Transport Capacity Modelling

Frazer-Nash Consultancy

We are a leading systems and engineering consultancy. We are renowned for our work in the transport, defence and energy sectors. We have extensive experience modelling complex systems in the presence of high levels of uncertainty. Our tried and tested systems approach leads to high impact solutions that deliver value to our clients.

The Problem

As the COVID-19 lockdown eases, and more people start to travel, there will be an impact on London Underground passenger throughput as a result of social distancing and the need to maintain surface hygiene. Both are vital to ensure the safety of the general public and public transport workers. Mainline trains and buses will also be affected.

Therefore, the question we will aim to solve is, how do we maximise the throughput of the London Underground during the COVID-19 pandemic to enable as many people as possible to return to work safely?

Technological Solution

We will develop a flow network model of the London Underground containing all lines and stations with configurable capacities and maximum flow rates in, out, through and between stations. Then, using an existing flow network solver, we will solve for the maximum flow through the network, using machine learning methods to tune parameters of the model until the flows match the pre-COVID-19 passenger throughputs. This will provide us with a baseline with which to compare new operating scenarios.

Operating during the pandemic will involve implementing a number of measures within stations and carriages, for example: one way systems, social distancing, limited carriage capacities, reduced station entrances and exits, revised timetables etc. The effect of each of these measures on passenger flow isn't currently fully understood. We will use modelling software that simulates the movement of individuals through a station (including concourse areas, ticket barriers, elevators, corridors and platforms) taking into account human behaviour in order to determine the effect on passenger throughput of each of the measures.

We will then use the results of this simulation to factor the maximum flow rates for the baseline flow network model and calculate the new maximum flow rate through the system. By comparing this to the baseline results we will be able to identify pinch points in the system. We will then be able to run what-if scenarios to find implementable solutions that increase passenger throughput within acceptable social distancing and hygiene guidance. The results will be presented visually to enable all stakeholders to understand quickly the effects of the operating restrictions on passenger flow and to identify problem areas in the network.

Our solution tackles an immediate London Underground challenge, but the approach could be applied to other public transport systems (e.g. buses or mainline trains) and is applicable in the longer term for other, non COVID-19 related, scenarios (e.g. station layout design, large-scale event transport planning).

Timescales

We propose to deliver the initial phase of our solution in 'sprints' using an agile approach. We expect our tool to start providing meaningful insights by the end of the first month and then provide increased granularity month on month. Ultimately, as the forecasting becomes more widely used and trusted, it could be integrated as part of a dynamic train scheduling approach in future phases.

Relevant Work

We have a strong pedigree in modelling structures and flows in complex systems. We are involved in optimising last-mile logistics in the presence of threats for the military. We have recently modelled assembly and maintenance logistics for a train company in the context of the COVID-19 pandemic.

Contact Information

Dr Peter van Manen – p.vanmanen@fnc.co.uk – 07880 706550

Find out more
To find out more about our work and how we can add value to your business visit our website.

FRAZER-NASH CONSULTANCY