

# SYSTRA Optimizes People Movement in a Railway Station Expansion

LEGION<sup>®</sup> Software Helps the Design Team Eliminate Unnecessary Space in Gare du Nord to Lower Energy Costs

## UPDATING EUROPE'S OLDEST RAIL STATION

The Gare du Nord railway station in Paris is the oldest in Europe. Though Gare du Nord is relatively compact, it has become the busiest station on the continent, with an annual service volume of 200 million passengers. That volume is expected to grow to nearly 300 million in 2030. Additionally, Paris will host the 2023 Rugby World Cup and the 2024 Summer Olympic Games, bringing thousands of spectators to the city. That influx of visitors for the two events is the immediate concern, and rail operator Société Nationale des Chemins de fer Français (SNCF) sought to renovate and expand Gare du Nord to comfortably accommodate the anticipated increase in passengers.

The EUR 600 million renovation project, dubbed "Stationord," does not only aim to expand the station's size from 35,000 square meters to 124,000 square meters. Developers also want to transform the station into the heart of an urban hub, catalyzing the revitalization and development of the surrounding neighborhood. In addition to improving capacity and safety, the project seeks to encourage connectivity with nearby businesses, as well as facilitate access to transportation options that emit lower amounts of pollution than older vehicles. To meet their ambitious goals, SNCF retained SYSTRA, an engineering and consulting group that specializes in mobility solutions and ecological transitions.

## MOVING PASSENGERS THROUGH COMPLEX STATION WORKS

SYSTRA wanted to create dynamic simulations of pedestrian movement throughout the updated Gare du Nord. These simulations will help the project's architectural and construction contributors optimize their designs to eliminate potential bottlenecks and ensure an unimpeded flow

of passengers. SYSTRA and these contributors would need to work closely together to finalize the exact placement and dimensions of all elements of the complex project, including the passenger hall, exchanges hall, ticketing areas, and bridge access.

SYSTRA's work to improve passenger flow had to account for numerous systems and additions at the station, including quickly clearing platforms of passengers, separating pedestrian flow between boarding and departing passengers, and developing new departure terminals. They also had to accommodate passengers with different types of transit needs, including individuals traveling internationally, nationally, and within Paris suburbs, as well as for passengers seeking local connections via buses and the city's metro system. SYSTRA needed a way to dynamically model passenger movements within the complex environment and clearly communicate that data.

## ACCURATELY MODELING THE BEHAVIOR OF ALL PEDESTRIANS

As a longtime user of LEGION, SYSTRA knew that the foot traffic simulation application would allow them to accurately measure the effects of the station's operations and architectural designs on pedestrian flow. They also found that the application could be used to test out the effects of different design proposals on foot traffic. Once complete, they quickly delivered simulation results to the design teams using LEGION's ability to export simulations in easily accessible formats. They also made the simulation results easy for everyone to understand, creating traffic density maps and animated videos in 2D and 3D. SYSTRA and the design teams compared different options, then selected the scenario that combined the best foot traffic flow with close adherence to the project owner's original vision of the expansion.

## PROJECT SUMMARY ORGANIZATION

SYSTRA

## SOLUTION

Pedestrian Movement Simulation

## LOCATION

Paris, France

## PROJECT OBJECTIVES

- ◆ To help design a rail station expansion that optimizes passenger movement.
- ◆ To create a connected hub that encourages neighborhood redevelopment and walkability.

## PROJECT PLAYBOOK

LEGION

## FAST FACTS

- ◆ The EUR 600 million Gare du Nord expansion will more than triple its size from 35,000 square meters to 124,000 square meters.
- ◆ Developers want the renovated station to encourage connectivity with nearby businesses and improve access to sustainable transportation options.
- ◆ SYSTRA used LEGION to create people movement simulations and determine how the design could accommodate growing numbers of passengers.

## ROI

- ◆ The passenger simulation informed the station's final configuration, ensuring smooth operations during peak volume.
- ◆ Simulations in LEGION enabled the team to eliminate unnecessary spaces in the station, allowing operators to lower energy costs.
- ◆ The design will encourage passengers to shop at station stores and choose transportation options that are more friendly to the environment.

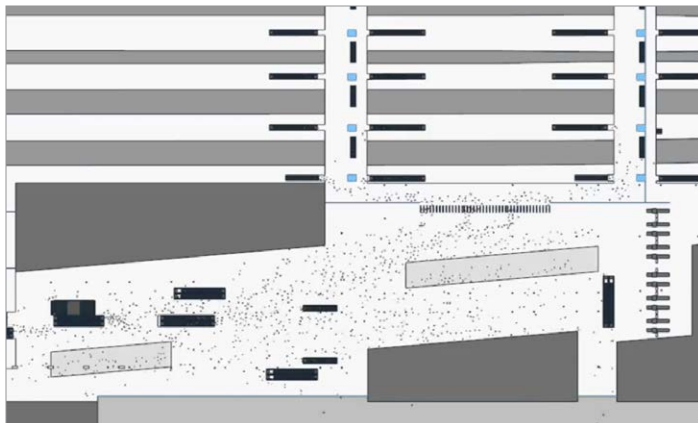
“This tool, which we know well after hundreds of projects realized with this software, is the ideal solution for this sizing study at the Gare du Nord. Highly visual, LEGION makes it easy to validate and adjust, if necessary, the design and relevance of the redevelopment project.”

– *Gonzalo Tavares, Mobility and Pedestrian Flow Analyst, SYSTRA*

Within the preferred scenario, SYSTRA next ran more complex simulations and measured the levels of congestion, comfort, and use of space within the halls and shops. They used LEGION to model how different types of pedestrians would move under various conditions, including regular commuters, tourists who are unfamiliar with Gare du Nord, and passengers with special mobility requirements. They also adapted the application to model unusual moving elements, such as the refueling trolley, as they wanted to fully account for all potential obstacles to passenger flow. Lastly, the design teams further optimized their plans using the results of SYSTRA's in-depth simulations.

### PROVIDING SAFETY AND COMFORT DURING PEAK OPERATIONS

By the end of the planning process, SYSTRA ensured that the Gare du Nord expansion design stayed close to the project owner's original vision while prioritizing pedestrian safety and comfort, even during peak use. Their pedestrian simulations will improve operations at the expanded station, as designers used them to optimize the use of facilities and open spaces.



*SYSTRA used LEGION to create people movement simulations and determine how the design could accommodate growing numbers of passengers.*

SYSTRA prevented spaces from being too small to handle crowds, eliminating the expense of reworking them after completing renovations. Conversely, removing unnecessary or underused spaces in the station will help station operators to lower energy consumption costs and pollution caused by electrical generation. The design also helps passengers easily choose transportation options that are more friendly to the environment. Establishing the station as a walkable, connected crossroads will not only encourage neighborhood development, but it will also reduce the need for individual vehicle use.

By optimizing passenger movement during the building's design and configuration phases, the project team anticipates that the new Gare du Nord will accommodate growing pedestrian traffic for several decades. Future-proofing the station will prevent the project owner from undertaking expensive changes in station design sooner than anticipated. Additionally, making shops as attractive and accessible as possible is expected to increase their revenue.



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