

Transport Hubs as Public Space

Using architecture to improve the public space in future intermodal transportation hubs

Research Plan

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1. Introduction

The implementation of high-speed rail in transportation hubs and stations have caused a series of (re)developments in European cities. These developments however have not addressed the problems of integration and experience of the public space in and around the stations. Therefore, this research continues the studies to improve the spatial experience and integration of public space in transportation hubs, focussing specifically on the relation of public space inside intermodal transportation hubs with the current and future transport modes.

The aim of this research is to understand the relation that public space has with the different transport modes inside an intermodal transport hub and how this space can be improved and integrated within the complex and the city using architectural methods and tools.

1.1 Research Background

Stations have been part of the urban fabric for a long time and are considered essential to a good functioning city. With the increasing population of urban areas and the need for environmentally friendly transport, their role and importance will only increase. Combined with the need to implement high speed rail most cities are transforming their stations to adapt the high-speed rail and the increasing number of travellers. Most often the redevelopment is considered an success, while researchers see it as a missed opportunity to rethink stations.¹

¹ Marcel Hertogh, "Towards an integrated approach for stations," in *Station as Nodes*, ed. Manuela Triggianese, Roberto Cavello, Nacima Baron and Joran Kuijper (Delft, TU Delft Open, 2018), 17-19.

The redevelopments kept the same layout and principles, pleasing the financial stakeholders with focussing on efficiency. Other aspects like the experience of users often not prioritised.²

The lack of focus on the experience of the users is becoming an bigger problem with the functional shift that stations are going through. The last couple of years the major stations are partly changing from an place to travel to an place to be. However, this change is not reflected in the way the stations are designed. Transport hubs are often still just stations, not an place of its own³. The role of public space inside the station is therefore not utilised to its potential, leading to the public space mostly being unattractive. The problems continue when looking at the surroundings, with an clear disconnect of the public space inside and the public space surrounding the area.⁴ This last problem is not only related to the public space, but the stations in general being disconnected from the urban context.⁵

With the introduction of autonomous vehicles, shared vehicles, and other new modes of transport most of the stations will have to transform again to adjust for these options. This transformation is another opportunity to rethink how public space inside stations should be, which is the main reason behind this research.

2. Problem Statement

As stated before, transportation hubs have gone under several redevelopments and transformations, but are always neglecting the experience and spatial performance of the hubs itself. This lack of focus on these aspects leads to unattractive public space inside the area and an disconnect to the surrounding urban fabric. The methods from designers and experts like Bureau Spoorbouwmeester are implementing therefore space where people can stay,⁶ but this space is often still undefined, unattractive, and not prioritised. Most often this leads to the same formula of shops and cafes, not designed places itself.⁷ Since the public space inside the hubs as place to be is becoming more important, the design of the transportation hub should reflect this change. Otherwise, the potential and functioning of these transportation hubs will decline and will in the future be avoided by the travellers due to the negative experience. Therefore, a change is needed to the design of public space inside and around the hubs. This change could be implemented during the next redevelopment, integrating new transportation modes that will be implemented the near future.

The interaction of the different transport modes and the public space in between is therefore important to understand to be able to investigate the required changes needed. This leads to the focus of this research being on intermodal transportation hubs with at least three different types of transportation modes. One of these transport modes will be rail transport since these stations have the most opportunity to be its own place inside the city and could benefit the most from this research. This research will exclude transportation hubs with boat & air travel since these are not as common or require a specific solution. Another limitation in this research is region. Since culture and regions cause major differences in transportation systems and their usage, this research will only focus on the transportation hubs inside Europe. Further mentions in this research will therefore refer to these specific intermodal transportation hubs, unless mentioned otherwise.

² Yo Kaminagai, "Intermodal hubs as urban spaces," in *Station as Nodes* (see note 1), 33-35.

³ Yo Kaminagai, "Intermodal hubs as urban spaces," 33-35.

⁴ Ana Conceição, *From City Station to Station City* (Delft University of Technology, 2015), 17.

⁵ Cavello, Roberto. "The Railway and the Dutch City." *OverHolland 5* (2007): 43-59.

⁶ Bureau Spoorbouwmeester, *Het Stationsconcept*. (2011).

⁷ Conceição, "From City Station to Station City," 14, 23.

3. Research Questions

The central goal of this research aims to investigate the spatial relationship between the different transportation mode in the transportation hub of the future, with the goal of understanding how the public space currently exists and how the function of this space can change to an place of its own. To understand how this goal can be reached, the following main research question (RQ) is formulated:

“What can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future?”

To answer this main research question, four sub research questions (RsQ) are formulated. These questions are based on the several aspects that will be investigated in the research.

“What is the current role for public space in transportation hubs?”

“What is the relation between different transportation modes in transportation hubs?”

“How can the experience of transportation hub be improved without limiting the efficiency?”

“How will the new transportation modes influence the transportation hubs?”

The first two questions are set with the purpose of understanding the current situation of transport hubs, with the first question focussing on the public space itself and the second question more on the relation between the different modes of transport. These questions should give an overview how the current spatial situation is inside and surrounding the hubs. The third question was created to investigate deeper the experience the current situation gives and how this should be improved. The final question looks to the future and investigates what new modes of transportation could change. The answers from these question function as an base of knowledge that can be used to answer the main research question.

4. Theoretical Framework

To study and analyse the space inside an structure, this research must go beyond the scope of architecture and the traditional scope of the building. The connection with the surrounds and functioning of the stations itself will have to be considered when researching to prevent the solution only being focussed on the domain of architecture. Instead of limiting to only using the domain of architecture, this research will therefore expend the scope with theory from the domain of Urbanism and the domain of Transport, Infrastructure and Logistics (TIL). Nevertheless, the research will use mostly tools from the domain of architecture.

The public area will be investigated through multiple methods, consulting different fields of theory. To study the spatial layout, part of the research will be an architectural typology study, studying the important aspects of this type of building. This theory should give insight in the spatial configurations of transportation hubs, which is essential to understanding the role of the public space. This research will be combined with insights to the functioning and performance of these public areas by investigating the experience of the users. This insight is supported with theory from the field of phenomenology and praxeology.

Besides these fields, the research will be supported by a wider framework of other sciences to wider the discussion and relevance. As example, the research will consult the field of axiology to understand the complicated stakeholders situation this research is operating in and to provide an deeper understanding of how the problems surrounding the unattractive public space have originated.

5. Methodology

This research investigates the physical layout and function of public space inside and surrounding intermodal transportation hubs of the present and the probable future mostly using the method “design research”. The research itself is divided in three sections, split into three parts. The first part forms an base of knowledge and an deeper understanding of the problem, which will be used for the second part. The second part consists mostly as an comparative analysis of an selection of case studies. The final part will take shape of an design assignment and will use the method “research by design”. The result of this final part will be an design and several design interventions to improve the public space inside hubs. An overview of the different sections is visible in the research diagram in figure 1.

5.1 Part One: Literature Research

The research is split in three different sections each investigating one of the aspects of public space related to transportation hubs. This division will already happen in the beginning of the research. The first section will focus on the spatial layout of the public space in and surrounding the transportation hub, with the aim of answering the first two research questions. The second section of this research will focus on the performance of the public space, by studying the experience and function. The third section will investigate the different modes of transport itself and the potential future additions. In the first part of the research, all these sections will take shape as an literature study, with the goal of gathering information to proceed in the analysis of the case studies.

Following the introductory literature research, an separate study will investigate a wide selection of transportation hubs in Europe, with the goal of making an selection of case studies that will be analysed further in a comparative analysis. The case studies will differ in size, modes, and complexity to analyse all different kind of scenarios and different roles for the public space. The varying aspects of the transportation hubs will be displayed in analytical graphs and heatmaps, displaying an overview of the different transportation hubs. These graphs will help make an informative choice for the selection of case studies, with the goal of an range as wide as possible and make sure that the results of this research can be applied to as much different transportation hubs as possible.

5.2 Part Two: Comparative Analysis

The second part of the research will focus on the comparative analysis of the case studies. Each of the sections will analyse the case studies with its designated method to extract the required information to answer the research questions. The first section will use the method plan analysis to construct an graphical analysis of the physical public space in and around the transportation hubs. This method requires the availability of floor plans, which could also be acquired from navigation maps that are often present inside the hubs. With the previous acquired knowledge from the literature study this section will answer the first two research questions. As this section answers more than one question, it is expected that this section will use more time than the other sections.

The second section will continue the investigation to the usage and experience using methods relating to phenomenology and praxeology. The methods tracking and sensory mapping combined with the earlier literature research are chosen to provide information to answer the third research question. These methods however can take an large amount of time, which should be considered when executing this part of the research. If it happens that the methods would require more time than available, literature studies into the same topics could provide enough information to still answer the third question.

The third section uses the found information and knowledge from the first two sections to help answer the fourth research question. Combined with the literature information it should give insight to what effect each transportation mode has on the public space, and therefore should be able to understand what influence the future transportation modes will have. The results of this are depending on which case studies are selected, making the right selection even more important.

5.3 Part Three: Research by Design

The answers to the different research questions and the found knowledge will be translated into several design interventions that should help improve the public space in and around transportation hubs. These interventions are created using “research by design”. This progress will take shape as an design process, aimed to create an more ideal transportation hub using the knowledge learned from this research. This design will be a new concept of transportation hub or as an transformation of an existing transportation hub and will be created on the location of one of the case studies since information about this location is already known. The design interventions created during the design process should be made in consideration with the problems relating to formulaic designs, meaning that these interventions should not result in an formula that can be applied anywhere but interventions that can change the core of the functionality of the transport hubs.

Main Research Question

“What can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future”

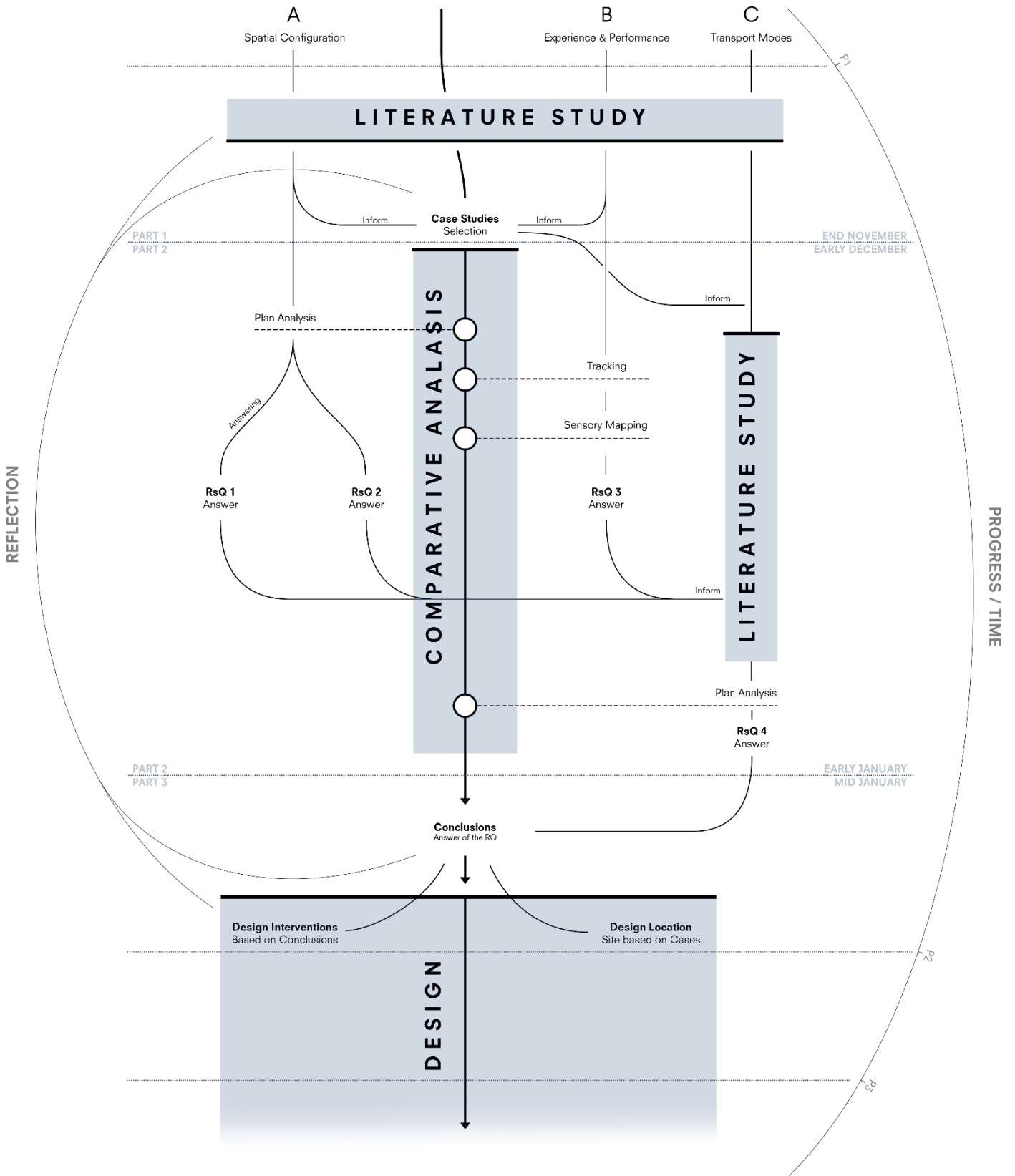


Figure 1: Research Diagram

6. Results & Relevance

The aim of this research is to rethink and revalue the public space inside and around intermodal transportation hubs to improve the experience and usage of the space. The place inside the station should become a place on its own. This research is expected to contribute to this goal with a series of design interventions, which should be applicable to as many transportation hubs as possible. With the role of transportation hubs only becoming more important and the hubs themselves bigger, the issues that currently plague the hubs should be resolved.

However, transportation hubs are complicated structures in complex and unique situations. It is therefore difficult to research all different hubs or make the design interventions relevant for every single type of hub. The boundaries mentioned earlier aim to limit the research, to make sure that the design interventions can work on these hubs. Nevertheless, the relevance will not be impacted much since these hubs represent the majority of the transport hubs.

The relevance of the research is also dependent on the selection of case studies. The wide range of case studies will make the research more relevant to a wider range but requires extra thought into the differences between these cases. This research therefore also studies the role of the public space itself, to see how the different scales of transportation hubs influence the role and requirements of the public area.

7. Bibliography

The research focuses mostly on the architecture domain. The literature however uses information from multiple domains, to support the research from most angles related to transportation hubs. Below, a preliminary list of literature is located which will be consulted during the research. The list is divided into subjects, to help understand where the research will be used for.

7.1 Stations & Transportation hubs

The main subject of investigation are the transportation hubs. Therefore, this section of literature is the most important of the research. The main source in this section is the book: *Station as Nodes*. This book is a collection of different opinions and research from current experts in stations. Therefore, this source functions to give insights into various topics which could be useful to study. However, further research must be done to be able to apply these topics to this research.

Cavallo, Roberto. "Design Studies on the Coexistence of City and Rail." EURAU, 2012.

Cavallo, Roberto. "Het Spoorwegstation: Van Monument Naar Multifunctionele Terminal. Het Geval Van Het Amsterdamse Centraal Station." *OverHolland*. 2007.

Cavallo, Roberto. "Railways in the Urban Context." TU Delft, 2008.

Conceição, Ana. "From City Station to Station City." Delft University of Technology, 2015.

Conceição, Ana. "Rethinking the Railway Station Area." Delft University of Technology, 2011.

Fleming, Douglas K., and Yehuda Hayuth. "Spatial Characteristics of Transportation Hub: Centrality and Intermediacy." *Transport Geography* 2, no. 1 (1994): 3-18.

Hertogh Marcel. "Towards an integrated approach for stations." In *Station as Nodes*, edited by Manuela Triggianese, Roberto Cavello, Nacima Baron and Joran Kuijper, 17-19. Delft: TU Delft Open, 2018.

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Siblesz, Johannes M. "The Integrated Station: A Transfer Quality Assessment Model for Multi-Modal Stations." Delft University of Technology, 2021.

Spoorbouwmeester, Bureau. *Het Stationsconcept*. (2011).

Triggianese, Manuela, Roberto Cavallo, Nacima Baron, and Joran Kuijper. *Station as Nodes*. Delft: TU Delft Open, Faculty of Architecture and the Build Environment, Delft University of Technology, 2018. ISBN 978-94-6366-140-9

Triggianese, Manuela, Roberto Cavallo. "The Station of the Future: Amsterdams Stations in Transition." *OverHolland* 20 (2019): 33-60. <https://doi.org/10.7480/overholland.2019.20.4143>.

7.2 Public Space

The focus of this research is placed on the public space, inside and surrounding the transportation. The sources below help understand the relation of the public area with the transportation hubs and the surrounding area. More literature relating this aspect with stations itself is found in the aforementioned book *Station as Nodes*.

Abutaleb, Ayman, Kevin McDougall, Marita Basson, Rumman Hassan, and Muhammad Nateque Mahmood. "The Impact Of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station RIDERSHIP: Dubai Metro Redline." *Urban Rail Transit* 6, no. 3 (2020): 157–70. <https://doi.org/10.1007/s40864-020-00129-0>.

Cavallo, Roberto. "Railways in the Urban Context." Thesis, s.n., 2008. ISBN 978 90 5269 361 3.

Fleming, Douglas K., and Yehuda Hayuth. "Spatial Characteristics of Transportation Hub: Centrality and Intermediacy." *Transport Geography* 2, no. 1 (1994): 3-18.

Harteveld, M. G. A. D. "Interior Public Space: On the Mazes in the Network of an Urbanist," 2014.

7.3 Underground Space

Due to the nature of transportation hubs often there are some parts located underground. The relation between the space above and space underground is therefore important to the functioning of the transportation hub. This section or research focusses therefore in understanding this relation.

Admiraal, Han, and Antonia Cornaro. "Why Underground Space Should Be Included in Urban Planning Policy – and How This Will Enhance an Urban Underground Future." *Tunnelling and Underground Space Technology* 55 (2016): 214-20. <https://doi.org/10.1016/j.tust.2015.11.013>.

Cui, Jianqiang, Andrew Allan, Michael A.P. Taylor, and Dong Lin. "Underground Pedestrian Systems Development in Cities: Influencing Factors and Implications." *Tunnelling and Underground Space Technology* 35 (2013): 152–60. <https://doi.org/10.1016/j.tust.2012.12.009>.

Cui, Jianqiang. "Building Three-Dimensional Pedestrian Networks in Cities." *Underground Space* 6, no. 2 (2021): 217-24. <https://doi.org/10.1016/j.undsp.2020.02.008>.

Durmisevic, Sanja. "The Future of Underground Space." *Cities* 16, no. 4 (1999 1999): 233-45. [https://doi.org/https://doi.org/pii: s0264-2751\(99\)00022-0](https://doi.org/https://doi.org/pii: s0264-2751(99)00022-0).

van der Hoeven, Frank, and Akkelies van Nes. "Improving the Design of Urban Underground Space in Metro Stations Using the Space Syntax Methodology." *Tunnelling and Underground Space Technology* 40 (2014): 64–74. <https://doi.org/10.1016/j.tust.2013.09.007>.

7.4 Experience

To understand how people experience transportation systems, several aspects relating to it must be studied. The main aspect that will be researched is the aspect wayfinding, an element crucial to the functioning of a transportation hub. Literature related to this subject and other research relating to experience is in this section

Carvalho, Joao, Manuel Marques, and Joao Paulo Costeira. "Understanding People Flow in Transportation Hubs." *IEEE Transactions on Intelligent Transportation Systems* 19, no. 10 (2018): 3282-91. <https://doi.org/10.1109/tits.2017.2775285>.

Clever, Jan, Jimmy Abualdenien, and Andre Bormann. "Deep Learning Approach for Predicting Pedestrian Dynamics for Transportation Hubs in Early Design Phases." 2021.

Loukatou-Sideris, Anastasia, Brian D. Taylor, and Carole Turley Voulgaris. *Passenger Flows in Underground Railway Stations and Platform*. Mineta Transportation Institute (Mineta Transportation Institute, 2015).

Mbatta, Geophrey, Thobias Sando, and Ren Moses. "Developing Transit Station Design Criteria with a Focus on Intermodal Connectivity." *Transportation Research Forum* 47, no. 3 (2008): 77-91.

Molyneaux, Nicholas, Riccardo Scarinci, and Michel Bierlaire. "Pedestrian Management Strategies for Improving Flow Dynamics in Transportation Hubs." Swiss Transport Research Conference, Monte Verità, 2017.

Shi, Yuqi, Yi Zhang, Tao Wang, Chaoyang Li, and Shengqiang Yuan. "The Effects of Ambient Illumination, Color Combination, Sign Height, and Observation Angle on the Legibility of Wayfinding Signs in Metro Stations." *Sustainability* 12, no. 10 (2020). <https://doi.org/10.3390/su12104133>.

Zhang, Yuanyuan, Xiaohong Chen, and Jingwen Jiang. "Wayfinding-Oriented Design for Passenger Guidance Signs in Large-Scale Transit Center in China." *Transportation Research Record: Journal of the Transportation Research Board* 2144, no. 1 (2010): 150-60. <https://doi.org/10.3141/2144-17>.