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## What's in a railway station? Developing a scientific model for sustainable railway stations of the future

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This work addresses the following topic(s) from the Call for Contributions:  
(Please check at least one box)

- Placemaking to integrate urban spaces and mobility
- Promoting sustainable mobility choices in metropolitan regions
- Governing responsible mobility innovations
- Shaping the transition towards mobility justice
- System analysis, design, and evaluation
- other: \_\_\_\_\_

### Extended Abstract

#### Problem statement

Stations hold a unique position in the urban landscape: They not only act as complex nodes of mobility providing points of access to trains and other modes of transportation, but also as public places that can be seen as integral elements of the city (Bertolini 1998). This is the case especially in Europe, where stations are historically highly integrated into the respective urban systems. Stations are part of the social infrastructure of a city, rather than simply part of its mobility infrastructure (Banerjee 2022). Therefore, they affect more stakeholders than just railway companies and travelers: businesses, consumers, other economic actors, communities, citizens – virtually everyone. The size of stations can range from large hubs serving over 1 million passengers per day to small stations serving only one main line with few passengers, but stations of all sizes have a decisive impact on their urban surroundings as places of everyday life (Pucci, 2019). Considering the urgently needed transformation of our urban structures towards more sustainable cities reaching the Sustainable Development Goals (SDGs), the potential of railway stations as key urban elements enabling cities to develop sustainably has so far only been marginally exploited (Spinosa, 2023). To date, there is no uniform approach to describing railway stations in Europe, and classifications range from the documentation of land-use patterns around the stations (Wenner & Thierstein, 2022) to the assessment of bike-train intermodality (Pazzini et al., 2023). This lack of a consistent concept makes it hard for policy makers, railway station operators or civic initiatives to identify potentials for sustainable change in stations and explore the potential of stations as carriers of larger urban transformations.

#### Research objectives

Therefore, the project “*Railway stations for green and socially-inclusive cities (Rail4Cities)*”, which is supported by Europe’s Rail and its members and funded by the European Union, aims at finding a common European-wide definition of railway stations, unifying different approaches to station classification and functions, in order to then derive a model useful for describing current stations as well as a sustainable future for

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them – and the transition pathways toward achieving this vision. Our aim is to describe an approach that is useful to stations of different sizes or urban surroundings, for example, while at the same time enabling sufficient latitude to accommodate specific local conditions or prevailing opportunities, thus guaranteeing opportunities to scale up the model to applicability across the EU.

### **pMethodological approach**

To develop a model for current and future European train stations, we first conducted a review of the scientific literature available on station classification methods within the European context. We screened 496 publications (title & abstract) and identified relevant ones to further investigate ( $N = 13$ ). More sources were retrieved through snowballing, resulting in a total of 25 eligible publications. Through this study of classification approaches and their criteria, we extracted relevant KPIs for the station model. The chosen KPIs were then grouped into thematic categories based on the UN SDGs and the Urban Agenda for the EU (Pact of Amsterdam).

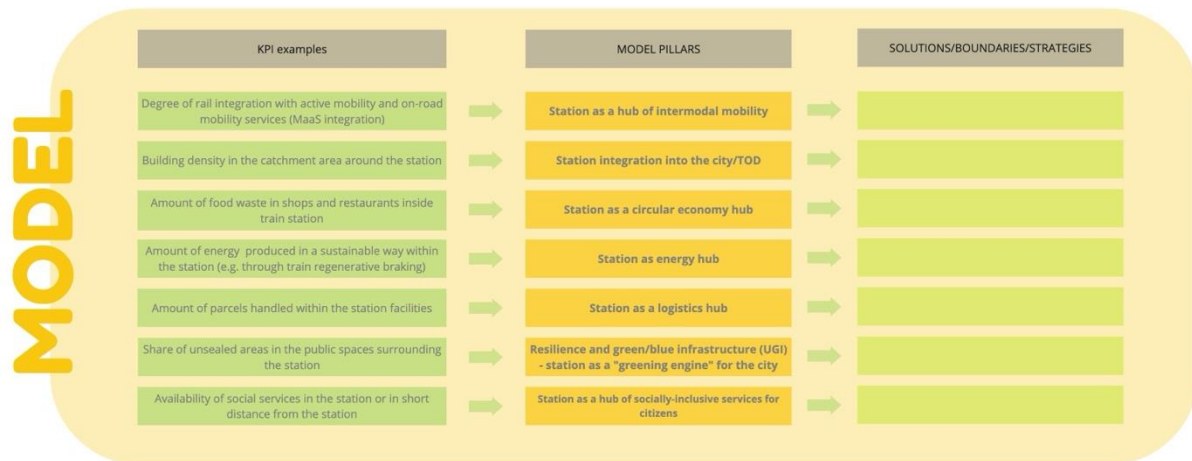
Complementing this process, we conducted a series of expert workshops, activating the members of the *Rail4Cities* consortium and members from the projects' international advisory board (IAB). Three initial workshops were carried out based on the Cambridge value creation model (Bocken et al., 2013). The invited experts were divided according to their field of expertise and current activities (railway industry, urban governance, academic background) and were asked to analytically discuss the current situation of railway stations within the framework of various relevant topics such as intermodal mobility at the stations, the stations' spaces and services and the potentials of transit-oriented development, for example. By combining these contributions with the already developed KPIs, we were able to define the pillars of a first draft of the station model. The second series of workshops, which will take place in November 2022, will test a methodology for co-creating strategies aimed at implementing the goals mentioned in the model pillars by bringing different stakeholders together. These stakeholders will be represented by members of the IAB and the project consortium. Each workshop group will focus on a specific model pillar to develop strategies and explore possible boundaries that could prevent their realization in the future, thus actively testing a hands-on method for using the model to foster sustainable change in stations. The combination of all the mentioned elements including KPIs developed based on the literature review and the workshops, the jointly developed transformation strategies and boundaries, divided according to thematic pillars, constitutes the initial model for the station of the future.

### **(Expected) results**

The results of the literature review show that there are various methods for classifying railway stations with different goals. Furthermore, similar methods are often applied to different sample scales (e.g., all 1,684 Swiss stations, Reusser et al., 2008, or only 6 stations in a specific area, namely the Campania Region in Italy, Nigro et al., 2019) and railway types (e.g., suburban railway, high-speed rail). Most studies use quantitative methods like point systems or principal components analysis, thus often making spatial-oriented conclusions on specific contexts and urban scales quite challenging. The data and classification methods usually depend on the goals of the study, which in the case of the railway industry are usually oriented on the topic of transport, whereas the academic domain usually includes data of the surrounding area and context. Accordingly, we integrated these different approaches to station classification in the KPIs that were developed. They therefore include various factors which do not only concentrate on the station itself, but also on the stations' impact to the urban transformation and citizen life, for example KPIs on the amount and diversity of available jobs and services in short distance around the station, the degree of rail integration with active mobility and on-road mobility services or the extent of public spaces provided around stations.

In the workshops, we were able to identify current challenges, chances and risks, as well as different interests of the stakeholders involved in the transformation of railway stations and their urban surroundings. An initial suggestion for our model entails seven pillars which can be seen in Figure 1 and which describe the diversity of roles railway stations will have to assume in the near future. The first draft of our model, once finished, will then be iteratively tested and adjusted with data from five living labs and three case studies across Europe over the next two years within the framework of the RAIL4CITIES-project, ultimately leading to a revised, tested model for railway stations of the future.

Note: At the time of abstract submission, research is still ongoing. The results mentioned in this abstract on the first model draft will be available at the time of the conference.



**Figure 1:** Model development process and pillars

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