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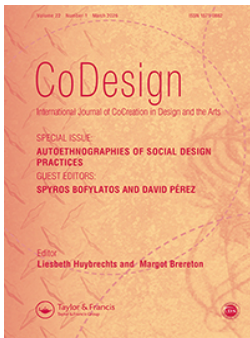
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# Thick mapping mobility: a design-driven research for the architecture of interchanges

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## ABSTRACT

This paper examines thick mapping as a design-driven research method applied in the educational setting of an international architectural design workshop. The workshop brings together 45 students at different levels and fields of education, academics, and practitioners in a collaborative exercise to co-create new knowledge about mobility at railway stations. Participants reinterpret stations as architectures of interchanges through three thematic lenses of investigation: articulation (flows), light & safety (perception), and interfaces (interaction with users). By combining mixed-media drawings with thick mapping practices, the workshop explores the visible and invisible relationships between mobility infrastructure, architectural space, and human perceptions in stations. The contribution of this paper is threefold: 1- to demonstrate how thick mapping can reveal new spatial narratives, creative potentials, and constraints that define mobility architecture and its experience; 2- to illustrate how it provides a deeper understanding of stations by visualising interactions between multiple scales, systems, modalities, agents, and flows; 3- to show how it supports co-design across different disciplines. Thick mapping thus emerges as a critical collaborative method of production linking research, learning, and design in addressing the complexities of mobility architecture.

## ARTICLE HISTORY

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## KEYWORDS

Thick mapping; railway stations; mobility experience; co-design; design-driven research

## 1. Introduction

Contemporary living, labour, and leisure patterns at stake in our society demand a high degree of movement and interconnectivity (Colleoni 2019), intensifying infrastructural interventions in our cities to enable the spatial exchange of people, goods, and information (Larkin 2013). Infrastructures are not only technical systems that facilitate the exploitation and distribution of resources, but they also actively reshape conditions, opportunities, and constraints of modern life (Edwards 2002). Today, this endless growth of infrastructural networks pushes the human footprint, requiring an urgent need for reimagining the architecture of infrastructures (defined in this paper as ‘interchanges’) with recent

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environmental challenges, social shifts, new data, and information technologies. Mobility hubs play a pivotal role in this transformation, where the infrastructure spatialises as an architectural realm mediating multiple flows, systems, interchanges, and experiences (Jensen 2009). In this sense, mobility hubs, in the form of railway stations or airports and their local interconnections (such as metro/bus stops, bike/car parking), are no longer considered just functional transit nodes (Bertolini 2006); but architectures of interchanges with new roles that organise the dialogue, exchange, and interaction between different agents, systems, and the environment (Eckart and Vöckler 2022; Vöckler et al. 2023). The design of railway stations, their spatial articulation, as well as the environmental ambiance influence passengers' multisensory experience (Van Hagen 2011; Vos 2015).

Dealing with this complexity requires more than technical knowledge, but new design approaches, research methods, and representation tools that foster participation, integration, and multiplicity (Kling and Roidis 2021; Yaneva 2012). In this context, thick mapping offers a critical collaborative way of working and a design-driven research practice for researchers, students, designers, and practitioners to dive into complex conditions to unveil the hidden mechanisms of architectures (Cuff et al. 2020). It operates as a methodological bridge between theory and spatial investigations for breaking down relations, scales, and layers. Presner, Shepard, and Kawano (2014) explain that 'thick mapping refers to processes of collecting, aggregating, and visualising ever more layers of geographic data'. 'Thickness' claims for stratification: bringing together distinct social, spatial, temporal, perceptual, qualitative, and quantitative information to reveal alternative spatial relationships and narratives (Corner 1999; Presner, Shepard, and Kawano 2014). This multilayered media embodies both place and community, humans and nonhumans, and does not intrinsically prioritise one over the other in addressing socio-environmental challenges.

Thick mapping allows multiple interpretations for creating alternative associations with 'external reality' (Presner, Shepard, and Kawano 2014). 'Mapping' as a verb becomes an operational 'process' that transcends the view of a singular objectivity, instead embracing the ongoing process of multiple voices and realities (Presner, Shepard, and Kawano 2014). Corner (1999), in reference to Deleuze and Guattari, explains the agency of mapping beyond simply tracing what is already known to reveal latent potentials, hidden contradictions, and new possibilities for reconfiguring architectural and planning projects. Crampton and Krygier (2006) emphasise that mapping is not a passive, neutral way of representing reality, but a powerful mediator in constructing it, aligning with Evans' (1997) arguments underlining drawings' autonomy and power for reshaping the built environment. Ultimately, thick mapping embeds multifaceted definitions: as a critical thinking approach to understand the hidden stories of the built environment, as a method to facilitate visual analysis and exploration for uncovering these hidden stories, as a continuous process of design, collaboration, and investigation, providing an essential pedagogical framework for researchers and students in higher design education.

Yaneva (2012) highlights 'Mapping Controversies' - although not directly mentioned as 'thick mapping' - as a significant teaching and design methodology within architectural research to explore diverse actors, networks, political, social, and economic factors, and controversies around the projects in contested spaces. Recently, practitioners, institutions, and researchers across different disciplines have embraced thick mapping in multiple fields for critical analysis, investigation, and future projections. *Urban Humanities Initiative* (UHI) and *cityLAB* at the

University of California, Los Angeles (UCLA) utilise thick mapping as a learning, spatial analysis, and design practice in workshops (Cuff et al. 2020). They explore urban and territorial scales to conduct spatial ethnographic investigations of border types and conditions of the neighbourhoods (Urban Humanities Initiative 2017), spatial justice through sensory conditions in urban parks (Urban Humanities Initiative 2019), selected social/cultural spatial moments (Urban Humanities Initiative 2020), and power and resistance embedded in urban physical infrastructure of mobility around the neighbourhood (Urban Humanities Initiative 2023). In Turkey, a research-based design studio at METU highlights the creative potential of representing the thickness of the urban context in design projects for the coastal town of Bodrum (Savaş et al. 2022). In Belgium, Furlan (2019) investigates the historical transformation of the post-industrial landscape of the wastelands of Charleroi through a thick mapping approach. The Chair of Sustainable Urbanism at the Technical University of Munich, School of Engineering and Design, utilises thick mapping in their seminar *Thick Mapping: Extending the Mapping Tools in Architecture and Urbanism* as a multifaceted analytical and design tool to map 'social, material, and temporal dimensions of space' for urban design projects (Kling 2023).

Despite the increasing interest and literature of co-mapping exercises on territories, landscapes, and urban analysis, there is little attention has been given to thick mapping at the 'building' scale in architectural education, specifically in the case of mobility hubs. This paper addresses this gap by situating thick mapping as a design-driven research method for exploring mobility design through the lenses of the architecture of interchanges (railway stations). Thick mapping was implemented in a one-week international design workshop, enabling an opportunity for hands-on exercises, embodied observation and quantitative and qualitative exploration on site for its participants through visualisation experiments. Through the workshop, this paper focuses on the main research question of how thick mapping functions in a pedagogical environment for an interdisciplinary group of students to understand, evaluate, and co-design the social/spatial/technological complexities of station architecture.

The workshop *Reimagining Architecture of Interchanges* explored how intermodal hubs in the form of railway stations are evolving under new mobility challenges, needs, and technologies. It aimed to investigate stations as an active environment with dynamic flows of people, vehicles, and information interlacing to accommodate varying needs, activities, and programmes. The goal was to look beyond the physical arrangement of stations and visualise the invisible relationships between mobility infrastructure, architectural space, and human interactions that define the mobility experience, for unveiling new narratives about these hubs. Based on Davis (2020) and Davis and Chouinard (2016) *mechanisms of affordance* framework, the workshop aimed to extend the question from 'what artifacts afford' to 'how artifacts afford, for whom, and under what circumstances'.

The paper is structured into five sections. Following this introduction, the second section introduces the context, the setup of the international workshop, and the method of thick mapping. The results section presents the workshop's main findings, which are then further examined in the discussion section, to reflect on how thick mapping facilitates collaboration and co-working within the interdisciplinary workshop.

## 2. Materials and methods

The study adopts the workshop as a methodological framework to examine thick mapping in didactic practice. The workshop served as a collaborative research and design studio, providing a structured yet flexible setting for participants to investigate the complexities inherent in the architecture of intermodal railway stations. Thick mapping is therefore applied not only as an analytical representation, but also as a ‘co-design’ process and a ‘design-driven research method’ for critical investigation and communication within interdisciplinary teams throughout the workshop. The definitions are described in the following sections.

### 2.1. Workshop setup and focus

The workshop is organised in collaboration between scholars from two universities for 7 days in March 2025. It brought 40 international students from different European universities at different levels, including bachelor’s, master’s, and PhD. The participants’ interdisciplinary background is almost equally divided into three disciplinary fields, Architecture, Engineering, Urban Studies and Planning, generating an interdisciplinary learning environment.

The programme included lectures, guided site visits with local partners/stakeholders, fieldwork, on-site mappings, collaborative working sessions, visualisation, and mapping activities, pin-ups, and lectures to introduce theoretical concepts such as system thinking, innovative mobility technologies, affordance theory, human-building interaction, and practitioners’ insights about railway stations and mobility challenges in the context of the Netherlands. It concluded with a final presentation with a public exhibition.

The workshop started with the following overarching question:

*How are mobility hubs reshaped as an interactive **system of infrastructures mediating between multiple scales, modalities, and flows?***

This central question is articulated into three sub-questions that clarify the workshop’s position and aims:

- (i) How does the articulation of the spaces of the mobility hub facilitate the multi-modal transition between the urban and architectural environment?
- (ii) How do light, time, and temporality influence the mobility experience and sense of safety during the day and night?
- (iii) To what extent are stations responsive/interactive, and in which ways do their interfaces facilitate spatial interactions that affect movement, perception, and experience?

To address these questions, the workshop was split into three thematic lenses of investigation:

- (i) **Articulation & Flow** of the hub, concerning the urban and architectural spaces that host intermodal flows (circulation patterns, barriers, stairs, rooms, gates, physical obstacles, transitions, bottlenecks).

- (ii) **Light & Safety**, addressing both the configuration and utilisation of the lighting systems and the perception of safety that stems from it across day and night.
- (iii) **Interface**, in the form of both digital and physical interfaces of interaction (sensors, installations, screens, multimedia, communications, wayfinding, machines), facilitating information flow through different modalities of interaction (tactile, visual, acoustic, kinaesthetic).

## 2.2. Case studies of the workshop

The workshop themes were investigated in two specific case studies, Delft Central Station (Figure 1(a)) and Delft Campus Station (Figure 1(b)). These two stations were selected as they are the only stations in Delft. They are part of the same railway infrastructure of Delft, providing access to the central and southern districts of the city. Both are recently renovated stations with peculiar design decisions that facilitate smooth interchange within and around the stations. However, they correspond to different urban contexts and architectural configurations of intermodal hubs with different user groups and flows. The choice of these two case studies with the same function but different typology allows for a comprehensive comparison between scales, architectural, urban development, infrastructural integration, and user experiences within these stations through thick mapping.

Delft Central Station is the main railway station and mobility hub of Delft, located near the city centre. Within the ongoing sustainable urban development programme of the city since 2009, the Nieuw Delft Spoorzone redevelopment (Gemeente Delft n.d.), the old railway line has been buried and replaced by a new district, with the construction of a new station next to the former one. The new station, integrating the City Hall, is designed by Mecanoo Architects as a multilayered interchange, organising the seamless flow between trains, trams, buses, bicycles, pedestrians, cars, and boats on multiple levels and directions, having a prominent role in the urban configuration of the city (Houben 2015). It was completed in 2017, serving the overall population of the city, including residents, tourists, visitors, students, and employees. Delft Campus, previously Delft Zuid station, is a secondary, peripheral, relatively smaller-scale station located in South Delft between Delft Central and Schiedam Stations. This station is part of a large mixed-use redevelopment project (Gemeente Delft 2025) that aims to improve the quality of public spaces and urban life in the neighbourhood. With this ambition, the station was recently renovated in



a



b

**Figure 1.** (a) Delft Central Station. Map data ©2025 Google, Landsat / Copernicus. (b) Delft Campus Station. Map data ©2025 Google, Landsat / Copernicus.

2021 with a new design by Benthem Crowel Architects, becoming the first energy-neutral train station in the Netherlands (Crowel 2020). The design of the station converges the platforms and a new innovative solar canopy with the underground bicycle and pedestrian passage that connects the west and east neighbours and provides access to the transversely located platforms. It is inserted in a heterogeneous urban context between the TU Delft Campus, an industrial area, leisure and sports facilities, and residential districts mainly used by the residents in the neighbouring areas, TU Delft students, and employees of the new start-up companies.

Both stations were visited during the second day of the workshop, guided by architects and municipal officers who provided essential information on the stations' design and the surrounding urban developments. During the workshop, students visited stations multiple times to collect data and make observations on-site. All the drawing materials regarding the stations were prepared and provided to participating students for analysing the case studies.

### **2.3. Process and phases**

To perform the workshop activities, the students were divided into two main groups, one for each hub. Each main group was then divided into three subgroups per the workshop's investigation themes (Articulation, Light & Safety, Interfaces). Each subgroup performed a twofold research: i. on the user level, which focused on the user perspective and experience, and ii. on the station level, which investigated the buildings' features. These 12 groups, each consisting of 3 members, are composed to include participants from different disciplines and backgrounds. The workshop activities were organised in three sequential phases: Phase I – Observation and Data Collection focused on understanding the WHAT by performing *analytical readings* of the selected cases to represent the as-is status. Phase II – Critical Analysis & Visualisations, focused on HOW stations afford their operations, in which students performed a *critical reading* of the stations, using creative and analytical tools to represent the relationships and actions that take place in the station and inform its design. In Phase III – Implementation & Visionary Design, students developed *scenarios* for the hub to respond to and to speculate on the *implementation of new mobility challenges*, needs, and technologies at those station locations (e.g. mobility on demand, intelligent vehicles, Urban Air Mobility, Internet of Things). For each phase, a different requirement was set, enabling experimentation with different forms of thick mapping.

### **2.4. Learning objectives**

The learning objectives of the workshop were twofold. The first is to understand stations as relational systems beyond their physical forms, mediating between architecture, urban scales, and different modalities of transportation and user groups. The specific thematic lenses were also designed to provide further insights about how articulation, light and safety, and interfaces influence the morphology of the stations, user experience, movement, and interactions within them. The second learning objective was to develop students' skills in co-creation, critical analysis, and visualisation. By combining quantitative and qualitative methods, the workshop is designed to explore different visualisation methods to understand both spatial constraints and potentials at the stations.

### 3. Workshop results

The workshop provided a great opportunity to reflect on how thick mapping helped students during the working sessions to generate new forms of visual materials, critical analysis, and design approaches for investigating the architecture of mobility hubs. The selected outputs not only present the results from the last phase but also share insights from the critical analysis phase to represent the entire co-design process.

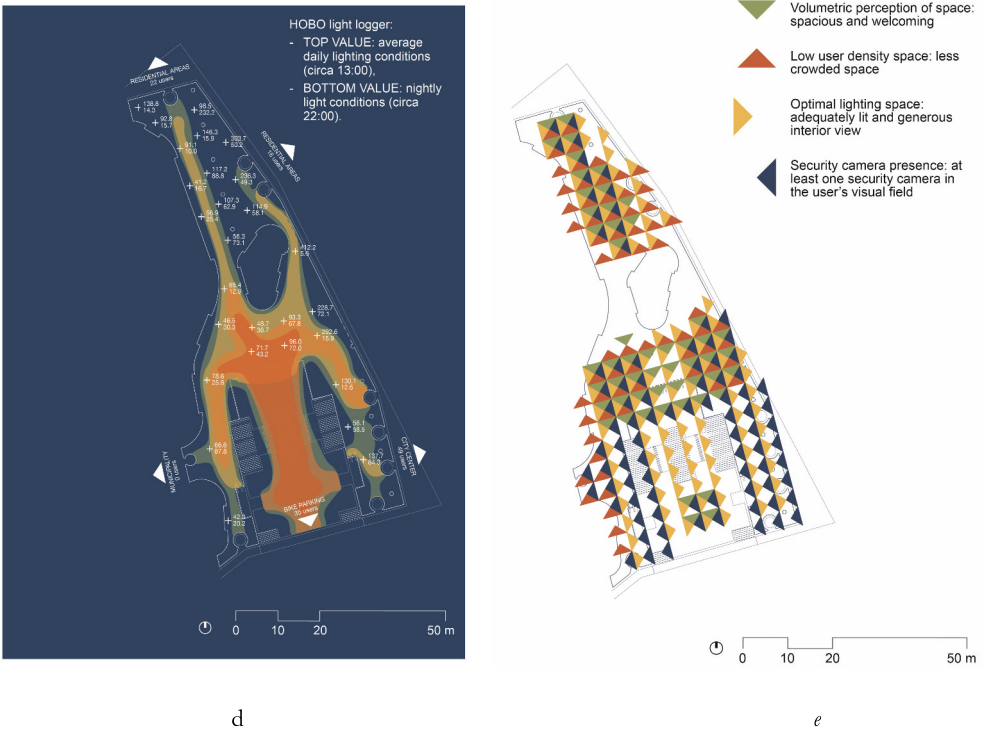
#### 3.1. *Thick mapping as a co-design process*

Throughout the workshop, thick mapping worked as an essential instrument for the co-design process. While it was helpful in investigating the relationship between architectural space and experience, it allowed participants to discuss their ideas through their mapping activity. The openness implicit in the thick mapping method is well-suited to the interdisciplinary background of the students. The critical investigation they performed emerged through different visualisation outputs and served as a reflective learning and co-design process to incorporate different perspectives during the last workshop phase. Although the design phase was limited only to the last day of the workshop, materials produced during the first two phases highlighted peculiar topics through open-ended communication and collaboration that served as a basis for the third-phase visuals. In this way, final co-design outputs were the result of this participatory process of mapping potentials and constraints to inform mobility hubs' future scenarios.

The example shared in [Figure 2](#) exemplifies this multilayered process in the lighting investigation of Delft Central Station. The first hand-drawn annotation shows the architectural layout of lighting fixtures ([Figure 2\(a\)](#)). The second one shows the quantitative data of lighting measurements using lighting sensors ([Figure 2\(b\)](#)). The third image visualises the illumination level as well as security camera placement within the architectural layout ([Figure 2\(c\)](#)). The fourth one translates the manual annotation and quantitative data into a digital format, merging the light analysis with a heatmap of the daily usage pattern of the station ([Figure 2\(d\)](#)). The last one benefits from these insights to formulate a new grid-based, detailed architectural design strategy and intervention plan for improving lighting and safety in the station ([Figure 2\(e\)](#)). The produced maps unlocked multiple layers of information in each phase, enabling a flexible, intuitive method for students to synthesise diverse mapping techniques of manual and digital, soft, and hard data to suggest design solutions. The layering operation (Corner 1999) enriched the co-design process by combining the spatial investigation with participatory discussion and design interventions through thick mapping.

#### 3.2. *Thick mapping as a visual experimentation*

The three phases of the workshop set continuous but varied requirements, encouraging the use of different representation techniques as a form of thick mapping. Participating students benefited from various media, including sketches, drawings, photos, diagrams, physical and digital models, and maps for thickening the spatial information to understand, discuss, and speculate. They interpreted thick mapping in a mixture of different data collection and visualisation methods to investigate relationships between space, technologies and experiences. The transition between analog and digital representation techniques,

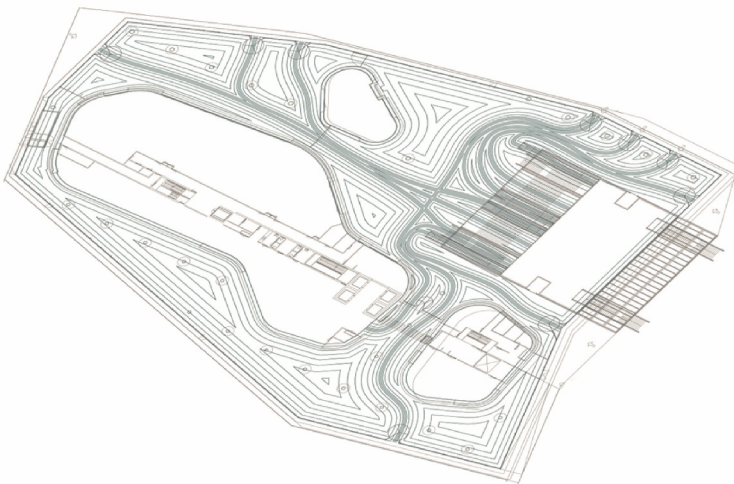


**Figure 2.** (a) Annotation of lighting fixtures. (b) Quantitative lighting measurements in the selected points of the station. (c) Lighting levels, shadow distribution and security camera placement. (d) Superimposition of user heat map and lighting measurements. (e) Proposed design interventions for lighting and safety in the architectural plan. Visualisations by Annika Alfarei, Giorgio Campese, Edip Bera Eren, and Vojtech Haslinger during the workshop. Edited by the authors. Reproduced with permission.

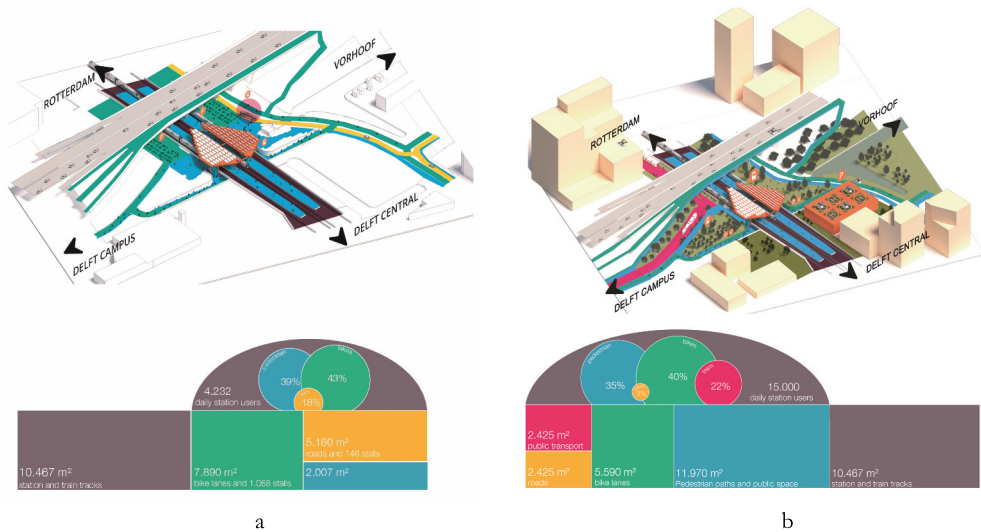
quantitative, and qualitative methods, became a design approach to reveal alternative narratives and information during the different phases of the working process.

The open-ended mapping approach provided an opportunity for participants to explore alternative ways of representing and crossing information within the different groups, which is evident in the group work focusing on Delft Central Station. Instead of a conventional flow analysis - usually conducted with digital simulation software like MassMotion - by tracing the flow paths at different entrances and platforms, students translated these paths into movement patterns within space (Figure 3). The group showed how curvilinear forms and articulation of architectural space transform these dynamic patterns. Their mapping created an understanding of space as a topology of flows, visualising it as a heterogeneous field of movement and stasis. These field representations allowed for the detection of bottlenecks and problematic points for dynamic human movement within the station. In the last phase, the group used this mapping to design potential areas for locating new interfaces, furniture, signs, and additional functions.

On the other hand, the visual explorations were not limited to architectural plan drawings. In the case of the articulation and flow investigation of Delft Campus Station (Figure 4(a,b)), axonometric drawings were chosen as a primary analysis, representation, and design method to visualise both findings stemming from a critical reading of the existing architectural and urban space and envisioning future scenarios. The group visualised three-dimensional relationships of multimodal interchanges between railway, pedestrians, bicycles, and vehicular modes. They coupled these colour-coded spatial analyses with data visualisation of the spatial distribution of different mobility systems to compare existing conditions (Figure 4(a)) with potential design scenarios for integrating new mobility modes (Figure 4(b)) for enhancing interchanges and intermodality.



**Figure 3.** Topological representation of flows within Delft Central Station. Visualisation by Yasemin Zorlubilek, Arif Batın Turan, and Santiago Perez Tena during the workshop. Edited by the authors. Reproduced with permission.

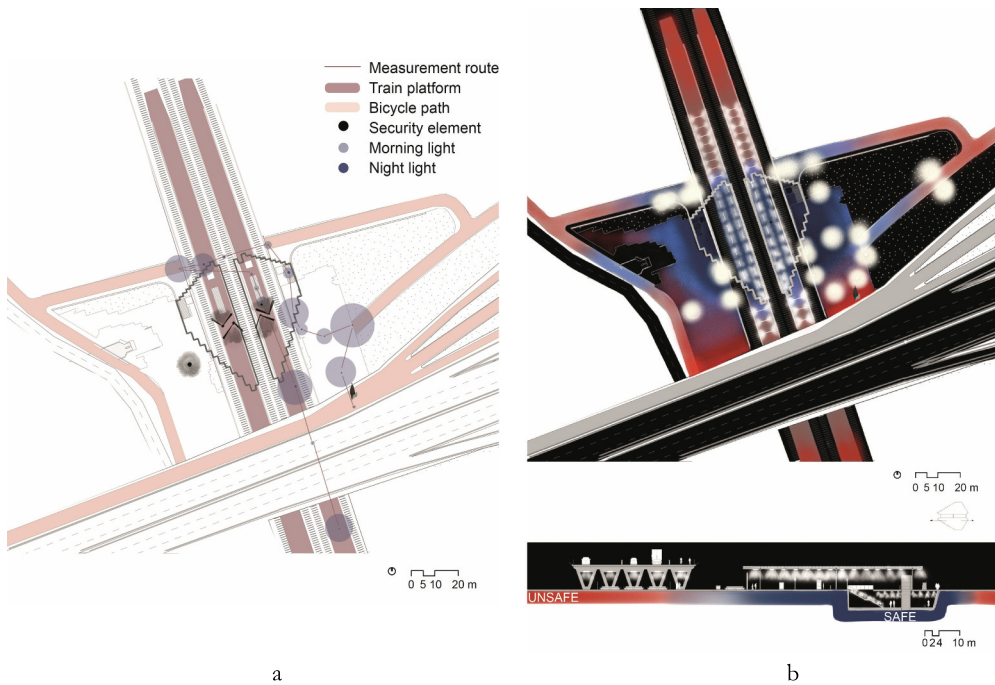


**Figure 4.** (a) Axonometric drawing representing the existing flows and functions in Delft Campus Station. Authors: Collotti, Hinterleitner, Kesimoglu. (b) Proposed design of the mobility hub with the integration of new flows in the Delft Campus Station. Visualisations by Matteo Collotti, Teresa Hinterleitner, Berk Kesimoglu, Levente Csonka, John Leermakers, and Kornél Károly Mogyorósi during the workshop. Edited by the authors. Reproduced with permission.

### 3.3. Thick mapping as a narration of user experience

Spatial conditions and environmental ambiance, including lighting, sound, vision, and colour, deeply influence passengers' experiences, perception of safety, and overall satisfaction within railway stations (Van Hagen 2011). Thick mapping provided a suitable method for students to explore this influence on passengers' experiences in the architectural space of stations to enrich qualitative analysis and critical representations during the workshop. This approach, in fact, was particularly helpful for the student group focusing on the dynamic interplay between perception of safety and the lighting conditions in and around the Delft Campus station, by using a combination of plan and section drawings (Figure 5(a,b)). The plan drawings were used to map the overall perception of safety within the station, yet the section drawing was also essential to represent the level and distribution of lighting, resulting in a sense of security within the station's space. In Figure 5(b), the group used inverse colours to emphasise the illuminated areas in night conditions. The comparisons between lit and dark areas and safety perceptions (Figure 5(b)) show how these perceptions are temporal and dynamically changing during different times and conditions. The exercise helped participants to include time as a fourth dimension for temporal, dynamic, sensory conditions and design considerations inherent in mobility spaces.

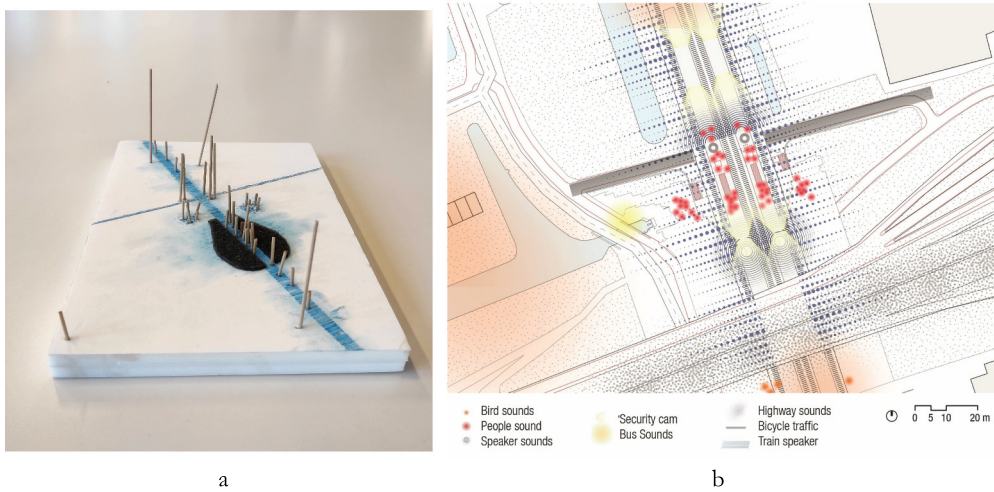
Another essential aspect of the sensory experience within the station is sound (Van Hagen 2011). At Delft Campus station, students explored the soundscape around the railway infrastructure. Sound is also considered as a spatial interface between the technical components of the station (streets, vehicles, railway lines, speakers) and living beings (people, birds). The different sound sources are mapped with the origin, types, distribution, intensity, and propagation and represented with colour-codes in the drawings, allowing for the



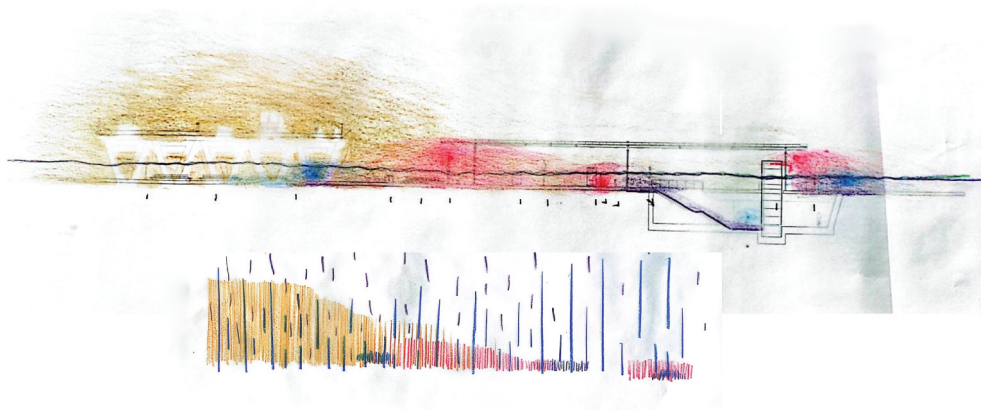
**Figure 5.** (a) Analytical mapping of lighting sources. (b) Map of the perceived safety in the station in relation to the lit areas. Visualisations by Ayşenur Tamtekin, Dilay Berşan Kızılarıslan, and Dominika Fonferová during the workshop. Edited by the authors. Reproduced with permission.

differentiation of desirable and undesirable ones. This spatial approach to the soundscape also communicated with a 3D physical model (Figure 6(a)). The group attempted to visualise temporal and sensory perceptions and, indeed, the invisible relationships with urban space in their visual explorations (Figure 6(b)). They found that even though there is no sound barrier enclosing the highway, its noise is quite confined due to the higher elevation. The railway noise, instead, in the absence of barriers, propagates, and dominates the immediate surroundings of the station. Initial hand-drawn on-site observations of the spatial distribution of sound (Figure 7) emphasised the soundscape as a heterogeneous topology, allowing alternative interpretations and insights into the sensory experience within and around the station.

The project in Figure 8 benefited from visual storyboards to examine and design lighting and safety perceptions at the Delft Campus station. The storyboard helped to illustrate the narrative of the passengers' personal journey, movement, and experience during the interchange from bicycle to the train. Visualising essential moments within this interchange allowed students to identify even the micro problems through first-person observation. The same approach became a co-design tool for communicating and presenting solutions at the same level of detail. The group incorporated design interventions again, using first-person notes within these drawings, emphasising how these lighting implementations and building components could enhance the perceived safety of the passenger route. This example clearly illustrates the power of mapping in taking a position and revealing actionable insights and spatial solutions (Corner 1999).



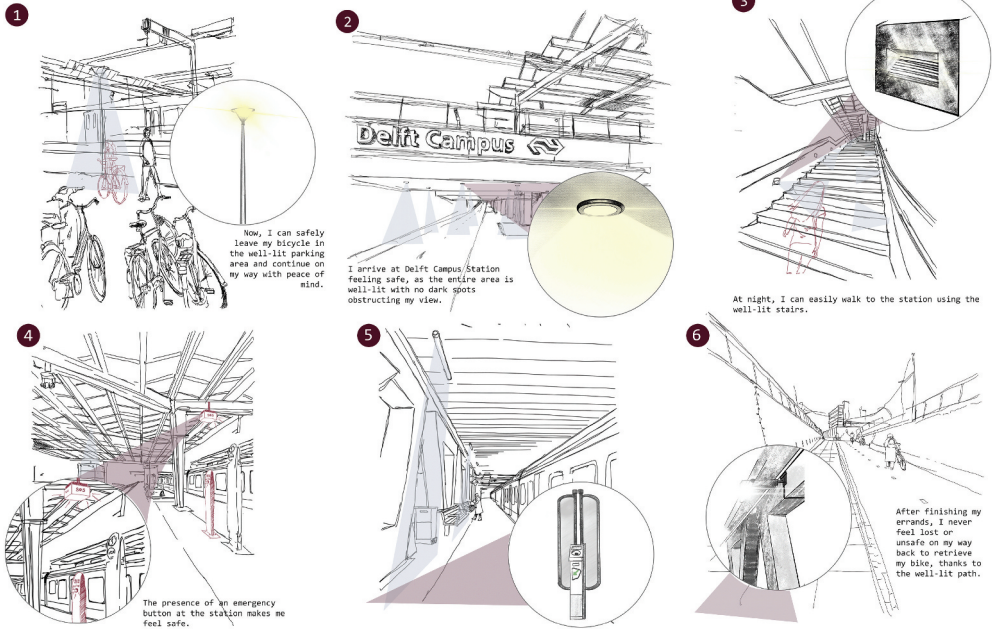
**Figure 6.** (a) Soundscape model represents the sound distribution around Delft Campus Station. (b) Plan drawing of the different sound sources and their propagation. Physical Model and Visualisation by Candan Bodur, Aleyna Cebecioğlu, and Büşra Arıman during the workshop. Edited by the authors. Reproduced with permission.



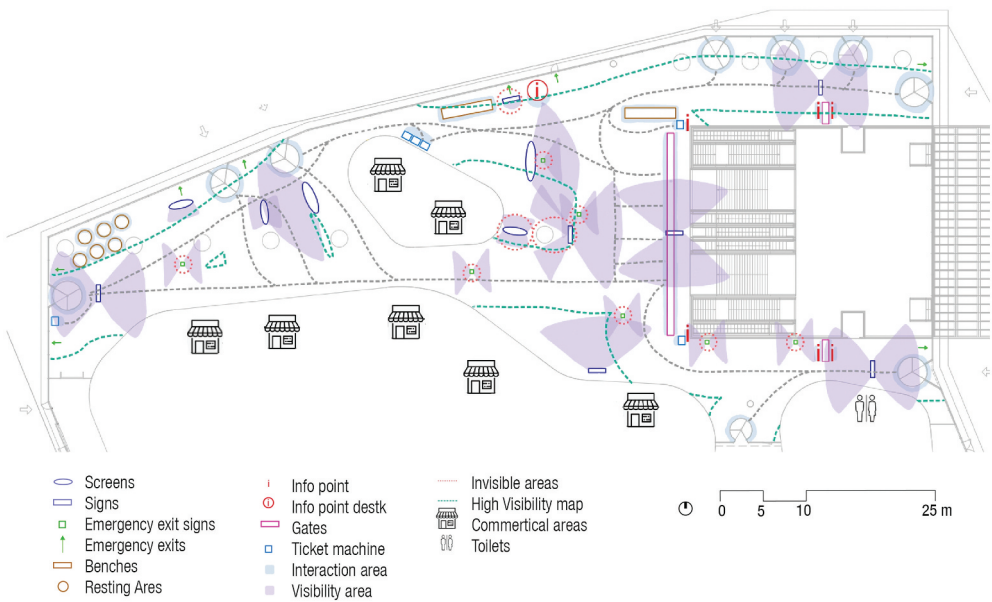
**Figure 7.** Initial abstract mapping of the spatial distribution of sound. Visualisations by Candan Bodur, Aleyna Cebecioğlu, and Büşra Arıman during the workshop. Reproduced with permission.

In addition to lighting and sound, digital and physical interfaces within the stations are also essential components for the passengers' experience. One group of students mapped these interfaces and signs within the Delft Central Station (Figure 9), combining them with the flow patterns. The group explored ways to visualise the footprints of these interface components through their visible range during the site visits. The locations and scales of multimedia systems, screens, ticket machines, gates, and signs are superimposed in architectural space to show how these interfaces facilitate information exchange about train schedules, arrival times, locations within the interchange, and affect the overall user experience. Visualising the affordances of

Storyboard



**Figure 8.** Storyboard of personal experience of light & safety design at Delft Campus. Visualisations by Belinay Hira Güney, Yagmur Konec, Francisco Garcia Cabral Fernandes, Aysenur Tamtekin, Dilay Berşan Kızırlarşlan, and Dominika Fonferová during the workshop. Reproduced with permission.



**Figure 9.** Mapping of the digital and physical interfaces at Delft Central Station and their footprints. Visualisation by Claudia Carlucci, Eva Maria Parra Parra, and Vera Puhalo during the workshop. Edited by the authors. Reproduced with permission.

digital technologies through their footprints allowed students to assess the interaction potentials between humans, technologies, and architectural space (Jensen 2025). This mapping, together with photographic evidence, enabled an opportunity to evaluate wayfinding and signatures within the station, specifying locations with challenges regarding interface placement and information gathering systems that control and regulate flows for spatial interventions.

## 4. Discussion

### 4.1. *Thick mapping as a design-driven research method*

The workshop tested thick mapping not only as a didactical instrument in a co-design process, but as a methodology of design research in architecture (Sádaba Fernández and Arratibel 2025). It aligns with exploratory design research methods in education (Frayling 1993; von Seggern 2019), helping future designers and practitioners to embrace the complexity, intuition, and negotiation for situated knowledge production (Silberberger 2021). The production of thick mapping facilitates a profound understanding of the mechanisms underneath the architectural composition of the space. Understanding the space is already a design process, having the capacity to connect new knowledge (von Seggern 2019) as well as produce it. This approach in the article frames thick mapping as a design-driven research method since the act of design is described as an exploratory research method (Breen 2002; Lenzholzer, Duchhart, and Koh 2013). The exercise enriches the design-driven research in two distinct ways. Firstly, thick mapping allowed participants to acquire empirical knowledge regarding the complexity of mobility design, embedded in its function as an interchange, by learning from the actual morphology and condition of the station design. Secondly, it informed the investigation of potential interplays between the different systems shaping stations through visual representation and scenario building in a co-design process. In this way, new knowledge is produced within the educational framework that prioritises ‘Learning by doing’ in the versions of ‘by drawing’ and ‘by design’ as fundamental to design disciplines (De Vos et al. 2013). Synthesising the contradictory layers of information (such as quantitative and qualitative, manual and digital, technical and perceived) into coherent visual representations became a (co)design act.

This approach recognises the importance of mapping as a procedural medium of drawing within the discipline of architecture as ‘an endogenous aspect of the disciplines, that is to be constantly trained in vision, in visual projections rather than in the verbal ones’ (Berlingieri 2022). Diverse drawing techniques were helpful for students to become deeply involved in analysing and learning from the present space to reflect on future projects. Annotating hard and soft data into layered maps and superimpositions allowed deeper discussion and interpretation beyond representing a single state of facts (Presner, Shepard, and Kawano 2014). The resulting visualisations emphasise, through the tools of design (analysing, mapping, projecting, envisioning), the research on the (co)construction of mobility hubs and, consequently, cities. Using drawings as a communication medium for participation, discussion, and collaboration allows thick mapping to transcend traditional disciplinary boundaries, generating results that could be used by multiple actors and stakeholders, offering a valuable interdisciplinary instrument for research, education, and communication (Cuff et al. 2020).

Therefore, instead of traditional site analysis, which is often separate from the design process, this method provided students a comprehensive approach that integrates observations, discussion, and proposal within the design-driven research.

#### **4.2. Thick mapping to reveal new spatial narratives about the mobility experience**

Throughout the workshop, thick mapping exercises on stations enabled diverse representations of similar thematic focuses, embracing the multiplicity of interpretations, views, and standpoints (as described in 3.2). The range of illustrated outcomes reflects this polyvocality of authors, narratives, and meanings on architectural infrastructures and their entanglements with human perceptions (Presner, Shepard, and Kawano 2014). Different interpretations of the same theme emphasise this multilayered, temporal, ongoing process of investigation for alternative spatial potentials, constraints and design solutions, aligning with the argument of critical cartography by acknowledging and promoting the subjective nature of spatial representation to challenge socio-political dynamics (Crampton and Krygier 2006).

The produced materials clearly emphasised mapping not as a merely neutral, objective method of simply tracing or annotating spatial elements, but ‘as a productive and liberating instrument’ for emancipation and interpretation, emphasising ‘the agency of mapping’ for revealing actionable insights (Corner 1999). The workshop results were more than conventional technical diagrams, but critical representations highlighting both contradictions and latent potentials for design interventions. On-site observations of user-level experience and perceptions about light, sound, vision, and safety allowed students to learn more about the intangible constraints and temporal conditions inherent in architectural space, particularly in mobility hubs. This helped them to understand mobility beyond a simply rational transport function, to embrace spatial experience, emotions, culture, and sensory perceptions that define these interchanges for designing meaningful interactions within the space of mobility infrastructures (Eckart and Vöckler 2022; Jensen 2009).

#### **4.3. Thick mapping to understand the multiscalar dynamic system of stations**

Mapping exercises throughout the workshop contributed to students’ comprehension of the spatial composition of the station, beyond the standard categories of entry halls, platforms, shopping areas, and their related technical functions, but as a complex assemblage of multiple scales, times, systems, modalities, stakeholders, user experiences, and dynamic flows. Thick mapping enabled multiscalar, multilayered research from station-level flows to interior furniture, from interfaces to perceptions, combining top-down with bottom-up design approaches. By shifting the question from what building components, technologies, and systems are to how they afford, operate, and emancipate certain needs and perceptions (Davis 2020). Thematic mappings enabled critical thinking about spatial affordances and revealed new insights about the articulation and flows, lighting and safety, and interfaces that influence the architectural design and the mobility experience.

Participants interpreted mobility hubs as socio-technical infrastructures for investigating spatial interchanges and flows of people, goods, and information (Larkin 2013). This approach stimulated system-thinking throughout the workshop and helped students to visualise stations as a dynamic topology of relationships, highlighting interactions between

systems, users, and spatial technologies. They explored the *field conditions* (Allen 1999) through systems, flows, forces between isolated objects and forms to understand the unique spatial and operational mechanisms of stations. This perspective aligns with the argument of Latour and Yaneva (2008), participants represented the building not only as a fixed object, but as a moving project composed of human and non-human components, transforming over time. The workshop illustrated how thick mapping exercises emerge as a profound didactic method that can challenge dominant assumptions and design approaches by revealing alternative representations of user narratives, unnoticed architectural features, and invisible mechanisms in the case of mobility hubs.

#### 4.4. Limitations

While the workshop generated valuable insights about thick mapping as a design-driven research method with exploratory approaches and diverse representations, it also revealed several challenges regarding the time limit, diversity of educational background and scope of the assignment. Firstly, the entire workshop was completed in just one week, in which the students were also involved in presentation sessions and lectures. Such a limited time factor required quick decision-making, lacking a full engagement with the stakeholders, which affects the depth of investigation, iterations, testing, and development of design proposals. Secondly, the group of participating students was quite mixed in terms of educational level, international and interdisciplinary backgrounds; most of them were early-career researchers who had been in the city for a short period. Even though fresh perspectives of participants on the hubs enriched the narrative about those places, it still offers a partial perspective, prioritising speculative thinking and experimentation over technically feasible solutions.

Moreover, thick mapping exercises mainly relied on visual and spatial representations, which cannot fully illustrate the overall complexity and mobility experience, as well as the socio-political dimensions that shape the stations. The work developed by the students targeted specific thematic scenarios, but not as comprehensive design solutions. Although the selection of two stations, which are the only stations in Delft, generated variability and enabled comparisons to test the versatility of thick mapping, the findings were inherently site-specific and cannot be generalised to other stations and contexts. While acknowledging that these limitations of time and scope are essential for evaluating the results, the workshop presents valuable insights for future educational settings that aim to integrate thick mapping into the co-design process of railway stations.

## 5. Conclusion

This article investigated the role of thick mapping as a generative method for the co-design process of stations within an interdisciplinary workshop. The method was particularly well-suited to a collaborative exercise, allowing interdisciplinary participants to learn from the station's actual morphology, context, and condition to comprehend invisible relationships, interactions and forces that shape these contemporary urban mobility infrastructures. The multilayered maps also facilitated productive conversations with practitioners, municipalities, architects, students, and researchers to enrich the overall learning experience. The inclusion of on-site observations into thick mapping

revealed subjective, temporal, and sensory qualities of mobility design, which are often overlooked in conventional architectural site analyses. Through visual representation and systems thinking, participants investigated challenges and frictions between systems as a design potential for envisioning future scenarios. Using thick mapping as a design-driven research method has demonstrated its creative potential in an interdisciplinary educational setting by combining deeper analysis, communication, and design stages within the co-design processes. Here, mapping functioned not only as an object (outcome) but also as a verb (process and a tool) to explore the architectural space, blurring the strict boundaries between analysis and design.

Ultimately, thick mapping provides a sound methodological and pedagogical framework for (re)designing the layered complexities and experiences embedded in mobility infrastructures, particularly in railway stations. Nevertheless, the limited time, scope, and outcomes of the overall exercise demonstrate only the partial potential of thick mapping for critical analysis and design implementations in broader mobility design research, indicating that revealing the full ‘thickness’ requires extended time, careful attention, and ongoing collaboration. Future research should investigate thick mapping in extended educational formats where design iterations can be extensively studied, tested, validated, and discussed back and forth between all participants involved in co-design processes. In this way, thick mapping can reveal further potential for implementations as an open-ended process of observing, reinscribing, narrating, rethinking, communicating, contesting, designing, perceiving, and experiencing (Presner, Shepard, and Kawano 2014) and reimagining the architecture of mobility spaces. This article highlights its value as a critical collaborative design method for future practitioners, bridging empirical inquiry with imagination. Thick mapping underscores that this imagination is never detached from knowledge and experimentation; rather, it emerges from them.

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