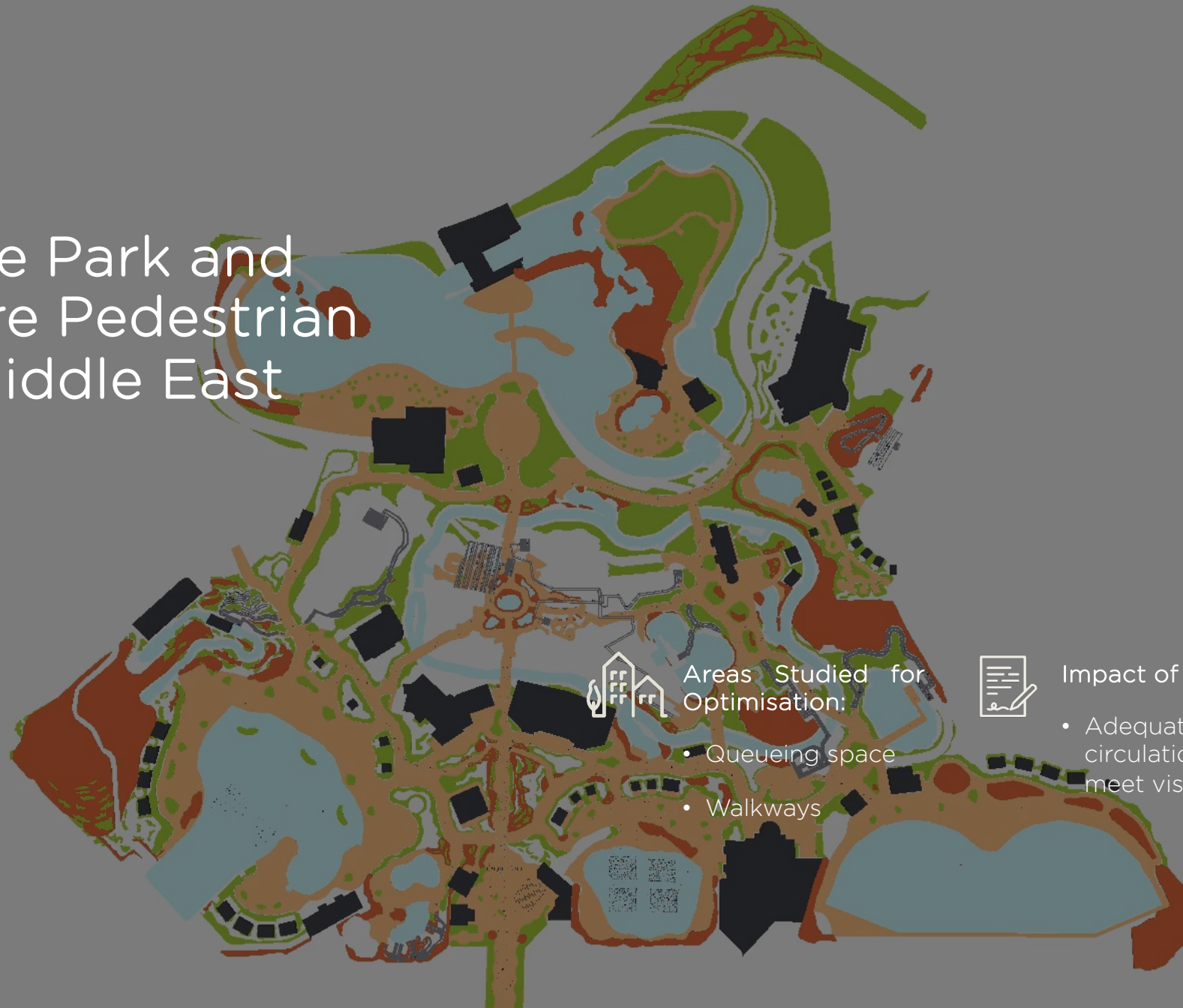
- Queueing space
- Walkways



Impact of Study:

- Adequately designed circulation space to meet visitor projections

Water Theme Park and Amphitheatre Pedestrian Modelling, Middle East



Singapore National Gallery and Concert Stadium Pedestrian Modelling

Ramboll evaluated a peak arrival profile of spectators entering the stadium. Conducted pedestrian modelling of the processes addressed in the design, such as baggage screening, body screening, internal circulation, etc., with the goal of validating the design.

The pedestrian modelling revealed several opportunities to optimize and improve pedestrian circulation. The end design resulted in an architectural layout that can cater for 30,000 spectators with adequate numbers of security scanners on site. With screening of all spectators within the facility enabled, it has resulted in a shorter travel journey to the seating areas as compared to the previous facility that required screening off-site.



Areas Studied for Optimisation:

- Escalators and staircases
- Walkways
- Screening facilities



Impact of Study:

- Spectators to be provided with sufficient space and facilities

Johor Bahru – Singapore Rapid Transit System Link

Ramboll Smart Mobility conducted pedestrian modelling services for the new Singapore-Johor Bahru Rapid Transit System (RTS) termini in Woodlands, Singapore and Johor Bahru, Malaysia. The objective of the pedestrian modelling was to optimize the architectural design of the termini by validating and fine tuning the pedestrian spaces while enhancing user friendliness.

Ramboll helped to achieve a more efficient RTS termini that accomplishes the target throughput of 10,000 passenger per hour per direction (total 20,000 passengers per hour) while meeting the service pledge of a 30-minute journey from drop-off kerb side to train.



Areas Studied for Optimisation:

- Escalators and staircases
- Walkways
- Screening facilities



Impact of Study:

- On-time departure of transit links

Bright
ideas.
Sustainable
change.

RAMBOLL



People Flow at Building scale

Tomi Sipilä, Offering Manager, KONE Corporation

4 OCTOBER 2024

Dedicated to
People Flow™