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How to design the train stations of tomorrow

What does your local station mean to you? For some, it represents opportunity: the chance to go anywhere. Others might actively dislike the noise, the crowds, the aesthetic... Or perhaps you never think too deeply about stations. But they definitely affect you, according to Dr. Manuela Triggianese. “At stations, all scales come together: from the building and its elements, to the neighbourhood, the city, region, even country. They are involved in every aspect of urban life.”

Trains have a vital role to play in our future. Manuela: “By providing an alternative to cars, trains help us tackle environmental challenges such as air pollution and climate change.” Her research group works on, among others, train stations: “Essential as transfer hubs between modes of transport, but also as enablers of urban regeneration.” But making the right decisions about stations is incredibly complex. Not only because of the huge number of stakeholders, but also because “stations can be in continuous use for over a century! New technologies have to be incorporated over time.”

Broadly speaking, Manuela’s group advances the Train Stations of Tomorrow by:

1. Promoting and enabling the responsible use of data during (re)design
2. Exploring innovative design tools
3. Develop methods for Activating Design

She elaborates on the third point: “Put very simply, we seek to involve all stakeholders and to include their inputs and needs in the design process. Station design affects users, companies, governments, the environment... We believe in co-creation as a strategy to arrive at a better solution.” Halina, Nils, and Inès are three of the researchers in her group. Each has their own approach to improve the train stations of tomorrow.

Low-carbon stations through smart data use

Like Manuela, Halina finds train stations fascinating because “they blur the line between scales: regional to local, community to person, and city to building.” Her PhD is about improving the integration of data in the sustainable (re)design of stations and their surroundings. She decided to focus on embodied carbon: simply put, the CO₂ emitted while producing construction materials and assembling structures.

[Read the story of Halina.](#)

Designing stations and surroundings for social safety

Inès investigates how the movement of people within and around urban train stations influences their design. She is especially focussed on one common issue: obsolescence. When areas like tunnels or corners fall out of use, they can become unsafe. A vicious cycle develops: from neglect, to abandonment, to antisocial behaviour, to more neglect, eventually affecting the whole area.

[Read the story of Inès.](#)

Stations as organisms, the network as ecosystem

Nils works on two conceptual models for improving train stations. “At my firm, we base our work on a EMC2B approach: energy, material, carbon, climate, and biodiversity. These five themes challenge the potential impact of our construction and inform any design from the start.

[Read the story of Nils.](#)

Carbon emissions, urban heat, or gentrification

What are the challenges to building the Train Stations of Tomorrow? Manuela knows them all too well: “Like every construction project, we will have to use less material, less consumption, and a low-carbon approach... all while keeping stations attractive and vibrant, and adapting them to new technologies such as digitalisation and automated vehicles. Large urban stations often face problems like urban heat, wind tunnel effects, or flooding due to heavy rain. Smaller stations might struggle to ensure social safety, avoid excessive gentrification, or balance their roles as transit hubs and public spaces.”

Future train stations: the ultimate hubs

At the same time, Manuela sees the potential. “Ideally, stations should go beyond mobility and contribute to the social and environmental transition of their city. Like station Delft, a hub for public transport and residential functions; or some French stations building childcare facilities or co-working spaces. Railway yards are now mostly dead zones, but can we redesign them as ecological corridors? Or can stations generate renewable energy and distribute to buildings, buses, cars, and trains?” These are just some of the myriad possibilities for the Train Stations of Tomorrow.

This story is published in September 2024.

More information

This story is published to mark TU Delft’s 2024 [‘Week of Urban Mobility’](#).

Read our [previous story](#) about Manuela.

Read more about Manuela’s work: co-creation project [‘Walk-In’](#) (also including Halina) focussed on small train stations in southern Rotterdam, while the international collaboration [‘Stations of the Future’](#) investigated case studies in both the Randstad and the suburbs of Paris.

The image at the top of this article is made by and owned by Manuela Triggianese.