# The Performance of the Amsterdam Bijlmer ArenA Station compared to European Hubs

*Cross-case Comparative Analysis of Transit Nodes near Major European Event Sites*

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**MSc Complex Systems Engineering and Management**

# Performance of the Amsterdam Bijlmer ArenA Station Compared to European Hubs

Cross-case Comparative Analysis of Multimodal Transit Nodes near Major European Event Sites

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# Acknowledgements

Dear reader,

This thesis marks the final stage of my Master's studies. I have worked on this thesis project with a lot of happiness, excitement and of course effort. It discusses the performance of stations, one of my favourite subjects, public transportation and the systems around it. I'm proud that I have finished this thesis and contributed to its context.

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Stef Peper

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# Summary


## Introduction

The Amsterdam Bijlmer ArenA Station (ABAS) is a unique and complex station area within the Dutch public transport network. It is located in the rapidly growing Amsterdam Zuid Oost, where the station serves a dual function that creates operational tensions. On the one hand, it acts as a critical daily commuter hub for the residents and workers of the area. On the other hand, it serves as the primary entrance to the largest entertainment district in the Netherlands, hosting three major venues: the Johan Cruijff ArenA, the Ziggo Dome and AFAS Live.

The urgency and importance of this research come from the friction between these two functions. Daily, the station facilitates approximately 10,000 travellers, but this number doubles at least during event peaks. With an annual visitor count of around 10 million for the event area alone, the station must handle extreme 'triple events', scenarios where up to 200,000 people visit the area in a single week. During these triple events, the three major venues host an event simultaneously. The pressure on the station is further intensified by the municipality's ambition to build over 30,000 new homes in the area by 2030, transforming the district into a busy urban centre.

The current infrastructure of the station struggles to accommodate these two conflicting types of demand. The station faces some physical bottlenecks, including the illogical transfers between metro and train, a poorly located bus station and insufficient vertical transport capacity (escalators and stairs) to handle massive crowd outflows. Furthermore, the area around the station, specifically the Johan Cruijff Boulevard, acts as a necessary buffer zone for the crowd before they enter the station. This blurs the lines between the public space and the station infrastructure.

Another significant part of the problem lies in the governance structure of mainly the redevelopment process and on the other hand the event coordination. The redevelopment of the ABAS area involves multiple stakeholders with diverging interests. The municipality of Amsterdam views the station as a crucial catalyst for urban development and housing, emphasising the need for a new station hall and the integration with its surroundings. On the other hand, the transport operators NS and ProRail prioritise the daily usage as a baseline. Emphasising that this is the most reliable measurement, they are therefore hesitant to design infrastructure solely for event peaks that occur only roughly 20 times a year. While the Dutch MIRT (Meerjarenplan Infrastructuur, Ruimte en Transport / Multi-Year Programme for Infrastructure, Spatial Planning and Transport) framework provides structure for these discussions, the decision-making process remains slow and sometimes fragmented. The event coordination is done through the Operational Mobility Centre (OMC), in which several stakeholders are together before, during and after events to manage the crowds, transport and safety in an integrated manner.

Currently, there is no standardised tool or benchmark in the Netherlands to identify such specific event-related transit nodes. Because of the unique characteristics of the Amsterdam Bijlmer Arena Station, there is the opportunity to compare this Dutch complex station to other nodes in Europe in the event context. This thesis addresses that gap by analysing the current system and looking across the border to find best practices in Europe. As well as coming up with a structured way to assess these observations and to systematically operationalise the comparison. Therefore, the main research questions are:

1. *"How is the redevelopment of Amsterdam Bijlmer ArenA Station approached in terms of integrated decision-making, and what lessons can be drawn from comparable international transit-nodes in event context?"*

2. *"How can recurring aspects from international cases be systematically operationalised in a Comparison Tool, and how can this tool be implemented and applied to a complex multi-actor infrastructure project like ABAS?"*

Due to the two main questions discussed in this paper, the thesis will consist of two different parts, one empirical and research focused, and the other focused on designing and application of the tool.

### Methodology and Comparative Framework

To address these questions, the research uses a multi-phase comparative case study, which is based on the theoretical framework of Robert Yin on multiple case-design with an embedded unit analysis. Instead of comparing entire stations and their surroundings, this framework basis allows to focus on replication logic. Therefore, this research identifies eight specific embedded units (aspects) crucial for event stations:

- 'Position in Network': The station's role in the regional/national network
- 'Transportation Modes & Transfers': The presence of modes and efficiency of multimodal connections
- 'Economic & Urban Integration': How the station blends with the city around
- 'Safety & Security': Physical and social safety measures
- 'Event Management': Operational planning for peak demands
- 'Crowd Management': Physical handling of passenger flows
- 'Governance & Organisation': Decision-making structures
- 'Fully Integrated Station': The overall coherence and synergy of the station.

The research analysed several high-profile European transit-nodes that share characteristics with ABAS to derive lessons and design the Comparison Tool. Five key cases included:

- Rotterdam Stadionpark (The Netherlands): This future project will transform an event-only stop into a daily urban hub. It consists of a 'dual-state' design with separate entrances for event and daily commuters. It is located next to the stadium De Kuip.
- Madrid Santiago Bernabéu (Spain): A high-capacity metro station design for the 'worst-case scenario', focused on 70,000 visitors of the adjacent Santiago Bernabéu stadium. This station is also being renovated and will feature a new massive mezzanine level to buffer crowds, and the management uses a 'hold-and-go' strategy at street level (stadium promenade) to prevent the platforms from overcrowding.
- London Wembley Park (UK): The standard for crowd management strategies. It uses the Olympic Way as a massive external buffer and operates in distinct phases to enable 'event mode' protocols.
- London Stratford Station (UK): A massive multimodal hub which drives regional regeneration. It successfully integrates a shopping mall, as well as the public space around the station as a buffer zone and relies on 'learned behaviour' of sports fans to manage flows. It is located next to the Queen Elizabeth Olympic Park, which hosts the London Stadium.
- Stockholm Slakthusområdet (Sweden): A new metro development where station entrances are strategically placed at a distance from the arena to regulate flow within walking distance. In addition, the metro station and new tube lines are critical for urban development.

Next to these stations, two stations from Paris were also analysed: St-Denis-Pleyel and La Défense, and the Fröttmanning Station in Munich as well.

The tool is based on the Capability Maturity Model Integration (CMMI), which uses five levels to assess the maturity of processes in systems. The reason why maturity is considered, is because the aspects consider the performance of the station, and improving on maturity shows progress of the processes. Every aspect is identified with recurring patterns, creating checklists per aspect. Before being able to develop into a higher state of maturity, a station needs to pass a quantitative and qualitative threshold per level of maturity.

### Implementation, Application and Discussion

The second main research question focuses on the practical implementation and applicability of this comparison tool. To ensure the developed Comparison Tool bridges the gap between diverging stakeholder interests, specifically between local authorities and transport operators in the case of Amsterdam, the research proposes that the tool should function as an instrument according to the 'Boundary Object' Theory. The tool is designed to function as a strategic instrument for stakeholder dialogue during the early exploration stages (e.g. the 'MIRT-Verkenning' in the case of Amsterdam). Once stakeholders first use the tool individually, a neutral party can identify the similarities, but mainly the differences in the outcome. These differences can be used in different stakeholder arenas to start the conversation on the different interpretations on how and why certain design elements of a transit-node in the event context should turn out. The tool as a boundary object bridges the gap between the performance of the station in event context and the stakeholders in the process of the infrastructure project.

When the developed Comparison Tool was applied to Amsterdam Bijlmer ArenA, some interesting results were described. These are also validated and discussed. Firstly, the 'Governance & Organisation' was surprisingly mature, which contradicts the initial perception of fragmented decision-making, as the tool scored in the highest level (Maturity Level 5). This is largely due to the existence of the Operational Mobility Centre (OMC), where the event operators, emergency services, municipality and transport operators collaborate effectively during events. Additionally, the Dutch MIRT framework is internationally regarded as a well-working system for handling complex infrastructure projects. Hence, ABAS is performing better than many European stations and their infrastructure projects in terms of formal coordination.

Moreover, there are some physical and operational gaps. After validation, the station scored lower on 'Transportation Modes & Transfers' and 'Fully Integrated Station'. This reveals that even though ABAS is a very strategic node, it lacks the seamless physical integration seen in stations like Stratford or La Défense. The transfer is especially hindered by height differences. Furthermore, regarding 'Safety & Security', the station falls short of the 'safety by design' principles found in Madrid or Wembley. Dark corners and some obscure sightlines remain an issue, whereas best-practice stations fully utilise open spaces and mezzanines to enhance visibility and ensure (social) safety.

Lastly, the comparative analysis highlighted that successful event stations use two different states: a daily mode and an event mode. Some stations apply differences in the physical infrastructure, such as opening and closing certain entrances (Rotterdam and Madrid) or changing the position of gates to regulate crowd streams better (Stratford), all depending on the need and demand. ABAS currently lacks this physical flexibility; it relies heavily on temporary measures on the Johan Cruijff Boulevard or on stewards, rather than permanent infrastructural solutions like a unified mezzanine or types of scalable entrances.

## Conclusions and recommendations

This research concludes that while Amsterdam Bijlmer ArenA is a mature and critical node in the Dutch network, its physical design can learn and profit from European transit nodes in the event-context to improve its operational performance. The Comparison Tool is an effective instrument to identify maturity gaps in the researched aspect, making the translation from qualitative insights to measurable differences. In addition, for stations near event areas, the tool is especially relevant because it highlights aspects that traditional infrastructure planning often misses. Hence, this comparison tool can be a powerful communication aid in the early phases of an infrastructure project. Especially for different stakeholder arenas, like the analytical arena, where specialists justify certain design choices, and also the policy arena, where those elements and choices are translated to the main stakeholders involved.

Moreover, to make the comparison tool a more valid instrument, it is necessary to incorporate more and different cases of transit-nodes in the event-context. It would be interesting to research cases outside the borders of Europe. In addition, the comparison tool is primarily focused on qualitative performances, while integrating quantitative performances would also strengthen the tool. However, this should be done critically as the dimensions of stations differ. Lastly, testing and validating the tool in other real-world planning processes would help improve the use of the comparison tool in stakeholder conversations. Furthermore, there are some recommendations for Amsterdam specifically. Firstly, following the examples of Madrid, La Défense, Stratford and Wembley, the implementation of a mezzanine level or pedestrian bridges over the tracks would resolve the vertical transfer bottleneck and provide some internal buffer zones to manage the crowds more safely before reaching the platforms. As validated, this should go in line with the safety standards and regulations.

Secondly, some stations in the cross-case analysis were designed and dimensioned specifically based on event peak capacity, prioritising reliable performance during peak demand. Once Amsterdam is expecting a lot of growth besides the event demand, dimensioning the station for bigger capacity will also be future-proof. This dimensioning should be compensated for with safe and lively conditions during quieter daily scenarios. Moreover, the Municipality of Amsterdam should consult the Municipality of Rotterdam regarding their ‘dual state’ design. While Amsterdam faces some and perhaps also more spatial limitations than Rotterdam, the flexibility of changing physical differences between daily and event use should be further explored.

Concerning events, event and transport operators should consider ‘event boosted’ transport options, which either improve the frequency of transportation options, or use a mode which is a ‘direct’ or ‘express’ option to different nearby hubs like Amsterdam Centraal or Utrecht Centraal. In addition to events, the crowd management should implement stop-and-go tactics. Currently, the municipality of Amsterdam uses physical barriers to separate crowds before entering the station. However, the implementation of stop-and-go measures in the public space will result in positive consequences inside the station, as it will be less crowded. This will enhance the visibility, calmness and therefore safety of all travellers.

In conclusion, the redevelopment of Amsterdam Bijlmer ArenA requires improvement. It must evolve from a transit node that is now tolerating events into a dynamic system that is designed to handle both the events and the daily usage. By adopting the maturity-based frameworks and steps in this thesis, stakeholders can bridge the gap and start conversations during the planning process. Stakeholders can learn from different cases, as well as identify and design ambitious urban developments and practicalities when it comes to moving masses of people into and around transit nodes.

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# 1. Introduction

## 1.1. Background

The degree of urbanisation in the Netherlands was just above 93 percent in 2023 (O'Neill, 2025). Our capital, Amsterdam, is the biggest city in the Netherlands and has different fast-growing parts. One of these parts is the Zuid Oost Area. By 2030, more than 30.000 new homes will be built, as the city expects to grow by 40% of inhabitants by the year 2050 (O&S Municipality of Amsterdam, 2024). Public transport is crucial for the residents of Amsterdam to get around the city. The Dutch government has a clear goal, which states that not only now, but also in 2040, everyone in the Netherlands must be able to travel by public transport in a fast, comfortable, reliable, and affordable way (Dutch government, n.d.).

One of the bigger transport hubs in Amsterdam is the Amsterdam Bijlmer ArenA Station (ABAS). The station is a hub for the train, metro, and buses of the agglomeration area of Amsterdam, with several shops and horeca facilities in the surroundings. Such highly connected transport hubs, driven by commercial and social activities, play a key role in population growth (Floerl et al., 2009). Amsterdam Bijlmer Arena serves the citizens and labourers in the area and is the main entrance to the biggest event area in the Netherlands. Daily, the station serves around 10.000 people, while it doubles when there are big events. Some of these big events are the so-called triples, this is when the Johan Cruijff ArenA, the AFAS Live and the Ziggo Dome simultaneously host an event. With around 10 million visitors to events a year, it reaches a serving scale of up to 200.000 people a week (APPM, 2024).

Both the demographic surge and the existing peak-use during events intensify the demand for the public transport infrastructure ABAS has. One of the infrastructure limitations is the current issue of overcrowding during peak times with events. In addition, there is limited bicycle parking, and there is a need to improve and expand the bus station. When it comes to transfer efficiency, there are a lot of obstacles which disturb the transfers between modes of transport within the station. Lastly, there are challenges and a lot of potential in passenger comfort, safety, and the overall satisfaction of the travellers (VPRC, n.d.; Grimshaw, n.d.; APPM, 2024).

## 1.2. Problem, opportunity and purpose

Amsterdam Bijlmer ArenA Station faces increasing pressure from event-related peak travel demand, combined with the long-term urban growth of Amsterdam Zuid Oost. The station functions as one of the main multimodal hubs in the Amsterdam region, and its infrastructure and operations are being stretched during large events. And other limitations are also putting pressure on the station, limiting the transfers, passenger comfort and safety (VPRC, n.d.). At the same time, responsibilities for addressing these challenges are fragmented across multiple stakeholders, including transport operators NS and ProRail and the municipality of Amsterdam.

There is also a clear opportunity: ABAS is a highly specific case within the Dutch public transportation system, combining a major multimodal hub with one of the largest event districts in Europe. Comparable contexts are rare within the Netherlands, meaning that there are no similar stations for a national benchmark. Moreover, there is currently no structured comparative framework that systematically captures and evaluates stations across multiple dimensions like challenges to peak demand, governance complexities and spatial integrations, which can be seen as a problem in this case. Therefore, a systematic benchmark against international best practices can reveal measures that are relevant and adaptable to ABAS. Such a comparison can also show which aspects of planning and implementation are likely to succeed within the Dutch context.

The purpose of this research is therefore to develop a Comparison Tool that integrates physical, operational and governance aspects to position Amsterdam Bijlmer ArenA Station relative to comparable European cases. Bekiaris et al. (2020) state that transport in Europe is generally well researched; however, due to some fundamental changes, such as new technologies and new services, public transport systems are affected and therefore have potential for more research.

By creating this tool from an embedded unit (confined) case analysis and applying this tool to ABAS and to selected international cases, the research aims to produce actionable lessons that can inform and help stakeholder discussions in the early stages of decision-making in redevelopment and transformation processes. In addition, it tries to examine and evaluate the complex redevelopment process of Amsterdam Bijlmer ArenA and search for transferable lessons that help within this context specifically. This leads to two separate main questions, which slightly intertwine with each other:

1. *"How is the redevelopment of Amsterdam Bijlmer ArenA station approached in terms of integrated decision-making, and what lessons can be drawn from comparable international transit-nodes in event context?"*
2. *"How can recurring aspects from international cases be systematically operationalised in a Comparison Tool, and how can this tool be implemented and applied to a complex multi-actor infrastructure project like ABAS?"*

## 1.3. Scope

This thesis will merely focus on how the train station as a whole works, therefore progressing on the problem analysis of the whole ABAS area. To do this, performing a system analysis and understanding which stakeholders play in which arena is necessary to understand the complexity of the decision-making processes, organisation, infrastructure, and governance of ABAS. This will also be the focus fields for the other stations included in this research.

Initially, the thesis will not focus on the financial aspects of the complex problem. The thesis will not dive into the construction technicalities and its technical design, nor into the jurisdictional aspects of the renovation of train stations, as these are not part of the study's background. The thesis will talk about design principles of the station, which contribute to the safety & security or to the general crowd management.

## 1.4. Relevance

This thesis research is valuable for both the academic field and in practice. Its relevance contributes to the scientific and societal field, as well as being within the Master's guidelines.

### 1.4.1. Scientific

From a scientific perspective, this thesis contributes to the challenges of integrated decision-making in complex infrastructures, such as transit-nodes near major event locations. The study will develop comparative insights across European Transport hubs near event sites and propose a tool to guide such systems within their redevelopment processes. This adds to the limited body of research that combines infrastructural, operational and governance aspects of major transit hubs adjacent to event sites. In addition, the thesis will find out whether this methodology is useful to create a generic comparison tool. In addition, it uses, applies and extends existing scientific frameworks, such as the Basic types of Design for Case Studies by Yin (2003), the Layer model of Transportation and system decomposition for the analysis of ABAS, and for the tool, a variation of the Capability Maturity Model Integration framework.

### 1.4.2. Societal

From a societal perspective, this research is directly relevant to the consultancy VPRC, their client, the municipality of Amsterdam, as well as other stakeholders involved in the redevelopment of the ABAS. By systematically analysing challenges and best practices, this study provides an overview of which sub-systems of ABAS have potential for improvements. The outcomes will contribute to the development of a Comparison Tool that supports integrated decision-making and starts stakeholder conversation in future station area redevelopments. More broadly, these insights can be transferred to comparable projects across Europe, offering practical guidance for cities that seek an integrated approach to developing their transport hub. The aim is that all transit-nodes in an event-related context in Europe can be measured in the tool.

### 1.4.3. MSc Complex Systems Engineering and Management

Furthermore, this thesis is in line with the CoSEM guidelines. The Amsterdam Bijlmer ArenA station seeks solutions to redevelop the station on both technological components, as well as on process management components. Since the public transport networks and human transport flow are discussed, both technical and physical features are examined, as well as the crowd management and process management of events. The station area and transport modes are in the public domain, while the event sites have their private needs and goals, ensuring the complexity of the thesis. The designed tool attempts to bridge the gap between the different domains and stakeholders, through creating a base setting for stakeholder dialogue. Lastly, several CoSEM methods can be applied to create and design the comparison tool.

## 1.5. Outline of the thesis

This thesis will have a logical sequence; Chapter 2 explains the methodology. Here it is mentioned that there are two different parts and four separate phases. This chapter explains how they interact with each other. For the outline, it is important to know that the first part is based on empirical research and the comparative analysis, while the second parts focus on designing and applying the Comparison Tool. Therefore, the first part is more stand-alone than the second part, as all the design steps are needed for full understanding.

In Chapter 3, a literature analysis is conducted, diving into terminology which is necessary for the next steps. The fourth Chapter focuses on Amsterdam Bijlmer ArenA Station and its surrounding area, where a case analysis is conducted with both empirical research and interviews. Chapter 5 does similarly for other respective cases at different European transit nodes, however, not in the same depth as Amsterdam, but on a more abstract and specified level.

Furthermore, in Chapter 6, the recurring patterns are discussed and the type of framework which is the foundation of the Comparison Tool. The next Chapter, 7, will apply the tool to European Cases, as well as to the case of Amsterdam. Chapter 8 consists of an explanation on how the tool should be implemented in decision-making, as well as a validation step by an expert and what the tool means for Amsterdam Bijlmer ArenA Station.

Chapter 9 will feature the discussion of the research and its methods. Furthermore, Chapter 10 consists of the conclusion, specified in conclusions on the tool, conclusions on the cases, and answers the main question. Then, Chapter 11 will end with some policy & research implications and future research recommendations. Finally, Chapter 12 ends the thesis with a final reflection. After that, the TPM AI Statement can be found before the bibliography. In the back of the thesis, there are several Appendices with some more information on graphs, the tool, and the summaries of the interviews taken.

# 2. Thesis Project Methodology

This chapter explains the Thesis Project Methodology, in which all the different steps and phases of the thesis are described, as well as the general research approach for the literature review. Section 2.2 explains the procedure stepwise, showing what part answers what sub-question. After this, the thesis project methodology is summarised and systematically shown as an outline for the research.

## 2.1. Research Strategy and Theoretical Foundation

This paragraph provides an explanation of the research approach. This approach is mainly focused on the literature, which is necessary to execute because of the necessity to fully understand the core subjects of the thesis. The literature review will also develop insights which are useful for further research of this thesis. The literature is divided into the multimodal transport hub (MTH) and event management, as well as briefly covering aspects of governance and decision-making in major infrastructure projects. These main themes are chosen because the Amsterdam Bijlmer ArenA Station and its area is connecting the complex transport sector with the dynamic event sector within its radius. With a logical flow, these subjects form the basis for the research, which help understanding the problem statement and to form the basis of a comparison framework.

Searches have been conducted using academic databases such as Google Scholar, Science Direct and Research Gate. For the cross-case comparison, documents need to be found via 'normal databases,' like Google Search. Key search queries for the literature analysis include combinations of the following terms:

- 'Multimodal Transport Hubs' AND 'Stakeholder collaboration in infrastructure projects'
- 'Multimodal Transport Hubs' AND 'Urban Mobility'
- 'Decision-making frameworks' OR 'Stakeholder collaboration in infrastructure projects'
- 'Multimodal Transport Hubs' OR 'Event venues' AND 'Europe'
- 'Multimodal Transport Hubs' AND 'Comparative Case studies'
- 'Event Management' OR 'Crowd Management' AND 'Case studies in Europe'

These terms will be refined based on the search results. The literature will help to understand the complexity of infrastructure projects at MTHs into broader scientific themes, such as stakeholder collaboration in socio-technical complex situations, how MTHs serve their surroundings and integration of certain methods of comparative case studies in this field.

Iterative processes also took place for the literature analysis. The empirical research resulted in new subjects and aspects of transport nodes in event-context, such as the term *nudging* or understanding how the *MIRT processes* work (Meerjarenprogramma Infrastructuur, Ruimte en Transport). These are also included in the literature review and written in the most logical place.

## 2.2. Four-Phase Research Design

In this subchapter, the methodology for this research is explained in detail. To address the dual nature of this study, the methodology is structured into two parts, which are further divided into four distinct phases, which are shown in Figure 1 below. These different phases with each their own methods will answer the two main questions, which combines empirical analysis with a design-oriented research. There are seven different sub-questions, which belong to a specific step in the process; these will be discussed in the following sections (2.2.1. and so on).

**Part A: Empirical and comparative Analysis (Phase 1 & 2):** In *'Phase 1'*, The Case of Amsterdam Bijlmer ArenA Station is analysed through three different sub-steps, together with a Literature Analysis. These steps give input for the list of Aspects / Embedded Units (explained in 2.2.3). '*Phase 2'* is where different international cases are selected and analysed according to the Embedded Units. This is done iteratively, as some cases couldn't provide enough valuable information. The information from these cases is finally used in the comparison tool, which includes lessons from the Cross-case analysis of Embedded Units.

**Part B: Design and Application (Phases 3 & 4):** The third phase, '*Phase 3',* is where the recurring patterns of embedded units in the cross-case comparison is analysed. These patterns are used for the comparison and for the design of the Comparison Tool. The last sub-step is also included in '*Phase 4*', because the design of the tool and its application also have some iterative steps when it comes to making and testing. One the one hand, the application consists of using the information from the Embedded Unit Analysis in the tool, defining and scoring the performance of the transit node. And on the other hand, the application consists of an explanation and setting in which the tool could be used in complex decision-making.

Lastly, Phase 4 consists of applying the tool with the information of the Case Analysis of Amsterdam Bijlmer ArenA Station, providing tangible and practical recommendations for both Amsterdam and the tool in general. Although done in Part 2, the recommendations for Amsterdam fit to answer Main Question 1, while the recommendations for the tool fit to the answer to Main Question 2.

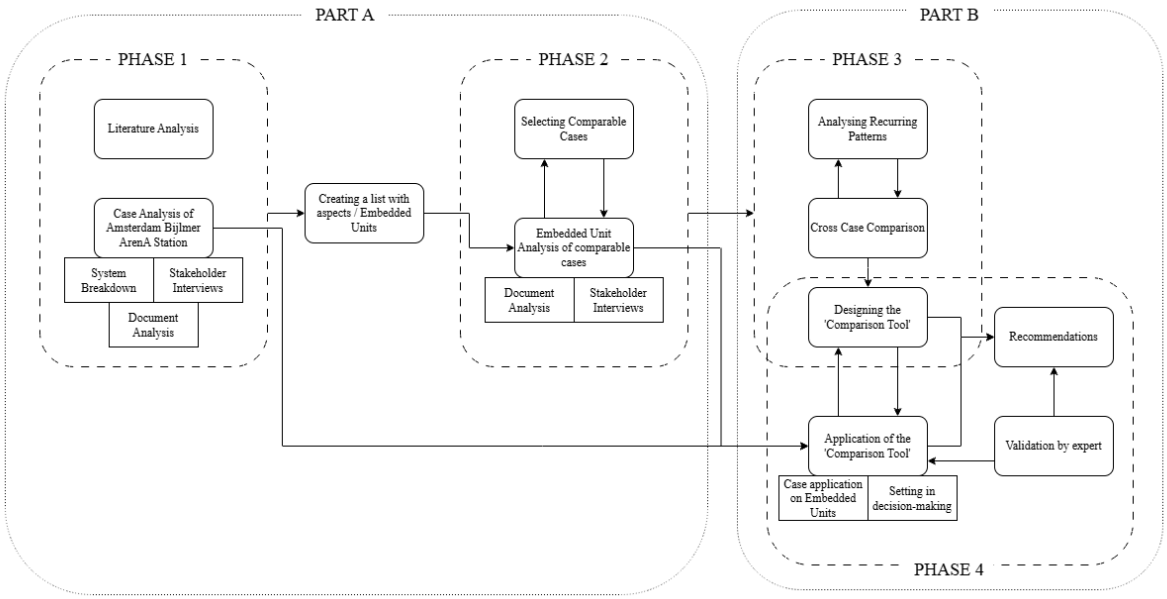



*Figure 1 - Thesis Project Methodology*

In Appendix A, this thesis project methodology is enlarged.

## 2.2.1. Phase 1: Literature Analysis and Case Analysis of Amsterdam Bijlmer ArenA Station

The literature analysis allows for explaining the basics of terminology used in this thesis. The findings from the literature will be used for the creation of a list of aspects. The literature review is more generally structured and not specifically applied to the case of ABAS. Namely focused on four main fields: 'Multimodal Transport Hubs and Urban Mobility', 'Mobility and Event Dynamics', 'Event Management

and Operational Challenges' and 'Governance and decision-making in Complex Infrastructure Projects'. Further information on the literature and its approach can be found in 2.1.

Moreover, the case analysis of Amsterdam Bijlmer ArenA Stations tries to seek an answer to the first sub-question: *How is integrated decision-making currently organised in the redevelopment process of Amsterdam Bijlmer ArenA Station? –* As the station is not only a multimodal hub embedded in a unique urban environment, Amsterdam Zuid-Oost and the ArenA Poort, a rapidly growing area in both demographics and economic aspects, it is also the entrance to the largest event area in the Netherlands. Hence, understanding how decision-making is structured, both for the renovation of the station as well as for management during events, is an important aspect in the case analysis. This step requires understanding how all the actors involved interact with each other. The method for this sub-research is stakeholder interviews and a brief stakeholder analysis.

To further approach this first phase, a document analysis, several stakeholder interviews, and a system decomposition will be executed, the latter referring to answering the second sub-question: *How do all the systems at ABAS interact with each other and why does that make the area so unique? –* Understanding the complete system in and around the Amsterdam Bijlmer ArenA Station is necessary to identify the unique interactions during event peaks, as well as during daily usage. This will develop further on understanding the complexity of the decision-making and thus on the answer to sub-question one. The methodology for this sub-question is a system decomposition. This step required both empirical analyses, as there are already many documents available from previous research about redeveloping ABAS, as well as using theoretical frameworks to actually execute the system analysis. The system analysis is done through three frameworks, as well as the earlier-mentioned document analysis and stakeholder interviews, to better understand the complexities of the area. Concluding this sub-method as a triangulation of methods.

### 2.2.2. Creating a list of Aspects / Embedded Units

Before going to the third sub-question, an intermediate step of 'Creating a list with Aspects / Embedded Units' is done. This step is a follow-up from the first Phase, whose information gives input to systematically analyse different cases. For this, a theory on comparative case study needs to be explained. Namely, within a comparative case study, the aim is to compare two or more cases to identify similarities, differences, and patterns. After which, it may develop explanations or generalisations that are easier to share across cases (Goodrick, 2014). Before being able to analyse recurring aspects in *Phase 3*, this study adopts a version of a multiple embedded case design, based on the framework by Robert K. Yin for cross-case comparative analysis. Yin defines case studies as *"an empirical inquiry that investigates a contemporary phenomenon (the 'case') in depth and within its real-world context"* (Yin, 2014), using multiple sources of evidence and emphasising contextual differences where the line between the case and the context might be blurred. In a multiple embedded case design, each case contains more than one unit of analysis, allowing for both within-case and cross-case comparisons along specified dimensions (Yin, 2003). Figure 2 below shows that the design for this thesis is based on the fourth quadrant of the framework.

The aim of this thesis is not to treat each station as a single complete unit, but rather to compare specific aspects across multiple event-related (rail) transit nodes. This is therefore the definition of the cases used: event-related transit nodes in a metropolitan context instead of stations. Traditionally, multiple case studies typically require each case to be analysed holistically and in similar depth (top row in figure 2), which is not practical in this case due to varying data availability and the scope among transit-nodes. Instead, this study uses embedded units, defined as aspects relevant to the station performance, to ensure valid comparison without asking for equal depth across each of the cases.

Yin (2003) uses the replication logic within the multiple embedded case study. This means that similar elements are compared across different cases. In this thesis, the selected aspects (embedded units) are analysed across several event-related transit nodes. The replication does not take place at the level of the full cases, but at the level of these specific embedded units. This means that the complete cases are not analysed in the same depth. Instead, the focus is on comparing the chosen aspects across cases in a structured way. By doing this, recurring patterns and differences between transit nodes can be identified, while still recognising that each case has its own local context. Amsterdam Bijlmer ArenA Station functions as the base case. Therefore, it is analysed in greater depth in Phase 1. The other cases are examined mainly through the selected embedded units, in order to support the cross-case comparison.

The list of aspects, thus the embedded units, flows logically out of *Phase 1.* The literature analysis, together with the system decomposition of the ABAS case, gives the basis for the list of aspects. The list of aspects is created and based on the system analysis, especially the Handelingsperspectief by Goudappel (2022), and the literature analysis on crowd and event management tactics. This list is crucial for *Phases 2 and 3*, as it is the basis for examining the different cases, as well as the basis for the Cross Case Comparison. When going into research *Phase 2*, the critical consideration of not using ABAS too much is executed, because this would otherwise create too much bias.

The embedded units consist of mobility criteria of the transit node, security systems, event and crowd management conditions and governance and stakeholder collaboration structures. This basis allows to systematically analyse cases on the embedded units. Moreover, in *Phase* 3, the cross-case comparison will reveal both differences, as well as commonalities, helping to gain context-specific and general lessons for event-related transit nodes.

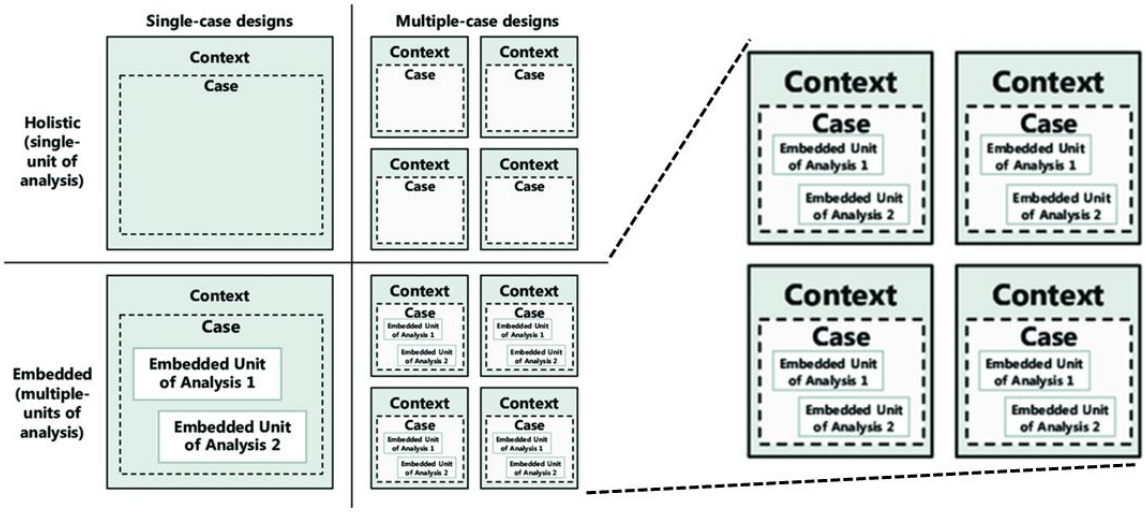



*Figure 2 - Basic types of Design for Case Studies (Yin, 2003)*

## 2.2.3. Phase 2: Case Selection and Embedded Unit Analysis

The second Phase identifies which international cases are suitable for comparison with ABAS, and therefore answers the third sub-question: *Which international multimodal hubs adjacent to major event venues provide relevant cases and based on what criteria?* – This question is both a 'do-question' and a 'research question'. As this phase is selecting cases, a long-list was completed, based on transit-nodes where the surrounding context, such as an event area, urban centre and extensive economic activities are similar to that of ABAS. In addition, cases are considered which have recently been, are currently in, or are planning a redevelopment of the station area soon.

Here, the iterative step of Phase 2 comes, as once the cases are being analysed on the Embedded Units, more specific criteria must be applied to shorten the list and determine which transit-nodes remain on the short-list for the in-depth analysis. In this step, 4 criteria are set up, which can be found in 5.1. If at least 3 out of the 4 criteria are checked off, the case will be further reconsidered. Moreover, the critical criterion of whether enough data is available, or if a station or project manager is available for an interview, finally determined the cases for this thesis research. Going from 13 cases of the long list to 8 cases in the research, of which 5 cases include an interview with a project or station manager.

The cases are further examined based on document analysis and some on interviews. The combination of these two is, therefore, the sub-method of this phase, a triangulation of methods. Similar to the Amsterdam Bijlmer ArenA case combining different types of qualitative and quantitative research, combining all the possible sources of information to develop the embedded unit analysis for the cases.

In this phase, two cases consist of so-called 'vignettes'. Miles & Huberman (1994) defines vignettes as *'compact stories that can be used to predict events, to highlight specific highlights and to sum up a particular topic or subject'*. For these specific cases, the data availability was more limited to the primary cases, as also no interviews could be conducted. However, the available documentation provided valuable information that were too relevant to exclude. By using the vignette approach, these cases function as a small summary that capture the most interesting and useful aspects of the transit-node and its surroundings. This allows for more options for a comparison, even though the depth of data differs across the cases (Hoelz & Bataglia, 2024).

#### *2.2.3.1. Document analysis approach*

A document analysis is executed on the cases which are considered to be in the short list. This involves collecting project reports, planning documents, policy papers, and evaluations, which must be available through online databases. The document analysis allows for the identification of the set of embedded units, which are later used for the input of the comparison tool. The accessibility of these types of documents is crucial for the transit-node to develop from the long list to the short list. If limited documentation is easy to access, the station is dropped.

#### *2.2.3.1. Stakeholder interviews*

Early in the process of the thesis, the researcher reached out to project managers, transportation companies and other local authorities to get in touch for an interview. Several interviews have been held online, while the researcher also went to visit Madrid and London. The interviews are considered as crucial data points, including qualitative data on event and crowd management, safety aspects and decision-making practices. Interviews provide insights which documents often cannot reveal, and more in-depth questions can be asked when a specific case becomes very familiar with ABAS. Some cases have been dropped due to the fact that the needed people were not willing to participate in an interview.

### 2.2.4. Phase 3: Cross-case Comparison and Designing a 'Comparison Tool'

In this Phase, the method is explained in 2.2.2. is crucial for this part for the subparts of Analysing Recurring patterns and doing the Cross Case Comparison on the derived Embedded Units. Therefore, this part addresses the fourth question: *What are the recurring aspects and lessons that can be used in the cross-case comparison?* – The Multiple Embedded Case Design, together with the replication logic, compares the units on mobility aspects, events and more general aspects like safety and governance. This step is much different from the steps in Phase 2, as that Phase is still within the research of cases, while this Phase is based on analyses, helping to understand patterns and recurring aspects.

Together in the third and fourth phases have some overlap in the design of the tool. This is because the cross-case comparison serves as the input for the design of the tool, while in the fourth phase, there is some iteration on the tool. The fifth question: *How can the identified aspects be operationalised into criteria that form the basis of a Comparison Tool?* – is therefore done and made in *Phase 3*, but its final answer is in *Phase 4*, in Chapter 7. This Comparison Tool is an artefact which is designed and built upon the results of *Phases 2 and* 3. The answer to the fourth question is also located in this sub-chapter.

The development of the Comparison Tool aims to bridge the gap between research and practice. By combining the recurring pattering into a checklist per specified aspect, the Comparison Tool is designed. The Tool is also tested on several frameworks, each of which has their own advantages and disadvantages. In the end, the Capability Maturity Model Integration (CMMI) is used as the conceptual backbone for the tool and is therefore the base sub-method. As the conceptual backbone of this tool is focused on organisational and development progress through different phases and it can be applied to the mobility and transport sector (Eruyar & Özen, 2025). This tool uses the bottom-up CMMI approach, assessing each station and its embedded units at a different maturity level (Becker et al, 2009; Lehrman et al., 2011). Allowing to compare transit-nodes on the maturity of processes and organisational structures. The Comparison Tool will incorporate both quantitative thresholds and qualitative process markers. Finally, the scores are plotted on a Radar Chart. This visualisation enabled decision-makers to identify maturity gaps across the different embedded units.

Hence, the ambition and aim of the tool is to support decision-makers by providing a structured way to assess and compare transit-nodes in the event-related context. As many of the researched nodes are in the (early stages) of their redevelopment process, it is interesting to learn from the other international cases. This tool is further explained in Chapter 6.

### 2.2.5 Phase 4: Finalising the Tool, Application, Implementation, Validation and Recommendations

The last step in this research is Phase 4, in which the Design of the Tool gets finalised, with iterative improvements if needed after applying the Comparison Tool to the cases. As mentioned earlier, this phase will therefore answer the 5$^{th}$ question.

Before being able to validate the tool, it is necessary to create the setting for the usage of this tool. Why and how should to tool be used in the complex decision-making context. Therefore, this phase will also answer the 6$^{th}$ sub-question: *How can the Comparison Tool serve as a strategic instrument for stakeholder dialogue in complex infrastructure projects?* – This sub-question allows to ask the questions ‘Who?, When? and How?’ to bridge the gap between the tool as an artifact and the implementation in real-life infrastructure projects. In this part, the application tool will also be validated by an expert. This is done to verify the understanding of the Amsterdam case, as well as to evaluate the comparison tool. Therefore, the recommendations and conclusion will not only be focused on Amsterdam, but also with respect to the effectiveness and validity of the tool itself. The experts' feedback will serve as a reality check for the recommendations. The method to tackle this question is to understand some basic ‘Boundary Objects Theory’ and to apply that in the context of major infrastructure projects.

Finally, as the Tool is completed in Phase 4 and ready to use, the information from *Phase 1* on the Case analysis of Amsterdam Bijlmer ArenA Station will be used and applied to the tool. Here, the 7$^{th}$ question will be answered: *What are the results of applying the Comparison Tool to ABAS and what recommendations and conclusions can be made for the ABAS redevelopment process?* – This step will therefore consist of the recommendations following from the lessons learned from the cross-comparison

of the embedded units analysed. These recommendations are categorised into general design principles and event scenarios to set up the specific recommendations for ABAS.

So, this Phase allows us to draw a conclusion from the tool on two levels: First, regarding the station performance of ABAS, secondly, on the effectiveness and validity of the tool itself. Therefore, the sub-methodology is the expert validation for reliability and validity. This will prove that the tool is not only a theoretical exercise following from this thesis, but also a functional instrument that can be used by professionals in the field of station and area management.

## 2.3 Research Questions and Analytical Framework

To address the main question systematically, it will be separated into six sub-questions (SQ). These questions follow a logical sequence: first analysing ABAS, then identifying international best practices, and finally incorporating the lessons learned into a functional tool. Figure 3 shows the Phases together with their questions, and Table 1 on the next page maps each question to its corresponding method, phase and chapter.

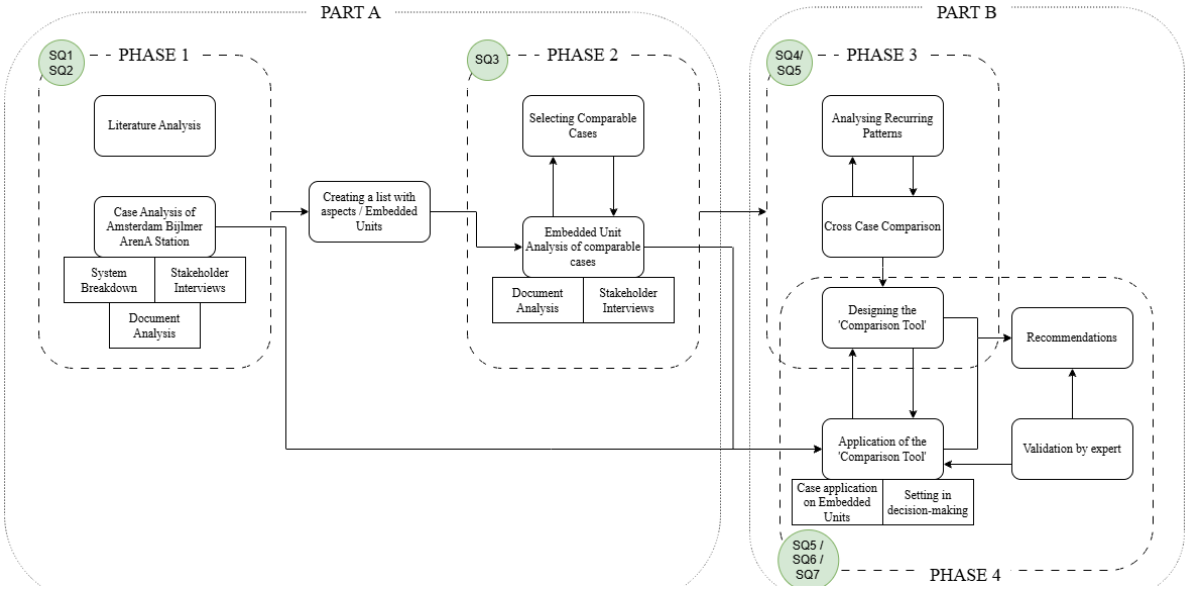



*Figure 3 - Thesis Project Methodology including where each SQ is discussed*

The figure above is enlarged in Appendix A.

Table 1 – Sub-questions - Method – Part - Phase - Chapter

| SQ | Questions | Method | Part | Phase | Chapter |
|---|---|---|---|---|---|
| 1 | How is integrated decision-making currently organised in the redevelopment process of ABAS? | Stakeholder Analysis & Stakeholder Interviews | A | 1 | 4 |
| 2 | How do all the systems at ABAS interact with each other and why does that make the area so unique? | System Decomposition, Stakeholder Interviews, Document Analysis | | 1 | 4 |
| 3 | Which international multimodal hubs adjacent to major event venues are most comparable to ABAS, and based on what criteria? | Multi-criteria Selection, Triangulation of Document Analysis & Interviews | | 2 | 5 |
| 4 | What are the recurring aspects and lessons that can be used in the cross-case comparison? | Multiple Embedded Unit Analysis & Replication Logic | B | 3 | 6 & 7 |
| 5 | How can the identified aspects be operationalised into criteria that form the basis of a Comparison Tool? | CMMI Framework Adaptation | | 3/4 | 6 & 7 |
| 6 | How can the Comparison Tool serve as a strategic instrument for stakeholder dialogue in complex infrastructure projects? | Boundary Object Theory & Expert Validation | | 4 | 8 |
| 7 | What are the results of applying the Comparison Tool to ABAS and what recommendations and conclusions can be made for the ABAS redevelopment process? | Case Application & Expert Validation | | 4 | 8 |

These six sub-questions represent different research types. SQ1 through SQ4 are primarily ‘descriptive and exploratory questions’, more focused on gathering empirical insights and identifying lessons from international cases. While SQ5 and SQ6 are ‘design-oriented questions’, focusing on creating the Comparison Tool as an artefact and validating the work. Therefore, as discussed in 2.2, there are two parts, which both answer a different main question.

**Part A: Empirical and comparative Analysis (Phase 1 & 2):** *"How is the redevelopment of Amsterdam Bijlmer ArenA station approached in terms of integrated decision-making, and what lessons can be drawn from comparable international transit-nodes in event context?"*

**Part B: Design and Application (Phases 3 & 4):** *“How can recurring aspects from international cases be systematically operationalised in a Comparison Tool, and how can this tool be implemented and applied to a complex multi-actor infrastructure project like ABAS?”*

# Part A: Empirical Research and Comparative Analysis

# 3. Literature Review and Conceptual Foundations

This part consists of the literature analysis on several subjects which are tackled in the thesis. This will be divided into the multimodal hub close to an event centre, which roughly describes what multimodal hubs mean in urban and event contexts. Secondly, the literature dives into governance of major infrastructure projects, as well as event management around transport hubs.

## 3.1. Multimodal Transport Hub and Urban Mobility

This section dives into the definition of Multimodal Transport Hubs (3.1.11) and what their effects are on the city and its surroundings (3.1.2). In 3.3.3. The literature analysis delves into the basics of Transit-Oriented Development.

### 3.1.1. Definition of Multimodal Transport Hub

In 1997, the European Commission defined intermodal transport: “Inter-modality is a characteristic of a transport system that allows at least two different modes to be used in an integrated manner in a door-to-door transport chain. In addition, intermodal transportation is a quality factor of the level of integration between different transport modes.” To extend on this, mobility hubs are described as mechanisms that help create a sustainable transport network, and in the last 20 years, they have been integrated into the transport systems of many cities. Initially, these hubs were introduced to address the shortage of parking spaces and therefore to promote public transport (Karbaumer & Glotz-Richter, 2021).

The effectiveness of a multimodal transport hub (MTH) largely depends on the degree of integration between different transport modes, both physically and digitally. The European Commission (2023) explains through a resolution that the role of hubs is increasingly crucial for the connectivity within cities. As they allow travellers to switch between trains, metros, buses, and bicycles, enabling them to switch modes quickly within the same station area, referring to the physical integration. On the other hand, MTHs increasingly rely on digital and operational integration to optimise user experience and system efficiency. For example, Mobility-as-a-Service (MaaS) frameworks provide platforms which integrate planning, booking and payment across different transport providers, where the Dutch 9292-app is a precursor of (Li & Vroege, 2018; Bassant, 2022). Such integration at MTHs asks for good collaboration among public authorities, transport operators and other (private) mobility providers (Kamargianni & Matyas, 2017). As a result, the MTH evolves beyond the physical interchange into a complete networked mobility system that supports urban travel across regional and national scales.

As mentioned above, MTHs have evolved and transformed significantly throughout the 21st century. They are no longer merely transit nodes; the surrounding spaces have diversified functions as well. Research on MTHs in urban transformation areas in Barcelona, Berlin, and London shows that MTHs act as catalysts for urban transformation and are correlated with economic investments (Anton et al., 2025). An MTH is more spatially and functionally complex compared to a conventional railway station. Next to their transport function, MTHs serve as drivers of sustainable urban regeneration, which encourages economic activity while reducing car dependency (Nikitas et al., 2025). New MTHs and improved MTHs therefore have several effects on the surrounding environment, as explained in the next section.

### 3.1.2. Effects of Multimodal Transport Hubs in the Urban Context

The transformation of MTHs improved its transport function, because connectivity and accessibility advances within urban and regional transport networks. As integrating various modes of transportation helps reduce the congestion on roads, it shortens the travel times, and it expands the mobility options for residents, workers and visitors of an area (Interreg Europe, 2025). If designed properly, there is potential for an MTH to develop into a great opponent for private car use and as a MaaS (Mobility as a Service) companion. In addition to the transport-related issues, an MTH can also develop into a place of social prosperity and as a supporter of the wider economy (Nikitas et al., 2025).

From a social perspective, investing in the improvement of an MTH leads to gentrification, which is when a (poorer) urban area is changed by improving housing, businesses and the urban environment. New and improved MTHs lead to the displacement of lower-income residents and small businesses. In addition, commercial gentrification can transform the retail environment, impacting local economies and communities 'identities. After hub interventions, there are also changes in walking behaviour across different genders and age groups (Villanueva et al., 2025).

From an economic perspective, already in 2002, the OECD Working Group stated that infrastructure investment that improves accessibility can boost regional performance. Going forward to transport infrastructure, it is an important element for economic growth and mobility for people, while higher economic growth also impacts positive revenues and allows for greater demand for good infrastructure, thus further stimulating improvement of transport conditions (Saboori et al., 2014). Research by Cigu et al. (2018) confirmed the positive relationship between investment in transport infrastructure and economic growth and public sector performance in the 28 EU countries. Their findings emphasise that improved transport infrastructure is not only a driver of economic growth but also a key policy lever for ensuring long-term sustainable development. Effective coordination among policymakers and public institutions is therefore essential to maximise efficiency, stimulate investment, and maintain a resilient growth path across EU economies (Cigu et al., 2018).

### 3.1.3. Transit Oriented Development (TOD)

Transit-Oriented Development (TOD) principles highlight the importance of integrating land use, mobility, and governance in infrastructure planning, often to reduce car dependency and promote sustainable transport and transit stations (Ibraeva et al., 2020). TOD's approach of urban development around railway networks builds on strategies applied since the early 20th century in the U.S. and Europe (Papa & Bertolini, 2015). In the context of multimodal transport hubs, TOD provides multiple benefits, such as boosting public transport ridership, increasing biking and walking and supporting economic growth (Papa & Bertolini, 2015). Zamir et al. (2014) concluded that TOD residents make more trips, have a more active lifestyle and a higher quality of life. As well as the fact that TOD residents take transit more often than residents in non-TOD zones, and their trips are, on average, 25% to 40% shorter than those of residents in non-TOD zones. Moreover, Papa & Bertolini (2015) did a comparative analysis of six European metropolitan areas. Showcasing that rail-based accessibility is higher in cities with a higher TOD degree. Cities where jobs and population densities are spatially concentrated along highly connected rail corridors achieve significantly higher accessibility levels.

Ibraevea et al. (2020) show similar effects of TOD concerning MTH. The mobility effects are strongest when TOD combines with high densities, mixed land uses and pedestrian-friendly design. In addition to travel behaviour, TOD is associated with higher real-estate values around stations. Although it also

contributes to gentrification and affordability issues. TOD can also influence the form urban areas take, like more compact metropolitan structures and mixed-use developments, while impacting community life and social cohesion are more context dependent. They also mention that TOD implementation requires governance challenges due to its complexity. Successful TOD requires very close coordination between stakeholders like transport agencies, governmental authorities, and private developers, often at a regional scale (Ibraeva et al., 2020). This transport planning and its complexity are also acknowledged by Papa and Bertolini. They state that accessibility performance of hubs depends on coordination between transport services, infrastructure institutions and spatial developers.

## 3.2. Mobility and Event Dynamics

Large events place significant pressure on urban mobility systems, often resulting in temporary congestion and decreased transport efficiency (McGillivray & Duignan, 2022). Events such as football matches, concerts, fairs, and other large gatherings not only bring cultural and economic benefits but also stress transport infrastructure (Garrido et al., 2023). These events influence how people move and interact with their surrounding environment (Giulianotti et al., 2014). When for many people the purpose of travel is to attend an event, the travel demand is heavily constrained in time and space. This is due to the fact that visitors share a common location and therefore also very similar optimal times of travel. The impacts of the peak period of transport are often very intense for the transport infrastructure (Robbins et al., 2007).

More generally speaking, because mega-events and event areas attract hundreds of thousands of visitors, it can be seen as a catalyst for urban development of a metropolis. The big event sector creates an opportunity for a city to gain the status of a global city and thus play a big role in the urbanisation of modern cities (De Menezes & Souza, 2014). These opportunities can be translated to the requirements of the transportation system around event areas within main cities; therefore, events can be used as a tool to pressure for desired changes (Ballarano et al., 2022). Organising the surroundings of event areas can improve transportation and mobility in urban areas (Kassens, 2009).

On the other hand, event mobility therefore goes further than only physical transport systems, managing crowds before, during and after events requires careful planning, dynamic decision-making, and innovative solutions, which should be integrated into the planning and regulation of events and around venues (Robbins et al., 2007; Tian et al., 2023). Even though events are hosted in privately owned venues, the resulting crowds are managed in public spaces such as streets, squares, and parks (Smith, 2016). Numerous policies have been developed to mitigate the effects of peak demand during events; however, such measures also produce negative externalities for residents (Garrido et al., 2023).

In order to mitigate event-generated impacts on the transport system, stakeholders responsible for planning and managing travel during events must tackle and manage the flow of people (Latoski et al., 2003). To mitigate these short-term disruptions in the transport networks, several policies can help lighten the impacts of peak mobility demand associated with major events. Examples of these measures are controlling road closures, diverting motorised traffic onto alternative routes, enhancing the public transit systems, managing pedestrian traffic, etc. (Garrido et al., 2023). The challenge, therefore, lies in creating a transport system that is operationally resilient and adaptable, allowing for smooth coordination between event organisers, public transport authorities, and local governments.

Furthermore, the relationship between event activity and mobility patterns has been studied in the context of mega-events such as the Olympic Games or major football tournaments. Two studies on the Football World Cup in 2014 and the Olympic Games in 2014 in Brazil have shown that large-scale events create temporal and spatial distortions in urban transport networks. Which causes shifts in peak

hours, different travel behaviour, and temporarily transforms local accessibility (De Menezes & Souza, 2014; Silva & Torres, 2025). A city and the stakeholders of events must consider the movement of the following three groups of people when organising any event: residents or regular travellers, spectators, and workforce staff (Silva & Torres, 2025).

Events are very dynamic and find their grounds in different systems, split amongst others, public transportation networks, people flow, public areas, private venues, etc. Therefore, it is crucial to understand the challenges of events and how to manage them in broad terms.

## 3.3. Event Management and Operational Challenges

This subchapter is focused on events and crowds and their management. Diving into crowd management and safety aspects in 3.3.1. Moreover, the next section explains some coordination frameworks of governance and events, examining a framework by Santos & Gómez (2022). Sections 3.3.3. and 3.3.4. Talk about some capacity planning and sustainability challenges involved in event management.

### 3.3.1. Crowd Management and Safety

Event-related crowd management is a critical component of urban mobility planning. To start with, crowds can be understood as a temporary gathering of individuals who come together in a shared space, varying from a few hundred to several thousand people. Such groups are typically emotionally charged and highly responsive to social and environmental impulses, which can lead to unpredictable behaviour, and in some cases, unintended disruption (Wren, 2005; Struniawski, 2024).

Managing crowds is therefore very important, if only for purposes of general safety. It is key to prepare events so that as little intervention as possible is needed; it is not sufficient, meaning that monitoring crowds during and after events, and possibly anticipating, remains essential (Wijermans et al., 2016). According to Still (2014), crowd management involves both the preventive design of space (‘crowd safety’) and the dynamic control of movement (‘crowd control’), emphasising anticipatory planning rather than interventions. Even though prepared, the number of passengers in stations or other public transport facilities can exceed the typical daily numbers by far. Hence, the public transport management needs to align its planning to ensure safe and efficient transport to and from event venues (Seer et al., 2008).

The integration of public transport operations with pedestrian flow control determines the overall safety and experience of event attendees. Which can be measured through the perception of passengers, especially how they rate the quality of the transport service on how well the service is functioning (Bukhtoyarov et al., 2020). In order to manage the crowd and secure the safety standards, understanding the surroundings from the event location through the transport facilities is crucial. Before designing estimation and management measures for crowds, some key elements are needed to gain insight into the area, such as the maximal capacity of the transport system, interval of trains or metros, what the control mechanisms are (think of doors and meanders), how the corridors flow and of course the number of visitors and passengers. They all contribute to the set of decision-rules event controllers need to maintain a safe environment (Seer et al., 2008).

Controlling pedestrian flow is often focused on constructional modification or staff guidance. These constructional interventions can be costly and are generally fixed into the design of the area. While staff guidance relies on the capability of the people and the governance involved (Feliciani et al., 2024). Influencing crowds can also be done by ‘nudging’, which entails ‘any aspect of the choice architecture that predictably alters people’s behaviour without forbidding any options or significantly changing their economic incentives’ (Thaler and Sunstein, 2008). In the context of crowd management, environmental

stimulation such as visual cues and layout changes has been explored to modify and change movements and improve pedestrian flow (Feliciani et al., 2024). For example, large scale experiment done in Eindhoven shows that direct influences like arrows can bias routing choices within crowds, which is very relevant in crowd management during public events with high attendance (Corbetta et al., 2018).

Managing crowds effectively and efficiently remains a challenging issue (Almutairi, 2024). Struniawski (2024) explains crowd management through the following principles. The first one is Communication, where all the participants are well-informed. Secondly, Enhancement, which is about monitoring behaviour and police strategies. Thirdly, Diversification, which deals with inappropriate behaviour. And lastly, Balance, which concerns maintaining balance between the police and the nature of risk.

On the other hand, Almutairi (2024) created a framework for effective crowd management, going through different stages. The first one is the Planning Stage, which focuses on vital infrastructure and potential crisis management strategies. Followed by the Organisation and Monitoring Stage, integrating technologies like IoT, AI, drones, etc. to monitor crowds. Which lastly flows into the Flow Regulation Stage, which is the management with the tools for precise control and thus trying to avoid bottlenecks. Altogether, crowd management is difficult and ever evolving, the challenge lies in aligning transport schedules, security measures, and real-time decision-making processes to avoid bottlenecks.

### 3.3.2. Coordination Frameworks and Governance of Events

Event mobility and management depend heavily on coordination among a wide range of stakeholders, ranging from transport authorities and municipalities to private event organisers and police. Coordination frameworks are important in the context of major events because they structure how stakeholders act as a complete system, instead of separately. For example, on transport and mobility, Liu (2021) states that public transport networks and their transfers need to be coordinated and optimised well to provide visitors with a well-connected service. Public transport coordination is key for events, but next to that, stations remain transport nodes and require transfer coordination optimisation. Integrating public transport timetable design with other operations-planning activities, such as events, is known to be a heavy, time-consuming problem (Ceder, 2016; Schöbel, 2017).

These actors must jointly make operational and strategic decisions, often under time pressure and uncertainty. Research from mega-events such as the London 2012 Olympics demonstrates that advanced coordination across agencies and investment in infrastructure can substantially improve crowd dispersal efficiency. For example, Giulianotti et al. (2014) explain that the city was divided into three different ‘speeds’ for diverse social groups, like the sporters, the visitors and the normal residents and commuters around the Queen Elizabeth Olympic Park.

Governance for major events depends on an effective system which entails direction, control and evaluation loops according to Santos & Gómez, 2022. They established a framework for the governance of major and mega-events, this framework views governance as a systematic decomposition consisting of three interdependent dimensions: context, content and system (see figure 4 below). The governance is shaped by the interaction between organisational and interorganizational contexts (1), involving both permanent event planners and temporary event organisations. Strategic Direction (2) consists of the purpose, vision and strategic orientation of event planners. Governance becomes effective when Strategic alignment (3) meets the event planner’s direction, which allows to set the content of the event. Furthermore, governance effectiveness depends on a coherent systemic composition (4), including structures, agents, processes, and control mechanisms (Santos & Gómez, 2022). This framework can be used to analyse major events, whose context is defined by the typologies of the event area and its organisational variables.

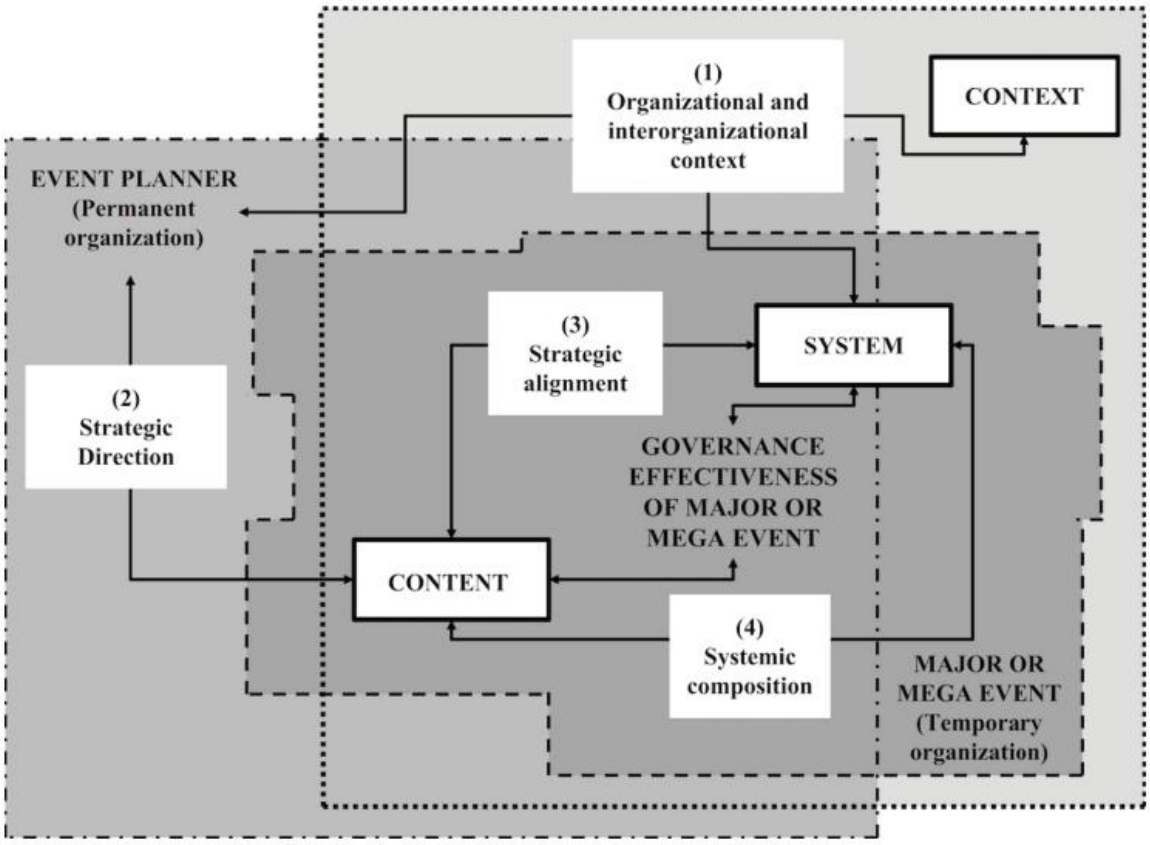



*Figure 4 - Major and mega-event governance assessment framework (Santos & Gómez, 2022)*

### 3.3.3. Capacity Planning

In the context of large events, it is crucial for both the event organisation and the public transport operators, especially around MTHs, to deal with capacity planning. The arrival and departure times of event visitors are highly condensed, and therefore the supply of transport modes must be planned to manage peak loads without causing delay or disruption (Santanam et al., 2021; Robbins et al., 2007). A study by Santanam et al. concluded that it is possible to predict with reasonable accuracy how crowded each train after events is. That prediction is mostly based on the behavioural consistency of attendees. This is a useful insight for the planning of public transportation times after main events.

Focusing on the MTH, sudden crowd build-ups could overwhelm the existing infrastructure. Designing complementary transport services well should not only affect the potential bottlenecks on vehicles, but also on the station interchanges, pedestrian areas and tunnels, access routes and at modal transfers (Du et al., 2015). This means that event organisers and public transport planners must not only consider vehicle supply, but also passenger flow design and station-area capacity. Whilst planning public transport around events, encouraging public transportation often results in fewer private vehicles on the road; however, crowded buses or trains can also cause inconvenience for residents who rely on them on a daily basis (Garrido et al., 2023).

The latter is called the background demand. Consisting of the already established network of commuters, businesses and every traveller. Without the capacity planning, peak fan arrival and departure can overwhelm transport networks. In order to manage demand, event organisers and public transport planners should prioritise influencing travel behaviour and timing. Fuller (2025) found four different strategies which can help with capacity planning. The first one is ‘Marketing, communication, and

individual travel behaviour', which includes strategies like pre-event engagement and real-time updates. Secondly, beyond the individual travellers, the business is an important aspect of managing background demand. Thus, 'engaging the business and industry sectors' becomes a second strategy, which asks local employers to adapt to the increased pressures. Thirdly, 'Journey planning and real-time adaptation' is a strategy which used planning platforms like Google Maps, which provides real-time travel demand. And lastly, she found that providing the public with visibility into high-demand areas enables them to make better-informed travel decisions (Fuller, 2025).

### 3.3.4. Sustainability challenges

When organising and managing an event, sustainability concerns remain important, and the transportation sector plays a crucial role in this. Urban development and transportation together show some opportunities with regard to sustainable transportation, especially events and the so-called mega-events, which can transform cities' transportation systems in less than 10 years (Kassens, 2009). And in recent years, the event sector has played a large role in travel demand and the contribution to increasing greenhouse gas emissions (Burton et al., 2021).

Because of the different demand and supply characteristics affecting the local transportation systems before, during and after an event, designing sustainable mobility for an event is very complex (De Menezes & Souza, 2014). Although not always being the main focus of event management, sustainable transport is one of the main challenges (Kassens-Noor, 2010) and should therefore be considered as well throughout the research.

## 3.4. Governance and Decision-making in Complex Infrastructure Projects

This subchapter dives into the governance and decision-making in major infrastructure projects. Starting off with what stakeholder collaboration means in redevelopment processes, talking about the stakeholder and governance perspective. Moreover, a major decision-making framework will be discussed in 3.4.2. There will also be two small sections on the specific decision-making framework in the Netherlands, the MIRT (3.4.2.1), and some comparative analysis in foreign countries (3.4.2.2).

### 3.4.1. Stakeholder Collaboration in Multimodal Hub Redevelopment

#### *3.4.1.1. Stakeholder perspective*

Across the world, mega transport infrastructure projects involve diverse groups of stakeholders, often with conflicting interests and high political sensitivity. These conditions complicate decision-making due to uncertainty and competing objectives (Erkul et al., 2016). Effective stakeholder involvement and collaboration are therefore key success factors. Several frameworks explore stakeholder engagement processes, identifying both success and failure factors in infrastructure delivery (Prebanic & Vukomanovic, 2023). The framework Prebanic and Vukomanic (2023) present is that stakeholder engagement and measuring success can go through three managerial levels, namely operational, organizational and strategic. The first one focuses on the actual performance indicators, such as time, quality and scope. While the organisational processes focus on how the client and the project team score the project, and what they see as satisfactory achievements. Thirdly, the strategic level is about the effects on the wider industry and regulatory context of the infrastructure project.

To develop further on the organisational success factor, stakeholders' perspectives are vital, as they shape outcomes, particularly in projects that combine public and private actors. Within public transport infrastructure, Vuorinen & Martinsuo (2019) identify four main influence strategies of stakeholders:

communicating, complaining and resolving disputes, setting rules and supervision, and exercising decision-making authority. The latter two are especially influential in public infrastructure governance. The effect of the setting rules and supervision strategy is that authorities often limit the project work and thus give renovation projects a certain frame in which they are allowed to work and operate. The use of decision-making authority leads to more hierarchy getting involved, for example, the government or politicians ask for more explanation before accepting an infrastructure project. This often leads to postponement and rescheduling of the project (Vuorinen & Martinsuo, 2019).

To overcome such effects, especially between public and private actors, a study by Nisarat (2022) acknowledges that for urban planning of an MTH, it is important to have a lot of physical gathering spaces with supporting technology for visualisation. Communication, collaboration and public participation will evolve better in such settings, because it helps build on mutual understanding and consensus. Especially in practice, of infrastructure projects including the public sectors, corporates, researchers and operational and maintenance workers of an MTH project.

#### *3.4.1.2. Governance perspective*

From a governance perspective, cities and municipalities play a very important role in giving shape to urban mobility, as they are obliged to regulate the road network, urban space and land use. However, when concerning infrastructure such as railroad, the infrastructures grow over time and develop to very unique local context (Götz et al., 2016). Many cities already have a grant network of mobility hubs, and the current transport systems seem relatively stable, hence change in this system can happen very slowly (Geels, 2012; Gösslin & Cohen, 2014; Manderscheid, 2014).

A study by Hansel (2025) concludes that local governance is very specifically applicable to cases of arranging mobility hubs. They found that governance can be structured into a four-dimensional analytical framework. Divided into an organisational dimension and an ideational aspect. The organisational dimension includes structural components of governance, such as which actors are involved in the project around the MTH, as well as the local and regional (transport) networks. In addition to those, another crucial structural component is the resources, for example, human resources and financial aspects. Furthermore, some organisational governance aspects are the policy instruments, for example, local mobility plans, which municipalities and provinces often introduce. In addition, these governmental bodies also regulate the public space around and sometimes in MTHs.

On the other hand, we have the ideational dimension, which firstly includes the ideas. These ideas range from policies, programs and philosophies to development plans on, for example, sustainability. Secondly, this framework ends with negotiations, which consider citizen participation, (in)formal cooperation between actors, the political opposition and public debate. Within this useful framework, all dimensions are strongly linked to each other. This framework helps identify several factors of governance arrangements, which help to analyse obstacles and differences in the (renovation) arrangements of an MTH (Hansel, 2025).

An example of these governance dynamics is found by Müller (2024), who analysed ‘network governance’ within Swiss transit station district developments. This means that no single actor possesses all the necessary resources for such complex projects, and that the decision-making process heavily relies on how public authorities organise the networks of public and private stakeholders. This example shows that the organisational dimension of Hansel is not just a static map of actors involved in the MTH, but a dynamic process where formal governance structures must facilitate collaboration in order to overcome delays in decision-making processes for MTH (Muller, 2024).

Governance and decision-making are closely interrelated but conceptually different. Governance refers to the broader institutional arrangements, policy instruments, and actor constellations that define how infrastructure projects are organised and regulated (OECD, 2017). On the other hand, decision-making is a component within governance, "it refers to the process when, after identifying problems, analysing, developing, assessing, and choosing, the final scheme comes into being" (Shi et al., 2020). In other words, governance provides the framework, explained as the "rules of the game", while decision-making represents the actual "moves" made by the players. Understanding this distinction is crucial, as effective redevelopment of multimodal hubs like Amsterdam Bijlmer ArenA requires not only good governance arrangements but also well-designed decision-making tools that can navigate complex trade-offs among stakeholders.

Before diving into the literature of decision-making, it is important to better highlight the relationship. Good governance leads to better decision-making. If regulations and rules, involvement of stakeholders, how transparent a project is and how well it is monitored are well-grounded, the decision-making will be better substantiated. For example, well-designed governance structures help with the risk management and the decisions for that by big infrastructure projects (Guo et al., 2013). On the other hand, bad governance leads to bad decisions. The nature of the infrastructure field can be complex, uncertain and very political; therefore, the governance before going to the decision-making process needs to be set in stone well. Often, independent actors in infrastructure governance are highly influential, which can influence the decision-making process. Therefore, governance needs to be considered well by all institutions involved in major infrastructure projects (Hammerschmid, 2016).

### 3.4.2. Decision-Making Frameworks for Complex Infrastructure Systems

As mentioned, decision-making represents the 'move' of all the players. And as the construction of complex infrastructure projects spreads across the world, there is a high interest in them by project managers and researchers due to the impacts on the regional and local socio-economic environment (Salet et al., 2013). Just as the state of governance, decision-making in infrastructure projects is as important for the infrastructure system, and it could be the difference between success and failure (Jato-Espino et al., 2014). The decision-making process is often challenged by high uncertainty, political pressure and stakeholder diversion, and therefore the decision-making process must be transparent and based on well-structured frameworks that can improve legitimacy and efficiency (Hammerschmid, 2016; OECD, 2017). Furthermore, large infrastructure projects require robust frameworks to guide decision-making before financial, or implementation phases begin. Decision-making frameworks are essential in ensuring that choices align with broader policy objectives and that stakeholder collaboration is effective. Increasing urbanisation, demographic changes, and fiscal constraints highlight the need for coordination across interdependent assets and actors, taking into account system-wide impacts (Poole et al., 2014).

The definition of decision-making by Shi et al. (2020) concerning Major Infrastructure Projects, and this can be applied to understand the complexity of the whole system as well as the foundation for decision-making frameworks. The definition is: *"The interactive process in which integrated considerations lead to long-term strategic and short-term operational choices on essential issues in the front-end phase of Major Infrastructure Projects (MIP), which have a profound influence on the whole life cycle of the MIP. The outcome selected from multiple alternatives is the decision-making scheme in MIPs, which consists of decision objectives, variables, values, measures, and criteria. The decision-making outcome is the final "product" of the decision-making process, which has a strong dependence on the decision-making process."* This shows that a framework is needed to approach infrastructure projects in a structured way that integrates capacity and resources when decisions are made under uncertainty (Marcelo et al., 2016).

A general framework created by Shi et al. (2020) explains the complexity of decision-making well by explaining it through rounds and phases, and the difference in certain types of complexity. With regards to the phases, the framework goes through an initial phase, which is the basis for the project and the number of stakeholders proposed to be involved. Secondly, a preliminary planning phase, which focuses on technical issues. This is followed by a phase of deeper research, in which critical aspects such as finance and legal come forward. The phases end with a round which includes the agreements and decisions, which focus more on organisational and time complexity. After analysing the rounds, the main findings of Shi et al. (2020) are the six different complexities. These are divided into Technical, Social, Financial, Legal, Organizational and Time complexity, and they all have different assets within either Detail Complexity (which affects decision-making outcome) or Dynamic Complexity (which affects decision-making processes). All the complexities influence or trigger each other.

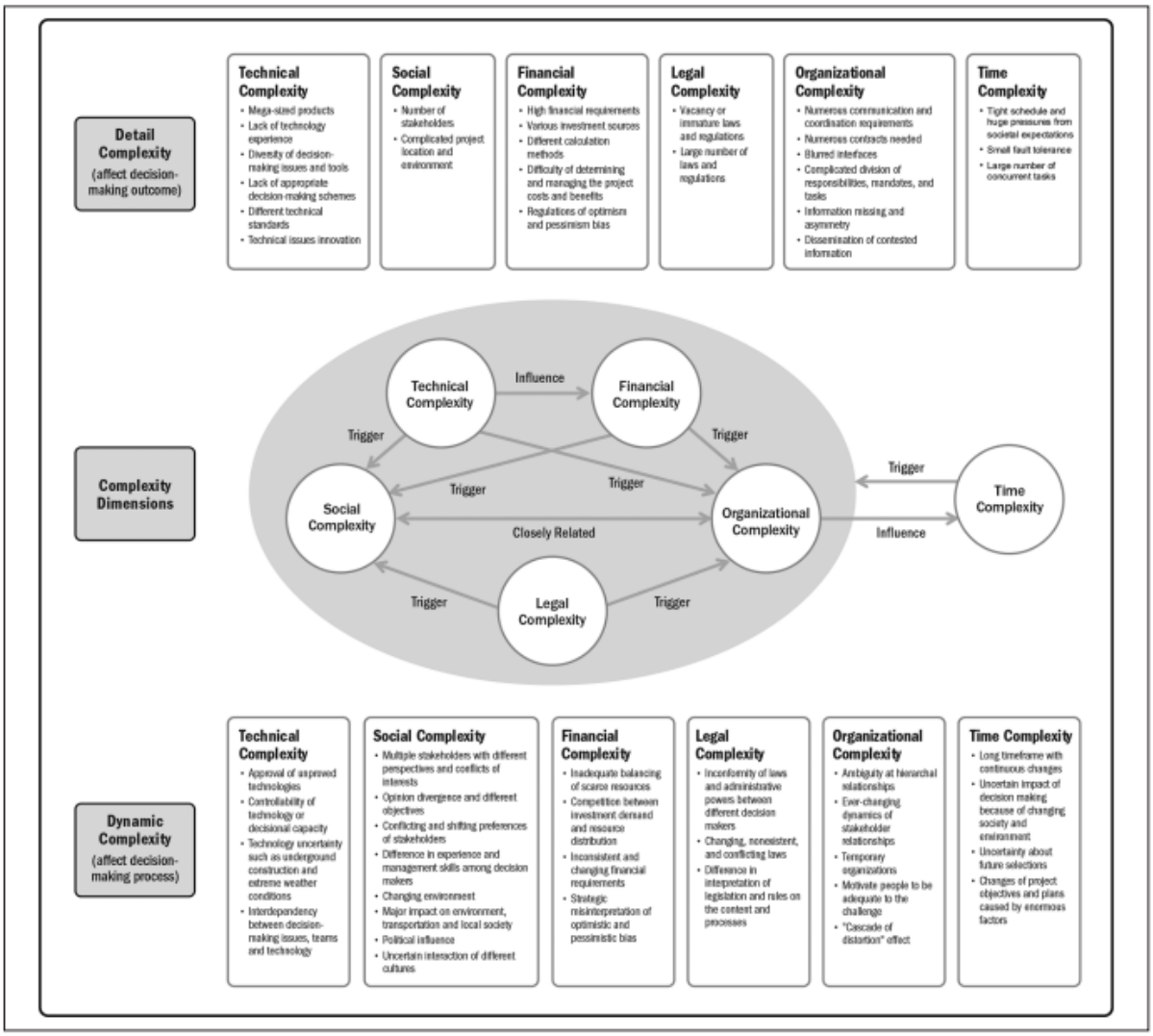



*Figure 5 - Complexity Framework (Shi et al., 2020)*

Furthermore, there are several other frameworks and tools which contribute in general to complex systems and are therefore also often applicable to complex infrastructure projects. For example, Enserink et al. (2022) provide several steps to systematically analyse complex problems. The dimensions of complexity they identify are an extension and explanation of the complexity framework of Shi (2020). They discuss the technical, social, institutional and normative dimensions of complexity.

Furthermore, before decision-making can start, the problem scope should be examined very well to create the most-fitting solution space.

Moreover, a well-known tool is the *Multi-Criteria Decision Analysis* (MCDA). This tool applies to a great number of fields, therefore also in major infrastructure projects. MCDA methods have been applied to diverse topics in different sectors of transportation and infrastructure (Broniewicz & Ogrodnik, 2025). Often, the common denominator in these different sectors is to structure the decision-making process, which often entails conflicting decision criteria, and most often a finite set of alternatives. The methodology of MCDA is increasingly being applied to complex infrastructure projects and their decision-making processes, because it is stated to be crucial for considering the conflicting interests and points of view of the various parties involved in the decision-making process (Kicinski & Solecka, 2018).

Another tool to help in decision-making context is a *Boundary Object*. This is defined as '*an artifact or a concept with enough structure to support activities within separate social worlds, and enough elasticity to cut across multiple social worlds'* (Star and Griesemer, 1989). Boundary objects try to tie together different actors in different social worlds, helping to understand and bordering the two or more social worlds (Bergman et al., 2007). Star (2010) in later studies mentions that these objects are soft arrangement which allow that groups, even without general agreement, can work together, showing a lot of potential as a conceptual tool for decision-making between various groups (Matilainen, 2018). Simplified, boundary objects provide a common frame and language across different domains of knowledge and understanding practical implications (Oswick & Robertson, 2009).

Decision-making in complex infrastructure projects cannot be reduced to optimisation problems alone, nor merely relying on a framework, such as that by Shi, but it should be understood as a socio-technical and balanced process in which frameworks must interact with uncertainty, stakeholder conflicts and dynamics in project governance. As this is very general, it is interesting to see how these decision-making structures turn out in the Dutch infrastructure scenery. This will be explored in the next subchapter.

#### *3.4.2.1 Framework in The Netherlands, the MIRT*

In the Netherlands, there is a specific framework used for decision-making, namely the 'Meerjarenprogramma Infrastructuur, Ruimte en Transport' (MIRT). These programmes include projects in which the government works together with regional stakeholders on infrastructure, transport and public space. It follows a systematic approach, starting from examining the problem situation until the realisation of the project. The MIRT brings stakeholders together to the specified arenas, it organises the project overall and structures the financing of complex infrastructure projects (Ministerie van Infrastructuur & Milieu, 2016). This framework is, in essence, the guideline for the project around ABAS. The reason why this framework is analysed, is because ABAS is the base case, and 3.4.2.2 shows that the decision-making process in the Netherlands is among the best. Understanding such a decision-making process is crucial to comprehend the complexity and the phase-focused style of decision-making, also for other cases.

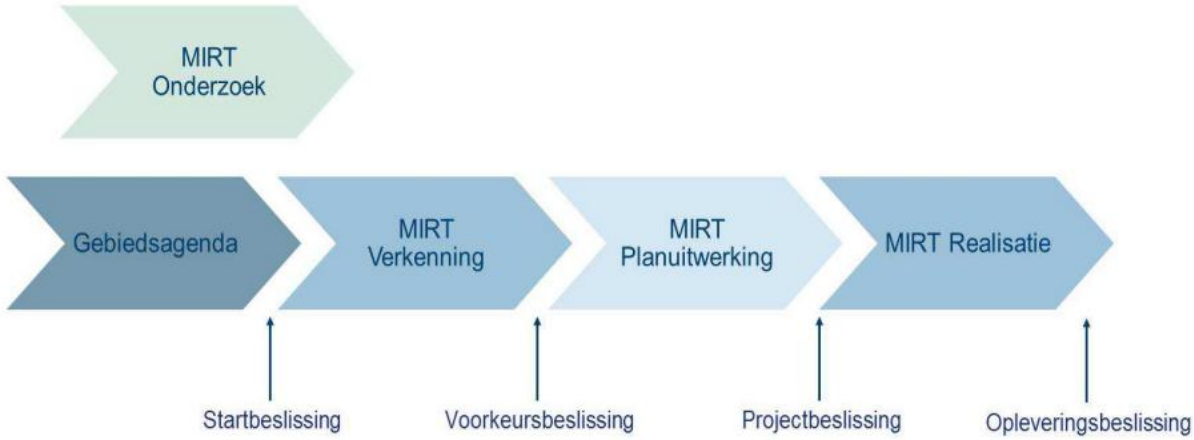



*Figure 6 - MIRT phases (Ministerie van Infrastructuur & Milieu, 2016)*

The MIRT consists of 5 phases, which each having a decision-moment, allowing to go to the next phase. The following explanation is based on the 'Spelregels van het MIRT' (2016). Starting with the 'Gebiedsagenda' (Strategic Area Plan), which defines the ambitions and local assignments the government and the region have. These plans have a holistic character and consist of all the spatial and physical tasks the region has.

Secondly, there is the 'MIRT Onderzoek' (Research), which outlines thematic assignments when they are not clear enough. This research is standalone; it can result in the 'Startbeslissing' (start-decision) when it has consequences for the regional plans. Thirdly, there is the 'MIRT Verkenning' (exploration), which is a crucial phase within the MIRT. The goal of this phase is to propose smart, sustainable and climate-proof solutions, following from wide research of a singular regional assignment. This is the problem-analysis of a major project. The 'Voorkeursbeslissing' (preference-decision), which is a follow-up, is a well-established choice by politicians and public administrators. The next step is the 'MIRT Planuitwerking' (execution), which entails the research on whether the realisation is legally and financially feasible. This phase involves stakeholders creating more realistic goals for how to approach the project. It has a maximum duration of two years, then this phase ends with the 'Projectbeslissing' (project-decision) and is often proposed to the House of Representatives (Tweede Kamer). The last phase starts, the 'MIRT Realisatie' (realisation), in which the Planuitwerking and the Projectbeslissing will be executed. If the project is (partly) finished, the 'Opleveringsbeslissing' (final accord) is made, and the financials are finished.

This process is very detailed and well-known within the Dutch infrastructure world, notably in the railroad sector. The Dutch system has detailed rules, which are further explored in the Spelregels van het MIRT (2016), but those do not engage with the subject of this thesis. Concerning the MIRT, Mouter (2015) explained the governance around the MIRT and discussed several strengths and weaknesses. Firstly, starting with some of the strengths (+) and after that some weaknesses (-):

- The MIRT presents itself as evidence-based, yet decision-making is largely driven by informal political dynamics.
- Due to the nature of the MIRT process, directors and some ministers have early access to expertise and analysis, while the parliament does not. This undermines parliamentary review of the documents. This causes information asymmetry.
- A main calculation method, the CBA (cost-benefit analysis) rarely affects opinions and points of view but is often used to justify decisions.

+ The MIRT is resilient to political conflict by integrating informal negotiation into formal decision-making and is thus politically robust.

+ The MIRT uses methods which are generally accepted and seen as a common language for policies and a frame of reference.

+ Since CBAs are not decisive, the MIRT allows political values, regional impartiality and regional considerations to play a role in complex decision-making (Mouter, 2015).

In addition to the discussion of Mouter, there are some other weaknesses of the MIRT. The 2nd Supervisor from VPRC, Bert van Eekelen, concluded the following: *"Rather than facilitating systematic transformation, the MIRT functions mainly as a mechanism for legitimising incremental change, thereby limiting the dynamic adaptability of the infrastructure system"*. Explaining that due to the different decision-moments, the MIRT can be very disintegrated and only looking to a smaller scope than the whole system. As a final remark, the procedures come with several consequences, especially the long turnaround and lead times. In addition, due to its procedural nature, there is not a lot of flexibility to reconsider already made decisions within the converging process. Specifically, when the defined problem changes over time. This makes the procedure too rigid (NLingenieurs, 2023).

### *3.4.2.2. Decision-making in foreign countries*

Before executing the comparison analysis, it is interesting to examine the differences to some degree. Especially to show the Dutch position within an international perspective, the figures provided by Hammerschmid (2016) offer a comparison for coordination challenges with respect to strategic public infrastructure (figure 7). This graph is based on 10 coordination challenges (see figure 8). Figure 7 shows the average level of coordination challenges that countries face, measured on a 3-point scale where 1 = no challenge, 2 = moderate challenge, and 3 = major challenge.

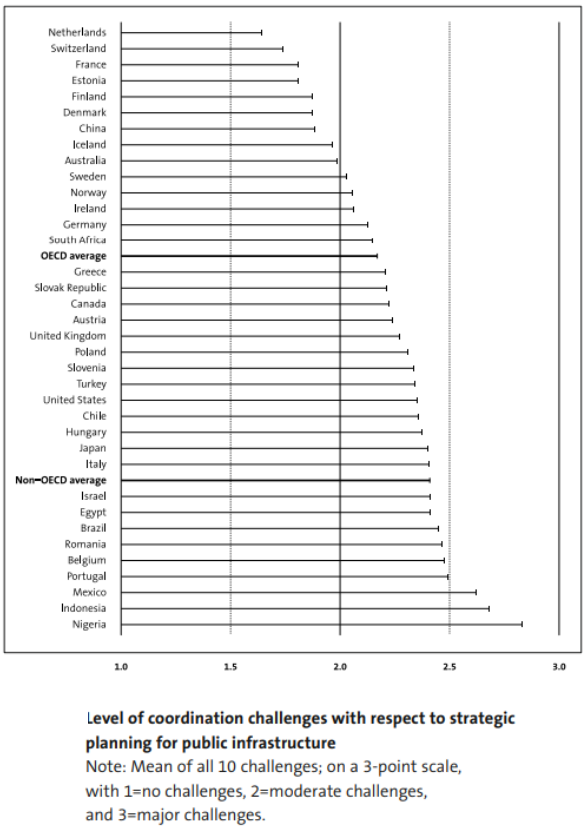
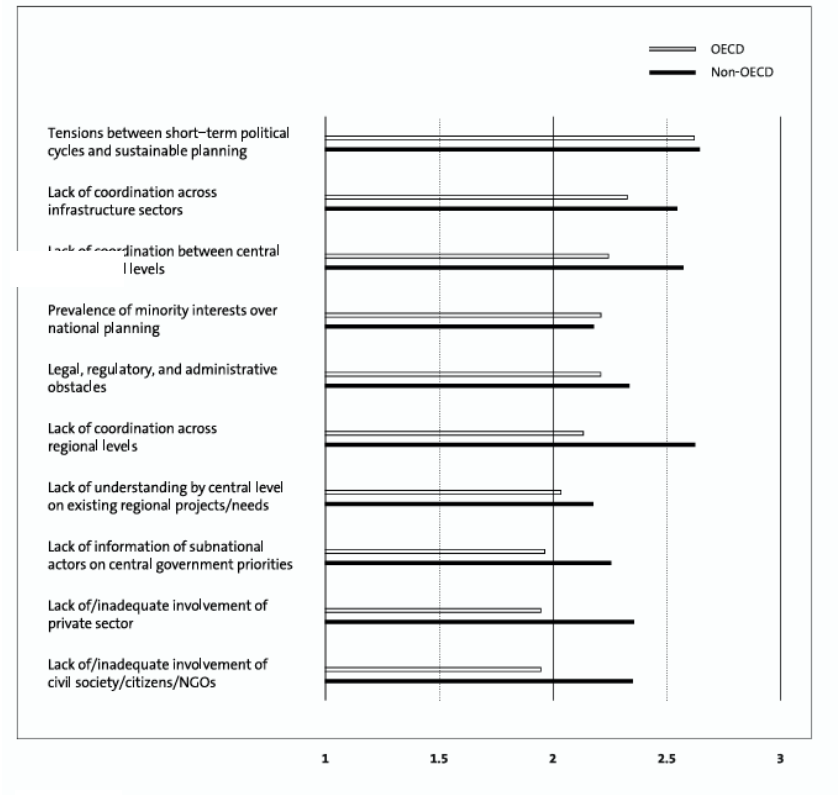



*Figure 7 - Level of coordination challenges with respect to strategic planning for public infrastructure (Hammerschmid, 2016)*

As Figure 7 shows, the Netherlands exhibits the highest level of coordination effectiveness (or the lowest level of constraints compared to other European nations. This high score can directly be linked to the MIRT, which overcomes several of the then coordination challenges as defined in Figure 8. For example, 'Tensions between short-term political cycles and sustainable planning' is overcome by creating a common language and being politically robust. Furthermore, the 'lack of coordination across regional levels' is overcome by the MIRT, as it forces municipal, provincial and national authorities to align their agendas before advancing to the Exploration phase.

The international ranking also provides a reason why ABAS is potentially a strong base case. This thesis and the comparison dive into transit nodes in France, the United Kingdom, Spain, Germany and Sweden. France, Sweden and Germany score very well, just above the OECD (Organisation for Economic Co-operation and Development) average. On the other hand, the United Kingdom scores just below the OECD average, as it often struggles with fragmented coordination between transport operators and local planning authorities (Hammerschmid, 2016).




**Main coordination challenges with respect to strategic planning for public infrastructure**
Note: On a 3-point scale, with 1=not a challenge, 2=somewhat a challenge, and 3=major challenge.

*Figure 8 - Main coordination challenges with respect to strategic planning for infrastructure (Hammerschmid, 2016)*

The understanding of these international challenges is interesting when comparing cases. Especially when comparing coordination and governance with the Dutch MIRT. Hammerschmid's finding that short-term political cycles are the most important challenge is directly relevant for the MIRT because it requires long-term and often cross-sectoral commitment, which can be weakened by political changes. These figures, and plotting the Dutch MIRT against these international challenges, are interesting to this research and should be kept in mind when comparing the cases in this study. For example, this international comparison suggests that while the UK or Spain may struggle more with general

coordination, they might occasionally exhibit more flexibility in "stand-alone" project delivery because they are less bound by a framework like the MIRT.

## 3.5. Sub-conclusion

This literature review demonstrates that a MTH adjacent to an event venue goes hand in hand with a unique intersection of daily transit functions and extreme peak-period pressures. Some of these academic perspectives provide the foundation of three embedded units later in the thesis, which are required for the Comparison Tool.

First, ‘Crowd Management’ is an important aspect for transit nodes in the event sector. Effective hubs must integrate spatial design with the actual movement control to ensure safety. The literature sets the basis for evaluating the physical capacity of crowd management, as the dynamic strategies involved. These can include tactics as direct communication, or nudging techniques. All to manage (unpredictable) passenger behaviour.

Secondly, there is the ‘Event Management’ & Capacity Planning. Major events create a temporal and spatial shortage of infrastructure, asking a lot on the operational strategies. The literature shows that event management requires a lot of stakeholder collaboration and strategic alignment among them. This aspect deems to be important for a tool which assesses stations in the event-context, as this background thinking is crucial for capacity planning based on event-demand.

Lastly, the literature identifies that there is the possibility of fragmented coordination among public and private actors. This is a primary barrier in integrated decision-making, asking to compare the ‘Governance and Organization’ in the tool. It is interesting to identify differences in decision-making frameworks and its governance, especially the Dutch perspective compared to others.

These theoretical insights are operationalized in the following chapters for the design of the tool, and to show that the combination of these units and the progress of them determines how well a station performs.

# 4. Phase 1: Case Analysis of Amsterdam Bijlmer ArenA Station

The first phase of this research included the literature analysis, done in Part A of this paper. Moreover, this phase consists of the Case Analysis of ABAS. This will be divided into the system decomposition, some insights from stakeholder interviews and lastly the main findings from the document analysis. This Phase tries to answer the first two sub-questions of this research:

*How is integrated decision-making currently organised in the redevelopment process of ABAS?*
*&*
*How do all the systems at ABAS interact with each other, and why does that make the area so unique?*

## 4.1. System Breakdown

This section discusses the Amsterdam Bijlmer ArenA Station case, with the System breakdown, after which relevant information is summarised from stakeholder interviews, ending with the main findings from the document analysis.

As explained by Santos & Gómez (2022), a system decomposition is needed to analyse the governance effectiveness. Therefore, the system of ABAS can be explored in three ways, namely via a Venn diagram, the system decomposition and the three-layer model of the transportation system. All separate analyses are used as the basis of understanding the ABAS region. The system decomposition is based on a mixture of findings from the interviews, findings from the documents published by the Municipality of Amsterdam (2025), the Handelingsperspectief from Goudappel (2022) and the MIRT research by Civic and Witteveen&Bos (2024), as well as findings by the researcher himself.

Before diving into the System Breakdown, it is interesting to define what the system is and to explain the context of the location a bit better. Drawing back on the work of Santos & Gómez (2022), the system is ‘shaped by contents addressed in governance, which, in its turn, is adjusted to its operating context’. More applied: the system of ABAS is a multi-layered, multi-actor transport and urban system built around five core sub-items: modes, infrastructure, users, public space and private enterprises. These are explained in 4.1.1. These independent subsystems are linked by three overarching subsystems: transfers, event management and information supply, explained in 4.1.2. The station's performance, therefore, depends on operational coordination of all the actors involved. The interaction between the actors and the systems is explained in 4.1.3 and developed further in 4.2. where the interviews of the main actors of the station are summarised.

The system boundaries extend beyond the physical station, as it includes its surrounding urban features. Specifically the Johan Cruijff Boulevard is an important extension of the station’s area. As this boulevard connects the station to the main event sites. The two figures are shown, which give the feeling of the station and its surroundings. Figure 9 shows the many enterprises and entertainment sites around the station, as well as many shops and other facilities. The station is at the bottom of this picture. Figure 10 shows an aerial view of the station and its surrounding area, mainly the Johan Cruijff Boulevard and the Johan Cruijff ArenA. This part of the station and its urban area are the key areas of discussion in this case analysis.


*Figure 9 - Amsterdam Bijlmer ArenA Station (under) and event sites and enterprises in the area (van Dijk, 2024)*


*Figure 10 - Aerial view of Amsterdam Bijlmer ArenA Station (middle-bottom), the Johan Cruijff Boulevard (left-middle) and the event sites around it (Google Earth Pro, 2026, screenshotted by Author)*

### 4.1.1. Venn diagram of Amsterdam Bijlmer ArenA Station

The Venn diagram illustrates the interaction between the different typologies within the Amsterdam Bijlmer ArenA station area. The most critical overlap lies at the intersection of public space, station infrastructure, users, and private enterprises. This synergy is not confined to the station hall itself but extends along the Johan Cruijff Boulevard (JCB). The Venn Diagram made for this system is shown in Figure 11. This research is based on the Eindrapport MIRT (2024), the Handelingsperspectief (2020) and the Plan Openbare Ruimte from the Municipality of Amsterdam (2025).

The Boulevard plays a hybrid and dynamic role. On regular days, it functions as a relatively calm urban space with cafés, a hotel, and a cinema representing the private sector. Some major private enterprises (Johan Cruijff ArenA, AFAS Live and the Ziggo Dome) are closed or in preparation for events later that day. During events and football matches, the Boulevard transforms into a "sponge zone." In this capacity, private hospitality venues are expected to absorb large visitor flows to reduce peak pressure on the station. The effectiveness of this strategy is argued, as travellers often feel compelled to leave immediately due to transport timetables.

In practice, this public space (JCB) operates as a secondary station hall: a buffer zone that distributes passenger flows before they enter the station's physical infrastructure. As a result, the boundary between public space and station infrastructure becomes blurred, generating friction between stakeholders. The key question that emerges is who holds authority over this space, and whether its current shortcomings should instead be resolved through a more efficient design of the station hall itself.

The public space cannot substitute for transfer infrastructure in the physical transfer between transport modes. Here, the design falls short: transfer areas are impractical due to significant level differences and a bus station that is in an unintuitive and poorly legible position. The infrastructure contains several bottlenecks (Eindrapport MIRT, 2024):

- The transfer between the metro and train is illogical.
- The exit towards the bus station is not intuitively recognisable.
- Bicycle parking facilities are hidden within the area.
- A clear entrance is lacking on the western side of the station.
- Retail units on the opposite side obstruct the Johan Cruijff Boulevard beneath the station, limiting access from the Bijlmerdreef and creating an unpleasant atmosphere.
- The two outermost tracks are rarely used, indicating inefficient use of available capacity.

The separate parts of the subsystems of the Venn diagram are shown and explained in Appendix B. In this appendix, the five sub-systems are explained in more detail. All different modes are described, and how many of them there are exactly. The users are explained, especially the modal shifts. Furthermore, some characteristics of the public space are given, which entail some safety factors and the ambitions the municipality has for the public space around the station. Lastly, the private enterprises are named and therefore what the visit goal is for travellers.

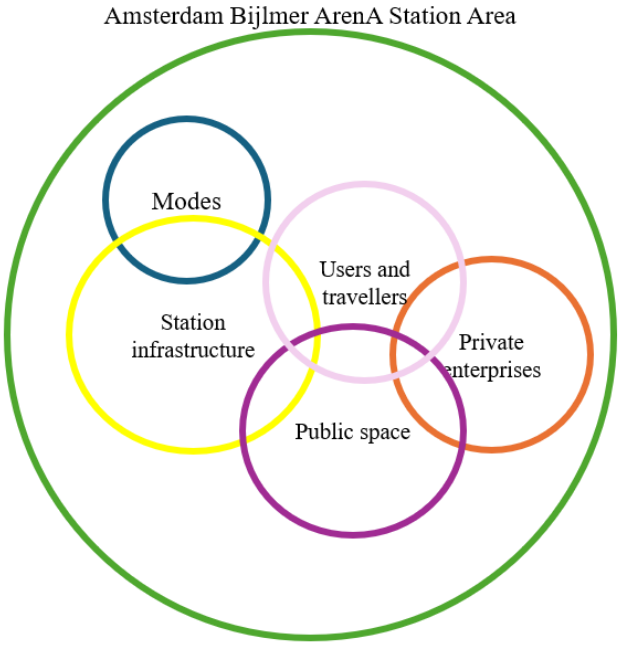



*Figure 11 – Venn diagram of Amsterdam Bijlmer ArenA Station Area, showing where the sub-systems overlap (Author, 2026)*

### 4.1.2. System decomposition of Amsterdam Bijlmer ArenA Station

The system decomposition dives deeper into the analysis than the Venn Diagram. As it shows the functional depth and decomposition of the system. In addition, it shows where several subsystems also interact with each other, adding to the analysis of the Venn diagram. The system decomposition is separated into two levels of hierarchy. The first level is the most deduced one, giving the best overview of all the subsystems and how they interact with each other. The interactions take place at the subsystems with a triangle on the right top side in Figure 12. These subsystems are explained in more detail in level 2, a less abstract system and thus more specified.

On the first level, the station area is separated into five independent systems, which form the basis of the ABAS. These systems are Modes, Station infrastructure, Users & Travellers, Public Space and Private enterprises. The systems are like the Venn Diagram; however, now they all contain some explanatory subsystems. For example, all the modes are listed, as well as the type of travellers visiting the station and the area and what different types of Public Space and Private Enterprises there are.

Even though the subsystems mainly operate independently, there are three overarching subsystems which need to be explored in more depth. These are ‘Information Supply’, ‘Transfers’ and ‘Event Management’.

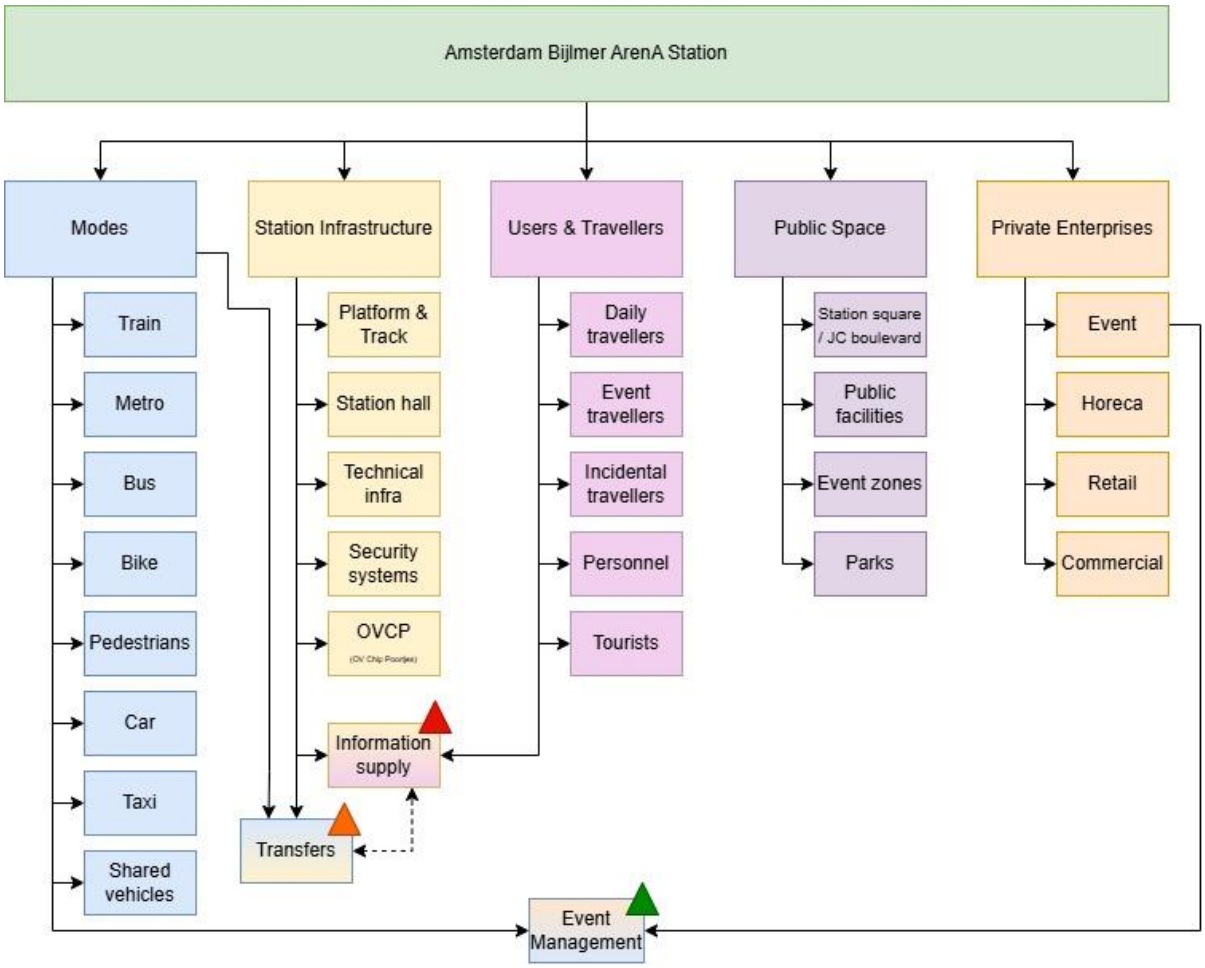



*Figure 12 - System Decomposition – main 5 subsystems, what they entail and where they interact (level 1) (Author, 2026)*

In the figure below, the three Subsystems are explained in more detail. These three subsystems are critical and unique for the ABAS area. As the station is big enough to function as a transfer station, as well as being the destination station for many events. The transfer subsystem is decomposed into five more subdomains.

The first subsystem, 'Transfers', serves as the logistical backbone of the station by facilitating the physical connections between different transport modes, directly shaping passenger behaviour. The complexity of this *Multi-Modal Transfer Hub* (MTH) is reflected in the need to streamline both horizontal movements within the station hall and along platforms, as well as vertical circulation via stairs and lifts. Within this process, 'transfer efficiency' and the management of specific physical barriers during events are crucial tools for mitigating well-known bottlenecks, while inclusivity is ensured through dedicated assistance points and clear wayfinding in the station for passengers with reduced mobility.

'Event Management' subsequently plays a distinctive and vital role that is highly specific to the context of Amsterdam Bijlmer ArenA. This subsystem regulates not only services and facilities, but also the management of event-related flows in the station area by scaling transport frequencies and adjusting some of the time schedules around events. Its operational effectiveness, often coordinated through an Operational Mobility Centre (OMC), relies on close cooperation and the deployment of additional staff from NS, GVB, and the police. The use of dedicated monitors and targeted crowd-control messaging aims to manage the extreme peak pressures associated with events.

Finally, ‘Information Supply’ combines the systems of travellers and the station infrastructure. This subsystem acts as a key steering mechanism for station management by combining static elements, such as fixed signage and maps, with real-time dynamic information on delays and platform changes. Information provision is closely intertwined with safety and event management: public address systems and emergency communications safeguard passenger safety, while contemporary tools such as crowding indicators on screens around the station provide travellers with immediate feedback on current conditions within the station.

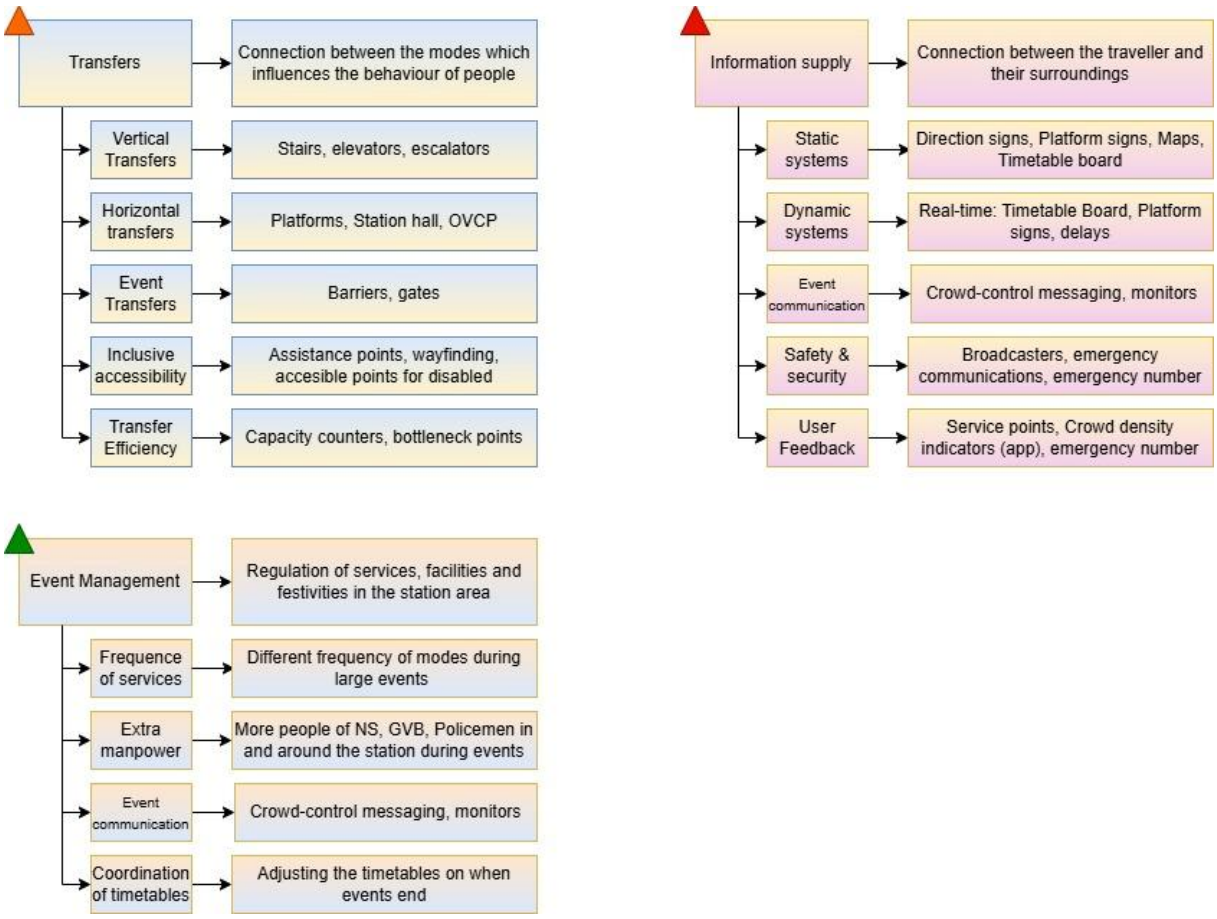



*Figure 13 - System decomposition – interconnecting subsystems: Transfers, Information Supply and Event Management, more in detail (level 2) (Author, 2026)*

In the figure above, Figure 13, these subsystems are analysed more thoroughly, and which sub-systems these systems consist of. The ‘Transfers’ consist of vertical and horizontal transfers, aiming at physical elements like stairs, platforms and OVCP (OV Chipkaart-Poortje / Public Transit Gate). Another physical element is the event transfers used at ABAS, like barriers and gates. Furthermore, the transfers also consist of inclusivity options and the transfer efficiency, of which the bottleneck points are crucial within the station.

Next, the station implements different types of Information Supply to connect important messages towards the travellers. There are both static and dynamic systems, for example, direction signs, timetable boards and platform signs. Some of them are both static and dynamic as they are often analogue or digital. Two important items of the information supply are the event communication and safety & security. As they are implemented during higher demand around events.

Lastly, 'Event Management' consists of four different sub-items. For example, the event communication is like information supply. Moreover, extra manpower can be used from the NS, GVB and Police force in and around the station during events. Adjusting the timetables on when events end can also be done during event management; however, that is not used very often and is merely done by the GVB.

### 4.1.3. Layer Model of the Transportation System applied to Amsterdam Bijlmer ArenA Station

The last system analysis tool is the Layer Model of the Transportation System applied to the case of ABAS. The analysis based on the Layer Model of the Transportation System provides an integrated perspective on how societal needs, transport services, and physical infrastructure interact at Amsterdam Bijlmer ArenA station. The Layer Model of the Transportation System is designed by Schoemaker et al. (1999). Within this model, the Economic Activities layer acts as the primary driver of transport demand, centred on a diverse group of users such as commuters, students, residents, and large numbers of event visitors. In addition to passenger movements, this layer also generates substantial logistical flows for the supply of local retail, hospitality venues, and surrounding event locations. These socio-economic dynamics create a direct *demand* in the transport market, which must subsequently be met by the available transport services.

The second layer, Transport Services, represents the interface where this demand meets the supply offered by different operators, this layer is related to multimodal transport. It determines the quality of the whole trip, which is affected by the vehicles and the network (Nes, 2002). Organisations such as NS, GVB, and Connexxion provide the modes going to and from the station, including intercity trains, metro services and regional buses. In addition, there are shared mobility services available at the station. The effectiveness of this layer depends heavily on coordination between providers to deliver a seamless travel experience within the transport market. Thus, creating a good supply which connects well to the demand of the transport.

The bottom layer, Traffic Services, forms the physical foundation of the entire system and focuses on hard infrastructure. Here, the capacity of the traffic market is determined by the availability of railway tracks, metro lines, bus lanes, and cycling infrastructure. Management responsibilities are distributed among several authorities, such as ProRail for rail infrastructure, GVB for the metro network, and the municipality or transport authority for roads and the bus station. Essential facilities, including OV chip gates and traffic control systems, also fall within this layer, which must ensure that sufficient physical capacity is available for all modes simultaneously using the station.

The key finding of this model is that Amsterdam Bijlmer ArenA station exhibits an exceptionally high level of organisational complexity. Its performance is highly dependent on intensive cooperation between ProRail, GVB, the municipality, and the nearby event venues. During events in particular, the system is placed under critical pressure, as the substantial demand generated by the economic layer must be absorbed by up-scaled transport services and the physical capacity of the traffic layer. Frictions arise when the physical configuration of traffic services, such as a poorly located bus station, impedes the efficient handling of transport demand. Lastly, all the layers of the model are connected to the corresponding systems in the system decomposition.

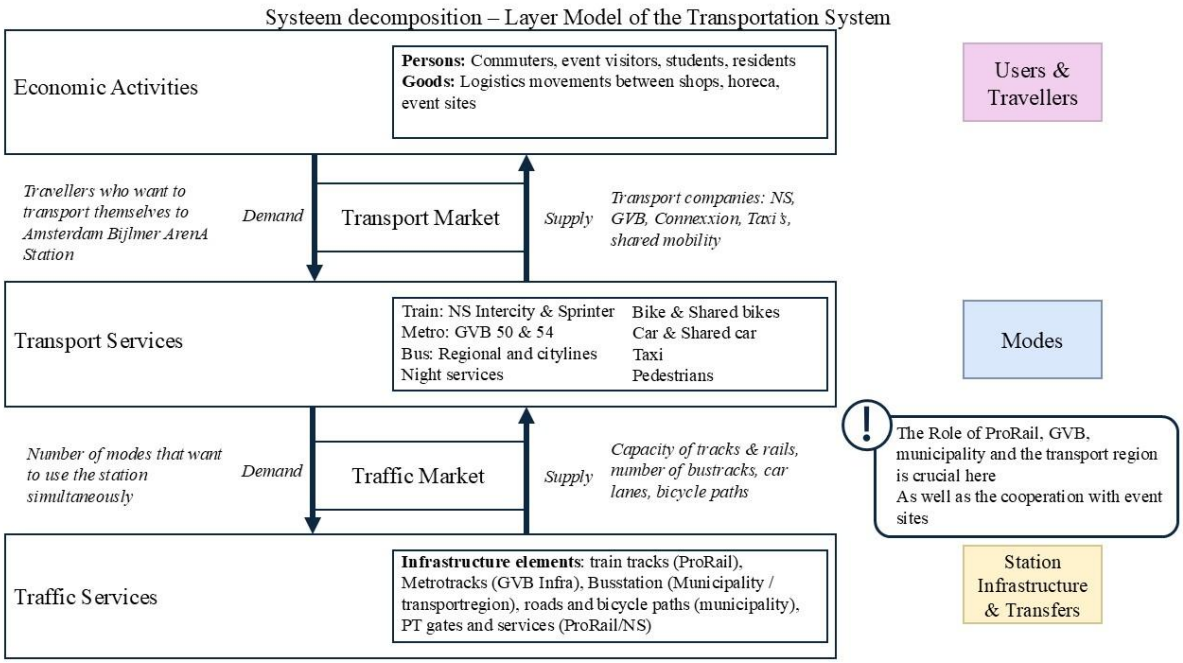



*Figure 14 – Layer Model of the Transportation System applied to Amsterdam Bijlmer ArenA Station (Schoemaker et al., 2019, applied to ABAS by Author, 2026)*

### 4.1.4. Main takeaway from system analyses

The three analyses demonstrate that Amsterdam Bijlmer ArenA station is a very complex hub in which public space and infrastructure overlap in a grey area. While the system decomposition reveals the crucial role of overarching subsystems such as event management and information provision, the Transport Layer Model shows that the effectiveness of these services depends on cooperation among multiple stakeholders within the traffic and transport market.

The most significant challenge lies in the friction within the physical transfer space. Although the Johan Cruijff Boulevard functions as a necessary "sponge zone" during events to relieve pressure on the infrastructure, the illogical connections between transport modes remain a structural bottleneck for passengers.

## 4.2. Stakeholder interviews of Amsterdam Bijlmer ArenA Station

Interviews have been conducted with five stakeholders. ProRail, NS, Municipality of Amsterdam – Event Coordinator, Municipality of Amsterdam – Project Manager and the Vervoerregio Amsterdam. They will shortly be introduced, together with the GVB and the main event sites, before developing on the main findings of the interviews.

### 4.2.1 Stakeholder overview

This stakeholder overview is deliberately limited to actors with direct operational or governance responsibilities within the station area. Users, residents, and commercial parties are therefore not treated as primary stakeholders at this stage, as their interests are indirectly represented through the institutional actors involved. A more detailed differentiation of, for example, the users is addressed earlier in the thesis at the system decomposition analysis.

A small introduction to all stakeholders is necessary before exploring the main findings from the interviews. Firstly, ProRail renovates and maintains stations in the Netherlands. On the other hand, there

is NS, they own and manages the facilities at the stations, as well as providing the trains on the tracks (Dutch Government-2, n.d.). The municipality of Amsterdam is responsible for the public space and permits. They also provide the coordinator of events and crowds during big event peaks. Fourthly, the Vervoerregio Amsterdam (VRA) is the concessionaire (concessiehouder) of the metropolitan region of Amsterdam, they are an administrative partnership of 14 municipalities in the region (VRA, n.d.). Next, the GVB is exploiting the bus and metro services in the area and at the ABAS. Lastly, there are three event areas, all being a separate stakeholder in this area. These are the Johan Cruijff ArenA, the AFAS Live, and the Ziggo Dome. They play a crucial role in why the travellers see the station as a destination.

In the figure below (15), the formal chart and stakeholder interaction are shown. This figure is based on the stakeholder analysis and the findings of the interviews in 4.2.2. There are four different stakeholder sectors, each shown in a different colour. Not all the interactions are shown, only the most important ones. Some interactions are between individual stakeholders, while some interactions are between the whole group. The most interesting interactions between full groups are that users & society use the services of the transport operators, as well as together with the event sector, generating (peak) demand on the available transport.

While ProRail and NS have a conflict of interest about the growth of the Amsterdam Bijlmer ArenA Station, there is also a lack of funding from the VRA for actually investing in the new station. Furthermore, the OMC has different relationships, which are shown with the thick arrows. The OMC is a main stakeholder as the operational coordinator during events. They synchronise operations, manage the peak situations and allow for real-time decision-making in the Operational Mobility Centre. They are a crucial node in the whole system of Amsterdam Bijlmer ArenA Station and its surroundings during events.

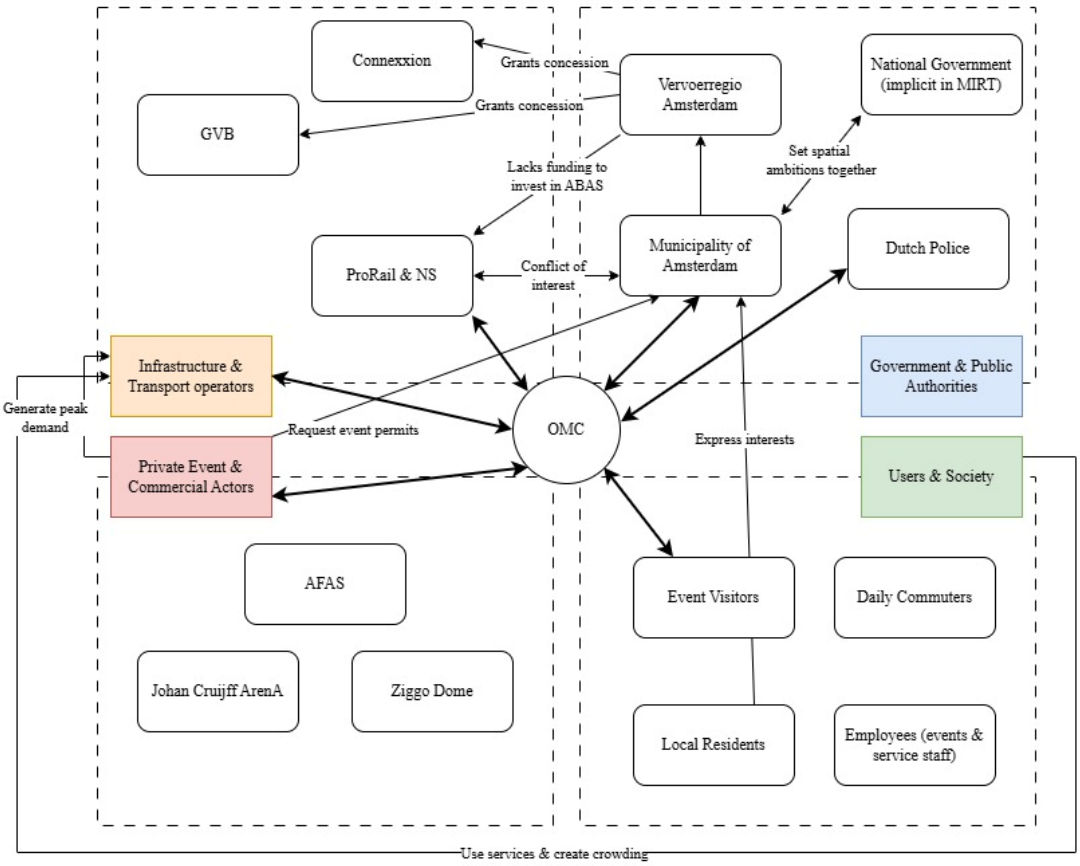



*Figure 15 - Formal Chart and stakeholder interaction of the ABAS Area (Author, 2026)*

## 4.2.2. Findings from interviews in Amsterdam

Four main points are overlapping from the interviews, which are: 1. The tension between daily function and peak capacity 2. Diverging interests and governance complexity 3. Crowd management and 4. Multimodality and future vision. The questions and answers of these interviews can be found in Appendix C.

### *4.2.2.1. Tension between daily function and peak capacity*

Firstly, all parties acknowledge the fundamental dilemma in designing and managing ABAS; the station must function efficiently as a commuter hub for 365 days a year, and yet also handle massive peaks during events (and triples) about 20 times a year. ProRail and NS emphasise that stations are not built purely for events and put the daily traveller as the baseline. They see the risk in creating a design that is suboptimal for both situations. The 'rail companies' indicate that the most effective safety measure is a sufficient discharge capacity (trains), but this can be costly and resource intensive. The VRA views ABAS as a fundamentally well-functioning station but recognises that expansion needs lie primarily with bus and bicycle facilities. Significant interventions and improvements are needed for events, but funding is currently lacking, and therefore, the urgency is not that high. On the other end of the spectrum, there is the municipality that is insisting on getting a new station which integrates completely with the surroundings.

### *4.2.2.2. Diverging interests and governance complexity*

Decision-making is very slow and complex due to multiple stakeholders with different interests and funding streams. Firstly, there is the public vs. private conflict, as the commercial interests of the event venues are often influenced by the artists or the type of events. Whereas the NS is willing to help and deploy night trains, but that is at the expense of public costs. Furthermore, the funding overall is difficult and complex, as government funding is often tied to the area development and the housing projects, which are via the municipality. They are pushing for a new station hall driven by housing ambitions. On the other hand, ProRail and NS lack their own budgets for area development, adding to the fact that they don't see the urgency of improving the station. They are sceptical about its utility for current passenger flows and events, which differ in passenger forecasting models from those of the municipality. The overarching stakeholder VRA does have resources for bus/metro, but not for the rail infrastructure.

### *4.2.2.3. Crowd management*

There is consensus that the solution to peak crowding lies not *inside* the station but also *surrounding* it. Both the VRA and NS/ProRail support the idea of activating the public space, the Johan Cruijff Boulevard, to retain visitors longer. These are the so-called 'sponge-zones', which offer accommodation to stay and improve the quality of the area. Due to this, the outflow can be spread over time. Currently, temporary measures are used during events, like barriers and announcements. The goal is to move towards robust, permanent solutions like fixed sound systems and screens on the rail infrastructure. Those screens will help to divert pedestrian flows onto the correct platforms in the station.

### *4.2.2.4. Multimodality and future vision*

The transfer between train, metro and bus takes time due to significant height differences. An 'intermediate transfer level' is a shared long-term desire, but it is probably very expensive. The long-term desire is emphasised by ProRail and NS. The VRA sees the most significant growth and challenge in the bus station and bicycle parking. This is mainly due to the growth of the urban areas. Which, in the end, also affects the role in the network of the station. The position in the national network in the future remains largely unchanged, but its regional role is growing due to housing development and the bus connections towards surrounding towns.

#### *4.2.2.5 Main takeaway Interview*

There is a clear conflict of interest among the involved parties, making governance a key factor. The Municipality of Amsterdam is heavily investing in the area development of ArenAPoort and therefore expects increased pressure on the station, arguing for its expansion. However, NS and ProRail do not see this as necessary, as the current infrastructure can adequately handle daily passenger flows, both in terms of access points and train capacity. During major events, all stakeholders acknowledge that station pressure increases; temporary crowd management measures are currently used to manage flows and optimise train use. NS and ProRail emphasise, however, that they do not build stations in the Netherlands designed primarily for events. Concepts like crowd management and "sponge zones" are crucial in this context.

The Amsterdam Transport Authority takes an intermediate stance, recognising that changes are needed but questioning whether these should focus solely on rail. They stress improving bus connectivity and multimodal integration, particularly enhancing transfers between transport modes.

## 4.3. Document Analysis of Amsterdam Bijlmer ArenA Station

For this document analysis, there are four documents which contribute to the specific themes for this thesis research. The first one is the Handelingsperspectief from Goudappel (2022), which describes the ambitions and scores the current situation. This document is important for the development of the list of aspects (chapter 6) and thus the tool. Furthermore, Goudappel (2023) also did a study on crowd management and their insights from 'Crowdsimulatie ArenAPoort West' in order of the Municipality of Amsterdam. Moreover, this document analysis includes the endpaper of the 'MIRT Verkenning' from 2024. This document is crucial for the understanding of the current position of the complete redevelopment of the station and the station area. Lastly, to progress on crowd and event management, there is a document on temporary and short-term measures to handle big crowds, set up by Veeger et al. (2020).

### 4.3.1. The 'Handelingsperspectief'

This document is of utmost importance when it comes to a major characteristic of this station; the station must function in two different ways. There is, namely, a big difference between the daily situation and when the station must handle event-situations. Goudappel states that the station functions better during regular days than during peak hours. The figure below (figure 16) shows the main differences between the two situations, showing the double-faced character of the station. The coloured parts of the graph show the daily/normal situation, while the line shows the event situation. This figure shows the scores of the current situation.

A useful insight is that during events, only the location of the station in its surroundings and the accessibility score are higher than during daily situations (orange). Moreover, regarding the mobility (purple), the modes score very similarly during both the specific situations, except for the pedestrian and K+R & Taxi score, even though those are very important during events. Regarding the green aspects, things like facilities, domains within the transit node and safety of the transfer score higher during daily situations, meaning that the event situation puts too much pressure on these factors. Finally, all the 'blue' aspects, considering social safety and traveller satisfaction, score low both during daily situations and event situations.

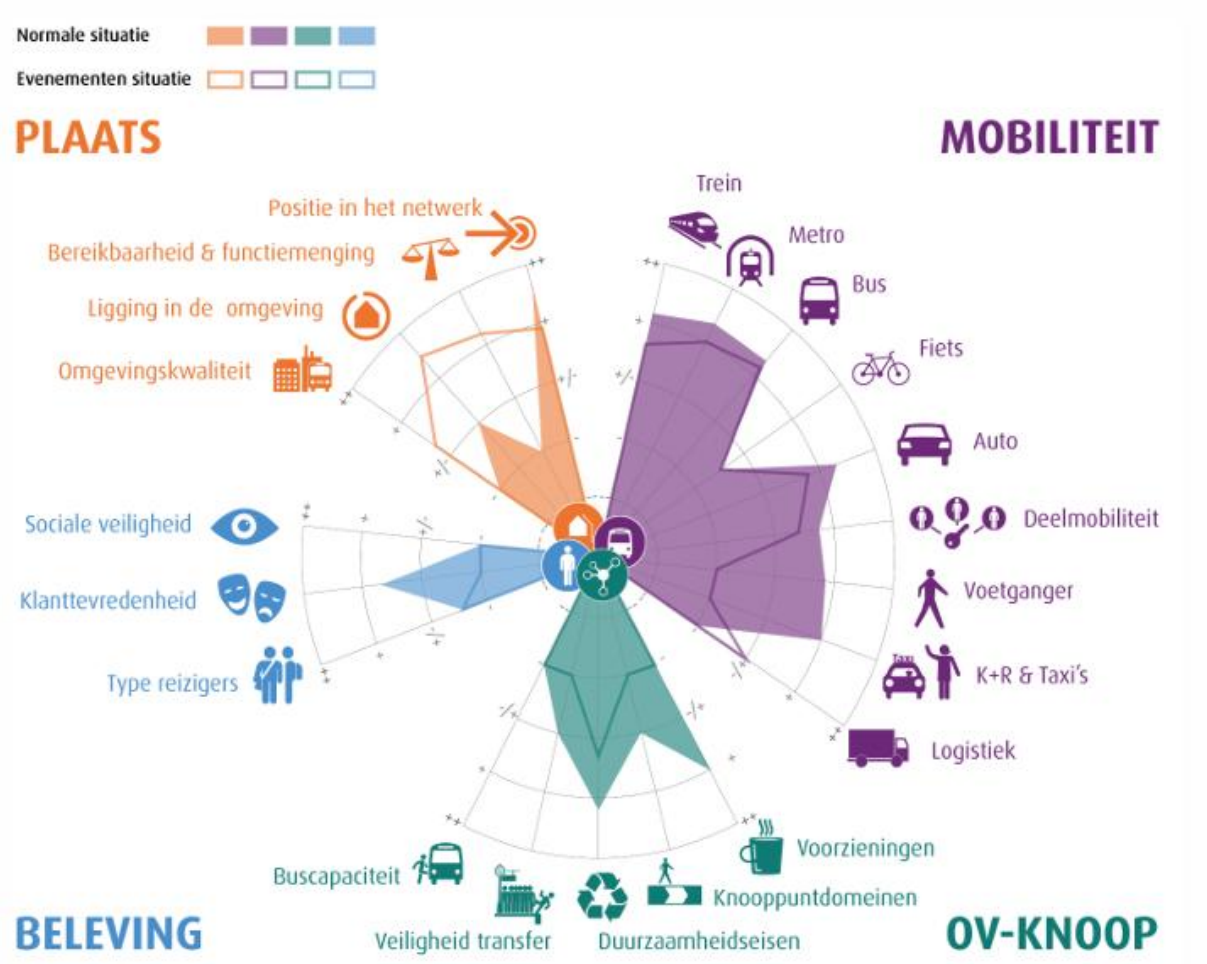



*Figure 16 - Scores and differences during daily and event situation current situation (Goudappel, 2022)*

The document also considers a desired situation. The picture below (figure 17) shows the current situation, light-toned, and the desired situation, coloured darker, on the same aspects as the last figure. Even though the current situation is double-sided, the ambition is to improve the spatial and public space on the four themes, making the station suitable for both situations, pleasant and functional. An important and challenging goal is the decrease in the mode of car travel. This will give more space to cars and bikes in the mobility aspects.

The orange, locational aspects, seem to improve a lot in ambition. This is mainly because of the goals regarding the surrounding areas and the quality of the stay. This ambition is to make sure that visitors to events will stay longer in the area to lighten the pressure on the station. The goals for the social and safety aspects aim to score positive, not perfect. The aim is to make the station a familiar and safe place to visit 24/7. The last desires are for the facilities in and closely around the station, improving the waiting areas and transfers are the most important aspects of the transit-node functions.

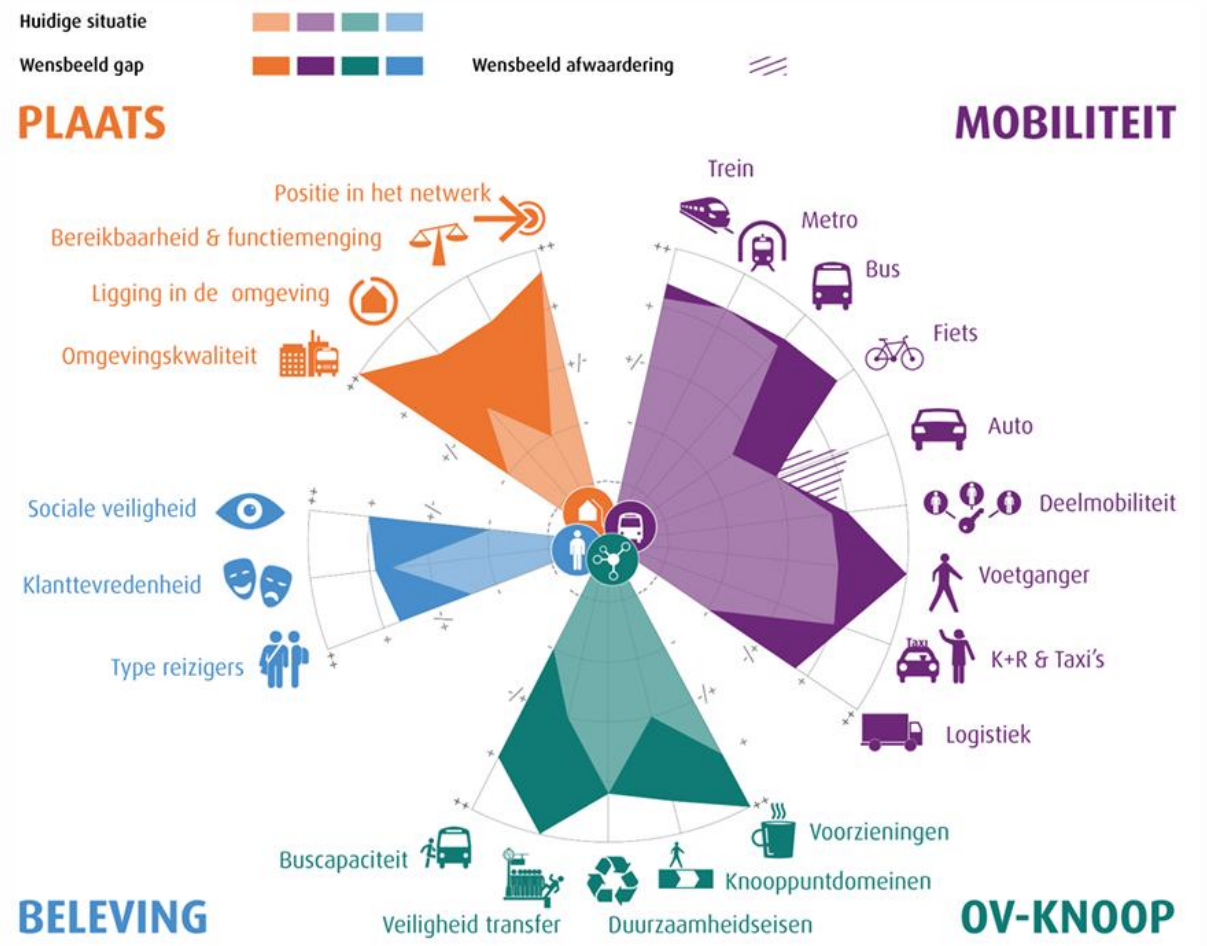



*Figure 17 - Scores of the current and the desired situation (Goudappel, 2022)*

### 4.3.2 Crowd Management and Simulation

The 'Crowd Simulatie ArenAPoort West' conducted by Goudappel (2023) provided a critical foundation for analysing the operational performance of the ABAS within the context of large event flows. The study evaluates projected scenarios from 2030, focusing on the triple events, meaning a simultaneous event and outflow of the Johan Cruijff ArenA, Ziggo Dome and AFAS Live, resulting in peak volumes exceeding 95,000 visitors. They expect that 85% from all visitors travelling with NS travel via the train station.

Dynamic simulations are based on several static and temporary aspects of the public space around the station. The simulation identifies several bottlenecks; the main ones important for this study are around 3 specific entrances of the Johan Cruijff ArenA (D, E & F); the connection between De Passage and the Johan Cruijff Boulevard and the square before ABAS. The picture below shows them, marked with the numbers 1 to 4. Bottleneck 5 is at a different public transport node.

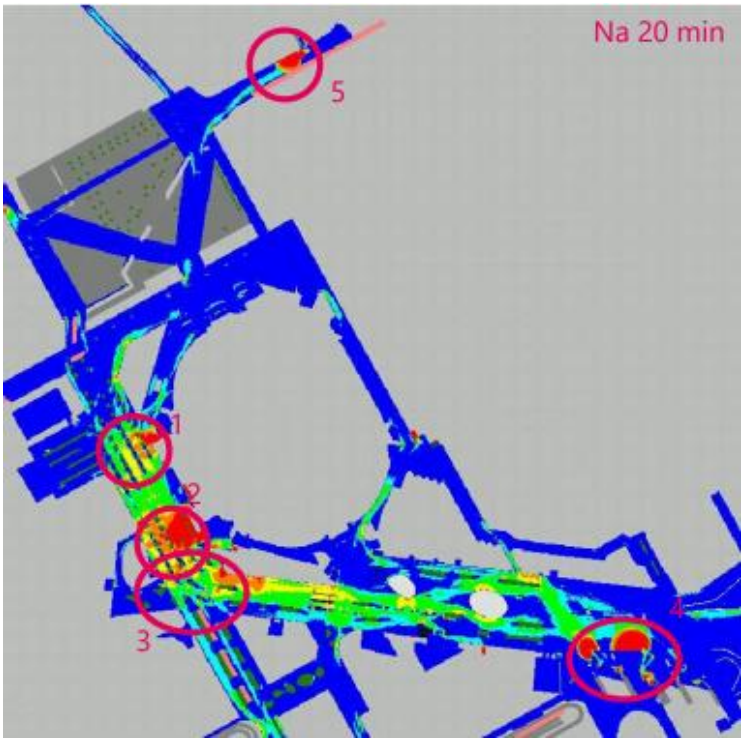



*Figure 18 - Bottleneck points during outflow of a triple in the public space (Goudappel, 2023)*

The report concludes that safety and throughput can only be guaranteed by drastically minimising physical obstacles across the entire width of De Passage, thereby maximising the capacity for the transit nodes and reducing all density levels. Furthermore, in front of the entrances of the ABAS, there are two main bottlenecks, as shown in the picture below.

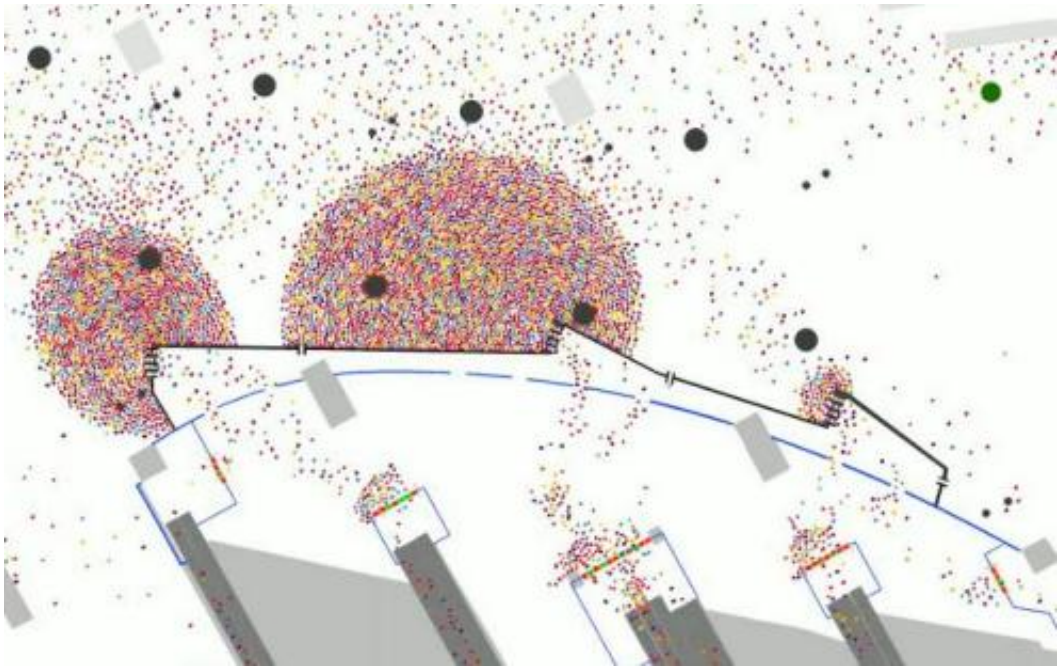


*Figure 19 - Bottleneck points at the entrances of the ABAS (Goudappel, 2023)*

The report concludes that the public space at the Johan Cruijff Boulevard is not being used optimally. In order the optimize this, a strategic repositioning of the street is required to balance the mass of people in the public space and give everyone more space.

### 4.3.3. ‘Eindrapport MIRT-verkenning’

The situation of the MIRT for the ABAS project is slightly complicated. The MIRT process is parallel to how the government it usually organises. In figure 20 you can see in which Phases of the MIRT ABAS now operates. As mentioned, the process is now not officially how the government operates, however several stakeholders work together to follow the rules and regulations of the MIRT. The government follows the project, as it has a high urgency as well as potential. Once all the financials are completed, the MIRT can be submitted with more ease and follow the official procedures quicker. The report follows the MIRT methodology.

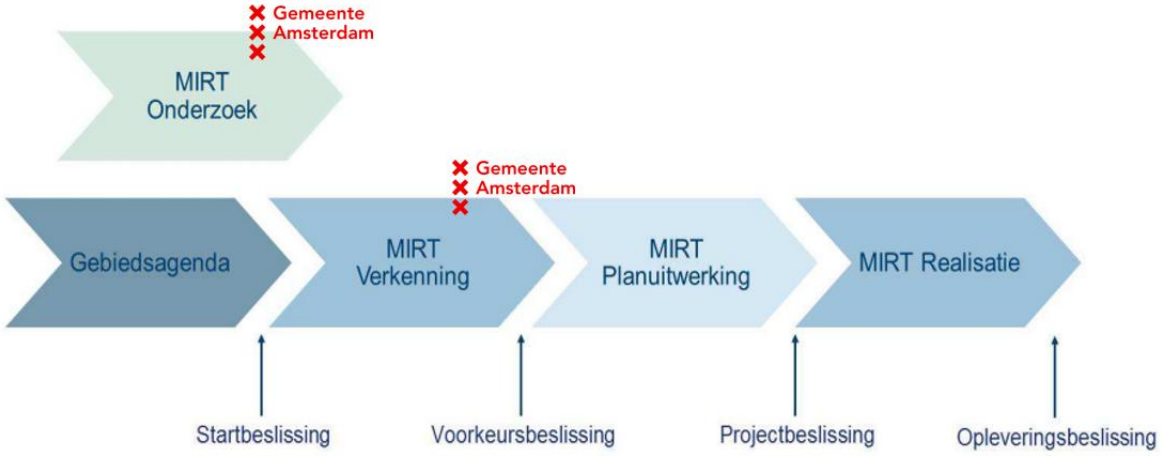



*Figure 20 - MIRT and the Phase of ABAS*

As of now, there is a document concerning the result of the MIRT Onderzoek, which makes the process, at the moment of writing, around the ‘Voorkeursbeslissing’. The result of the MIRT Onderzoek is documented by Civic and Witteveen&Bos (2024) and analyses the different integral scenarios of the design of the new station hall. The documents consist of the analysis of the ABAS area, developed on some separate parts of the system decomposition, referring to it as ‘building blocks’ and combining the blocks to show the different design options. Furthermore, it roughly focuses on the global costs and concludes the MIRT Onderzoek in the final chapter. For this specific research, some conclusions and interesting insights can be drawn from the document:

- The document translates 8 ambitions into integral assignments/tasks. For the thesis, the following are the most important: How will the station area improve its connection to the surrounding areas? – How can the quality of stay in the public space be improved? – How can the capacity of the bus station be improved? – What is the ideal structure of the station’s areas and its elevating areas, contributing to the integral vision and identity of the station? – And finally: how can the event capacity of the station improve, and how can this be used as a driver of urban development in the regular situation?
- In general, there is a big question on how to use the space most optimally, with the limited amount of space, while staying adaptable for future growth.
- One of the main recommendations, appealing for this research, is the improvement of the station hall, especially on the southside.

## 4.4. Preliminary Conclusions for Amsterdam Bijlmer ArenA Case

### 4.4.1. Synthesis of Phase 1 findings

The case analysis of Amsterdam Bijlmer ArenA Station reveals that the area functions as a complex socio-technical system with five different interdependent subsystems: Modes, Infrastructure, Users, Public Space and Private Enterprises. These systems interact with each other through three critical subsystems: Transfers, Event Management and Information Supply. These subsystems function as coordination layers that ensure the station can operate under different circumstances.

The area is namely unique due to its double-faced character, as it must function as a standard commuter hub during daily operations and as a massive event destination with big peak moments. This dual character results in tensions in the system and subsystems. Whereas the daily baseline can be accommodated within the physical station infrastructure, extreme event peaks, especially 'triple events' exceed the designed capacity. As a result, the public space, especially the Johan Cruijff Boulevard, becomes integrated into the station system, and functioning as a secondary station hall. This blurring of boundaries between public space and transport infrastructure illustrate that ABAS operates as an expended urban mobility system rather than a fully closed transit node.

From a governance and decision-making perspective, the redevelopment is shaped by some fragmentation. The municipality pursues area development, with a new station integrated with the residential and commercial ambitions. While ProRail and NS prioritise daily commuter baselines and design the station merely on that. The MIRT process provides the shared strategic framework, even though it is not processed officially. This emphasises the situation of the fragmentation and the friction between some crucial stakeholders. On the positive note, the Operational Mobility Centre is a well-working coordination between critical stakeholders during events.

These findings are interesting to consider for the cross-case comparison. The embedded units identified in Phase 1, especially the interaction of a station with its surroundings, the pressure of events on a transit node, the management of crowds and the governance fragmentation provide a basis to find structural similarities or differences in other European mobility hubs near major event sites.

### 4.4.2. Answers to sub-questions

As stated at the beginning of this Phase, there are two sub-questions which must be answered. This will be done below:

- *How is integrated decision-making currently organised in the redevelopment process of ABAS?*

Integrated decision-making is organised through a multi-stakeholder framework, following a non-official, parallel, MIRT methodology, currently nearing the 'Voorkeursbeslissing'. The governance of this decision-making is characterised by the high complexity and diverging interests of, on the one hand, the Municipality of Amsterdam and, on the other, ProRail and NS. The municipality is heavily investing in the area through residential and urban development, stating an increase in pressure on the station in combination with the event area. On the other hand, ProRail and NS are prioritising the daily baseline operations over event-driven pressure.

Furthermore, next to the redevelopment process and the strategic coordination through the MIRT, there are also some operational decision-making processes during events. These are synchronised between the stakeholders through the Operational Mobility Centre. Here, the rail companies, the municipality, the police and event venues synchronise event logistics.

- *How do all the systems at ABAS interact with each other, and why does that make the area so unique?*

The area is unique due to its double-faced character, where the station must function as a standard commuter hub, as well as being a massive event destination. There are several subsystems in and around the Amsterdam Bijlmer ArenA station which interact with each other: Modes, Infrastructure, Users, Public Space and Private Enterprises. They interact with each other through the Transfers, Event Management and Information Supply. Operated by the main transport operators in the Traffic Market and stakeholders in the event branch. The public space, mainly the Johan Cruijff Boulevard, is used to reduce pressure on the systems, blurring the line between the public space and the station infrastructure. This unique interaction forces the public space to serve as a secondary station hall, managing extreme 'triple event' peaks that the standard station infrastructure cannot handle alone.

# 5. Phase 2: Analysing Comparable Cases

In this chapter, the selection process and the case analysis of the comparable cases are explained. The case analysis will be based on the aspects which are explained in Chapter 5.2. This phase tries to seek an answer to the third question:

*Which international multimodal hubs adjacent to major event venues are most comparable to ABAS, and based on what criteria?*

## 5.1. Selecting comparable cases

Finding comparable cases for the ABAS situation was done in two steps: creating a long list based on criteria, and secondly, confirming whether there was enough data available. The long list was created on findings stations near event areas based on similar characteristics. The main criteria were:

1. If there are large event areas and/or big venues near a station, which can host at least up to 50.000 visitors, mainly searching for big football stadiums and concert halls;
2. If the station or station area has recently been under construction, / If there are currently renovations going on at the station or station area, / If a big renovation for the station is scheduled within the next 5-10 years.
3. If the station or station area is big enough to have at least two types of transportation modes;
4. If the station was feasible and applicable, with minor research at first sight, for further in-depth research.

The long list also included stations where a maximum of one criterion was missed. For example, at the station area of La Défense of Paris, there hasn't been a renovation very recently, and at the Santiago Bernabéu station and the Slakthusområdet station in Stockholm, there is only one main mode (metro). These stations are, however, interesting to develop further upon due to the positive scoring on the other criteria, which will be explained in their specific case.

After the setup of this long-list, research has been done to see whether there is enough information available and if a station or project manager was able to get in touch for an interview. After this step, some stations were dropped due to the limited amount of information available online or because they were unable to have an interview. Some examples of station areas which did not go into further detail are Witton Station in Birmingham, Décines OL Vallée in Lyon, Olympiastadion in Berlin, Westfalenpark in Dortmund and Stadion Narodowy in Warsaw.

## 5.2. Assessment of Comparable Cases per Embedded Unit

In this section, the other stations are further analysed amongst 8 different embedded units (explained on the next page). Section 5.2.1 - 5.2.5 contains more in-depth information on the stations, as these stations and areas had more information available and interviews with station or project managers were held. 5.2.6 till 5.2.8 contain so-called 'vignettes', as explained in 2.3.2. Here, some information on the cases was found which is interesting for the comparative analysis, but due to time restrictions and the availability of resources, the information is limited to some embedded units, thus aspects. Although the case of Paris St. Denis-Pleyel (5.2.6) has some more critical information, which could be clustered into one embedded unit. These cases are however incorporated in the research, as they still provide useful and inspiring information.

Below, every aspect is listed with the explanation it has in this study. How these aspects exactly were derived, is explained in Chapter 6.1.

1. **Position in Network**

Position in Network refers to the role of a station within the regional and national transport system. It describes how the station functions in various networks, like trains, metro, buses, and others, including its connectivity, accessibility, and importance for handling peak flows related to major events.

2. **Economic & Urban Integration**

Economic & Urban Integration relates to the relationship between the station and its surrounding urban environment. It examines how the station supports nearby economic activities, housing, and leisure functions, and how well it is integrated into the surrounding spatial structure.

3. **Transportation Modes & Transfers**

Transportation Modes & Transfers refers to the range and coordination of transport modes available at the station, such as train, metro, bus, bicycle, pedestrian, car, and shared mobility. The aspect focuses on transfer quality, capacity, frequency, and efficiency, especially under event-related peak demand conditions.

4. **Safety & Security**

Safety & Security addresses how a station-area ensures the physical and social safety of users, particularly during peak event situations. It includes transfer safety, crowd control measures, social safety, and how the safety protocols work in general terms.

5. **Event Management**

Event Management focuses on how transport systems and station areas are prepared and operated during major events. It includes planning and coordination between event organisers and transport operators. As well as considering possible timetable adjustments and operational strategies to ensure smooth arrival and departure flows before and after events.

6. **Crowd Management**

Crowd Management addresses the (physical) control and guidance of large pedestrian flows in and around stations during events. It includes design principles for crowd safety and flow regulation, as well as communication strategies of stakeholders and whether intervention measures need to be applied. In addition, some bottlenecks of stations are included and generalised.

7. **Governance & Organisation**

Governance & Organisation examines how responsibilities, decision-making, and coordination are organised among public authorities, transport operators, and private stakeholders. This aspect focuses on both the governance of events and the governance and organisation of infrastructure projects. It involves whether certain specified governance structures, collaboration structures and decision-making processes are included in the management of the event-related transit nodes.

8. **Fully Integrated Station**

The Fully Integrated Station represents the extent to which all functional, spatial, operational, and organisational aspects of a station-area work together as a coherent system. This aspect seeks towards a full integration of the social-economic features of the station, indicating whether the station performs as a complete hub, rather than a collection of separate components.

### 5.2.1. Rotterdam Station Stadionpark (Future)

**Introduction**

Rotterdam Stadionpark is the only comparable option considered within the Dutch borders. The station will make a shift from an event-only stop towards a new heart in Rotterdam South. The area has the second biggest football stadium, De Kuip, with a capacity of 47,500 people (dekuip, n.d.). In addition, the area will be developed so the station will be used by residents and commuters. It is important to note that this analysis will be based on how the future of this station will look.

The project is still in its design phase, so this analysis is based on a lot of information from the interview in Appendix D, and some policy plans: Rotterdam Verbindt (2024), Gemeente Rotterdam (2020) & (2022), ProRail (2024), StadsbrugOV (2025) and Movares (2022).

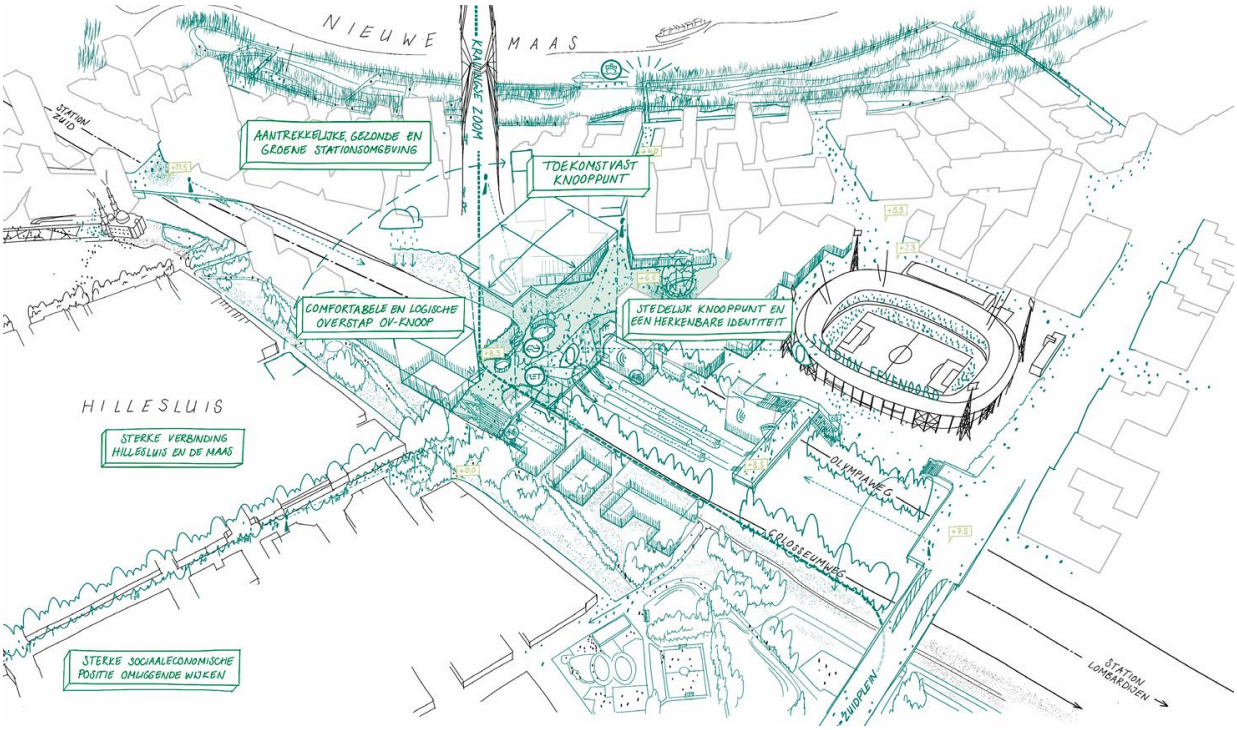



*Figure 21 - Ambition of the new station Stadionpark and its surroundings (StadsbrugOV, 2025)*

**Position in Network**

- Currently, the station is an event-only stop, but the station will transform into a permanent 24/7 Sprinter node serving the national network, specifically the Den Haag–Dordrecht and Rotterdam–Roosendaal connection;
- The station is a key component of the "Oude Lijn" MIRT exploration, designed to facilitate high-frequency Citysprinter services between regional urban centres;
- Infrastructure is being designed with "Intercity ambitions," including modular platform bridges (traverses) and escalators, which allow for future capacity upgrades;
- Acts as a strategic node for a new High-Quality Public Transport (HOV) tram connection between Kralingse Zoom and Zuidplein.

**Economic & Urban Integration**

- The project utilises the station as a primary tool to lift the physical barrier of the railway tracks, creating essential inter-neighbourhood connections.

- The western entrance is connected to a local park, featuring commercial spaces and bike parking built directly outside of the station;
- An eastern station and stadium square is planned as a central meeting point for the broader area development, serving as a hub for both commuters and residents.
- The area is designed to host "daily life" activities such as youth sports and small festivals on the Olympiaplein to ensure the district remains lively when no major events are scheduled.

**Transport Modes & Transfers**

- The station reroutes existing tram lines (like Line 3) and bus routes to create a single integrated transit node rather than an isolated stop;
- Pedestrians and cyclists are prioritised through new crossing points and extensive bike storage integrated into the station;
- The station is designed to facilitate rapid transfers between national rail and the high-frequency bus and tram lanes planned for the Stadionpark area and the surrounding neighbourhoods;
- Station includes dedicated lanes and parking zones for regional buses, ensuring they serve as an effective extension of the rail network.

**Safety & Security**

- Structural design prioritises the visual separation of home and away supporters to minimise verbal aggression and physical conflict;
- Design moves away from extreme "vandal-proof" (hufterproof) aesthetics toward high-quality, "soft" urban design to encourage more civilised behaviour of visitors;
- The design includes separate event entrances and buffer areas outside the rail-side infrastructure to manage fans before they enter the platform;
- Safety protocols are reviewed through a cooperative security meeting involving ProRail, NS, the police, and regional safety authorities.

**Event Management**

- The station is designed to handle "two states", with an extra entrance that can be used for supporters during events.
- Specific "bus pipes" and dedicated docks are maintained to ensure away supporters can transition directly from their transport to isolated station areas.
- Event governance is led by a mobility coordinator from the stadium (De Kuip) in collaboration with municipal managers and transport operators;
- Operational plans account for massive influxes of shared scooters, which can account for up to 70% of Rotterdam's total supply of shared scooters being around the stadium during major matches, those parties are also involved in the event management.

**Crowd Management**

- The primary design goal is to "unravel" passenger flows, physically separating different streams of travellers to eliminate bottlenecks;
- The new pedestrian bridges are modular, allowing for additional 8-meter-wide walking strips to be added if future crowd demand exceeds current predictions;
- Their priority in operations is using stewards and real-time information systems to manage fan distribution more effectively after events (outflow) than during arrival;
- The station relies on fixed wayfinding rather than steering the behaviour of passengers.

**Governance & Organization**

- The project operates under the national structure, involving state, provincial, and local institutions;
- Bi-weekly design meetings are held to ensure the station remains fully integrated with the many sub-projects of the broader area development;
- A single overarching manager oversees the coherence between ProRail's technical requirements and the municipality's urban development goals;
- Decision-making incorporates feedback from residents and stadium supporters gathered through large-scale participation evenings and surveys.

**Integrated Station**

- The station bridges are designed to be "green passerelles," featuring small plants to improve urban biodiversity and aesthetics (similar to Zwolle or Den Bosch);
- The station design emphasises "eyes on the street" by ensuring many active facades, doors, and windows rather than closed walls;
- The stadium (De Kuip) has classrooms, meaning that the station will be designed for and used by students as well, creating a community-centred environment;
- The new station functions as an economic and cultural engine for the district, where daily neighbourhood needs are balanced with large event requirements.

### 5.2.2. Madrid Bernabeu Station

**Introduction**

The Bernabeu metro station is located at north side of the centre of Madrid. The station is next to the Estadio Bernabeu, the home ground of Real Madrid and the 3rd largest museum of the city. In 2024, over 4 million passengers used the station (Skóra, 2025). The station is now under construction, because Metro de Madrid wants to triple its capacity and fully adapt to the needs of people with disabilities. Two years ago, the Community of Madrid completed 25% of the work, aiming to be fully done with the reconstruction works in 2027, when Real Madrid turns 125 years (Metro de Madrid, 2025).

This analysis is based on the interview with Metro de Madrid in Appendix E, the Estudio de Viabilidad by Real Madrid (2021), the 'Estudio de tráficio' of Estadio Santiago Bernabéu (2016) by Tema Ingenería and 'The urban environment plan' by Real Madrid (2016) and empirical research on Google Maps.

**Position in network**

- Acts as a vital station on Madrid's primary north-south axis, located just one stop from the Nuevos Ministerios regional transport hub;
- Currently being redesigned for the "worst-case scenario" by tripling platform space to safely accommodate 70,000-person event peaks;
- Functions as a relief system using three-minute train frequencies and inflow management to funnel crowds toward larger hubs like Plaza de Castilla and Nuevos Ministerios;
- Integrates with the city via four new access points, balancing high-capacity demands with its role as a tourism portal for the well-known Real Madrid museum.

**Economic & Urban integration**

- Station is located in a high-density office and residential district; the station is optimised by expanding its underground surface due to limited street-level space.

- New station features a massive new underground mezzanine designed to absorb crowd pressure while maintaining the flow of the surrounding city;
- Entrances are embedded directly into the stadium's promenade and local office buildings to minimise the station's impact as an urban barrier;
- Station utilizes specialized tunnelling techniques to preserve mature trees, ensuring capacity expansion remains respectful of the local environment.


*Figure 22 - Entrance of the new metro station next to Estadio Bernabéu (Metro de Madrid, 2024)*

**Transportation modes & Transfers**

- Mainly serves the underground-network via Metro Line 10, while multiple regional bus lines are available on the surface-level transit options;
- The goal is to include a modernised parking underneath the promenade, which includes shared mobility options (see figure 23 below)
- New station will be modernised with lifts and more elevators for full inclusivity and seamless transportation on foot;
- During major events, bus traffic is rerouted to prioritise high-capacity metro flow and ensure a bottleneck-free transition for spectators.


*Figure 23 - Shared Mobility underneath promenade, between stadium and station (Real Madrid, 2021)*

**Safety & Security**

- Metro de Madrid adheres to a general philosophy concerning safety;
- Tripling platform dimensions for the new station to physically prevent overcrowding;
- Specific protocol to hold crowds at the street-level promenade, allowing entry only when platforms are clear and safe;
- Supported by a presence of over 700 personnel, including police and stewards, alongside the removal of nearby parking and bus redirection, enhances safety;
- The "Gran Vestíbulo" (big central hall), the underground mezzanine, uses open sightlines and bright lighting to eliminate dark corners and enhance social safety;
- Modern entry-gates together with national safety standards complete the new station. Operational protocols are derived from the Metropolitano Station, near the Metropolitano Stadium of Atletico Madrid.


*Figure 24 - Layout inside the new metro station (Metro de Madrid, 2024)*

**Event Management**

- New station maintains a strict operational divide between daily urban use and the unique demands of high impact matchdays.
- Static layouts are replaced with surface areas that transform from a regular promenade into a regulated waiting zone for spectators;
- Stop-and-Go Strategy: Employs a specific influx regulation strategy, particularly to manage concert crowds who tend to arrive simultaneously;
- Centralised Governance through high-level coordination between the Central Government, the Mayor of Madrid, and transport authorities for major events.

**Crowd Management**

- Pedestrian prioritisation by rerouting vehicles to create a safe ground-level area;
- New station eliminates narrow hallways in favour of a massive mezzanine buffer, with designs validated by crowd-simulation software.
- During peaks, all escalators are synchronised in one direction (downward) to accelerate movement toward the tracks;
- Stop-and-go strategy restricts entry to specific controlled access points, ensuring passengers only descend once underground congestion is cleared.

**Governance & Organisation:**

- Real Madrid initiates and funds the urban renewal, while Metro Madrid retains authority over technical design and civil works, ensuring a public-private partnership;
- New design follows a legal sequence of feasibility and environmental studies, often influenced by high-level politicians;
- Due to its economic significance, the project does not have a typical 10-year cycle to align with the stadium's grand reopening, the project is fastened;
- Modernisation and thematics are driven by the club's global branding requirements but executed and regulated by state technical teams.

**Fully Integrated Station**

- Station renovation is inseparable from the stadium's transformation, acting as a cultural gateway with a dedicated club information point;
- New station **s**erves as an economic and social anchor that efficiently absorbs massive crowds;
- It **b**alances the needs of global tourism with the essential infrastructure requirements of a high-density urban district.

### 5.2.3. London Wembley Park Station

**Introduction**

Wembley Park is a London Underground station, served by two metro lines. The station is located next to the Olympic Way and is therefore the nearest station to Wembley Stadium and Wembley Arena. Two main event locations that can host up to 90,000, the 2nd largest stadium in Europe, and 12,500 people respectively (Wembleystadium, n.d. & DestinationWembley, n.d.). Although the station was rebuilt in the early 2000s, the station and the area around remains iconic, being the symbol for crowd and event management (Batista, 2025).


*Figure 25 - Famous Wembley Stairs at Wembley Park station (Author, 2026)*

The information in the aspects is based on the interview with station managers from Transport for London (TfL) from Wembley Park station in Appendix F, Wembley Park Case Study (ULI, 2021), Wembley Area Action Plan (Brent Council, 2015), Wembley Masterplan (Brent Council, 2008), Brent Local Plan (Brent Council, 2022) as well as empirical analysis of the station area.

**Position in Network**

- Station is connected via two metro lines to Central London (with some services skipping stops for speed) and suburban cities like Watford and Uxbridge;
- Station designed for peak event capacity; station remains fully open during off-peak moments and months to serve residents and commuters;
- Wembley Park station acts as a primary catalyst for the Brent Borough, driving the development of housing.

**Economic & Urban integration**

- The station blends into the neighbourhood via multiple entries, specifically the Olympic Way, which connects transit directly to the event district;
- The station is the gateway to the cultural centre, the district is filled with retail, leisure, and major venues like the Wembley Stadium and the OVO, making it a “15-minute neighbourhood”;
- Train tracks are currently a slight obstacle; future plans focus on new bridges to connect the station and the city.

**Transportation Modes & Transfers**

- Station is mainly used for the Jubilee and Metropolitan metro lines;
- Reducing parking and prioritising biking in the Wembley Park area, though biking remains difficult on event days due to pedestrian volumes;
- Integration of modes is improving through the development of bus hubs, although cycling integration remains poor due to the risk of road congestion.
- TfL introduced the 'SuperLoop', an express bus which links Wembley to areas that lack direct metro access;

**Safety & Security**

- Safety is driven by strict staff and evacuation protocols;
- There is structural surveillance through CCTV coverage and control rooms. Wembley Park has more staff-protected 'boxes' on the platforms compared to other stations;
- In addition, the station has several different 'levels' on which the hourly safety checks are done, mainly enhanced during events;
- During events, team leaders of TfL have a 'hot link' with the Metropolitan Police.

**Event Management**

- While inbound flow is natural, return traffic after events is the main challenge;
- The station profile changes during events, utilising exit- and entry-only points to avoid conflicting passenger traffic;
- Iterative learning of events, as cooperating institutions (TfL, Police, Brent Council, Event organisers) have regular meetings where lessons from every event are incorporated into the next management plan;
- Clear responsibility rules: TfL handles the people inside the station, while the 'last mile' from the stadium to the station is within the responsibility of the Police and Brent Council.

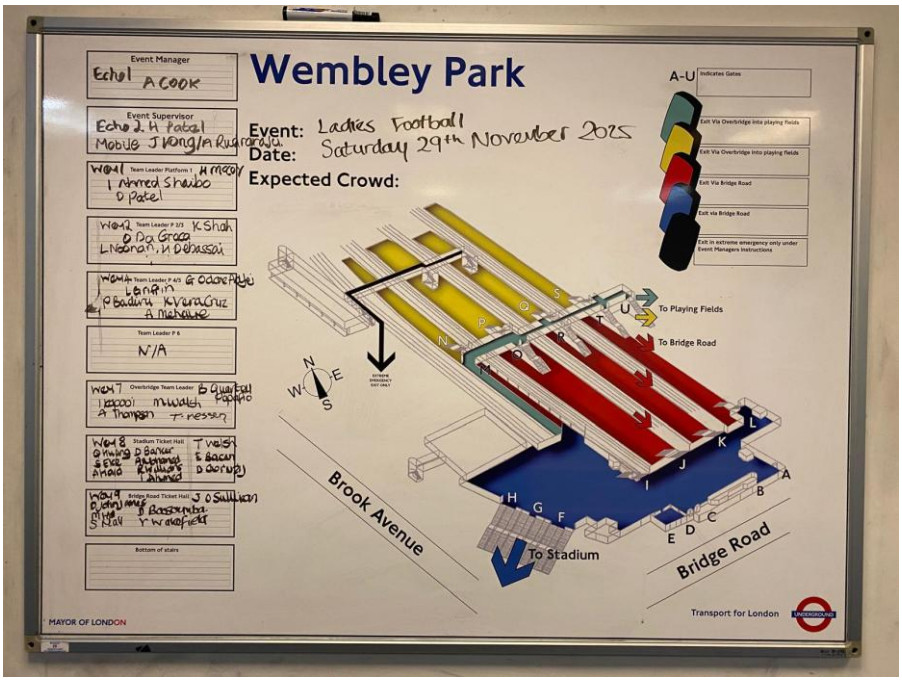



*Figure 26 - Event management poster in station office (Author, 2026)*

**Crowd Management**

- Inbound traffic before events naturally leaves the station, Olympic Way mainly acts as a 'sponge zone' for arriving fans, returning traffic often wants to depart immediately;
- Return traffic passengers are held in 'cauldrons' on the Olympic Way. The public space is used as a buffer to prevent the station platforms from overcrowding and ensure safety;
- To manage counterflows, specific platforms usually closed for daily use are opened, and all entry/exit points of the station are strictly regulated;
- Crowd simulation techniques are used, mainly to determine optimal staff deployment and emergency evacuation paths;
- Signage is static and permanent, designed for event-level crowds all year round, though dynamic staff communication is used for real-time diversions.

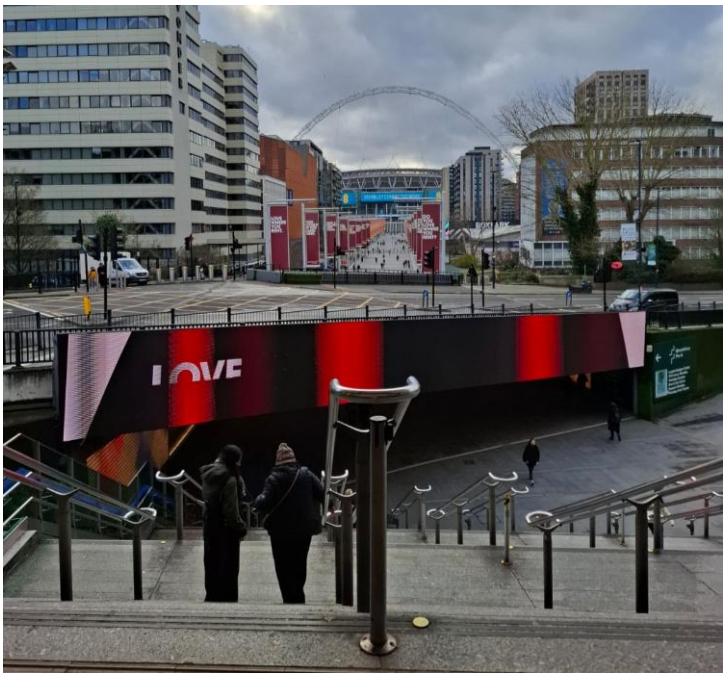


*Figure 27 - Stairs from the station and the Olympic Way (Author, 2026)*

**Governance & Organization**

- Developers provide funding to TfL to improve the buildings around the station;
- Decision-making follows a long design process, which is complicated by the need for parliamentary backing and strict 'Construction, Design and Management' safety regulations;
- Projects are often politically driven; TfL serves as the technical lead;
- TfL must adapt to fluctuating income, but the fixed nature of the railway infrastructure limits the physical adaptability of decision-making.

**Fully Integrated Station**

- The station is the economic engine of the district; local retail is dependent on the passenger output;
- TfL considers the station as a 24/7 home for staff who work there, and its cultural and social aspects to the Wembley Area;
- Station modernisation is inseparable from local area growth, meaning that accessibility and capacity upgrades are only triggered by the construction of the residential areas nearby.

## 5.2.4. London Stratford Station

**Introduction**

Stratford is one of the busiest stations in the UK and one of the most important public transport interchanges. The station had major developments around 2012, when London hosted the Olympic Games, as the station is next to the Queen Elizabeth Olympic Park. The area around the station, East London, is growing rapidly, and the station can no longer keep pace with this growth. As the TfL predicts that passenger numbers will increase by 60% by 2041 (London Assembly, 2023).

The analysis is done based on the interview in Appendix G, Newham Local Plan (2018), Newham vision for Stratford (2020), Newham Infrastructure Plan (2022), Stratford Station Regeneration Strategic Case (2023) and a technical paper by Charles Harmer (2016).

**Position in Network**

- Stratford is the 7th busiest station in the UK and connects London Underground, DLR, London Overground, Elizabeth Line and National Rail services and is therefore a critical hub;
- Despite the name, the second station connected to Stratford, Stratford International, does not have international trains, but it can be used as a pressure relief for high-speed trains when King's Cross fails;
- The station is the central pillar for the Stratford area, supporting thousands of homes and jobs.

**Economic & Urban integration**

- The station area has many high-level walkways and subways, ensuring to bridge the gap between all the rail tracks;
- The station itself is also the bridge between the historic Stratford town centre and the new development around the Olympic Park and the Westfield Shopping Centre;
- The adjacent mall acts as a natural buffer for arriving crowds, though it is often closed during post-event return peaks;
- The station area is essential for the development of the 35,000 new homes in the surrounding area.

**Transportation Modes & Transfers**

- The station includes metro services (2 lines), multiple regional and national trains, 1 light rail (DLR) and plenty of bus lines, which all contribute to the high-capacity transport in this MTH;
- The station can be seen as a maze of hallways and subways, ensuring both longer and shorter distances between high-level and low-level tracks;
- However, this physical distance is mitigated by the high service frequencies across the majority of the modes;
- The wider borough regeneration plan integrated segregated cycle lanes and pedestrian zones with multiple step-free access routes;
- There is the ambition to redevelop the station in such a way that there is a unified mezzanine on top of all tracks, to improve the overall overview and connection of various tracks. An example of this could be Utrecht Centraal.

**Safety & Security**

- A specific mezzanine level serves as a command-and-control point, providing an overview of passenger flows for real-time management (see figure 28 below);

- Structural design elements differentiate between wide and small concourses to slow down the masses unconsciously, to prevent the ‘tunnelling effect’, where crowds become too dangerously dense;
- An enhanced unit of the British Transport Police is deployed during events to manage safety;
- There are specified congestion control and emergency plans available for this station.


*Figure 28 – Command-and-control Room Stratford (Author, 2026)*

**Event Management**

- The station operates under two distinct profiles, ‘Business as Usual’ and ‘Event Plan’, which is activated approximately 3 hours prior to the start of an event;
- Hallway gates are physically shifted from a 50/50 daily split to a 70/30 (inbound) and 30/70 (outbound) to manage tidal flows (see figure 29 on the next page);
- Event Management benefits the most from the ‘learned behaviour’ of football fans, whereas often non-sporting events require doubled efforts in wayfinding and PA announcements;
- Detailed stewarding and safety protocols are implemented for West Ham United home matches at the London Stadium.

**Crowd Management**

- Marshalls use periodic ‘stop-and-holds’ between the stadium and the station to prevent the station from overcrowding;
- Most returning crowds are routed through a single ticket hall to prevent conflicting flows within the station;
- Arrival of people streams is slowed down using the physically smaller halls, which maintains, in the end, safe platform capacities.

*Figure 29 - Physical hallway gates, currently at a 50/50 daily split (Author, 2026)*

**Governance & Organization**

- Governance is managed through the Safety Advisory Group within the Borough of Newham, including TfL, Metropolitan Police, London Underground, London Stadium, West Ham United and Westfield Mall;
- While each party has their own driver (e.g. TfL safe railway operations & London Legacy Development Corporation, the broader social-economic regeneration), complex coordination structures are required to tackle and overcome the current capacity problems at Stratford station;
- Congestion Control and Operation Plans are reviewed annually to adapt to changes in the area;
- The Newham Council plays a driving role in ensuring transport plans that align with the socio-economic regeneration plans.

**Fully Integrated Station**

- Stratford station is the primary driver of the transformation of the former industrial land to a cultural, economic and sportive districts;
- The station is a gateway to the Olympic Park, a major shopping area and a centre for living, education and leisure;
- Ticket halls are designed to be light and airy, featuring coffee corners and cafes to improve the traveller experience;
- The ultimate long-term vision is to ‘stitch’ together the town centre and the Olympic Park, to ensure that Stratford becomes a world-class destination.

### 5.2.5. Stockholm Slakthusområdet

**Introduction**

Located in the heart of Stockholm’s southern event district, the Slakthusområdet project represents a transformation of a historic meatpacking district into a sustainable urban hub. By 2035, this area will integrate 4,000 new apartments and 10,000 jobs with a massive four-arena complex hosting up to 60,000 people (StockholmStad, 2017 & Stockholm City Plan, n.d.). On the other hand, there is the event area called Globe City, which consists of four major sites. Namely, the indoor Avicii Arena, the

multifunctional 3Arena, Annexet and the ice hockey stadium Hovet. Together, their maximum capacity for both concerts and sports events go up to 60,000 people (Cfmoller, n.d.; 3arena, n.d.; Annexet, n.d.; Hovetarena, n.d.). This analysis is based on the interview in Appendix H, City plans set up by StockholmStad (2017), (2018), (2019) & (2024) and a decision explanation by Region Stockholm (2019).

**Position in Network**

- The station serves as a critical expansion of the Blue Line (North-South), increasing the regional transport capacity and reducing travel times to the event area up to 8 minutes (see figure 30);
- The new station has a tunnel structure that can accommodate three tracks;
- Even though designed for high capacity, there will be no additional new metro lines planned for the specific node in the foreseeable future;
- The new metro station is only one stop, 2 minutes, away from the 2nd largest train station of Stockholm (Gullmarsplan);
- The expansion of this metro line is essential for the new urban development.


*Figure 30 - Location of the new metro station in its network (Region Stockholm, gained through interview, 2026)*

**Economic & Urban integration**

- Slakthusområdet is evolving from a meatpacking district into a destination for food, culture and experiences;
- One station entrance will be built directly into the ground floor of a new office building (see figure 31), while the other entrance sits adjacent to a central park, to maximise local accessibility;
- The station connects to the event area via a commercial street, filled with shopping and restaurants, accessing the event area via a pedestrian bridge;


*Figure 31 - Entrance north side integrated in building (Interview, 2026)*

**Transportation Modes & Transfers**

- The metro frequency is boosted to one train every four minutes during events, to ensure a consistent outflow of passengers;
- The new system is designed to handle a passenger volume of at least 1,300 people per hour during peak demand, and the station has 4 escalators instead of 2 to handle this higher demand;
- The transition between the station and event area is managed through designated walkways and bridges;
- There will be space for bike parking at the South entrance (park entrance) of the station; other modes are excluded in the first plans.

**Safety & Security**

- During events, the south entrance is dedicated solely to visitors to streamline flow and enhance safety;
- The second entrance of the park is reserved exclusively for emergency services during peak demand to ensure rapid response;
- The station and tunnel are located at least 50 meters underground, requiring strict safety standards that adhere to the national standards;
- With the design process, the event sector was considered, and the platforms are wider than other metro stations.

**Event Management**

- For the station itself, the only operational change will be at one of the south side entrances at the park;
- The entrance of the station is designed far enough from the event area, so people can wait in the surroundings above ground;
- Responsibilities are split between the transport company, the municipality and the event operators. The daily safety of the station and surroundings is the responsibility of the city. During events, the event operators are responsible for the crowds.

**Crowd Management**

- The park and nearby public spaces act as buffer zones where visitors after events wait before entering the station;
- The distance between the station and the event area also acts as a buffer, where security services can manage the crowds and reduce the pressure on the station (see figure 32);
- The stadiums can be filled in 2 hours, while emptied in roughly 15. Therefore, the 4-minute traffic is needed to handle the crowds;
- The signage and information at the event sites will be permanent. Only during really big events, like the WC ice hockey, there will be changes in wayfinding, as the crowds might not be local.

*Figure 32 - Pedestrian street towards the event area, seen from south entrance (Interview, 2026)*

**Governance & Organization**

- The city of Stockholm is the major investor and thus the most important stakeholder;
- The project stems from a 2013 agreement with two different processes, the Railroad Plan and the Environmental Impact Assessment (EIA). Usually, these processes go sequentially, but due to the process being 'time-critical', the processes went parallel to each other;
- The design stage includes specific periods for public and organisational consultation, allowing direct and indirect influence on the plans;
- While not involved in the initial design, event operators and venues must agree to the final plans as they have large responsibilities during peak moments.

**Fully Integrated Station**

- The station is a central component of transforming the former meatpacking district into a unique new city hub;
- Absorbing and regulating pedestrian flows is mainly done with the integration of public space around the south entrance of the station;
- Beyond events, the station is the primary infrastructure which supports 4,000 new apartments and many businesses, ensuring the district's liveable 24/7 community.

## 5.2.6. Paris St Denis-Pleyel / Stade de France

**Introduction**

Paris was the host city of the Olympics in 2024, which is why the metro station of St. Denis-Pleyel, and the train station Stade de France became of utmost importance for the connectivity towards the Stade de France stadium. For the Olympic Games, some major reconstruction was done for the metro station; after that, the plans continued to improve the overall mobility of Paris. This section is based on multiple resources: Réseau Ferre de France (2006), Do Amaral (n.d.), Plaine Commune Grand Paris (n.d.), Plaine Commune Grand Paris (2024), and Société du Grand Paris (2023). Some other general resources, also used for 5.2.8 Paris, La Défense, are: Ville de Paris (2025) and Gouvernement de France (2024).

**Position in Network**

- The station contains a list of RER trains which connect with small cities and towns outside the agglomeration of Paris, as well as a major metro line from the city centre towards the airport Orly;
- There are plans to have 3 more metro lines as part of the Grand Paris Express network (see figure 33), connecting major metro stations better;
- Multiple buses connect the station with the surrounding neighbourhoods;
- The event area is roughly a 20-minute walk from the station.

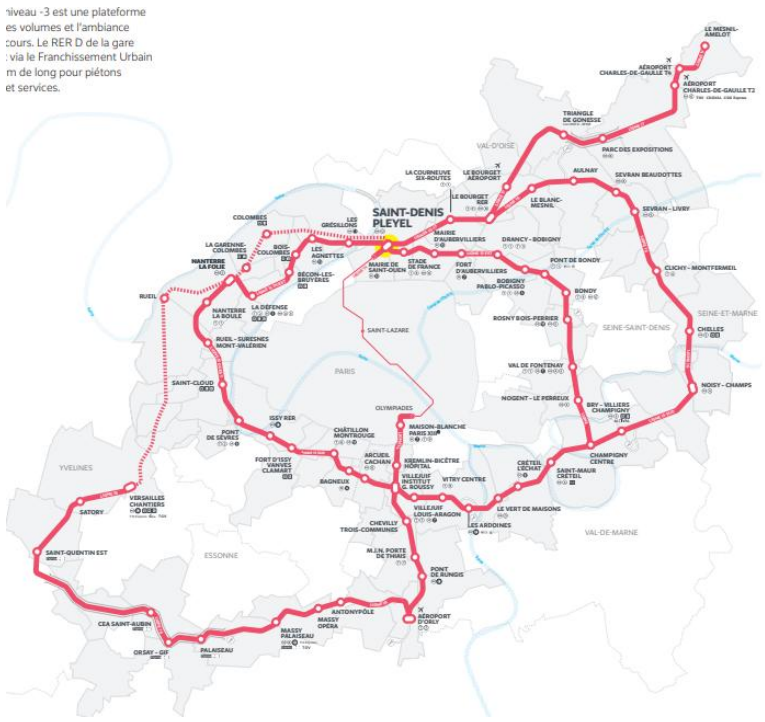



*Figure 33 - Grand Paris Express network, including St-Denis Pleyel and La Défense (Société du Grand Paris, 2024)*

**Economic & Urban integration**

- The station can be seen as a great barrier between the two areas, due to the large number of tracks. However, there is a new Urban pedestrian bridge, FUP, which is an extension of the public space. This bridge has possibilities to be adapted to a regular traffic road;
- Lots of economic enterprises between the station and the stadium.

*Figure 34 - Urban bridge that connects the two stations (Société du Grand Paris, 2024)*

**Transportation Modes & Transfers**

- Frequency of transportation modes is very high, also with the new plans of the Grand Paris Express Network;
- St-Denis Pleyel serves the metro network, while Stade de France St Denis serves the RER network.
- Transfer between stations is made easier through the FUP bridge (see figure 34);
- Plans for large biking infrastructure in the future;
- Roads close to open up space for pedestrians towards the stadium in case of events.

**Safety & Security**

- New metro station St. Denis will be lightened up well through creating a big glass window above the escalators and staircases;
- Every platform has screen doors to prevent people from falling on the tracks.

**Event Management**

- The new metro station and the urban bridge are designed for handling the peaks of the Olympic Games 2024, and therefore also future events of Stade de France;

**Crowd Management**

- Metro station is designed with a big hall and multiple mezzanine levels to handle large streams of people;
- Crowd simulation techniques used for the pedestrian bridge and new metro station;
- The station is equipped with 56 escalators and 18 lifts to manage passenger traffic, scheduled for the 2024 OG.

**Governance & Organization**

- Societe du Grand Paris builds and invests in the area around the station;
- Private partners have a say in the area development of St Denis;
- Four main stakeholders who regulate transport around the station, good collaboration is needed between the city of Paris, Saint-Denis, Plaine Commune and Société du Grand Paris.

**Fully integrated Station**

- Station feels as two separate parts due to the tracks in between them, but the pedestrian bridge and public space help to overcome this;
- Not many cafés and facilities yet around the new station, but plans include them.

### 5.2.7. Paris La Défense

**Introduction**

La Défense is Europe's largest business district, also known for the largest indoor event site, Paris La Défense Arena (GBDinnovation, n.d.). The Arena can take up to a capacity of 45,000 people for concerts and 30,000 people for sports (Parisladefense, n.d.). The public transit node has to balance between extreme event peaks and every commuter. The public transit is therefore served by multiple modes to ensure smoothing out rush hour and event situations. This part of the analysis also used the documents from Ville de Paris (2025) and Gouvernement de France (2024). In addition, it gains information from a Brochure Paris La Défense (2024), Ministere de Transports (2000), Hauts-de-Seine (2024) and a 2040 vision by Apur (2022).

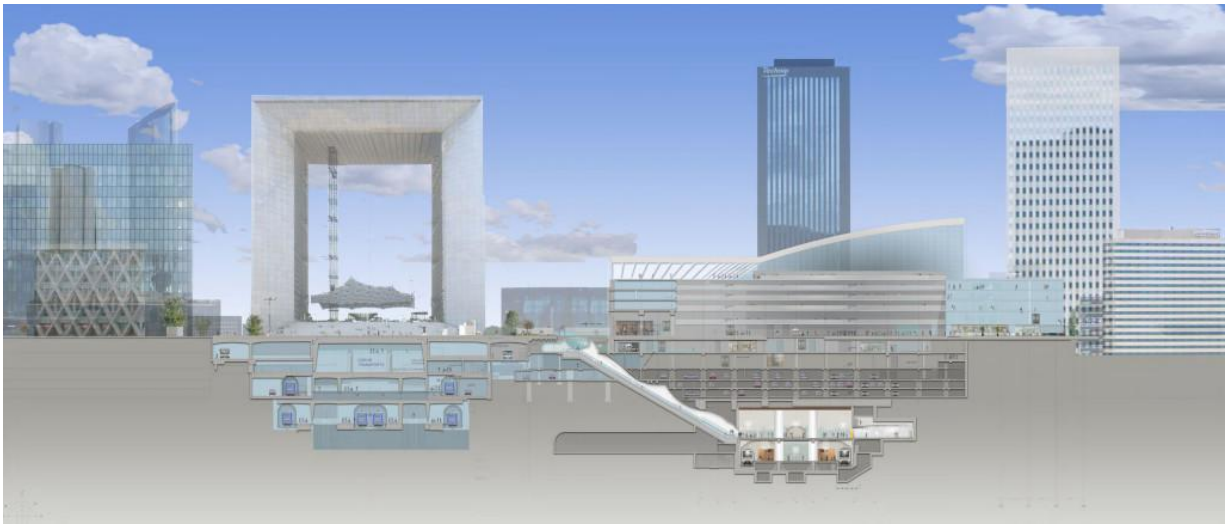


*Figure 35 - Gare La Défense under Grande Arche (Chroniques Architecture, 2024)*

**Critical Vignettes**

- La Défense is one of the most important hubs in Paris and the Île-de-France region, and the most important employment hub in the Paris region. In addition, the station is underneath a major shopping centre (Le Quatre Temps) and a convention centre (CNIT);
- The station is mainly underground, with a lot of levels, connecting the regional trains, metro and trams by numerous corridors and elevators. This design allowed for a 'pedestrian-only' platform on the surface;

- The key design principles underground include coordinated timetables and transfer points, agreements on maintenance and management responsibilities and spatial clarity, with visible entrances and connections that enhance the quality of effective transfers;
- The network is expanding with the new RER E train since 2024, connecting La Défense on a major East-West line connecting with several towns and cities in the agglomeration of Paris;
- A new nearby station for La Défense Arena, Nanterre-La-Folie, reduced the pressure on the regular La Défense station during events, critical for understanding event traveller behaviour;
- By 2031, the station will be connected to the Grand Paris Express network, improving its position in the network;
- Event security is ensured through the cooperation between state services, local authorities and transport networks. Event management includes lessons learned from past events, identifying key challenges for upcoming editions and adapting security and traffic management according to operational constraints;
- The esplanade above ground is seen as 'too wide', often making it difficult to manage crowds and, at the same time, enhance walkability;
- The station is managed through a partnership involving the public developer Paris La Défense, the RATP (transport company of Paris), SNCF (Paris railways), Île-de-France Mobilities and Hauts-de-Seine Department;
- During daily use and events, the main constraints are the oversaturated entrances at the main transport hub;
- La Défense is a pioneer in an integrated station area that mixes transportation services, public services and leisure and still acts as a main driver for local development as the area aims to be a "15-minute neighbourhood";

### 5.2.8. Munich Fröttmanning

**Introduction**

The Fröttmanning station in Munich is located in the North of Munich, near the Allianz Arena and the event area Showpalast, which can host more than 75,000 people and 5,000 people respectively (Allianz Arena 1, n.d.; showpalast, n.d.). The station is on a North-South metro line which connects to the city centre. The information of the critical vignettes is based on Herzogdemeuron (n.d.), Effern (2024), Gonçalves, A. (2018) and Allianz Arena-2 (n.d.).

**Critical vignettes**

- The station was redeveloped for the 2006 World Cup, enlarging it from two to four tracks and wider platforms than usual. The extra two tracks are used during events. There is also the possibility of using extra trains;
- The stadium is a 10-minute walk away from the station via the esplanade towards the Allianz Arena. The esplanade, the public space, serves as a buffer after events before entering the station;
- Underneath the esplanade, there is an underground parking for events. Next to the station, there is a big P+R for commuters to enter the city via public transport, or to park the car for longer use, as the station functions as a big long-haul bus node.
- The safety & security is managed by the police, together with the U-Bahn-Wache from the MVG (Muncher Verkerhsgesellschaft);
- There is a 'Verkehrskonzept', which is a collaboration between the municipality, police, MVG and Allianz. This collaboration ensures a direct connection on matchdays between stakeholders.

*Figure 36 - Fröttmanning station (bottom-left) and the Esplanade towards the Allianz Arena*

## 5.3. Findings from Comparable Case Analysis

This phase answers the third sub-question of this thesis:

*Which international multimodal hubs adjacent to major event venues are most comparable to ABAS, and based on what criteria?*

Firstly, stations were searched and selected on some main criteria, especially a similar capacity for event demand and if there was enough data available. Eight different transit nodes came forward for this research, one being a multimodal hub and the other not necessarily.

From the eight cases analysed, clear patterns emerge: comparable nodes combine high event-capacity (45.000 – 70.000 peaks) with either multimodal connectivity or strong single-mode capacity upgrades. These nodes pair operational event protocols (e.g. stop-and-go, dedicated entrances, etc.) with urban-integration ambitions (mixed-use development, using the public space as a buffer). These cases are therefore useful to compare with ABAS, as they show how physical design, operational rules and arrangements in the surrounding spaces together determine whether the station can absorb the event demand.

In the end, the eight cases described above will provide enough information in embedded units to allow for designing a tool later on in this thesis. Table 2 below gives an overview of the cases, based on mobility features, event sectoral features and some general remarks.

*Table 2 - Overview Comparable Cases - Case - Mobility - Event sector - General / Urban*

| Case | Mobility | Event Sector | General / Urban |
|---|---|---|---|
| Rotterdam - Stadionpark Station (future) | Multimodal: train, tram, bus and strong bike priority. | Serves de Kuip (47.5k). Design for two states with extra entrances and supporter segregation. | Transformation from event to 24/7 stop. Station becoming neighbourhood hub. |
| Madrid - Bernabéu | Mainly heavy single-mode, small bus stop. High frequency. | Serves Bernabéu (84k). Hold-and-go & mezzanine level. | Underground expansion integrated with the surroundings and promenade. |
| London – Wembley Park | Metro-focused (2 lines) and 'SuperLoop' buses. | Serves Wembley Stadium (90k). The Olympic Way as natural buffer. Stop-and-go. | Station drives local retail and area regeneration. |
| London – Stratford Station | 7th busiest UK station, complex interchange of 5+ modes. | Serves London Stadium (68k). BaU vs. Event Plan. Command centre focused. Stop-and-go. | Bridge between the centre and Olympic Park, engine for new homes. Ambition of mezzanine. |
| Stockholm - Slakthusområdet | Metro line expansion & high-frequency service. | Serves 3Arena & Annexet (max 60k). Park and public space as a buffer. Hold-and-go. | The station supports residential and commercial expansion. |
| Paris – St. Denis – Pleyel & Stade de France | RER + Grand Paris Express links. Big pedestrian bridge. | Serves Stade de France (80k). Focus on 20-min walkability & high-capacity escalators. | Multiple stakeholders in the area development after 2024 OG. |
| Paris – La Défense | Europe's largest business hub with a major multimodal node on underground levels. | Serves La Défense Arena (45k). New station as a relief station. | Business district core. 15-minute neighbourhood. Complex governance. |
| Munich - Fröttmanning | 1 metro line + major P+R & Long-haul buses. | Serves Allianz Arena (75k). Expanded to 4 tracks and wider platforms for the 2006 WC. Esplanade buffer. | Underground parking beneath the esplanade. Strong municipality-police-operator matchday cooperation. |

The multiple case analysis of these embedded units provides the foundation for the Comparison Tool in the next phase. Although the table below offers a summary, the cross-case comparison delves deeper into the eight aspects (the embedded units) for each case. For the final two cases, information from the vignettes is utilized where it is most applicable to the identified aspects.

# Part B: Design and Application of the Comparison Tool

# 6. Phase 3: Comparing the Cases

The third Phase consists of making the comparison and designing the tool. The methodology is explained more thoroughly in 6.1, after which the design choices are explained in 6.2. Chapter 6.3 consists of the explanation and operationalisation of the tool. This phase tries to answer the 4th and 5th questions.

*What are the recurring aspects and lessons that can be used in the cross-case comparison?*
*&*
*How can the identified aspects be operationalised into criteria that form the basis of a Comparison Tool?*

## 6.1. Cross-case comparison through embedded units

Comparing stations that are strongly shaped by their local context can be difficult, as each station-area operated within a different network position, event profile, spatial setting and different organisational structures. To address this challenge, this research uses a multiple case with embedded units of analysis, based on the framework developed by Robert Yin. According to Yin (2003), when a study includes more than one case, it becomes a multiple-case design. Often, findings are examined across cases using replication logic. This means that recurring patterns are identified across cases, while differences are interpreted in relation to specific contexts.

In this study, however, replication does not take place at the level of the station-area as a whole, but at the level of the embedded units (see Figure 2 in Section 2.2.2). These embedded units are analytically defined aspects that are examined and vital for event-related transit nodes. The aspects form the basis for the cross-case comparison and later for the application of the comparison tool.

The initial set of embedded units is derived from the system analysis, specifically the *Handelingsperspectief (2022)* discussed in section 4.3.1, together with the foundation in the literature. This analysis provided the foundation for the following units: ‘Position in Network’, ‘Safety & Security’, ‘Economic & Urban Integration’, and ‘Transportation Modes & Transfers’.

The ‘Position in Network’ unit is based on the orange segment of the Handelingsperspectief radar chart. As locational characteristics are essential for understanding a station's significance within the broader transport network, this unit aligns with established literature on Multimodal Transport Hubs (MTHs). Furthermore, both the literature and the Handelingsperspectief show the importance of the station's role as an economic driver for its surroundings. In addition to this, ‘Economic & Urban Integration’ was included to determine the degree to which a station functions as an economic engine. This is shown in the orange and green aspect of the radar chart in the Handelingsperspectief but also comes forward from the economic importance of a MTH in the literature.

The third unit, ‘Transportation Modes & Transfers’, originates from the purple segment of the Handelingsperspectief radar chart (Figure 16). Since specific modes (such as the number of metro lines or bus station capacity) are highly context-specific, this unit was combined with transfer efficiency to ensure a more robust analysis. The fourth unit, ‘Safety & Security’, is grounded in the traveller experiences documented in the Handelingsperspectief. Given that safety is a fundamental characteristic of major transit nodes, it is considered a vital performance metric within the tool.

The literature review further expanded this list by identifying units consistently discussed in relation to stations near major event venues: ‘Event Management’, ‘Crowd Management’, and ‘Governance &

Organisation'. These units (5 through 7) represent an expansion of the original radar chart, reflecting how station areas are coordinated and managed during peak conditions. Specifically, while 'Crowd Management' overlaps with safety, the actual management of passenger behaviour is a distinct requirement for event-context nodes. Similarly, 'Event Management' addresses the strategic planning and alignment necessary for collaboration between transport companies, local authorities, and event operators. Finally, the 'Governance & Organisation' unit was selected to evaluate how different cases navigate the organizational complexities identified in the literature.

The final unit, 'Fully Integrated Station', was developed based on reflective questions posed during the interview process. Participants were asked to identify missing elements or aspects they considered most critical for event-related hubs. Collectively, these embedded units provide the analytical structure for the cross-case comparison and the subsequent interview process. Detailed descriptions of each aspect are provided in Chapter 5.

### 6.1.1. Base and boundary conditions of the tool

After the cases have been analysed in chapter 5, a measurement tool is needed to generalise the aspects from the last section, thus the embedded units of a transit node in an event-related area. The tool must be something which can be used by policy makers and station designers who need a better understanding of transit notes in event context and as a conversation starter. The tool must be understandable and have an easy overview, which is consistent and applicable for every transit node in an event context.

The embedded units are specified in such a way that they do not form a loose theme but become building blocks for the evaluation. Every aspect should translate the qualitative findings from every case to comparable scales, creating a $1/8^{th}$ portion of the dimension of the tool. The cross-case comparison shows recurring patterns in the tool (section 6.3.1), and also which items are essential for transit nodes in the event context.

Some boundary conditions are that the tool must apply to all the different stations analysed, as well as many different, not considered, transit nodes near event sites. The tool must be made as general as possible so that it is not sensitive to explicit context-sensitive situations, although using the information from the cases in this research. Thirdly, the tool must apply to transit nodes in both the design phases, as well as the current situation of a node. This section has established the conceptual and analytical foundation on which the comparison tool is developed.

## 6.2. Construction of the Comparative Assessment Tool

This chapter explains the informed decision on why and how the tool has been developed. It explains the design-choices, based on the theory and empirical findings earlier discussed in this thesis. As the process is an iterative process, the tool is developed in parallel to the case analysis and interviews. Therefore, some framework options have been discarded, which are explained and motivated in 6.2.1. and the final choices on why the framework, the Capability Maturity Model Integration (CMMI), works are explained in 6.2.2.

### 6.2.1. Different framework options – the discarded ones

There were three other framework options which have been researched and slightly tested. These were the Complexity Framework by Shi et al. (2020), see figure 5, the Performance Benchmarking and the SWOT analysis. In this subchapter, a brief overview of the pros and cons of each framework is discussed.

**Complexity Framework**

A major advantage of this framework is that it shows the integration of all different complexities and how they affect each other, something which is useful for system analysis. In addition, it also uses financial constraints, which can be insightful for major infrastructure projects. This tool has been used and applied to different major infrastructure projects, as done by Hertogh and Westerveld (2009) in their work on Playing with Complexity. However, this tool is mainly designed for project managers, which can be seen as a disadvantage for scientific purposes. Furthermore, the use of the tool often results in the fact that social and organisational complexity is the main bottleneck in infrastructure projects, which is perhaps a very logical answer. As the comparison for this thesis is focused on transit -nodes near event sites, some characteristics of complexities can be considered, but definitely not all, as listed in Chapter 5.

**Performance Benchmarking**

Performance benchmarking can be seen as a very direct comparison of hard data. Peter Bogetoft (2012) explained some advantages and disadvantages of this method. The power of the comparison is that the method identifies best practices of organisations, using units or aspects which are identified that perform the best. In addition, the method sets realistic goals that benchmarking provides fair and attainable, as argued by Bogetoft.

Although one of the biggest disadvantages is that the context gets lost, as it compares units that operate under very different conditions. Performance benchmarking also has the risk that a unit of comparison looks inefficient or ineffective, simply because the data didn't capture a specific local constraint. Lastly, the benchmarking is focused on averages and is therefore time-stamped. Which is difficult because, for example, Amsterdam operates on two very different demand peaks.

**SWOT**

Lastly, there is the Strength-Weakness-Opportunity-Thread Framework, which is not used in this research. This is a very static tool, but as it is simple and straightforward, it is therefore easy to interpret (Vivadel, 2022). The SWOT has a very strategic focus, as it looks into the opportunities and threats. Another advantage is that the tool can use both qualitative and quantitative data. However, the tool does not provide a good measurement and just states facts, which are essential to compare the transit nodes. In addition, it is also a very situational measurement and can be very subjective (Vivadel, 2022). When is something considered a strength and when a weakness? In the event context, a station is a system-of-systems, but the SWOT can only analyse the station on its own. Furthermore, the SWOT (and benchmark) allows for scoring on so-called Key Performance Indicators, which can be set out per aspect. However, comparing qualitative KPIs within aspects becomes very difficult with this tool.

### 6.2.2. Capability Maturity Model Integration framework as a basis

The already mentioned comparison methods are well suited to compare quantitative indicators; however, in the context of event-oriented stations, these indicators are very situational and strongly dependent on local conditions and can therefore be very qualitative. For example, the size and capacity requirements of Amsterdam Bijlmer ArenA cannot be directly compared to Wembley Park station, as the differences in stadium size, event frequency and urban context can lead to very different demand levels.

As a result, the quantitative benchmarks risk-rewarding scale rather than the actual performance of a station. A higher passenger throughput does not necessarily mean that the station functions better. This is especially relevant for the aspects of (social) safety, event management, crowd management and governance, which are the identified embedded units in this research.

To address these challenges, this research uses the Capability Maturity Model Integration as a basis structure for the comparison tool. The CMMI is a specific branch of maturity models, whose foundation lies within IT management (Becker et al, 2009), but can be applied to other specific branches, like the mobility and transport sector (Eruyar & Özen, 2025). The conceptual foundation assumes that organisational and system development progresses through structured stages, which can be approached either top-down or bottom-up (Becker et al, 2009; Eruyar & Özen, 2026; Lehrman et al., 2011). This thesis will develop further upon the *bottom-up approach*, where distinct characteristics are determined first. They are then clustered in different steps, and each into higher maturity levels. This ensures a more general view of the different steps and what maturity evolution means in specific cases (Lehrman et al., 2011). The CMMI and its levels are used as a reference for the characteristics of the specific maturity level (see figure 37), and the processes each have their own different definition (Chatterjee, 2025).

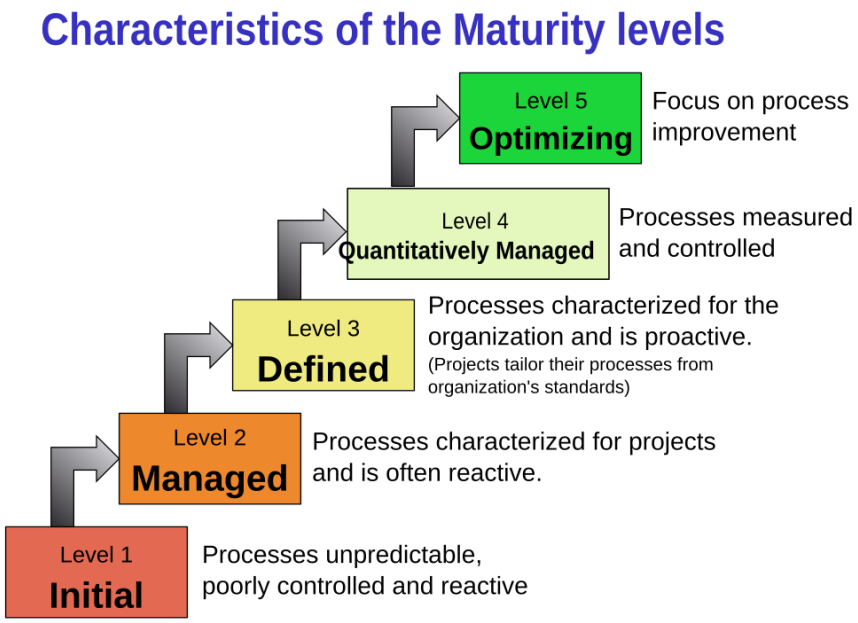



*Figure 37 - Basis of the maturity levels used in this thesis (Bel et al., 2016)*

A key advantage of maturity models is that they not only indicate where a system currently stands, but also what the next step of development could be. This makes these models suitable for policy recommendations, where the goal is not ranking but improvement. This is also very applicable to this research. For complex infrastructure environments, such as transit-nodes, maturity models allow multiple dimensions to be assessed simultaneously, like the different aspects and embedded units, in this thesis. These characteristics also align closely with the assessment logic used in the Handelingsperspectief (2022), where station performance is evaluated across multiple themes using qualitative levels rather than hard thresholds. The radar chart visualisation applied in that framework further demonstrates how multidimensional qualitative assessments can be communicated well. Which is why that will be used as an output for this comparison tool as well.

Before explaining how the comparison tool for this thesis works, it is necessary to mention some of the limitations of the maturity tool first. These models are merely qualitative, focusing primarily on processes rather than physical outcomes. Although the eight embedded units in this thesis are mostly qualitative-focused. Secondly, labels such as ‘Level 3 – Defined’ can be difficult to interpret. In the comparison tool, every aspect and its respective levels have a distinctive name.

Rather than avoiding these limits, this research incorporates them into the design of the tool, which comes to a proposed solution of a hybrid framework, in which the maturity model forms the conceptual backbone, while quantitative and qualitative aspects of transit nodes in the event context are used selectively.

## 6.3. Structure and Operationalisation of the Tool

In the proposed comparison tool, qualitative aspects, such as governance & organization, event management and crowd management, are assessed through maturity levels, five to be specific. Each level represents a clearly defined phase of organisational and/or operational development of the transit node, grounded by the repetition in the analysed cases, as well as some evidence from the literature.

The development of the levels, from Initial (1) to Optimizing (5), for each aspect, is embedded within the structure through threshold-based progression. Advancement to a higher maturity level is only possible if two relevant conditions are met. These conditions are dependent on two criteria simultaneously:

1. A quantitative threshold: a minimum number of total items on the *checklist* must be selected;
2. A qualitative threshold: specific, critical *checklist* items for that particular level must be present.

### 6.3.1. Recurring patterns and checklist items

The identification of the *checklist,* as mentioned, is grounded in the research done in chapter 5, from site-visits to the cross-case analyses of transit nodes. This checklist is based on the findings and the recurring patterns the stations show with regard to a specific aspect. As the maturity rises, the required checks often correspond to features that were observed less frequently across the cases, assuring that it is a more distinctive factor for higher-performing stations. Additionally, certain checks were designated as mandatory for specific maturity levels, based on the author's analysis and design principles, creating them as critical benchmarks that define essential development for each level.

The following section will explain the checklists and maturity levels of each of the embedded units and aspects. In general, all figures show the maturity levels on the left. These levels range from the bases of the CMMI 'Initial' (red) towards 'Optimizing' (green). Each maturity level has its own distinctive name, as well as a sentence with 'Checks [X], at least #[X]', explaining the minimum of checks needed to enhance to that level, with the threshold check of the number (#) indicated. All figures contain the checklist on the right. Whenever a check is derived from specific cases, the location will be in brackets behind the check. All other checks are either more frequent or marked as a familiar and basic check, some don't contain a location, because it is derived from more than one specific location.

**Position in Network**

Firstly, the aspect of Position in Network is shown in Figure 38 below. The corresponding names of each of the five maturity levels are: 'Event Only / Basic Stop', 'Functional Link', 'Permanent Urban Station', 'Strategic network node' and 'essential node in network'. This checklist is made up of all recurring aspects within the Position in Network embedded unit of the case analysis. For instance, the 4th check is based on the future station of Rotterdam Stadionpark and on the Slakthusområdet station. Whereas the 'Urban Corridor' check (5) can be derived from amongst others Madrid Bernabéu, Stockholm Slakthusområdet and La Défense. As a last example, check 12, 'Future network integration' is derived from the new Rotterdam station, Stockholm, St-Denis and La Défense.

For the second level, it is essential that the transit-node either is an intermodal node with regional accessibility or that it has an MTH in its proximity. Meaning that the position in the network of this station becomes more important. Becoming a Strategic network node, the station must have a high-speed or international status (#8), a direct airport connection (#9), or the node is a strategic relief function for other transit nodes in its proximity (13).

In order to achieve the most mature level, at least 10 out of 13 checks are needed, with the station being an MTH or the transit node being a catalyst for urban development.

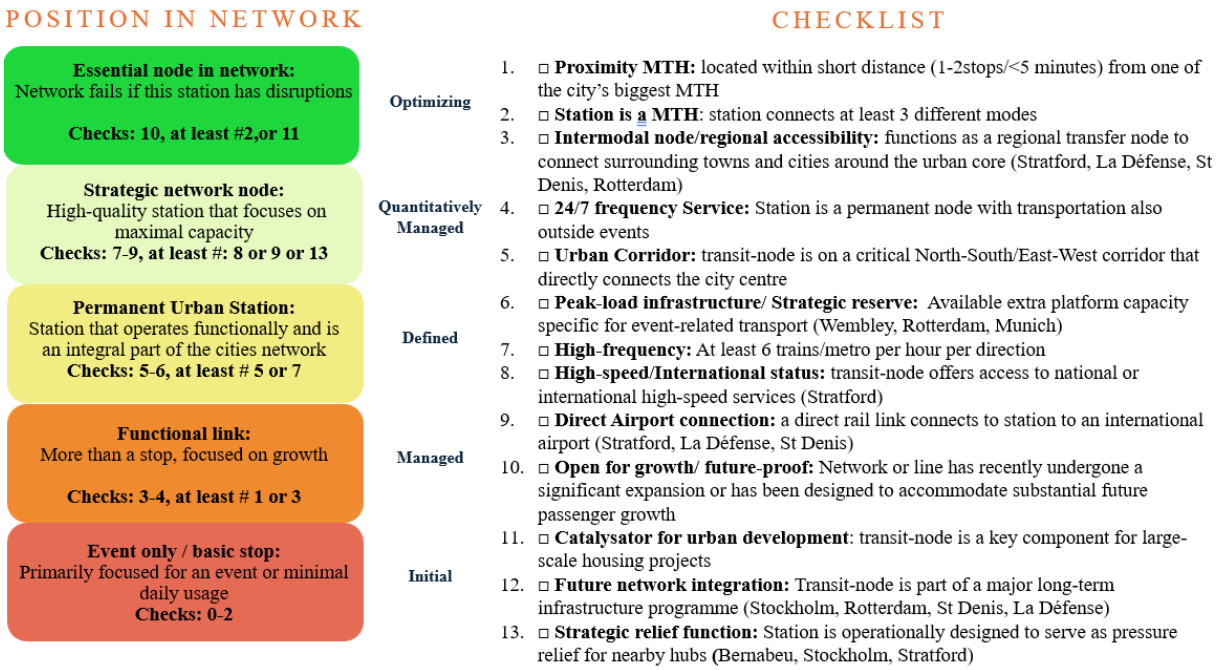



*Figure 38 - Maturity levels of aspect 'Position in Network' (Author, 2026)*

### Transportation Modes & Transfers

The maturity framework for 'Transportation Modes & Transfers' is shown in Figure 39. It shows the evolution from a 'Basic Transport' node towards a 'Seamless transfer machine'. The transition from the initial level to a 'Scale-up Station' is motivated by #7 (step-free and inclusive access), because this is a major driver to integrate the transfer more smoothly. Furthermore, check #1 is crucial to improve towards the 3rd maturity level, as the stations in London and Paris show that more transportation modes improve the capacity of the transport. This check overlaps a little with #1 and #2 of 'Position in Network', but the placement of the check and the corresponding maturity level is not the same or has an or function at the 'Position in Network' aspect. This assures that the two aspects don't interfere with each other too much.

Level 4 is the 'Synchronised Station', where the station is actively managing the modal split. When a transit node achieves this level, it is expected that the station also includes more transportation methods besides public transit. The majority of these checks are found in stations in London and Paris discussed in this research.

In the last level, either a unified mezzanine level (#6) or a pedestrian bridge (#8) ensures that the station is a seamless transfer machine where all the modes are visually and physically linked in an organised way. The advanced technique of a unified mezzanine is found in Bernabéu, Stratford and La Défense, while the stations in London and St Denis include the pedestrian bridge.

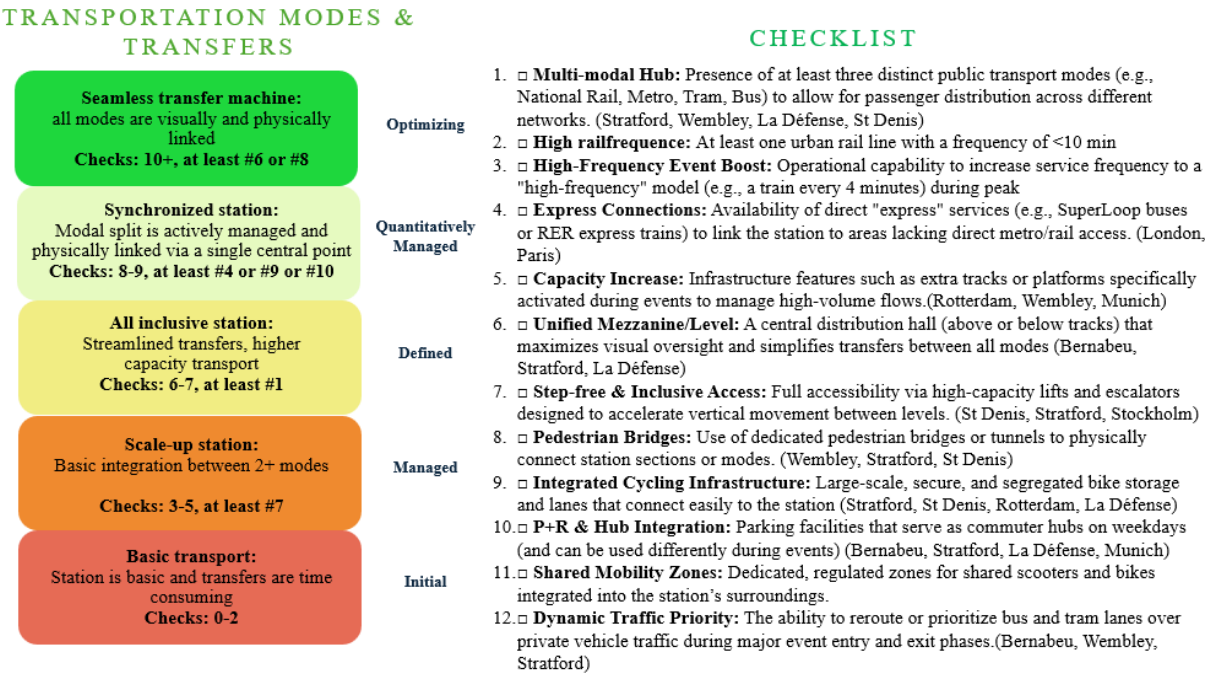



*Figure 39 - Maturity levels of aspect 'Transportation Modes & Transfers' (Author, 2026)*

**Economic & Urban Integration**

Figure 40 shows the maturity levels of the aspect 'Economic & Urban Integration', which has at least 12 recurring items in the checklist. If a station scores in the lowest maturity level, it means that it does not connect with its surroundings. The station is far away from all the facilities in the area. Once the transit-node contains at least #3 'Economic Diversity' and more than 3 checks in total, it develops to the Functional Connection level.

Once the stations are enhanced to the Basic Integrated area, meaning that the station, its surroundings and the event area are logically connected. The station has at least the functions of Horeca Integration (#5), or that there is retail inside the station and thus between the modes in (#10).

If the maturity level is Quantitatively Managed, the Station becomes the destination area. The area around the station is lively, and the station is a primary catalyst for the urban development, or the surroundings have a new urban centre (in the near future).

A 'Completely Interwoven Station' is when the borders between the station, event site and facilities are not seen. The station has more than 75% of the checks in this checklist, with the area being a 15-minute neighbourhood (#1) or the station is treated as an extension of the public space, just like Rotterdam, La Défense or Stratford.

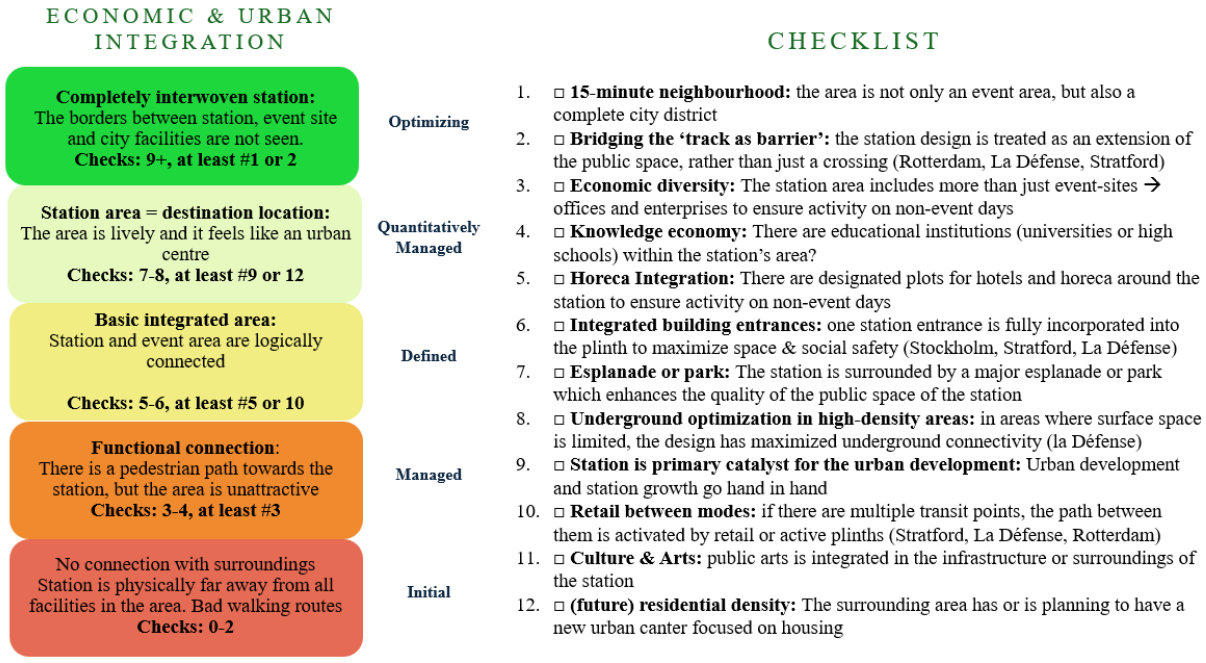



*Figure 40 - Maturity levels of aspect 'Economic & Urban Integration' (Author, 2026)*

**Safety & Security**

This checklist has the most checks, and thus recurring items of all. This means that safety is often found as a priority in public transit. A station is 'Unsafe' and belongs to the lowest maturity level if there are, for example, many blind spots, bad lightning and just basic security.

If the station develops into 'Structural Safety', it needs to have at least 4 checks, as well as a Basic Evacuation Protocols (#1) and enough surveillance coverage that 100% of the station is covered in CCTV (#4). These two items recurred over all the stations, meaning it is a basic necessity to advance to a more mature level.

Once the station includes 'Access Control' via gates to manage flow and prevent unauthorised entry (#12) or that there is a presence of special security next to regular stewards (in case of events) (#14), derived from London and Munich, the station can advance to the Defined level of maturity. Ensuring 'security during daytime and events.

Real time-safety measures are applied, for example, at Wembley, when there are periodic safety checks (#5). The station can then take the step to the Quantitatively Managed station, often having real-time safety measures.

Lastly, once the safety is ensured by its design (Optimising Maturity Level), the station has at least 12 out of the 15 checks. In addition, the station includes design principles like no hidden angles or no dark corners. These were found in Madrid, Wembley and St Denis stations. Furthermore, the station also needs to have a possibility to segregate the fan streams in case of away fans joining the crowds. This is especially the ambition for Rotterdam's future station.

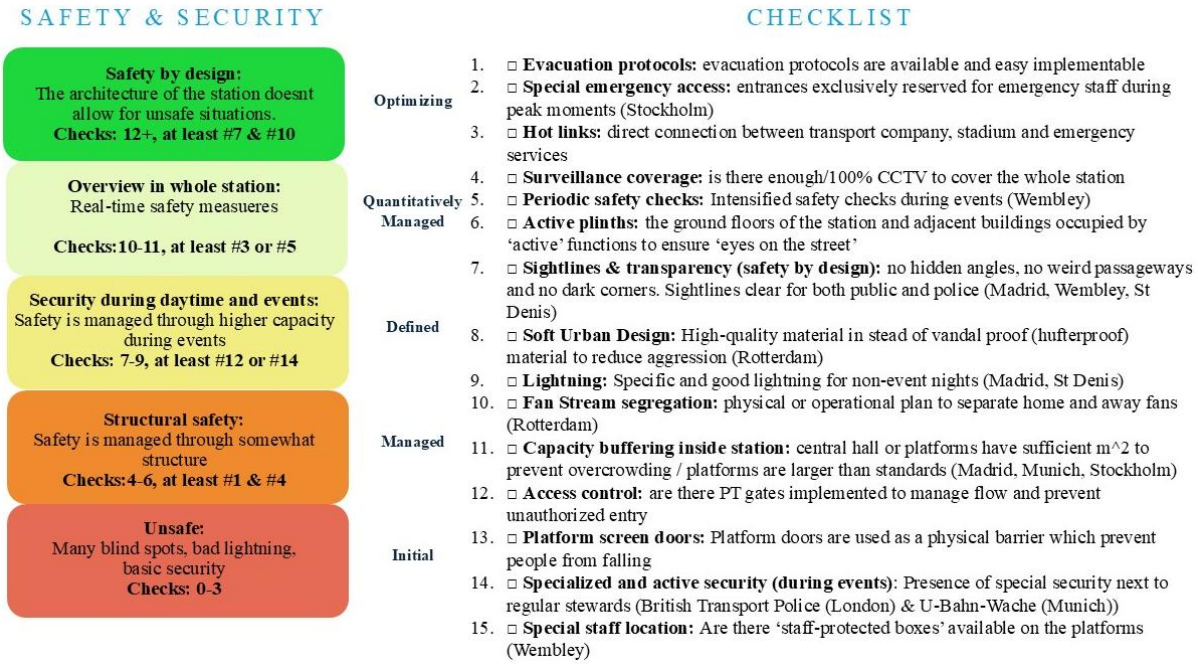



*Figure 41 - Maturity levels of aspect 'Safety & Security' (Author, 2026)*

**Governance & Organisation**

The recurring patterns of this aspect only count up to 9 items. The station's management can benefit from the 'Fragmented Governance' towards an 'Agile System', in which the adaptive governance is fully integrated in both the public and private organisations in and around the station and event area.

Moving onto the Basic coordination, maturity level 2, areas need at least a structural operation where different levels of public authorities are incorporated. This is derived mainly from Rotterdam, Paris and Stockholm. But the station areas in London also use a similar form to this with their local councils. Moreover, transforming to a formalised cooperation, where all the roles and responsibilities are fixed and stated, at least 5 checks are needed. Of those checks, #1, a high-frequency coordination infrastructure is needed. Or the regulatory processing. Which is an option to let the legal procedure run in parallel to check critical deadlines. This is derived from Stockholm and Madrid.

The fourth level is the Integrated Operation; at least a form of social-economic alignment is needed to enter this fourth level of maturity. This is operationalised from the cases of Stratford, St Denis and Stockholm. Lastly, when a station's governance has all the checks, it can be named as an adaptive governance network.

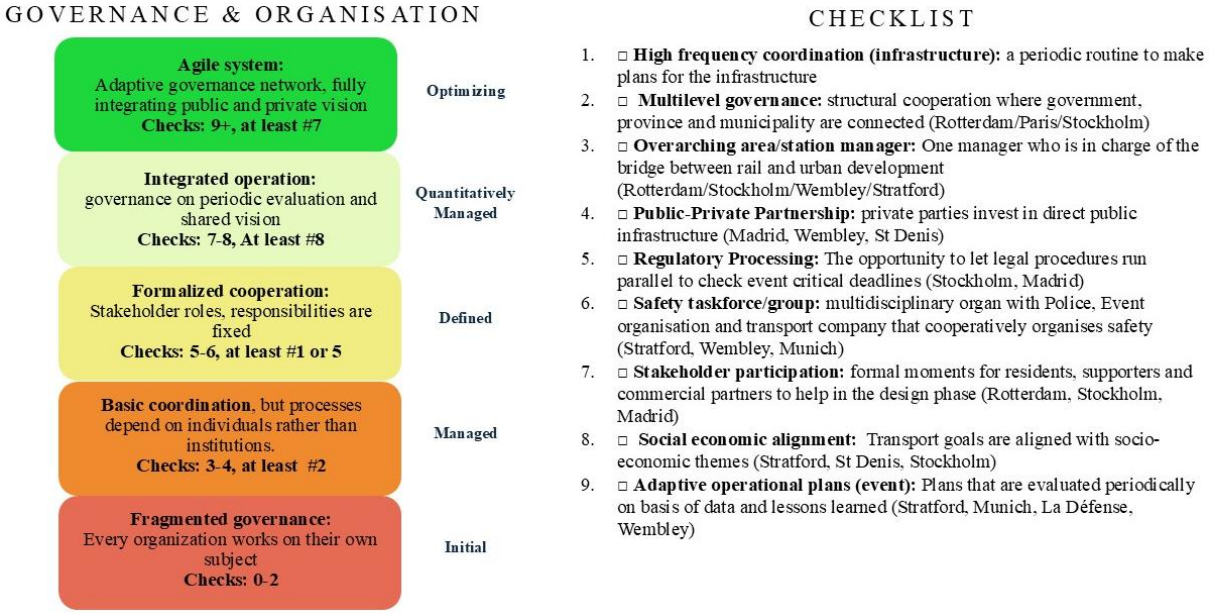



*Figure 42 - Maturity levels of aspect 'Governance & Organisation' (Author, 2026)*

**Event Management**

Figure 43 below shows the maturity levels and the checklist of Event Management. When a station has 3 checks or fewer, it is located in the Bad Event Management maturity level. In that level, there is no distinction between daily and event moments and the decision making with respect to events happens late on the day.

Moving onto the Managed level, there are basic event plans. There is at least a specific Event Profile (#4). This is a specific event mode protocol, which starts early enough before major events happen. This strategy is derived from the stations in London, Madrid and Munich.

Once at least 6 items are checked off, the 'Formal Event Plans' maturity level is reached. The qualitative threshold of #7 'Formal Organisation' is needed. This means that there is a concept that clearly describes the roles of stakeholders and that there is a well-organised difference between Business as Usual and the event situation.

Moving on to the fourth maturity level, the event management is done strategically. There is at least one person, either at the stadium or station, who is in charge of the event management as a main individual stakeholder (#8). This is derived from Rotterdam and Stockholm.

Lastly, there is a fully integrated management between the city-venue-transport operators-event sites. This is a continuous improvement where there are structural iterative evaluations after events (#10). These are already done at both the stations in London, Paris and Madrid.

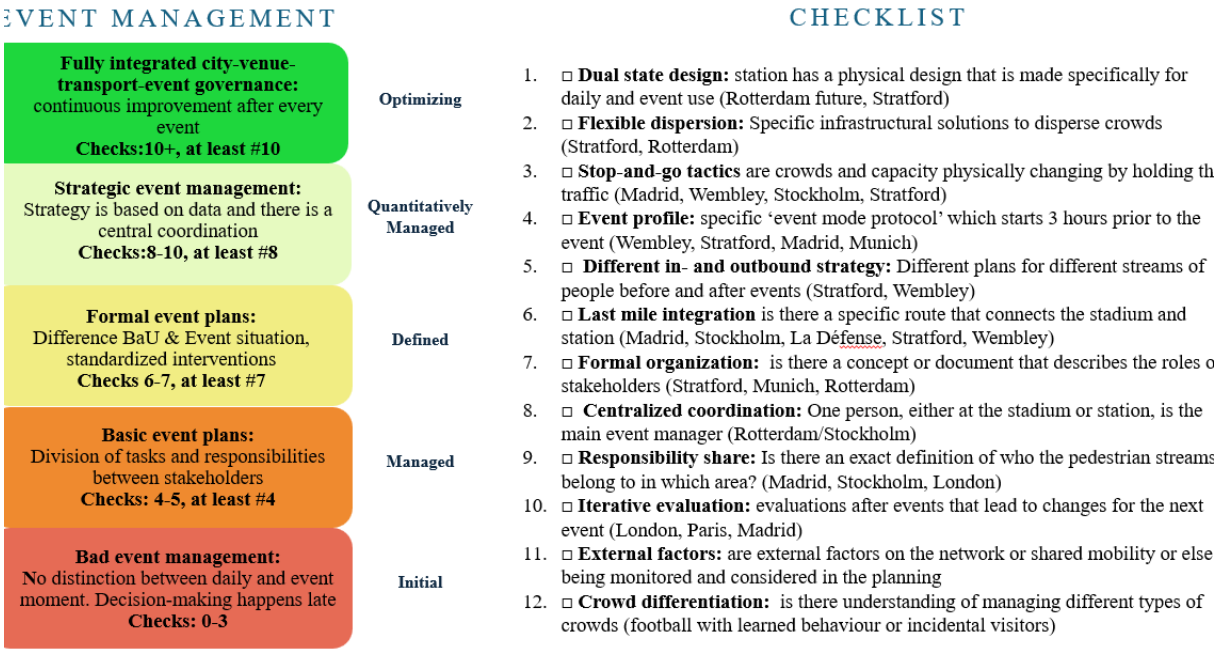



*Figure 43 - Maturity levels of aspect 'Event Management' (Author, 2026)*

**Crowd Management**

The checklist of Crowd Management consists of 12 items, shown in Figure 44. The levels are defined as 'Reactive Management', 'Basic Management', 'Active buffering', 'Dynamic Planning' and 'Fully Integrated Crowd Management'. Respectively moving from the lowest maturity level to the highest.

Once a station area deploys Extra Staff (#5) and is able to check off at least 4 items, there is basic management. This item came forward the most from the analysis. Something less frequent are the buffer zones. The buffers are explained through checks 1, 2 and 3. They are either external (Munich, Wembley, Stratford and Madrid), internal in the station (Madrid and Stratford), or distance is seen as a regulator and thus buffering (shown in Wembley and Stockholm). One of these methods is needed and is crucial to develop crowd management tactics actively.

The fourth maturity level is defined as Quantitatively Managed when the plans are based on simulation and/or the capacity of the station is being balanced. These are given by checks 7 and 8. #7 is the stop-and-go/hold-and-release method. Where physical checkpoints or stewards are used to let people enter the station. These methods are used in London, Madrid and Stockholm. Furthermore, the crowd simulation techniques are used in Madrid, Wembley and in Paris.

Lastly, to get to the Optimising Crowd Management Maturity level, real-time monitoring is needed and used to follow and regulate all the inbound streams (#9). This was a method which was only used in Stratford station and thus is relatively rare.

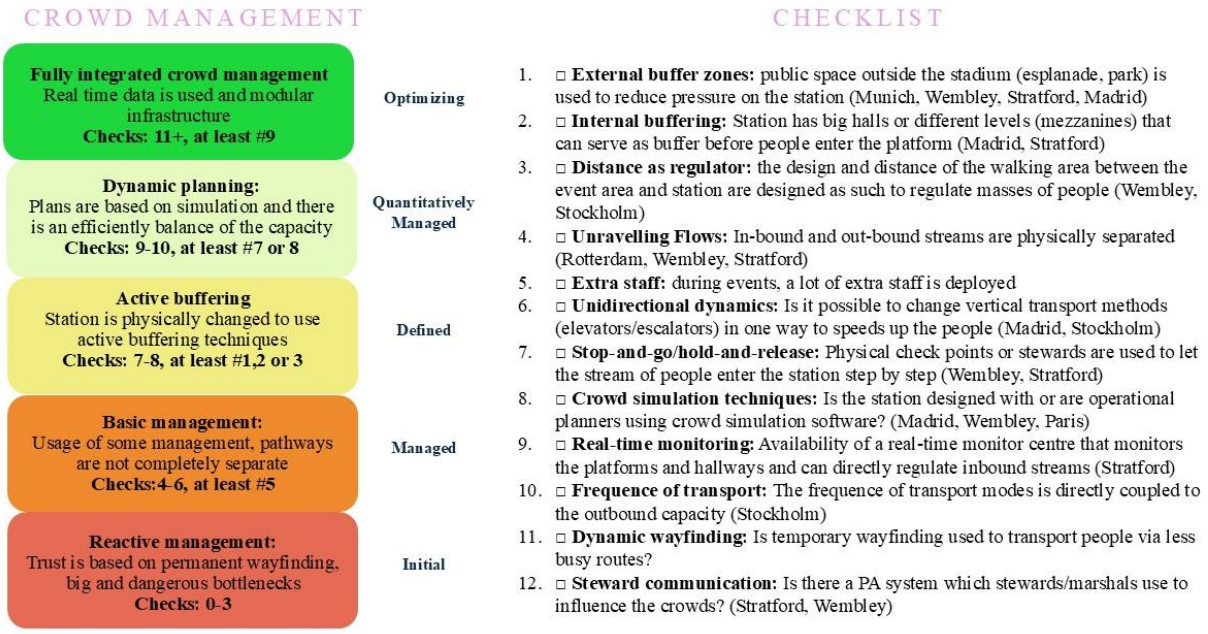



*Figure 44 - Maturity levels of aspect 'Crowd Management' (Author, 2026)*

**Fully Integrated Station**

The last aspect also has only 9 items in its checklist, as this is also an aspect with a very broad definition and therefore difficult to divide into very specific items. This aspect is somewhat overlapping with the other aspects, ensuring the combination and the feel of a complete station. However, some aspects are very distinct. For example, #7, whether the station is seen as a cultural gateway. The station is the business card (visitekaartje) of a surrounding club or event area. This is derived from Madrid (Real Madrid) and Stratford (Queen Elizabeth Olympic Park). Moreover, #9 'multi-modal harmony', if all timetables and transfers are designed as such, to enhance micromobility. This is derived from La Défense, the MTH in the centre of Paris, allowing for very smooth transfers with frequent transport.

The highest level of maturity is when the station is a meeting centre in itself, with a high level of facilities in and around the station. It needs to at least check off item #1, the seamless area connection. Meaning that the station functions as a physical and social bridge between the surrounding city areas. This was found in Stratford, St Denis and Rotterdam.

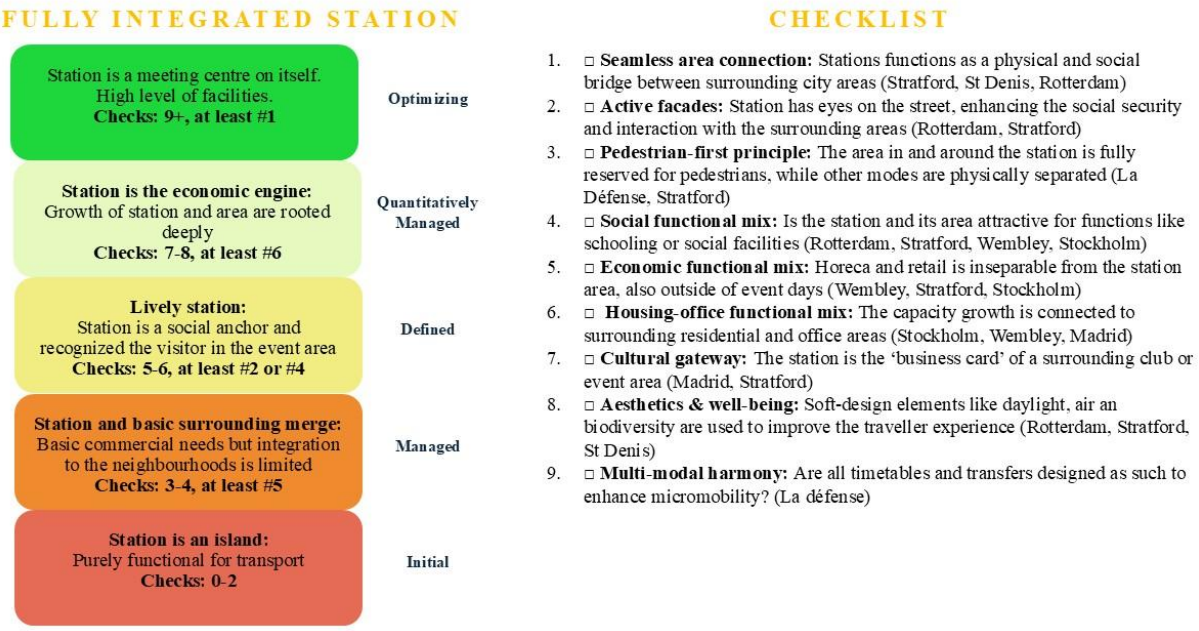



*Figure 45 - Maturity levels of aspect 'Fully Integrated Station' (Author, 2026)*

### *6.3.2. Practical application*

This tool is operationalised within a Microsoft Excel spreadsheet. Through the use of logic formulas, the tool automatically calculates the maturity level of each aspect based on the input data (checks). The output is visualised in an interactive dashboard, featuring a radar chart (spider web diagram). This visualisation allows for a direct overview of the selected station, as well as providing a direct comparison between different stations. With this tool, a policymaker or station manager can directly see an overview of their respective maturity profile compared to a 'better-performing' or 'worse-performing' station across all eight analysed aspects. This is shown in Figures 46 and 47 on the next page.

As explained, the tool operates on a hierarchy. This implies that the development is treated as linear and levels cannot be bypassed. To qualify for a higher maturity level (e.g. level 3), the specific mandatory requirement of all preceding levels (level 1 and 2) must also be fulfilled. Consequently, if a station lacks a fundamental check required for a lower level, it will remain classified at that lower level. This ensures that the foundational elements of this performance aspect are sealed before more advanced maturity is

recognised. However, to distinguish that a station checks off multiple criteria in the dashboard (see figure 46), the number will be shown in the row *'Total number of checks/maximum'* to show its development without achieving the threshold values, and to also create a clear overview for that aspect.

In addition, in this example, the practical explanation can be seen and explained for the 'Position in Network'. To reach level 3, a station requires a total of 5 to 6 checks (figure 34). However, it must also satisfy the qualitative requirement #5 '*Urban Corridor'* or check #7 '*High frequency'*. Moreover, due to the cumulative hierarchy, the station must meet the requirements of level 2 (#1 of #3). If a station scores 5 checks in total but lacks the foundation of check #1 or #3, it fails to meet the Level 2 threshold and therefore also the Level 3 status.

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ |
| | 2 | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ | ☑ |
| | 3 | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ |
| | 4 | ☑ | ☐ | ☑ | ☑ | ☐ | ☐ | ☑ | ☑ |
| | 5 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| | 6 | ☐ | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 7 | ☑ | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ | ☐ |
| | 8 | ☐ | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ | ☐ |
| | 9 | ☐ | ☑ | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ |
| | 10 | ☑ | ☐ | ☐ | ☐ | | ☐ | ☑ | |
| | 11 | ☐ | ☐ | ☐ | ☑ | | ☐ | ☑ | |
| | 12 | ☐ | ☐ | ☐ | ☐ | | ☐ | ☑ | |
| | 13 | ☐ | | | ☑ | | | | |
| | 14 | | | | ☐ | | | | |
| | 15 | | | | ☐ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels station A | 1 | 2 | 3 | 2 | 1 | 1 | 5 | 1 |
| Total number of checks / maximum | 5 / 13 | 6 / 12 | 5 / 12 | 10 / 15 | 3 / 9 | 4 / 12 | 11 / 12 | 5 / 9 |

*Figure 46 - Dashboard and explanation 'Station A'*

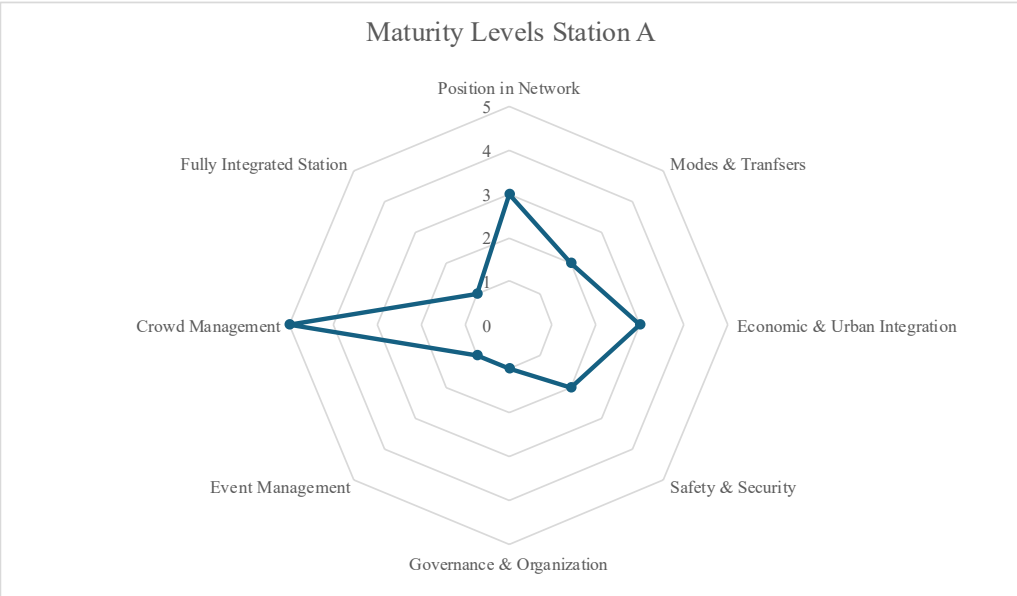



*Figure 47 – Radar Chart of Station A*

Figures 46 and 47 show an example of a singular station, its checklist and its specific radar chart. This process is repeated on different tabs in the spreadsheet, allowing for scoring different stations simultaneously. The comparison of these stations is shown in Figure 48. Here, only the maturity levels are compared and duplicated within one radar chart. Allowing for a direct comparison between the different transit nodes in event related context on every distinct aspect.

| | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Station A | 4 | 2 | 3 | 2 | 1 | 1 | 5 | 3 |
| Station B | 3 | 2 | 3 | 5 | 4 | 3 | 4 | 1 |
| Station C | 3 | 3 | 2 | 5 | 3 | 3 | 4 | 3 |

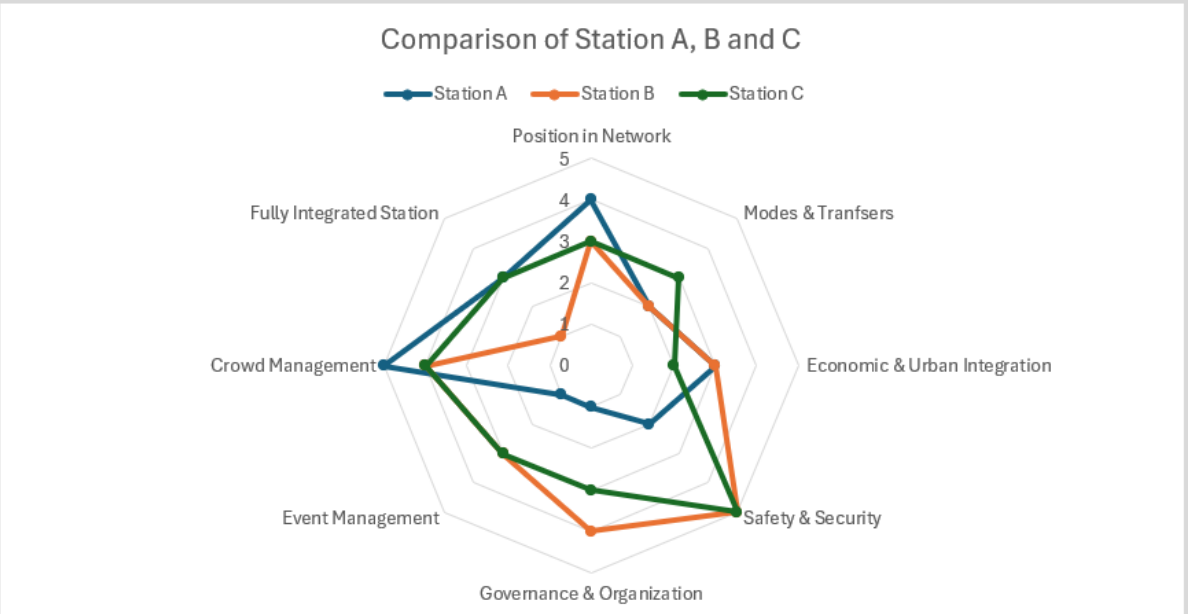



*Figure 48 - Comparison of three stations and their respective maturity levels*

# 7. Phase 4: Application of the Tool

This Phase consists of 2 parts: first applying the tool to some different cases as real-world examples, before assessing the Amsterdam Bijlmer ArenA Case. Thus, the ABAS case will be scored on the eight different aspects from this thesis: Position in Network, Economic & Urban Integration, Transportation Modes & Transfers, Safety & Security, Event Management, Crowd Management, Governance & Organization and Fully Integrated Station. The application is based on the tool with the basis of a maturity model, designed based on literature, Handelingsperspectief and interviews. Section 7.1 will apply the tool to some cases from this research, whereas 7.1.1. will apply the tool purely to Amsterdam.

## 7.1. Applying the Tool to different cases

The tool is applied to different cases from the case analyses. The cases used and explained in this chapter are Rotterdam Station Stadionpark (in the future), Stratford Station and Stockholm Slakthusområdet. The application is done on the information obtained and objectiveness of the author. All the other stations are scored in Appendix I. In this Appendix, also some recommendations are given per specific location. These are not included in the main part, as this part is focused on Amsterdam and on systematically creating the tool. An important finding in this, is that some criteria are seen as low-hanging fruits and other focus on long-term investment. Those long-term investments seem to be not directly applicable to the station as of right now but might change in the future. This is crucial for the understanding and implementation of the tool in further stages. This will be discussed in Chapter 8.

### 7.1.1. Tool Applied to Rotterdam Station Stadionpark

The future station of Rotterdam scores average (3) to too high (5) in this tool. The station will be developed from an event-only to a regular stop, meaning that the basis for aspects like Position in Network and Transportation Modes & Transfers is brought to a regular level. The ambitions of the municipality to further develop the surroundings help to score higher for Economic & Urban Integration and Fully Integrated Station. Concerning the event and crowd management, the new station does not fully include techniques and methods used in other stations, which allow to grow in maturity levels; however, it has enough ticked boxes to score similar but not achieving some threshold values.

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 2 | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ |
| | 3 | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 4 | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ | ☐ | ☑ |
| | 5 | ☑ | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ |
| | 6 | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 7 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ |
| | 8 | ☐ | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 9 | ☐ | ☑ | ☑ | ☑ | ☐ | ☐ | ☑ | ☐ |
| | 10 | ☑ | ☐ | ☐ | ☑ | | ☑ | ☑ | |
| | 11 | ☑ | ☑ | ☑ | ☑ | | ☑ | ☐ | |
| | 12 | ☑ | ☐ | ☑ | ☑ | | ☑ | ☑ | |
| | 13 | ☐ | | | ☐ | | | | |
| | 14 | | | | ☑ | | | | |
| | 15 | | | | ☐ | | | | |
| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
| Maturity Levels Rotterdam Stadionpark | | 3 | 3 | 5 | 4 | 3 | 3 | 3 | 4 |
| Total number of checks / maximum | | 9 / 13 | 7 / 12 | 10 / 12 | 10 / 15 | 6 / 9 | 8 / 12 | 8 / 12 | 8 / 9 |

*Figure 49 - Tool applied to Rotterdam Station Stadionpark*

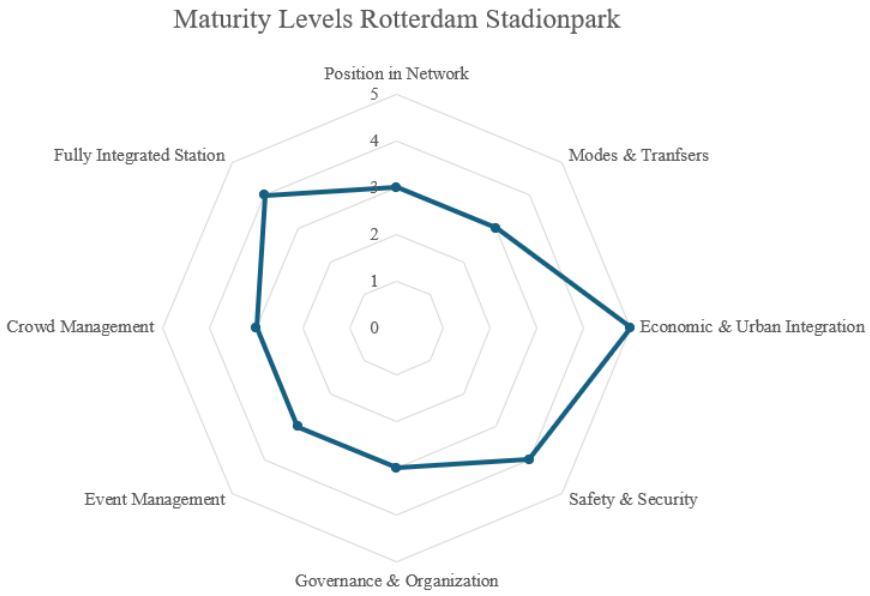



*Figure 50 - Radar Chart of Rotterdam Stadionpark Station*

## 7.1.2. Tool Applied to Stratford Station

Stratford Station can be named one of the examples of event stations coming forward from this tool, as it scores 4 or higher on all aspects. This comes forward from the station being one of the most crucial transit nodes in the network of London and the United Kingdom, scoring high on the mobility aspects. Furthermore, the management of this station is adapting and learning from every previous event, ensuring higher scores on organisational aspects. This also has to do with the fact that the station is the entrance of the Queen Elizabeth Olympic Park, and thus the entrance for the London 2012 Olympics. This ensured that the station is the engine of the residential growth, social activities, events and working conditions of its surroundings.

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 2 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 3 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 4 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 5 | ☑ | ☐ | ☑ | ☐ | ☐ | ☑ | ☑ | ☑ |
| | 6 | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 7 | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ |
| | 8 | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ |
| | 9 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| | 10 | ☑ | ☑ | ☑ | ☐ | | ☑ | ☐ | |
| | 11 | ☑ | ☑ | ☑ | ☑ | | ☐ | ☑ | |
| | 12 | ☐ | ☑ | ☑ | ☑ | | ☑ | ☑ | |
| | 13 | ☑ | | | ☐ | | | | |
| | 14 | | | | ☑ | | | | |
| | 15 | | | | ☑ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Stratford Station | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 4 |
| Total number of checks / maximum | 10 / 13 | 11 / 12 | 11 / 12 | 9 / 15 | 8 / 9 | 10 / 12 | 10 / 12 | 8 / 9 |

*Figure 51 - Tool applied to Stratford Station*

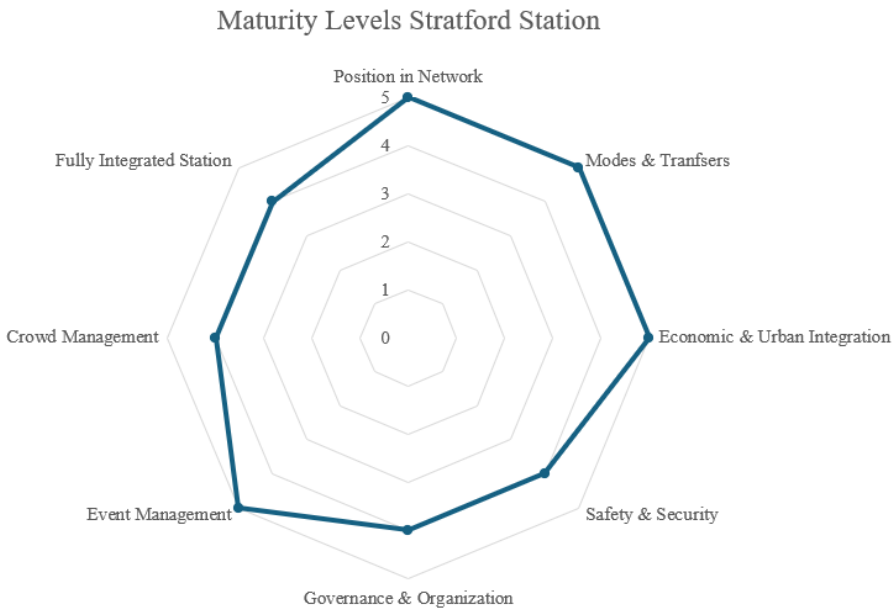



*Figure 52 - Radar chart of Stratford Station*

## 7.1.3. Tool applied to Stockholm Slakthusområdet

The station in Stockholm scores relatively well on most of the aspects, as the station is the motor behind the area development. In addition, a new station can be designed so that crowd management can be optimised according to the context. As this station is a metro-only node, the aspect of Transportation Modes & Transfers scores low. As the station is under development, just like the station in Rotterdam, the plans for event and crowd management are scored, meaning that in the end, this should be reviewed to get a better understanding of the actual situation. As of right now, the Governance and Management of this station is promising, as the Swedish are very structured, only missing out on the adaptive operational planning check.

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ |
| | 2 | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ |
| | 3 | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ |
| | 4 | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ |
| | 5 | ☑ | ☐ | ☑ | ☐ | ☑ | ☐ | ☑ | ☑ |
| | 6 | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 7 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| | 8 | ☐ | ☐ | ☑ | ☐ | ☑ | ☐ | ☑ | ☑ |
| | 9 | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ | ☐ | ☐ |
| | 10 | ☑ | ☐ | ☐ | ☐ | | ☑ | ☑ | |
| | 11 | ☑ | ☐ | ☑ | ☐ | | ☐ | ☑ | |
| | 12 | ☑ | ☐ | ☑ | ☑ | | ☑ | ☑ | |
| | 13 | ☑ | | | ☐ | | | | |
| | 14 | | | | ☑ | | | | |
| | 15 | | | | ☐ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Slakthusomradet | 4 | 2 | 5 | 3 | 4 | 3 | 4 | 3 |
| Total number of checks / maximum | 7 / 13 | 3 / 12 | 9 / 12 | 7 / 15 | 8 / 9 | 8 / 12 | 10 / 12 | 5 / 9 |

*Figure 53 - Tool applied to Stockholm Slakthusområdet*

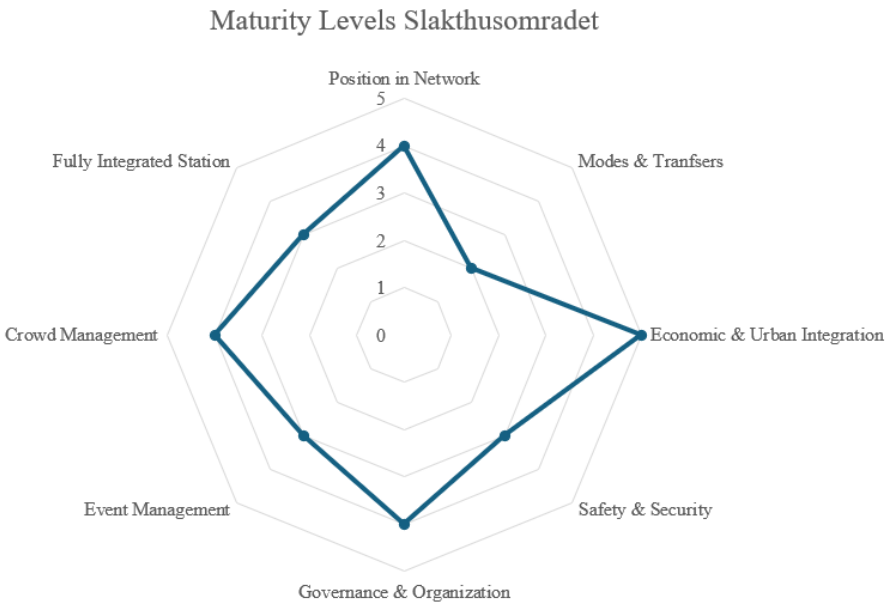



*Figure 54 - Radar Chart of Stockholm Slakthusområdet*

## 7.2. Applying the Tool to Amsterdam Bijlmer ArenA Station

This is one of the most interesting parts of this thesis, as the tool will be applied to the base case of the study. Similar to the previous cases, the tool will score Amsterdam Bijlmer ArenA Station on the eight aspects developed in this research. The information from Phase 1 will be used as input for the checklist.

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 2 | ☑ | ☑ | ☐ | ☐ | ☑ | ☑ | ☐ | ☐ |
| | 3 | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☐ | ☑ |
| | 4 | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ |
| | 5 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 6 | ☑ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 7 | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ | ☐ |
| | 8 | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☐ |
| | 9 | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ |
| | 10 | ☑ | ☑ | ☑ | ☑ | | ☑ | ☐ | |
| | 11 | ☑ | ☑ | ☐ | ☐ | | ☐ | ☑ | |
| | 12 | ☐ | ☑ | ☑ | ☑ | | ☑ | ☑ | |
| | 13 | ☐ | | | ☐ | | | | |
| | 14 | | | | ☑ | | | | |
| | 15 | | | | ☐ | | | | |
| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
| Maturity Levels ABAS | | 5 | 4 | 4 | 3 | 5 | 4 | 3 | 3 |
| Total number of checks / maximum | | 10 / 13 | 8 / 12 | 8 / 12 | 8 / 15 | 9 / 9 | 8 / 12 | 7 / 12 | 5 / 9 |

*Figure 55 - Tool applied to ABAS*

Within this tool, Amsterdam Bijlmer ArenA station is a mature, strategic node. Especially in its Position in Network and Governance & Organization it has the maximal score. Especially on Governance, all 9 checks are ticked, ensuring that ABAS is an adaptive station in which public and private visions are integrated. Furthermore, it is an essential node in the network; when the station fails, the network fails, acting as a crucial station in the Dutch and Amsterdam public transport system.

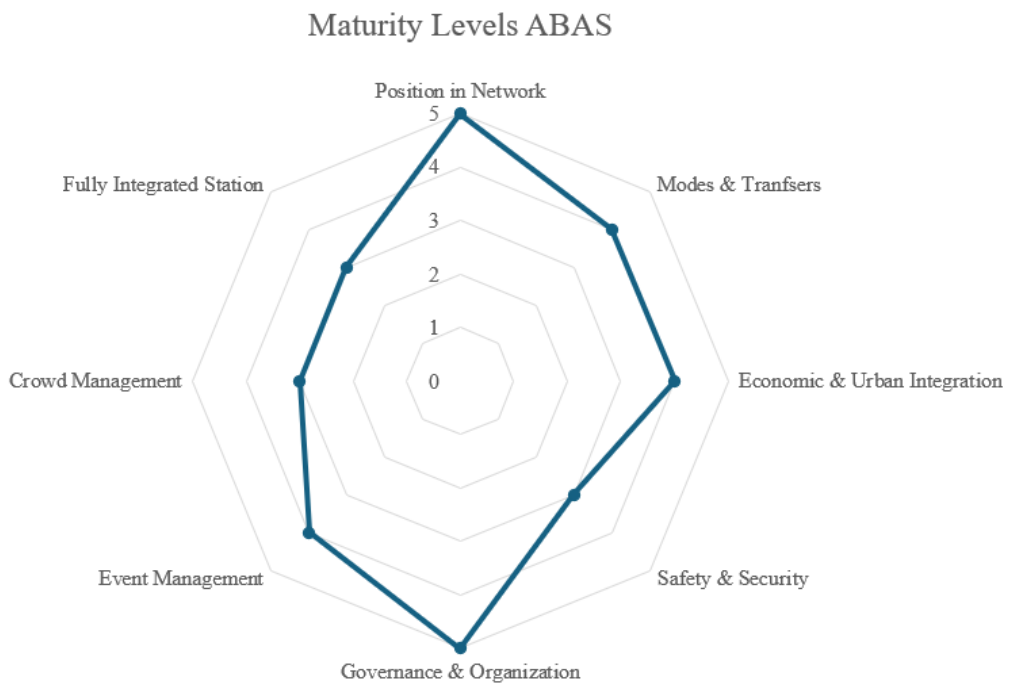



*Figure 56 - Radar Chart of ABAS*

Three aspects score the maturity of Quantitatively Managed, namely the Transportation Modes & Transfer, Economic & Urban Integration and Event Management. For the first one, it can be explained that the different transportation modes are there; however, the seamless transfer between these modes is not yet there. Secondly, the station and its area are integrated with its surroundings, as there is a lot of economic activity going on around the station; just because it misses one more check, it is not yet at maturity level 5.

The Event Management is also professional, but not yet fully integrated with the surroundings as it does not yet tick of the perfect score. The most important checks it misses out on are the stop-and-go method (check #3) and the dual design of the station (check #1). And lastly, the Crowd Management is based on simulations and learning from previous events, scoring Managed (level 3) in this Tool. However, within the checklist it misses the aspects of the internal buffering (#2), having enough distance between the event area and the station (check #3), separating the in- and outbound streams of people (check #4), the frequence of the transportation modes being connected directly to the outbound of the event site (check #10). This ensures its average score.

The other two 'weakest' points for ABAS in this tool are Safety & Security and the Fully Integrated Station. Which is striking, even though there is 'perfect governance', according to this tool, the safety by design elements is missing. For safety, this is mainly because check #7 is missing, which entails complete transparency and free sightlines, as there are some dark corners in and around the station. This is also missing in check #2 from the Fully Integrated Station aspect, having no eyes on the street, as the station and its surroundings are not regarded as safe during nighttime.

| | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Rotterdam Stadionpark | 3 | 3 | 5 | 4 | 3 | 3 | 3 | 4 |
| Stratford Station | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 4 |
| Stockholm | 4 | 1 | 5 | 3 | 3 | 3 | 4 | 3 |
| ABAS | 5 | 4 | 4 | 3 | 5 | 4 | 3 | 3 |

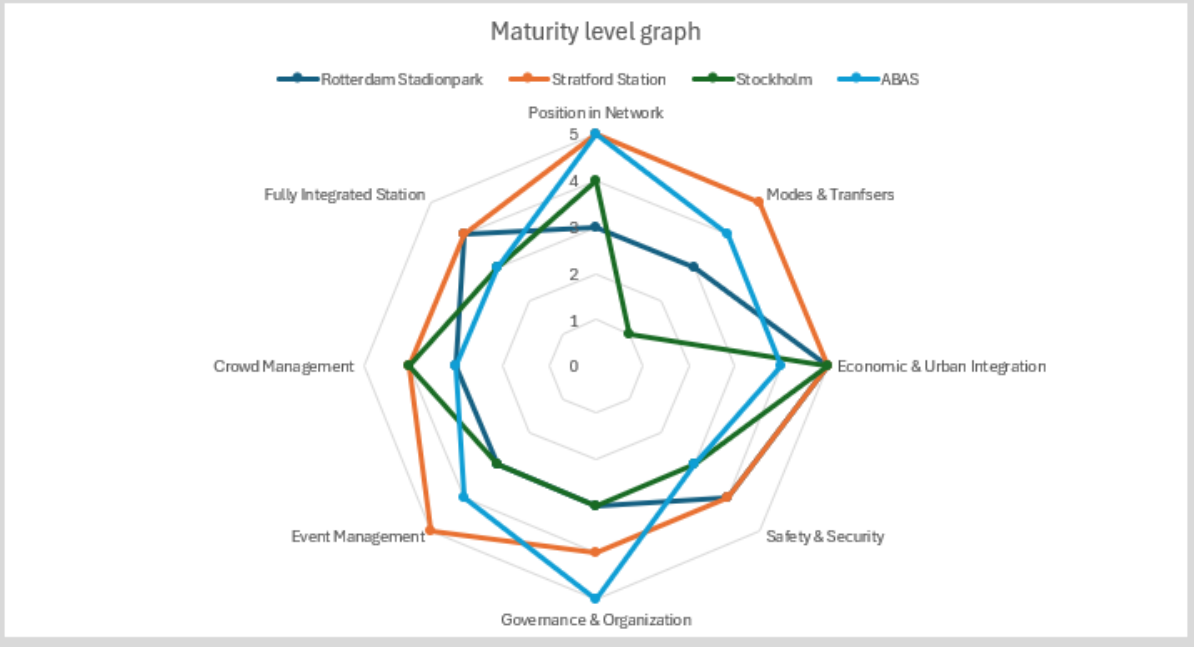



*Figure 57 - ABAS compared to the three other stations*

In the figure above (Figure 57), ABAS is compared to the other three stations used to explain the application of the tool in this chapter. The tool allows for a direct comparison between Amsterdam Bijlmer ArenA, Rotterdam Station Stadionpark (future vision), Stratford Station and Stockholm Slakthusområdet station. ABAS is coloured in light-blue and overall scores as mature or more mature than the compared stations. Within this specific comparison, Amsterdam is only behind Stratford on Transportation Modes & Transfers, Event Management and Crowd Management and compared to Rotterdam also on three aspects. Especially the Economic & Urban integration is an aspect Amsterdam can learn from compared to the others. On Governance & Organisation, Amsterdam scores the best, showing that other stations could learn from the processes like the MIRT and the coordination between stakeholders during events and the infrastructure regeneration.

### 7.2.1. Reviewing Phase 1

This subchapter reevaluates and reviews the first phase of the thesis. Seeking answers to whether the tool confirms, nuances or contradicts the initial problem definition and contextual analysis from Phase 1. In this phase, the primary challenge of ABAS is its dual-faced character, creating the tension between daily efficiency and peak capacity. Which results in complicated governance and physical bottlenecks during the events.

Firstly, the initial analysis notes that decision-making is hindered because the municipality of Amsterdam, NS and ProRail have conflicting priorities. Interestingly, the tool gives Governance & Organisation a maturity level 5. Suggesting that even though the process feels slow, the institutional framework is actually very mature. This is also confirmed in the analysis of the literature from Hammerschmid (2016), examined in chapter 3.2.2.2. Showing that the Netherlands is the leader when

it comes to having fewer challenges in major infrastructure projects. Mainly due to the nature of the MIRT and the processes according to it. All necessary stakeholders are at the table, and the MIRT process provides the formal structure for cooperation, which some other countries are missing. For this, a quote from the interview with Metro de Madrid contributes to this insight: *"The decision-making process is often driven by political priorities but follows a legal process; the MIRT systematics you describe are interesting to consider and learn from".*

Moreover, the physical design of the ABAS station contains structural bottlenecks, like the impractical transfer areas due to height differences and the poor location of the bus station, as well as the bottlenecks of crowds entering the station after events. This is reflected in the tool by the final score of Fully Integrated Station (Maturity level 3) and the Quantitatively Managed score of Modes & Transfers (Maturity level 4). The mediocre score of integration, especially not ticking off those specified checks, confirms the findings that the station is not yet a 'seamless hub'. The gap between its high position in the network and the physical integration shows that the infrastructure is somewhat behind its strategic importance.

Lastly, the Handelingsperspectief from Goudappel highlights that safety and satisfaction score low in event and daily situations, which is also the case in the comparison tool. Over there, the Safety & Security aspect scores maturity level 3. This is next to the Integrated Station, the lowest score in the radar chart, validating the findings from the Handelingsperspectief when compared to other stations.

### 7.2.2. Sub-Synthesis

As the tool validates some of the findings from Phase 1, it is important to realise that the statements above are not a standalone judgement. The statements are followed by the comparative analyses and recurring aspects of the used stations, performed through a very specific tool designed for this research. The maturity levels shown in the diagram represent how ABAS performs relative to the framework. This tool explicitly shows where the gap lies, or where Amsterdam is performing better than the other transit nodes in Europe in this research. This is crucial for the thesis, as a high score in the tool does not necessarily mean that the situation for ABAS is 'perfect'. It means that, compared to the recurring features of other major transit nodes in this research, ABAS has implemented more or fewer of the necessary components for those specific aspects.

In short, this tool acts as a reference point, as it translates qualitative observations into quantifiable comparison aspects. By measuring ABAS against the designed checklist that has proven successful in other contexts, the research provides insights into what and where Amsterdam can learn. Even though confirming some of the statements from the analyses in Phase 1, the results should always be critically reviewed. Therefore, the next chapter provides more relevant recommendations for ABAS specifically.

## 7.3. Integrated Findings from Tool Application

Phases 3 and 4 have had some overlap, hence the questions stated at the beginning of Phase three will be answered in this subchapter:

- *What are the recurring aspects and lessons that can be used in the cross-case comparison?*

The recurring aspects are anchored in the embedded units derived from the system analysis, literature and stakeholder interviews. They can be clustered into two roughly overarching clusters:
**Mobility & Spatial aspects:** 'Position in Network', 'Economic & Urban Integration', Transportation Modes & Transfers' and 'Fully Integrated Station'

**Operational & Governance aspects:** ‘Safety & Security’, ‘Event Management’, ‘Crowd Management’ and ‘Governance & Organisation’.
The lessons learned can therefore also be divided into the more general design lessons and the event-related lessons. This is useful for the recommendations in the next chapter. Without diving into them too deeply, the general lessons are to include more space inside the station with a mezzanine level, dimensioning the station on peaks, and explicitly designing for two distinct states: ‘Business as Usual’ and ‘Event Mode’.

- *How can the identified aspects be operationalised into criteria that form the basis of a Comparison Tool?*

The aspects are operationalised using the basis of the CMMI framework, moving processes and procedures from ‘Initial’ to ‘Optimising’ in 5 maturity levels. The recurring aspects are summarised per aspect into a checklist, which is used in a hierarchical logic:

- Quantitative threshold: A station must meet a minimum number of identified checks to progress to the next maturity level, in combination with;
- Qualitative threshold: Higher maturity levels require some specific checks, which are less recurring than others as the maturity level increases. This ensures a station cannot be labelled ‘mature’ just by having many small features if it lacks a fundamental requirement.

The scores are plotted on a Radar Chart, which allows for a comparison in one overview. For example, ABAS’s high governance is being prominently displayed over the other stations in this chapter.

# 8. Phase 4: Implementation of the Tool and Application Outcomes

In this chapter, the tool is explained through the who, when and how on the implementation as an instrument. This is done in section 8.1, and this paragraph is answering the 6th sub-question:

*How can the Comparison Tool serve as a strategic instrument for stakeholder dialogue in complex infrastructure projects?*

After that, to improve the practical validity of this paper to see whether the tool is interpreted the same by the designer as by an expert, a project manager of the Amsterdam Bijlmer ArenA Station also used the tool to come to conclusions (section 8.2). Section 8.3 states similarities and differences in the application of the tool by the expert and the researcher. Which is used to conclude the final recommendations for the case of Amsterdam. This provides input for the discussion.

## 8.1. The Tool in Early-Stage Planning

In complex infrastructure projects, such as the redevelopment of Amsterdam Bijlmer ArenA Station, decision-making is often complicated by the diverging interests of various stakeholders. The analysis in Phase 1 demonstrates a clear conflict of interest between the Municipality of Amsterdam and the transport operators NS and ProRail. To bridge this gap, the Comparison Tool could function as an instrument, therefore this paragraph tries to answer the 6th sub-question.

The conflict between the Municipality of Amsterdam and the transport operators shows the lack of a shared language, the stakeholders are thinking purely from the own sector and expertise. The municipality keeps thinking about the city and its growth, while the NS and ProRail only think about the current efficiency and their limitations in capacity of the tracks. Like this example, in this way, the lack of a shared language can prevent the integration between different stakeholders. This is where the Comparison Tool could function as a bridge, becoming a Boundary Object.

### 8.1.1. The Tool as a Boundary Object

As explained in Chapter 3.4.2. there is a theoretical tool called the Boundary Object, which tries to connect different stakeholders with a different knowledge and understanding of the work field. Bergman et al. (2007) defines a Design Boundary Object (DBO) as *'any representational artifact that enables knowledge about a designed system, its design process, or its environment to be transferred between social worlds and that simultaneously facilitates the alignment of stakeholder interests populating these social worlds by reducing design knowledge gap'*. Which is the goal of the Comparison Tool, to act as an instrument to start the dialogue and align different stakeholder interests. Bergman et al. (2007) therefore explained four different features a DBO should have, the features are shown in figure 58 below. Underneath this figure, Table 3 states the features and how the designed Comparison Tool from this research supports them.

| Table 1. Features of Design Boundary Objects | | | |
|---|---|---|---|
| Features | Definition | Design Ecology | Description |
| **Promote Shared Representation** | Encapsulates understandings based on a common syntax and semantics, which are shared across social worlds | **Functional** | Form shared functional representations, i.e. data and technical models, prototypes, architectures, specifications, etc. (Sutcliffe and Gault, 2004, Whitten and Bentley, 2006)<br>Transform knowledge at the boundary between social worlds (Carlile, 2002, Karsten et al., 2001) |
| | | **Political** | Form shared political representations, i.e. agreements, contracts, "sign-offs," memorandums of understanding, etc.<br>Perspective sharing, i.e. making sense of other social world's perspective. (Karsten et al., 2001) |
| **Transform Design Knowledge** | Manipulate, integrate and transform representations that will propel movement between design routines so as to facilitate finding a feasible functional solution and stabilize the political ecology | **Functional** | Move knowledge from ambiguous to specific; objective/goal to a problem; instable to stable; idea to solution (Henderson, 1991, Pohl, 1996)<br>Realign operational structure to stabilize functional ecology<br>Enable design traceability (Ramesh and Jarke, 2001) |
| | | **Political** | Hand-off of power and control from provider to recipient world(s) (Carlile, 2002)<br>Realign power to stabilize political ecology (Fairholm, 1993, Markus, 1983)<br>Enable agreements traceability |
| **Mobilize for Design Action** | Source and wield resources and power to propel progress along a design path. | **Functional** | Participate in SAD routines as to invite functional expertise, review solutions, etc.) (Henderson, 1991)<br>Reduce problem ambiguity for solution discovery in a design path<br>Conscribe expertise relevant for problem identification and solution (Henderson, 1991) |
| | | **Political** | Participate in decision making, mobilization of resources and allocation of design tasks (Hirscheim et al., 1995)<br>Mobilize bias towards preferred resolution (Hirscheim et al., 1995) |
| **Legitimize Design Knowledge** | Grant a legitimate status to a boundary object through validation of its content as to align with the stakeholders' intent. | **Functional** | Certify, verify and validate the truthfulness and correctness of design knowledge (Henderson, 1991) |
| | | **Political** | Demonstrate acceptability of goal(s), problem(s) and solution(s) in the given institutional order as to authorize the movement of design knowledge across social worlds (Bergman et al., 2002a) |

*Figure 58 - Critical Features of Design Boundary Objectives (Bergman et al., 2007)*

*Table 3 - Features - How Comparison Tool support the features*

| **Feature** | **Support of Comparison Tool to Feature** |
|---|---|
| Promote Shared Representation | The criteria and maturity levels from the tool form a common language ('common syntax'), all stakeholders should be able to understand these criteria and checks. The Embedded units and aspects show a shared representation among the stations. |
| Transform Design Knowledge | The comparison tool makes the problems specific. By plotting in which maturity level an aspect of a transit node is, feasible solutions can be found by the missed checks in the checklist of the Comparison Tool. Showing on how to improve the transit node's maturity level. |
| Mobilize for Design Action | The tool shows where the transit node misses out on compared to others, motivating stakeholders to act. → Especially in the early phases these action steps are useful. |
| Legitimize Design Knowledge | The Comparison Tool is validated by an expert in paragraph 8.2. If the expert understands the criteria, the knowledge from the tool will fit to the case if the criteria are checked. |

The boundary object, and therefore the tool, is acting as the bridge between the needs and design elements of a transit node in the event context and what decision-makers need to start stakeholder collaboration and strive for mutual understanding. The Tool is providing a common language across different stakeholders and their knowledge and understanding of practical situations (Oswick & Robertson, 2009). To transition from this theoretical framework to practical application, the following implementation framework defines the operational context of the tool.

### 8.1.2 When, Who and How?

This paragraph gives explicit answer to the 6th sub-question stated at the beginning of this chapter.

**When:**

The timing of the tool and its application is critical. By using the Comparison Tool in the early Exploration Phase of the project, for instance within the 'Verkenning fase' of the Dutch MIRT, the design principles are still flexible, and the budgets are not yet finalized. As explained in 3.4.2.1, the financials are discussed in the third step the 'Planuitwerking'. Applying the tool here before entering the more rigid technical phases allows for more creativity and flexibility. Of course, this procedure differs per country but generally applying this tool before the technical designs are locked in allows the project to move on from the sectoral thinking to ensuring that all the event-context requirements are considered in the agenda from early on in the process.

The implementation of the tool works ideally at one session during the early exploration phase. However, when multiple groups of stakeholders (see next paragraph) need to be consulted, a larger time window would be more optimal. Evaluating the tool and its results in a later stage of an infrastructure project, for example in the MIRT 'Planuitwerking' would also be a good moment for the use of the tool. As it is interesting if the stakeholder viewpoints have changed, and whether the first drafts are in line with the proposed changes from the discussion evolved of the earlier session.

**Who**:

The tool should be used by a multidisciplinary group of stakeholders. To ensure some objectivity, a neutral moderator, such as an external consultant, should facilitate the session. The participants should represent a stakeholder group as identified in this research, like in figure 15:

- Public authority: e.g. municipality of Amsterdam, Boroughs of London, Municipal de Madrid, provinces or institutions like the VRA.
- The transport operators: e.g. NS, TfL, Stockholm Lokaltraffic or Metro de Madrid.
- Private partners: e.g. developers of the region of Wembley, or the event venues Ziggo Dome/AFAS/Johan Cruijff ArenA.

The combination of stakeholder groups as described above would be the *Policy Arena*, as these parties have more influence on the political choices made. However, there are also other groups with useful interests. For example, as shown in figure 15 there are the users and the Operational Mobility Centre (OMC). Participation of residents and users of the station allow practical requirements to be heard by the higher-level stakeholders, even though they are not the primary decision makers. In addition, the OMC is a special institute, as they combine the actors during events and is therefore crucial for the hub's functionality. But in the case of ABAS, the OMC is from the municipality of Amsterdam, causing bias on the stakeholder table. Furthermore, there is more knowledge, from experts, spatial designers, architects and researchers. Together this group would form the *Analytical Arena.*

This mentioned, there are two arenas which can be generalised over all the transit node areas: the Policy Arena and the Analytical Arena. The differences between these groups allow to bridge the gap between reality in the operation, the strategic planning and the feasibility of design elements.

**How:**

The implementation follows six steps:

1. Organise a session with the stakeholders from the Policy Arena and a separate session with the stakeholders from the Analytical Arena.
2. Each stakeholder independently fills in the Comparison Tool based on their perception of the current or desired state of the hub.
3. The neutral moderator overlays the scores per arena, and also inter-arena. The value of the tool is not in the average score, but in the differences. If for example the Municipality scores 'Governance' a maturity level 4, but the transport operator a maturity level 2, this disagreement becomes a point on the agenda for the dialogue and discussion. The moderator should deal with the objectivity of the different stakeholders and use that as a way to start dialogue.
4. This dialogue should be done within the own arena, as well as between the two stakeholder groups. This allows for more differences and more insights. The challenge is to overcome the differences.
5. Guided by the international benchmarks, the criteria of the aspects, the stakeholders can discuss what is needed to reach a higher maturity level. This leads to opportunities in designs that can be supported by all parties, eventually with a consensus.
6. Bonus step: The international cases which are considered in the tool, could become *'official partners'* of the tool, and they could be contacted once other nodes want to learn from their design principles. In this way, different international arenas can learn from each other in a very specific and cooperative way.

In the next paragraph the expert validation is done and the differences in interpretation don't make it wrong but lead to a mutual and different understanding of some of the core aspects. This session is a first pilot from this process as described above.

## 8.2. Expert Validation

To fully understand the tool, it is necessary to validate the work by an expert at the Amsterdam Bijlmer ArenA station. This validation, and the comparison of the expert and the researcher (researcher's score of ABAS in Chapter 7.2), is interesting, as it establishes the baseline from the researcher using the methodology he developed, compared to an expert's reality check. While section 8.1.2 described the ideal multidisciplinary setting, this section serves as a pilot, and therefore a partial assessment of the implementation of the tool and a full session would be recommended. Comparing the researcher's assessment with that of an expert on the Amsterdam Bijlmer ArenA Station.

The expert himself is a consultant and project manager for the vision of the station area of Amsterdam Bijlmer ArenA, which he has been doing for more than 3 years. In Figure 59, the outcome of the tool is shown.

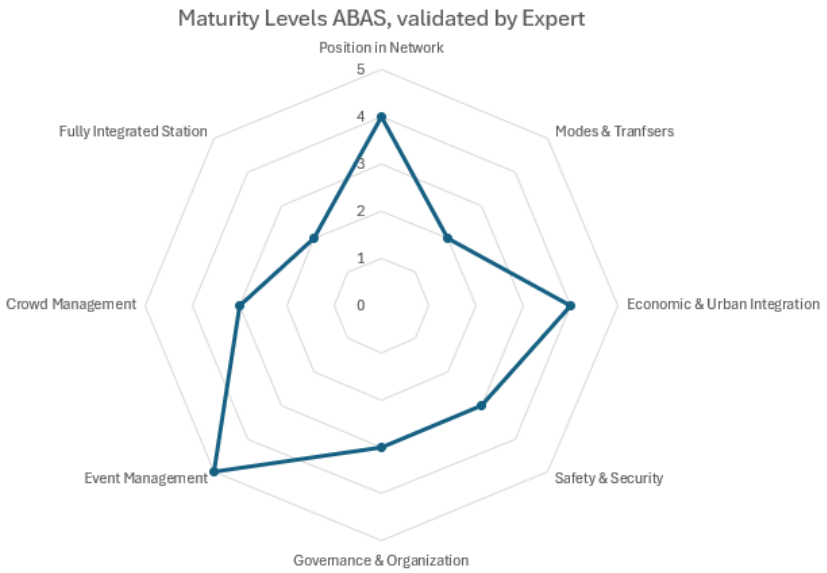



*Figure 59 - Outcome of tool as applied to ABAS, validated by Expert (2026)*

Compared to the results shown in Figure 56, there are some crucial differences and shifts in certain maturity levels. The biggest difference is within Modes & Transfers. The most important difference is #7, the step-free & inclusive access. While there are elevators and escalators available in the station, the expert mentioned that they are not high-capacity and often have failures. If this check had been given, the maturity level would have risen to 4.

Furthermore, another big difference is the shift in Governance & Organisation from level 5 to level 3. Which is mainly because the expert did not check #8's alignment of socio-economic goals. The motivation is clear: *"Overall, there is alignment; however, due to the disagreement between the road companies and the municipality, the main stakeholders on area development, I did not check this'*. The realisation of this fragmented governance is important for the researcher and for the refinement of the recommendations. The other aspect's maturity levels are globally similar. Some other important remarks are:

- There is a debate regarding the mezzanine. While the transport operators and the municipality think that it is good for internal buffering, a wrongly dimensioned mezzanine could risk a lot of safety issues.
- The finding that in- and outbound streams cannot be physically separated (Crowd Management #4) is due to one staircase per platform, which is interesting, as other stations can do so.
- Crowd Management #10 is debatable as well, as the NS/ProRail can adapt the timetable to the events, which is not directly applicable, whereas the GVB can almost directly adapt the timetable, as they have spare material.
- The station tries to integrate neighbourhoods east and west, while the north and south neighbourhoods are less integrated and still see the station as a physical barrier.

The expert mentions that a lot can be made with regard to transfers and with respect to crowd management, ABAS is growing, but standardisation is needed. His final remark refers to the main problem: *"ABAS functions as an event station that requires upgrading to current event standards, as parts of the original design are outdated or too narrowly dimensioned. At the same time, the station is expected to provide a more pleasant environment for daily users. This creates a fundamental tension between peak event performance and every day stay quality."*

| Embedded Units / Aspects | | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|---|
| Checklist | 1 | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| | 2 | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☐ |
| | 3 | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ |
| | 4 | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ | ☐ | ☐ |
| | 5 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| | 6 | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ |
| | 7 | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ |
| | 8 | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ | ☐ | ☐ |
| | 9 | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ |
| | 10 | ☑ | ☑ | ☑ | ☐ | | ☑ | ☐ | |
| | 11 | ☑ | ☑ | ☐ | ☑ | | ☑ | ☐ | |
| | 12 | ☐ | ☐ | ☑ | ☑ | | ☑ | ☑ | |
| | 13 | ☐ | | | ☐ | | | | |
| | 14 | | | | ☑ | | | | |
| | 15 | | | | ☐ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels ABAS, validated by Expert | 4 | 2 | 4 | 3 | 3 | 5 | 3 | 2 |
| Total number of checks / maximum | 8 / 13 | 7 / 12 | 7 / 12 | 8 / 15 | 5 / 9 | 10 / 12 | 7 / 12 | 4 / 9 |

*Figure 60 – Checklist validated by expert on ABAS*

## 8.3. Strategic Insights for Amsterdam Bijlmer ArenA Station

This paragraph consists of the outcome of the tool, the identified strategic insights from the tool for Amsterdam. The general research and policy recommendations are found in chapter 11. Figure 62 shows an overlapping radar chart of all stations in this research. In Appendix I, all the other stations included in this research are applied to the tool and per case some recommendations are done. It should be noted that the stations in Paris and Munich provided too little information to successfully apply the tool to them. Therefore, the main recommendations are based on the five stations, which included the in-depth research.

This paragraph answers the sub-question: *'What are the results of applying the Comparison Tool to ABAS and what recommendations and conclusions can be made for the ABAS redevelopment process?'*

As ABAS scores the highest in the maturity on Position in Network and Governance & Organisation, fewer recommendations are provided for those, it is reviewed in general concerning the MIRT process. Instead, the following insights focus on Economic & Urban Integration, Safety & Security, Event & Crowd Management and Fully Integrated Station.

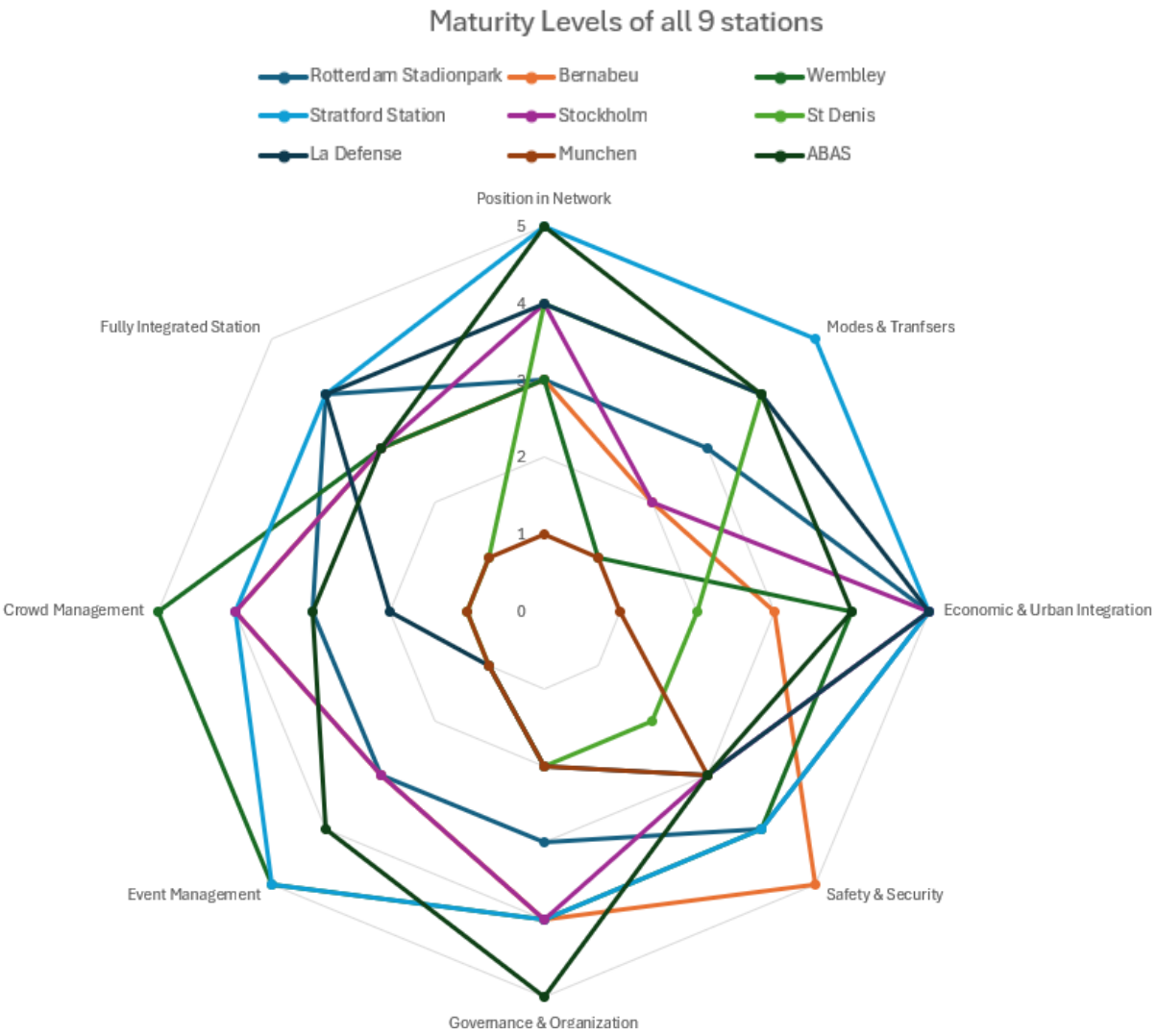



*Figure 61 - Maturity levels of all 9 stations*

The recommendations for station design, as well as policy recommendations, are listed below. They are divided into general station design principles and specific event usage:

**General design principles:**

- Implementing a unified mezzanine level to facilitate seamless transfers, as well as increasing the surface area inside the station to disperse the crowds more safely, is advised. Since a mezzanine is currently under consideration for the new station design, its effectiveness is concluded from the success of other event-related transit nodes. However, as the expert validated, this should be done in good consideration, and it is recommended to simulate this mezzanine level with crowd-simulation techniques. Both in the daily-use for transfers, as well as in the event-context for extra buffer space.
- Stations such as Wembley Park and Madrid Bernabéu were designed and dimensioned specifically based on event peak capacity. Operators like the Transport for London and Metro de Madrid deliberately prioritised reliable performance during peak demand around events, even if this results in lower levels of activity during the day. By ensuring the safety requirements for peak events and compensating for quieter daily conditions through design choices on improving the daily quality, these operators accepted

a lower level of daily activity as a reasonable trade-off. Moving forward, as Amsterdam is also expecting a lot of growth, dimensioning the station for bigger capacity will also be more future-proof.

- Moreover, the Municipality of Amsterdam should consult the Station Stadionpark project team of the Municipality of Rotterdam regarding their 'dual state' design. This design approach ensures the fixed physical differences between daily and event use. Rotterdam is going to implement extra entrances and station areas which are closed during regular daily use but can be opened during events. While Amsterdam faces more spatial limitations, this flexibility should be explored.

**Event scenario:**

- Event operators and NS should implement an 'event boosted' transport option, which either improves the frequency of the available transportation modes after events, or use a transportation option which is a 'direct' or 'express' option to nearby hubs, like Amsterdam Centraal or Utrecht Centraal. These options can be integrated into the regular timetable or adjusted so that it only occurs on the triple event days.
- If the station keeps its singular staircase or escalators to the platform, it is advised to install physical staff boxes on the platforms to perform more efficient and safer PA announcements during high-peak moments.
- The crowd management should implement stop-and-go tactics. Currently, the municipality of Amsterdam uses physical barriers to separate crowds before entering the station. However, when also implementing the stop-and-go measure in the public space, there will be positive consequences inside the station as it will be less crowded. In this way, people can safely find their transport options with more ease, as well as reducing the chance of the station being overcrowded.

Eventually, the Governance & Organisation aspect should still be evaluated and considered in its decision-making. In the Netherlands, the MIRT framework provides a powerful foundation for complex decision-making, as explained in the literature in 3.4.2.1. For the future of Amsterdam Bijlmer ArenA Station, the MIRT process should be treated as a strategic foundation rather than a rigid rulebook. This framework is effective at keeping the stakeholder like ProRail, NS and the Municipality together through its common language, which is an internal advantage of the MIRT, especially when interests diverge (like in the case of ABAS). Because of the characteristics of the MIRT, there is a risk that the unique needs of ABAS get lost in the administrative bureaucracy. Since the station is double-faced, with extreme pressure during events, the design phases require more than just the standard policy. Therefore, a major recommendation is to keep the MIRT to secure the political robustness and foundation, while also allowing for more creativity among the designers with the use of this tool. This allows the team to develop more innovative 'dual-state' solutions, without being limited by the rigid outcomes of the cost-benefit analysis provided by the MIRT. With, of course, the side note that everything remains possible within the context-related constraints.

# 9. Discussion of Findings and Methodological Limitations

This thesis examines how the redevelopment of Amsterdam Bijlmer ArenA station (ABAS) is approached from the perspective of integrated decision-making, and how lessons from comparable European transit nodes can be translated into a comparison tool. This thesis uses a combination of a single in-depth base case (ABAS) with an embedded multiple-case design across international event-related transit nodes and uses its recurring aspects as a comparison tool based on maturity levels. This section reflects on the methodological choices, the analysis of the data, the application and implementation and the societal and academic relevance of the thesis.

Firstly, starting off with discussing the methodology, the distinct and separate approach between the four different phases, contributing to two different questions, is coherent and traceable. As it was explained in the first part of the research, a logical sequence followed. To start discussing this thought, the use of the system decomposition, the layer model and stakeholder interviews in Phase 1 helped to analyse ABAS as a socio-technical system, rather than a physical transit node. This was necessary to understand the tensions between the daily operations and peak event uses, as well as the tensions between the stakeholders involved. However, the depth of insight gained in Amsterdam also created an imbalance with some of the international cases. This is because data availability and access to stakeholders were more limited outside the Dutch borders. This resulted in the fact that ABAS can be over-represented in the scoring system in the final list of checks per aspect in the Comparison Tool. Hence, sometimes results in the interpretation of ABAS scoring 'better' than the others. Even though the embedded multiple-case design explicitly allowed for only the aspect-level replication and comparison, instead of fully unravelling every case.

The cross-case study is based on document analysis and expert interviews, using the 'triangulation of methods' to strengthen the findings and therefore the validity of this research. Although it also brings in some qualitative limitations. For example, project documents and policy reports often present an official, and therefore sometimes abstract and formal view of the stations and their area development. On the other hand, interviews reflect the specific perspectives and interests of the actors themselves. This can cause difficulties in interpreting the collected data. A second limitation is that some potentially relevant cases were excluded because of the poor documentation or lack of willingness to participate in interviews. This was, amongst other locations, the case for Dortmund Westfalenpark, being a very interesting site, but not having enough information or not being willing to be involved in interviews. It was also the case in Munich, as the transport company from Munich also lacked the willingness to participate. Furthermore, there was substantial contact with different transport companies in Paris, but their bureaucracy and hierarchy made it difficult to get in touch with the right person.

Within this triangulation of methods, it must be mentioned that the final expert validation played a crucial role. This validation demonstrated that document analysis alone can lead to some 'oversights' or too optimistically interpreting situations. For example, in the aspect 'Modes & Transfers'. While documents and empirical analysis confirm the presence of the elevators and escalators, the area and station expert mentioned their low capacity and frequent failures. This makes a big difference in the final maturity level. A station may appear mature on paper, yet it can struggle significantly operationally. This validation step, therefore, helped correct the interpretive gaps and emphasised the importance of incorporating and validating via experts (when assessing the maturity of the tool of this research).

Next to the validation of the scores, the research into the implementation of the tool provided critical insights into how to use the tool strategically. By naming the Comparison Tool a 'Boundary Object', this study addresses one of the core problems of the ABAS case: the lack of a shared language between the municipality of Amsterdam and the Rail operators. The proposed implementation strategy makes a difference in the 'Policy Arena' and the 'Analytical Arena'. Already, the assessment of the researcher and the expert made a difference in Governance & Organisation, this confirms that stakeholders interpret criteria differently based on their operational view. This indicates that the tool should not be seen as a rigid checklist, but as a facilitator to find conflicts and consensus.

The implementation in sessions should therefore force stakeholders to explicitly discuss their perceptions of the same transit-node and why they differ. This disagreement should transform into manageable design challenges in the early phase of the projects process (like the MIRT Verkenning). The implementation showed that the tool not only evaluates performance, but also the reflection among stakeholders. Thus, suggesting that the tool is not only an assessment instrument, but a governance support mechanism.

Moreover, translating the qualitative insights from the cases into specific aspects and maturity levels required analytical judgement by the author. Even though this was done systematically and transparently, some bias is inevitable. In addition, the scoring of ABAS and other hubs contains some degree of subjectivity. Luckily, expert validation for Amsterdam is used as a corrective mechanism in the last chapter. This does not make the tool 'wrong', but it explains and illustrates the gap between the researched maturity and the operational maturity. The expert confirmed some aspects, as well as contradicted, especially on transport and governance. The misalignment was just within a couple of checks; however, those checks were crucial as they were often the 'qualitative threshold', ensuring big differences in maturity levels.

This (miss-)interpretation shows two things: 1) The misinterpretation of Governance & Organisation and Transportation Modes & Transfers shows some fundamental misalignment between the researcher and the expert and has consequences for the recommendations. And 2) it shows how different people could address and interpret the same criteria differently. Which indicated that the tool may require clearer definitions and that expert validation is essential for future applications, as the differences allow for stakeholder discussion.

As the application and expert validation was mainly done on the base case, the implementation reveals some limitations. As already mentioned, the scoring relies on the qualitative interpretation of policy documents and interviews. Therefore, the scoring of the cases in Appendix I is very context sensitive. This limits the immediate external validity of the tool. Further applications and validations in different institutional contexts and experts would strengthen the robustness of the tool.

The design of the Comparison Tool itself is both a strength, as it was the goal, and a limitation of reflection. Building further on the logic of the CMMI allowed the research to move beyond a simple checklist or benchmarking structure and towards a different view of development stages for a transit-node in an event-related context in this thesis. This goes hand in hand with the fact that station areas evolve over time and that the best practices from other cases are not fixed completely. At the same time, the maturity levels are based on the eight cases in this research, and therefore, are not empirically validated against the quantitative performance of some aspects in broader terms. For example, a quantitative measure of crowding levels, safety incidents and modal splits is missing in this thesis. These kinds of measurements are more applicable when scoring a singular station, and why not in a comparative way as well? These scores can be very context-dependent, but surely give an indication, or could also be standardised over the cases. This limits the tool to making claims about predicting the

effects of specific interventions. Future work could therefore strengthen the tool by integrating hard measurements and KPIs that validate the maturity scores against the qualitative as well as more quantitative performance of stations.

From a societal and managerial perspective, the thesis is clearly relevant. For VPRC, the Municipality of Amsterdam and other stakeholders around ABAS, the research offers a methodology to see where a station stands compared to comparable European transit nodes. In addition, it provides insights into design principles and event and crowd coordination management, and their tactics, which are either behind or leading compared to Amsterdam. Because of the scoping, the thesis is limited with this tool when it comes to diving into the depth of the political, procedural and other juridical cycles (MIRT), or considering budget constraints in Amsterdam, and whether there are big differences in institutional regulations across countries. Therefore, this tool can definitely be used as a support in conversations about (event) strategy and the long-term physical vision of Amsterdam Bijlmer ArenA Station. On a serious note, the interpretation of this should be considered well, meaning that a high maturity score in a certain aspect does not automatically translate into directly implementing those criteria from the checklist. The tool should therefore be seen as a decision-support element, and not a decision-maker. This statement can be substantiated by the fact that the expert validation showed that stakeholders may interpret the same criteria differently, revealing that the tool should be a conversation starter and not a definitive assessment.

Academically, the thesis contributes to some underexplored themes: multimodal hubs in event contexts, analysed through a socio-technical lens, and compared across countries using an embedded unit case design. The literature and empirical research extend on the existing work on multimodal hubs, TOD, event management and decision-making in major infrastructure projects (also including the Dutch MIRT) and by combining these themes into a comparative instrument as a Boundary Object. The use of aspect-specific replication with Yin's basic logic is new in this context, allowing to compare independent cases to be compared without forcing them to be completely equal and consistent across all characteristics. However, the contribution to the scientific world remains preliminary, as the number of cases, the qualitative nature of data, and the event-related nodes are very context-specific. This means that generalisability is limited. Rather than providing fixed conclusions, this thesis opens up promisingly for further research.

Finally, the research process shows the trade-offs that are common in CoSEM-type research projects. Due to time and resource constraints, hard choices had to be made regarding case selection, what to cover in the interviews, and the level of detail in the case analyses. Several potentially (very) relevant aspects, such as financials, legal frameworks or the actual crowd modelling simulations, were deliberately scoped out. The focus was to keep the research manageable and aligned with the COSEM profile. Future research could build on this work by deepening specific aspects (like crowd management strategies and interventions, specialised event governance frameworks, etc.) or by applying the Comparison Tool in other contexts than merely transit nodes in event-related situations.

# 10. Conclusions

This section builds further upon the discussion and the sub-synthesis in Chapter 7. It focuses on three smaller subjects before answering the main question. First, some conclusions specific to the analysed cases will be mentioned, after which the conclusions on the effectiveness of the tool follow, and lastly, the conclusion about the reproducibility of the research approach. Together, these reflections explain what the study contributes to understanding event-related transit nodes and how the development tool can support future decision-making processes.

## 10.1. Case-specific Conclusions

The most important and general conclusion from the comparative analysis is that across the selected European stations, adjacent to major event venues, similar tensions between daily operations and extreme peak loads are faced, similar to Amsterdam. However, information gathered through interviews highlighted that the physical design of metro station Bernabéu and of the new multimodal hub in Rotterdam fits more with the 'worst-case scenario'. On the other hand, stations like Wembley Park and Stratford in London are more dynamic, as they show very mature standards for crowd management. A recurring theme is that across cases, stations are no longer just transit nodes, but economic engines, even though the level of integration varies across every case. The stations in London and the metro station which is under construction in Stockholm are examples of how economic and urban integration are advantageous for the station and its surroundings. Lastly, the degree of institutional coordination and long-term planning culture with urban development varies significantly per country. Both literature and empirical research conclude that the formal processes of the MIRT in the Netherlands are the frontrunners in major infrastructure projects. Even though the Dutch processes also come with some externalities.

Furthermore, the information gathered also revealed that data availability and transparency differ across countries and cases, which influenced the depth of analysis. Some cases offer plenty of documentation and stakeholder access, while others rely on fewer resources. Despite this difference in availability, the eight recurring aspects identified (Position in Network, Transportation Modes & Transfers, Economic & Urban Integration, Safety & Security, Governance & Organisation, Event Management, Crowd Management and Fully Integrated Station) provided enough body for this thesis to compare stations across different contexts on these embedded units. Enabling the positioning of Amsterdam Bijlmer ArenA Station in a meaningful way.

## 10.2. Methodological Conclusions

The Comparison Tool, which is developed in this thesis, can serve as an additive instrument for redevelopment processes for stations, especially for the unique setting of event-related transit nodes. The major strength of the tool is translating qualitative and complex socio-technical data on governance and event operations into quantifiable maturity levels. Which are also visualised for a complete overview in a radar chart. For stations near event areas, the tool is especially relevant because it highlights aspects that traditional infrastructure planning often misses. Hence, this tool can be a powerful communication aid for specialists to justify certain design choices and elements to stakeholders in the infrastructure project.

The tool applies the CMMI logic and is thus moving beyond the 'simple' benchmarking. As the tool identifies not only where the station stands but also specifies the 'checks' the station requires to optimise its performance. Examples are the 'stop-and-go' tactics in event and crowd management, and a unified mezzanine level for the overall design for transfers and event management in a station.

There is also the limitation that the tool is based on eight cases in this research and is therefore less generalisable than initially thought. The tool is developed on the performance of some aspects at very specific stations, even though these stations are located near one of the biggest event areas in Europe or are very interesting because the transit nodes are currently being designed or under construction. There is therefore a risk that if the tool is re-evaluated and enhanced based on more cases, this tool will not work as well anymore. The interpretation of this tool should therefore always be considered with a pinch of salt.

To enlighten the statements above, the tool is also applied to the main Station of Delft. This station area, of course, does not have an event-related context. Hence, the maturity score on Governance & Organisation, Event Management and Crowd Management is Initial (score 1). However, the other aspects of the tool are general enough to let this station, in a non-event context, score either a maturity of Defined (score 3) or Quantitatively Managed (score 4). As this application is also done for the greater good and interest of the author, it suggests that some aspects of this tool can also be used in the general context for designing or redeveloping a station and its surroundings.

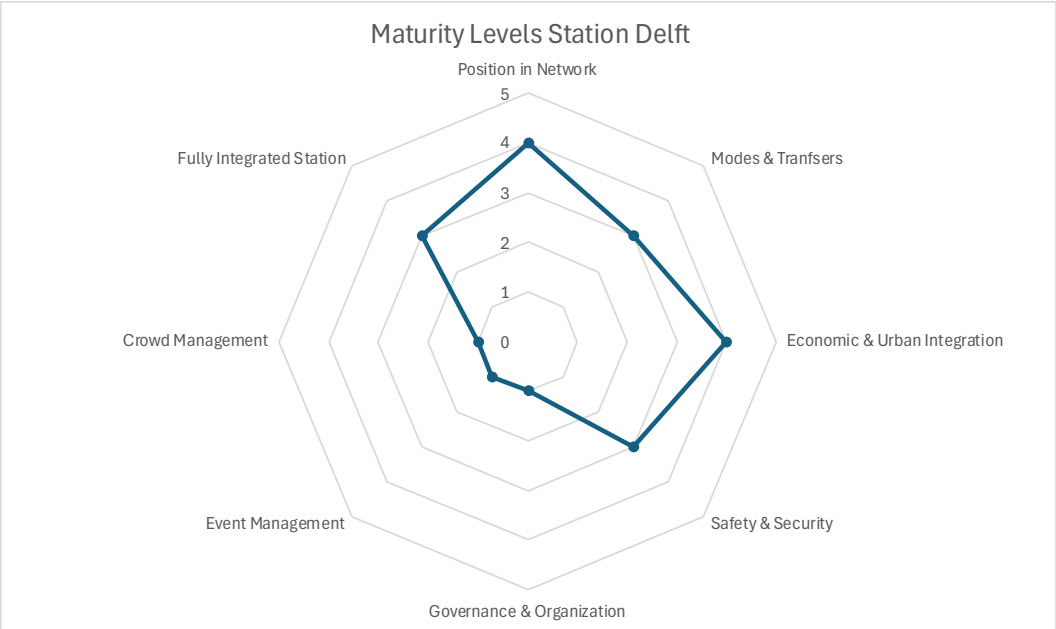



*Figure 62 - Tool applied to Delft Main Station*

## 10.3. Reproducibility of the research

The methodology of this thesis is structured in four coherent phases (Figure 1), ensuring that this approach is easily traceable and reproducible. The use of a 'multiple-case design with embedded units' by Robert Yin allows for the aspect replication without requiring complete in-depth data across international cases. This can therefore be applied to other multimodal hubs or complex transit nodes in an event-related context. In addition, returning to Phase 1 and therefore to ABAS itself, by using the triangulation of methods, the document analysis, a system decomposition and stakeholder interviews, the findings are grounded in the empirical research methodology. Moreover, the steps to design the tool are also reproducible, as the foundation lies in the CMMI maturity model, as well as providing hierarchical logic for the tool's checklist and the specified qualitative thresholds, which can be done by any researcher.

However, the reproducibility depends on the availability of documents and stakeholder access to more in-depth information. Even though the methodology is reproducible, the depth and insights of cases

depend on the local and political transparency, as well as the willingness to participate. Furthermore, even though the recurring patterns evolved in the tool, the author's analytical judgement was used to translate the insights from the discussed cases and their interviews into the maturity levels as described in this thesis. So, the overall process is traceable, structured and generic enough to be applied by other researchers who aim to benchmark transit nodes in event-related contexts or other similar socio-technical complex settings.

## 10.4. Main Research Questions

This thesis addressed to main research questions to tackle both the empirical complexity of Amsterdam Bijlmer ArenA Station and the design of a policy instrument. Below the two parts are stated with their respective main question. These are answered underneath them.

**Part A: Empirical and comparative Analysis (Phase 1 & 2):** *"How is the redevelopment of Amsterdam Bijlmer ArenA station approached in terms of integrated decision-making, and what lessons can be drawn from comparable international transit-nodes in event context?"*

The question is divided into two parts: the ABAS integrated decision-making part and the lessons from comparable cases in the event context. Firstly, the redevelopment of the ABAS is approached through a non-official, parallel MIRT methodology, currently nearing the 'Voorkeursbeslissing' (preference-decision). Within this process, there are diverging interests, with on one hand the municipality of Amsterdam and on the other hand the NS and ProRail. Here, Amsterdam pushes for expansion to accommodate residential growth and relieve the pressure on the station during events, while ProRail and NS prioritise the daily operational stability of the station. Concerning decision-making over this major infrastructure project, the Netherlands and its MIRT procedure are, even though very complicated, having little to moderate coordination challenges according to the literature and compared to other cases.

ABAS's uniqueness lies in its dual function, serving as a daily commuter hub and a crucial transit node during events. The management, coordination and decision-making during events is very effective through the Operational Mobility Centre (OMC). This centre synchronises logistics and manages crowds between transport operators, the municipality, emergency services and event venues.

Concerning the lessons learned from comparable cases, this thesis dives into eight transit hubs which provide 'embedded units' to evaluate a transit node in an event-related context. These cases show that successful event hubs are designed for a dual-state functionality or designed on the 'worst-case scenario' to cope with the big crowds, implementing physical design elements like a mezzanine level or crowd management tactics like 'stop-and-go'.

**Part B: Design and Application (Phases 3 & 4):** *"How can recurring aspects from international cases be systematically operationalised in a Comparison Tool, and how can this tool be implemented and applied to a complex multi-actor infrastructure project like ABAS?"*

The lessons are specified in eight embedded units, different aspects, based on mobility dimensions, governance and event logistics. All the lessons learned are operationalised through a checklist per aspects. The tool is based on the Capability Maturity Model Integration Framework. Based on the frequency of the recurring items, the framework follows a hierarchical logic. This logic ensures that before reaching a higher maturity in the tool, a station must pass both a quantitative threshold (total number of checks) and a qualitative threshold (critical check). This all results in a Comparison Tool that assesses stations across five maturity levels, using both quantitative and qualitative thresholds.

The Comparison Tool uses Radar Charts to visualise the maturity scores, allowing for benchmarking and comparing stations in a clear way with each other. For Amsterdam, this comparison resulted in recommendations about the general design of the station, as well as how to improve in the event scenario (these are stated in Chapter 8).

Regarding the implementation, this research concludes that the tool must function as a 'Boundary Object', to be effective in complex multi-actor projects like ABAS. It should be applied in the early phases of exploration in an infrastructure project. For example, the Exploration Phase (Verkenningsfase) of the MIRT. The implementation strategy requires a separation of stakeholders into a Policy Arena and an Analytical Arena. By comparing the maturity scores in the arena and inter-arena, the tool reveals misalignment in stakeholder perceptions. The difference in perceptions is demonstrated in the expert validation where governance scores varied significantly from the interpretation of the researcher. Therefore, the tool serves not only to rank stations on their performance, but to facilitate the dialogue which is required to bridge the gap between abstract policies and operational constraints.

However, further refinement is needed to increase standardisation of the tool (including more cases and more quantitative measures), and to reduce the subjective interpretation in the scoring. The tool is effective in structuring comparative analysis and identifying gaps in performance, but it requires more empirical testing across multiple cases to enhance reliability and generalisability.

# 11. Policy & Research Recommendations

This thesis has laid the fundamentals for a structured approach to evaluate and compare transit nodes in an event-related context. In addition, this research has come to recommendations for the Amsterdam Bijlmer ArenA case, (11.1) for other stations (11.2) and, there are several recommendations for further research to improve the robustness and applicability of the tool (11.3).

## 11.1. Recommendations for ABAS Case

The recommendations for ABAS are here simplified and categorised into immediate 'no-regret' measures and strategic long-term investments. Firstly, below the operational improvements that can be implemented relatively quickly to enhance safety and efficiency. These recommendations are policy-wise relative easier to implement, as it doesn't change the major physical structures of the area:

- Implement Crowd Control measures like the 'stop-and-go' tactics at the Johan Cruijff Boulevard.
- Install physical staff boxes to improve the communication during peak moments.
- Introduce 'event-boosted' transport options to Amsterdam or Utrecht Centraal.
- Use the MIRT Framework as a foundation for stakeholder alignment, rather than a harsh rulebook.
- Organise sessions with the proposed stakeholder arenas to validate the tool and the recommendations made in this thesis.

The following recommendations are focused on the long-term scale, as they often call for physical improvement which can be achieved through the infrastructure projects around ABAS. The long-term strategies to improve the station's performance towards a future-proof hub are:

- Develop a unified mezzanine level to streamline transfers and create buffer space, validate this through crowd-simulation techniques.
- Prioritize peak event capacity in design, to ensure the station remains resilient during the high-demand growth.
- Explore flexible 'dual-state' infrastructure, inspired by Rotterdam Stadionpark, to balance daily quality with event-peak demand.
- Encourage innovative design solutions with the use of the tool that overstep the standard cost-benefit analysis.

Furthermore, there are lessons which are not included in this recommendation. The empty checks of the checklist in the tool show many other lessons. For now, the recommendations listed above are the main ones, because these are elements which came across the stations more frequently.

## 11.2. General Recommendations for the other cases

The recommendations per case are described in Appendix I, but this paragraph will provide a small summary of some of the most common recommendations. Firstly, many transit-nodes could improve their connectivity by having direct airport links and more regional express lines, this would improve the hub's connection. Spatially, hubs must increase vertical capacity via escalators or elevators. Some nodes could improve their visibility and transfers by utilizing pedestrian bridges to overcome tracks as urban barriers.

Plenty of the other stations in this research could learn from better organization for infrastructure and especially for event management. A centralized coordination centre just like ABAS is very rare. The hot

links between transport operators, emergency services and the event operators are a major recommendation to implement. In addition, having more frequent evaluation moments for planning big events is crucial to have a good performing coherent system of events and transportation.

## 11.3. Future Research Implications

This paragraph consists of recommendations for future research and on how to improve the tool's credibility, validity and its implementation even more. Firstly, future studies could expand the tool and its checklists by incorporating more diverse cases, including non-European hubs or stations in countries that approach planning and event management very differently. This would potentially reveal new dimensions and test the currently identified aspects and maturity levels.

Moreover, integrating more quantitative performance indicators could strengthen the tool and its analytical potential. This integration would allow for more objective comparison and support more data-driven decision-making, beyond qualitative assessment.

A third recommendation is to test this tool better against real-world planning processes. Not only in the Netherlands, but also by validating the tool at different European transit nodes. Piloting this tool as boundary object in ongoing station redevelopment processes by researchers and/or experts would be interesting to find out how well this tool supports stakeholder dialogue and the decision-making arena in those specific contexts. The basis is made with the two different stakeholder arenas, however the specification per researched station could be improved.

Lastly, the broader applicability of the maturity approach could be tested. To different stations not in the event-context, just like Delft Station, or perhaps even wider infrastructure systems. These can include different mobility hubs or big events which take over the whole city in the case of Olympic Games or World Cups, which affect the whole transportation system of the city or region. The embedded case design can be used to offer a replicable methodology for comparative analysis in wider domains.

As a final remark, this thesis and the development of the Comparison Tool contribute to station and event management and its complex, integrated decision-making nature. The Tool provides a valuable overview to assess stations and their surroundings and identify lessons from other comparable cases. The primary takeaway from this research is that a station adjacent to a major event area can no longer be seen as a singular transit node, but as a dynamic system which is integrated in urban complexities. With the basic steps made for the tool as a Boundary Object, this tool can be very promising as a strategic aid in the landscape of urban mobility planning.

# 12. Reflection

In this part, I would like to reflect on the thesis, the methodology, the data collection approach, and the overall research process. While the methodology eventually worked out well, it initially was a complex puzzle to get everything into place.

First the reflection on the methodology, I initially planned for the research findings to lead the way, allowing for specific aspects and themes to emerge naturally from the data. However, as the study progressed, I realised that I needed a more systematic and structured approach to ensure the quality of the results, and especially to give direction to the interviews. I decided to make a conscious decision by integrating specific aspects from official documentation on Amsterdam and the relevant literature I studied. This change was necessary because my original plan was no longer feasible due to significant delays in the interviews planned. By using these existing aspects as a foundation, I was able to maintain a more structured academic approach despite the timing.

Furthermore, some cases had to be excluded from the research, as the data collection was a very challenging part of the research. Some cases provided insufficient information, or the parties involved were unwilling to participate in an interview. Although I was very proactive in following up on the leads I had, It was very unfortunate that they all fell through. Examples of the dropped stations include the Olympiastadion in Berlin, Westfalenpark in Dortmund and Stadion Narodowy in Warsaw. My main advice for future projects would be to start the recruitment of cases even earlier to account for these types of delays.

Regarding my role in this project. I feel that I showed a high level of ownership. I was particularly committed to ensuring that the research methodology was well-structured. Especially after the mid-term, where the Chair, Wijnand Veeneman, noted that my approach could not follow the rules of the complete case study. Therefore, I put in extra effort to research this, and I am happy that the framework of Robert Yin provided a good basis for my study. Furthermore, the rearrangement of the thesis project methodology also went more smoothly than I thought, which I told very early to both my supervisors at the university and the internship. After the main feedback moment, I realised I missed an important part of the thesis, the actual application. This ensured that the thesis got its final two parts, with a major extension of Chapter 8, how the tool must work as an instrument. I agreed with the examination committee that this was missing out, and I am happy to have included this.

My skills have developed significantly during this period. A highlight was conducting international interviews in Madrid and two in London, as well as an online interview in Stockholm. This was not only an interesting professional experience, but also very beneficial for my English language skills. In addition, the sense of being at a particular station and to feel what is happening there also helped to understand the case much better and therefore the progress of this thesis.

Overall, my time management was effective. I was able to maintain a good pace throughout the project. Although finishing up the cases later due to the interviews was quite disadvantageous, which had the consequence that the last month I had to work harder. Furthermore, I also benefited greatly from the guidance I received. I had regular and productive meetings with my supervisors from both the TU and VPRC (internship). Combining an academic perspective with the practical experience gained during my internship was a valuable addition to my thesis period.

# TPM AI Statement

WHILE PREPARING THIS WORK, I USED CHATGPT PRO AND GOOGLE GEMINI PRO TO BRAINSTORM IDEAS AND TO CREATE AN INITIAL GENERAL FLOW, FOR BOTH THE LITERATURE REVIEW AND THE OVERALL STRUCTURE. THESE TOOLS WERE NOT USED TO GENERATE SUBSTANTIVE ACADEMIC ARGUMENTS OR INTERPRETATIONS.

FURTHERMORE, I USED MICROSOFT TEAMS TRANSCRIPTS AND ITS AI IN COMBINATION WITH GOOGLE GEMINI PRO TO TRANSCRIBE AND SUMMARIZE THE CONDUCTED INTERVIEWS. GEMINI PRO AND CHATGPT PRO WERE ALSO USED AS A SUPPORT TOOL TO BRAINSTORM THE NAMES OF THE LEVELS OF THE COMPARISON TOOL, AND FOR EXPLORING POSSIBILITIES WITHIN THE WORK AND OPERATION OF THE TOOL.

IN ADDITION, I USED GOOGLE GEMINI PRO SERVICES TO HELP STRUCTURE TEXT I WROTE. TO ADD ON THAT, I USED GRAMMARLY, DEEPL AND THE BUILT IN MICROSOFT AI TO IMPROVE LANGUAGE QUALITY AND CLARITY OF SENTENCES.

AFTER USING THESE TOOLS AND SERVICES, I CRITICALLY REVIEWED, EDITED AND VALIDATED ALL CONTENT. I TAKE FULL RESPONSIBILITY FOR THE FINAL CONTENT AND CONCLUSIONS PRESENTED IN THIS THESIS.

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# Appendix A: Methodology and questions

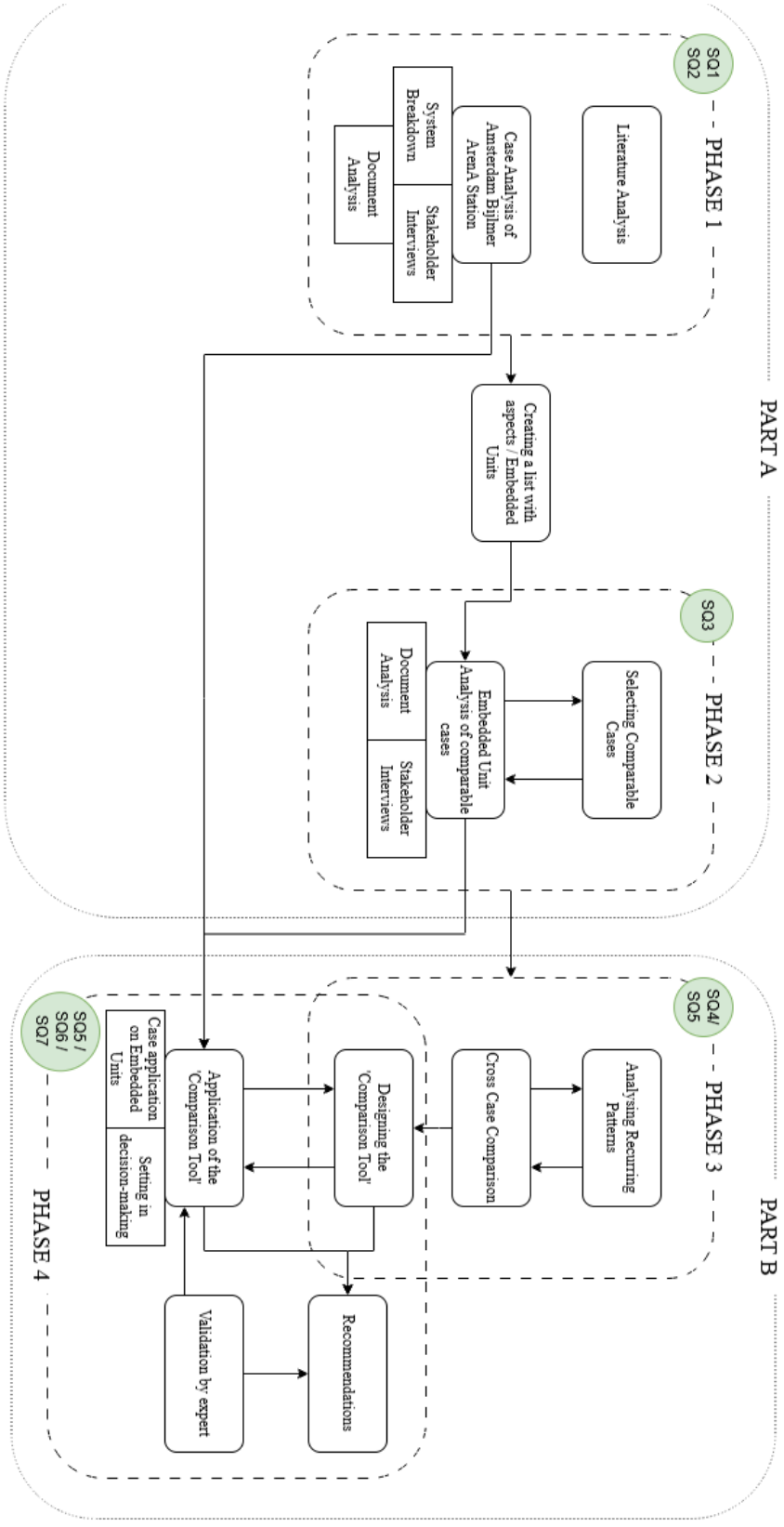



*Figure 63 - Methodology and corresponding questions*

The two main questions per part are:

**Part A: Empirical and comparative Analysis (Phase 1 & 2):** *"How is the redevelopment of Amsterdam Bijlmer ArenA station approached in terms of integrated decision-making, and what lessons can be drawn from comparable international transit-nodes in event context?"*

**Part B: Design and Application (Phases 3 & 4):** *"How can recurring aspects from international cases be systematically operationalised in a Comparison Tool, and how can this tool be implemented and applied to a complex multi-actor infrastructure project like ABAS?"*

The seven different sub-questions are:

1. How is integrated decision-making currently organized in the redevelopment process of ABAS?
2. How do all the systems at ABAS interact with each other and why does that make the area so unique?
3. Which international multimodal hubs adjacent to major event venues are most comparable to ABAS, and based on what criteria?
4. What are the recurring aspects and lessons that can be used in the cross-case comparison?
5. How can the identified aspects be operationalized into criteria that form the basis of a Comparison Tool?
6. How can the Comparison Tool serve as a strategic instrument for stakeholder dialogue in complex infrastructure projects?
7. What are the results of applying the Comparison Tool to ABAS and what recommendations and conclusions can be made for the ABAS redevelopment process?

# Appendix B: Venn diagrams

In this Appendix all the Venn diagrams are shown and all the sub-systems get an explanation and analysis next to the full graph.

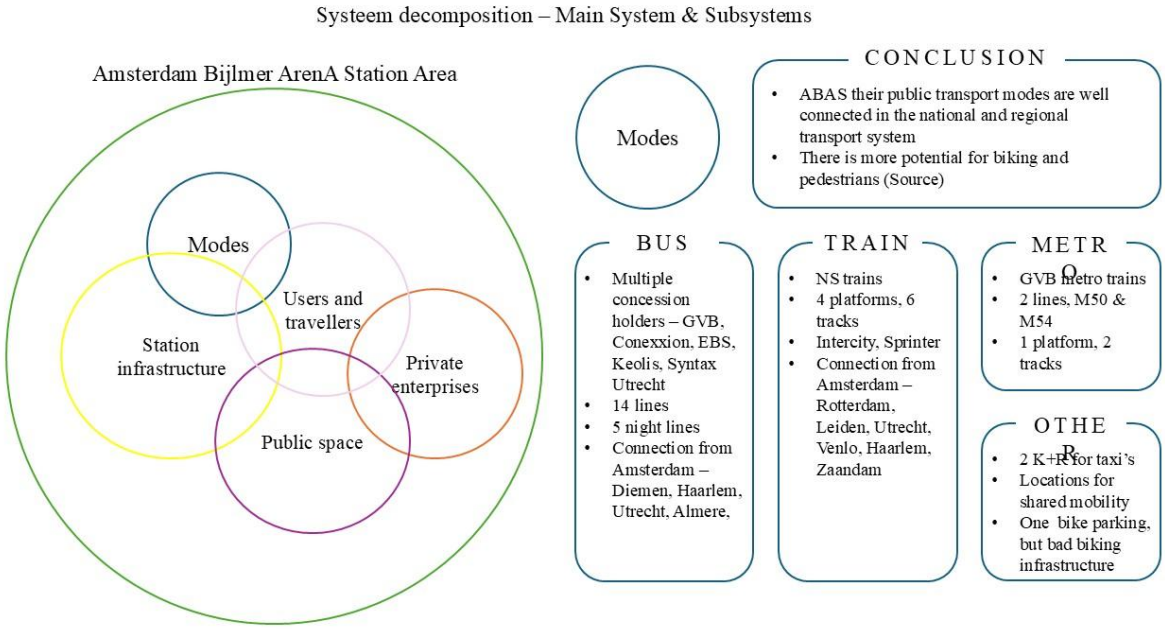



*Figure 64 - Venndiagram Modes explained in-depth*

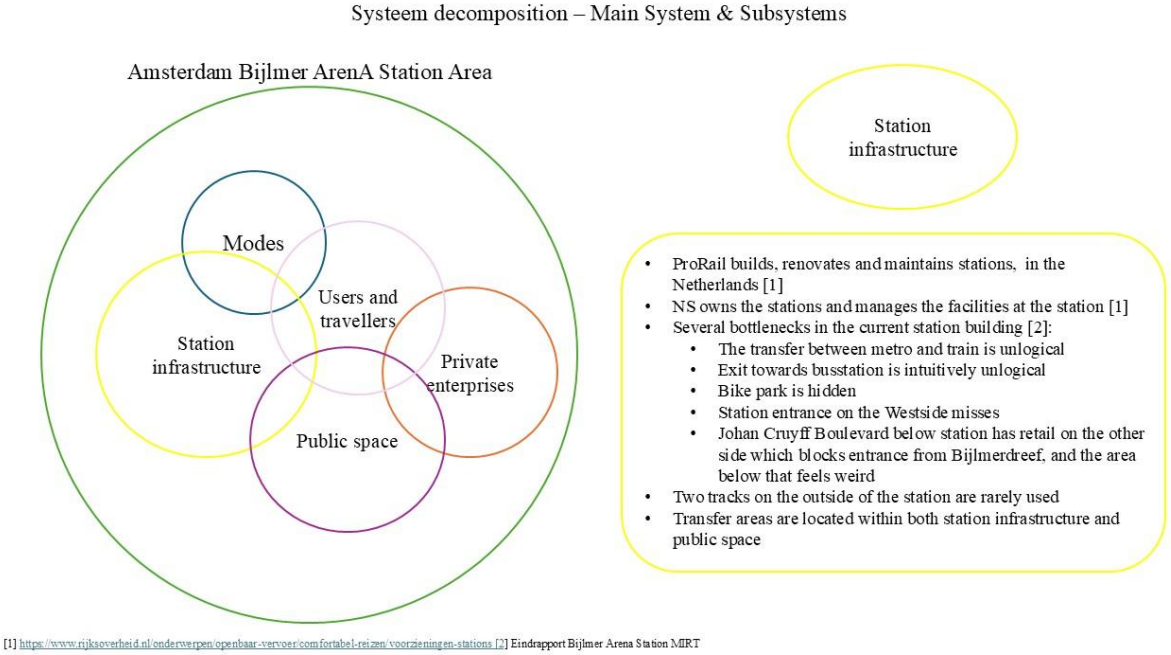



*Figure 65 Venndiagram Station Infrastructure explained in-depth*

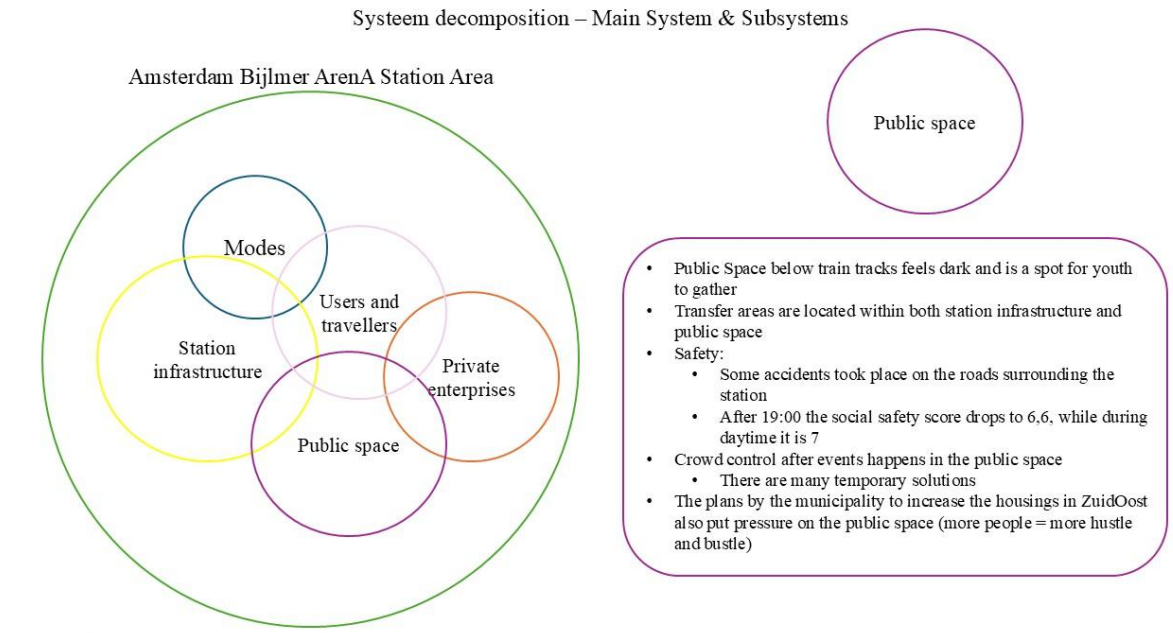



*Figure 66 - Venndiagram Users & Travellers explained in-depth*

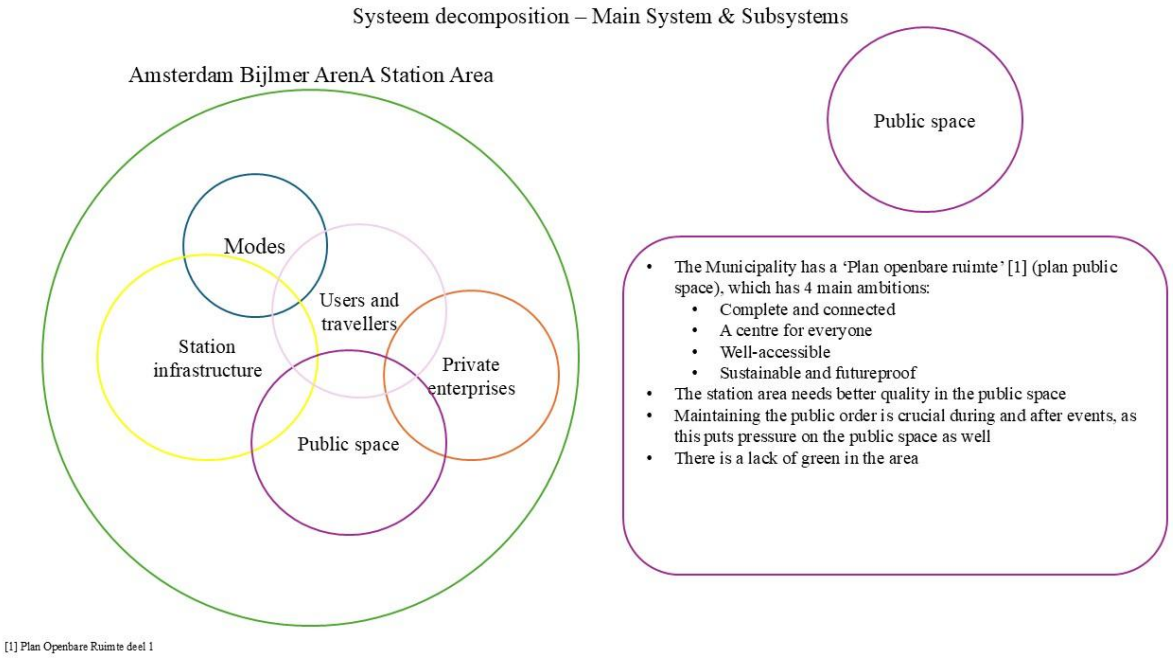



*Figure 67 - Venndiagram Public Space explained in-depth*

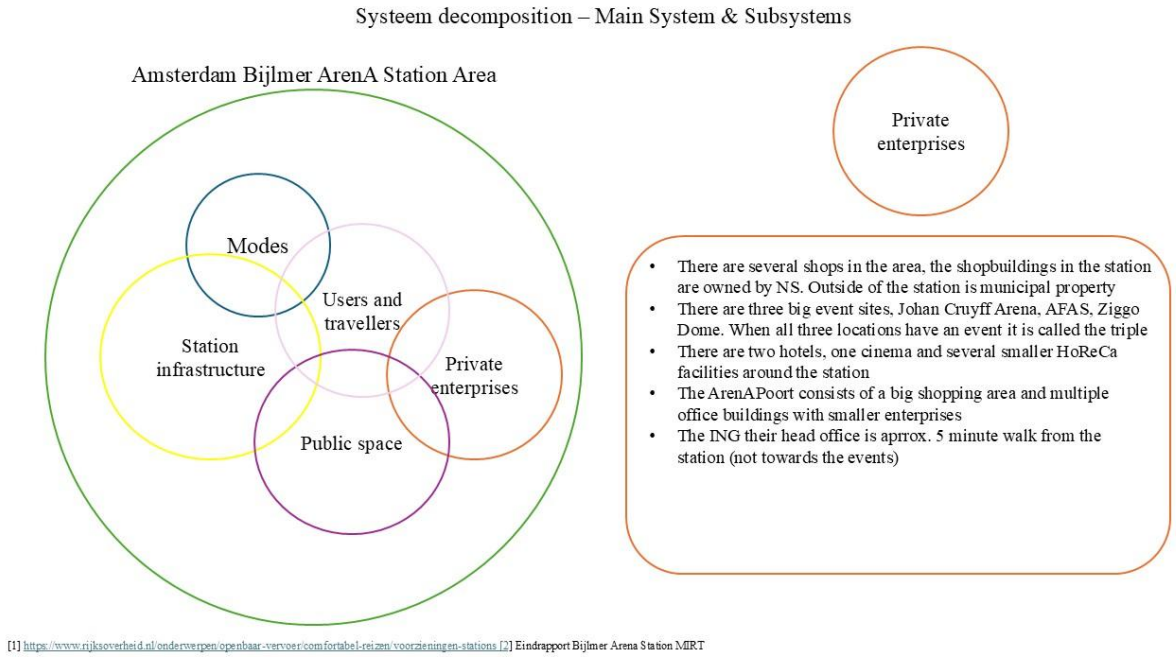



*Figure 68 - Venndiagram Private Enterprises explained in-depth*

# Appendix C: Interview summaries on ABAS

The interviews with people working on and around the ABAS were conducted on the 1st of December, 2025 with one projectmanagers of ProRail & 2 project managers of NS, the 2nd of December with a project manager within the Vervoerregio Amsterdam who deals with the project of ABAS and on the 9th of December with the crowd-control manager of the Municipality of Amsterdam. All the interviews were held in Dutch, hence the questions and answers remain in this language for total transparency.

## ProRail & NS

**Algemene vragen:**

- Welke internationale evenementen stations kennen jullie waar jullie van zouden willen leren, en waarom?
    - Fröttmaning in München kan mogelijk een interessant voorbeeld zijn.
    - Wembley Station wordt vaak genoemd als vergelijking
    - Contact met Ahoy mogelijk interessant over station Zuidplein.
    - Station Stadionpark is een interessant vergelijkingspunt binnen Nederland.
- Zijn er design principes van andere stations (Nederlands en Buitenlands) die jullie nu gebruiken voor ABAS?
    - Context nieuw station: ProRail en NS zelf geen nieuw station *willen*. Het is de Gemeente Amsterdam die ambities heeft voor woningbouw en een extra stationshal aan de busstation-zijde wil. ProRail/NS zijn sceptisch of een hal aan de zijde nuttig is voor de evenementenstromen.
      Er zit een verschil in de prognoses van de Gemeente Amsterdam en die van ProRail/NS. De hoeveelheid mensen en loopstromen worden anders benaderd in toekomstige scenaios. Voornamelijk de hoeveelheid mensen (capaciteit) in de toekomst wordt door de gemeente overschat.
      Het busstation heeft daadwerkelijk een capaciteitsprobleem, maar Bijlmer ArenA als instapstation voor treinverkeer, daar kan prima geaccomodeerd worden. Tijdens evenement situaties moet er echter wel 2x zoveel mensen geaccomodeerd worden.
      Het aantal uitstromende bezoekers bij een tripel zouden enorm moeten lopen naar een andere hal. Of dat effectief is, daar staan vraagtekens bij.

    - Design principes en dilemma: “Bij het plannen van een design denk je anders over situaties en scenarios na” ~ NS
        - *Evenement*: Reizigers moeten gecentreerd op één plek kunnen ‘bufferen’ (wachtruimtes). Het belangrijkste principe is dat stromen van ‘evenementreizigers’ zo vroeg mogelijk gescheiden worden (bijv richting Amsterdam of Utrecht) buiten het station.
        - *Regulier*: Er is een dagelijkse in en uitstroom aan ‘normale’ reizigers
        - Risico: “Het risico van het ontwerpen van een station is dat het voor beide situaties ‘net niks’ krijgt” ~NS

**Positie in netwerk:**

- Gaat het station een andere rol spelen in de toekomst in het regionale en nationale netwerk? En op welke manier?
    - De positie in het netwerk wijzigt niet zo veel, omdat de stationslocaties en spoorlijnen vastliggen.
      De rol daarentegen wel. Deze verandert omdat door de woning bouw meer reguliere bezoekers gebruik gaan maken van het station.
- Op welke manier kan het statoin 2 vormen aan kan nemen: piek capacitieit tijdens evenementen, en een normale vorm? En heeft vooral met de capaciteit van de trein te maken of met iets anders?
    - **"**Dit is een balanceeract" ~ NS. Het ontwerp van het station is voornamelijk gericht op de dagelijkse situatie, maar het moet ook functioneren tijdens de grofweg 20 grote evenementen per jaar. Dat betekent dat het een scheve verhouding is, waar we meer dan 300 dagen per jaar 'geen probleem' hebben, maar bij 20 dagen is het erg druk.

**Geografische locatie:**

- Hoe kan het station een toevoeging geven aan 'sponszones' tijdens evenementen? (Term uitleggen: op kunnen blazen als het moet, maar kleiner worden als dat het toelaat)
    - In de huidige situatie vervult de ArenA Boulevard die functie van 'sponszones' en van verblijfsgebied. Tijdens evenement situaties zien wij dit als 'de wachtrij'. Om daarbij nog aan te vullen op waar we het eerder over hadden: een van de bezwaren bij de huidige 2e entree, waar ga je de evenementen bezoekers opvangen?
        - Voor een beperkte groep zal het verschil maken als zij kunnen wachten in het gebied, verder verwachten wij dat mensen erg graag naar huis willen als de evenementen rond 23:00 zijn afgelopen.
    - Het liefst willen we een regelgeving invoeren dat de reizigers dus nog eerder worden voorgesorteerd in de juiste rij voor het station. We begrijpen wat de gemeente zegt, maar er gaat géén enorme betonnen vlakte komen waar er niks van gemaakt wordt, op evenementen na. De dagen dat er geen evenementen zijn, moet het natuurlijk gewoon een aantrekkelijk gebied zijn.
    - ProRail vult aan: "Het zou mooi zijn als de gebiedsontwikkeling die Amsterdam inzet natuurlijk bij kan dragen aan meer locaties die voor deze opvang zorgen. Al zal dit natuurlijk voornamelijk voor de mensen zijn die in regio Amsterdam erna blijven en tussen 12 en 1 's nachts nog de trein of metro kunnen halen. Dan is het ook rustiger op het station. Voor mensen die verder weg wonen, is dit geen optie."

**Safety & Security:**

- Welke structurele en fysieke aspecten nemen jullie mee voor het ontwerp van het nieuwe station? Welke zijn er nu en welke willen jullie in de toekomst hier hebben? En waarom?
    - Fysieke elementen zijn voornamelijk de barrieres MOJO barriers, waarmee mensen kunnen doseren. De metro heeft dan wel eens een paar lintjes gespannen. De fysieke ingegrepen zijn voornamelijk buiten het station.
    - Buiten evenementen om, dan moet iedereen zelfredzaam zijn. Dan is een fysieke element de OV incheck poortjes.
- Welke operationele ingrepen worden nu gebruikt om de veiligheid te waarborgen tijdens evenementen?

    - Afhankelijk van de situatie kunnen de poortjes open gezet worden. Verder worden mensen op straat met luidsprekers, borden, veel mensen ingezet. Dat zijn alleen al 70 mensen vanuit NS/ProRail.
    - De beste crowd control en daarom veiligheidsmaatregel is zorgen voor voldoende afvoercapaciteit (treinen), zodat het perron niet te vol raakt. Het laten wegrijden van lege treinen kost veel geld. Het aanpassen van de hele treindienst is veel werk, dat is veel handwerk en veel afwegingsmomenten.
- Wat zijn tijdens evenementen de meest kritieke punten als het gaat om de veiligheid?
    - Perron mag niet te druk worden, brandveiligheidsaspecten.

**Event management:**

- Welke organisaties en instituties zijn betrokken bij de governance van evenementen? Hoe gaat de samenwerking tussen deze partijen? EN welke rol neemt ProRail/NS aan tijdens evenementen?
    - Tijdens grote evenementen (Triples) zitten alle partijen aan de OMC, het Operationeel Mobiliteitscentrum). Alle partijen zitten daar samen, omdat alle verschillende beslissingen invloed op elkaar hebben, als er opeens een storing is, dan heeft dat direct invloed op de openbare ruimte. Ze zitten fysiek bij elkaar om direct te kunnen schalen.
        - Alle partijen = NS, ProRail, GVB, Politie, Gemeente, Venues
    - Daarnaast fungeren de NS en ProRail als vervoerder en stationsbeheerder. We moeten het landelijk belang (dienstregeling elders) afwegen tegen het lokale belang (Bijlmer).
    - Verder zit er dus namens ons eens contact persoon richting de andere organistaies. Organisatorisch gaat er heel veel aan evenementen vooraf. Bijvoorbeeld door covnenantnen. De NS kijkt dan meer landelijk, als er bijvoorbeeld een GrandPrix is bij Zandvoort, dan kan de Bijlmer daar niet op rekenen. Spoorse partijen blijven naar landelijk geheel.
- Wat zou volgens de NS & ProRail beter georganiseerd kunnen worden rondom events?
    - Planning van de andere evenementen locaties qua afstemming. Hier is sprake van veel conflicterende belangen, namelijk het Maatschappelijk publiek belang tegen het Commercieel belang.
        - *Onderhoud:* Die van het spoor wordt al lang van te voren gepland, als die samen valt met een tripel dan is er een grote uitdaging op operationeel gebied van het station. Wij moeten rekening houden met aannemers, want die zijn zwaar onder bezet. Plan zulke evenementen daarom niet op deze dagen.
        - *Commercieel:* Artiesten willen vaak later starten, zeker internationale artiesten. Dit komt door bijvoorbeeld lichtshows of horeca-omzet. Maar vanwege zulke late starttijden, zijn de eindtijden ook verplaatst. In de regel worden alle reizigers binnen reguliere dienstregeling tijden afgevoerd, en de NS zal er voor zorgen dat tussen 2230 en 2300 deze treinen gewoon op tijd tijden.
    - Je komt er niet onderuit dat verschillende partijen stuk voor stuk conflicterende meningen hebben, maar dit is wel een belangrijk aangrijpingspunt volgens NS & ProRail.

**Crowd management:**

- Zijn er zogenaamde bottleneck punten aan mensenstromen tijdens evenementen? Hoe zijn jullie van plan deze te verhelpen in de toekomst of tijdens grootschalige evenementen?

    - Er is maar 1 plek waar je naar omhoog kant, en dat is cruciaal voor de doorstroom. Ook vooral de trappen naar spoor 6-7 richting Utrecht zijn maatgevend.
- Wat zijn de overwegingen om de noodtrappen aan de noordoost kant van het station wel/niet open te gooien tijdens evenementen?
    - Deze trappen zijn natuurlijk in normale situaties echt alleen een noodtrap, maar kunnen tijdens grote evenementen open gezet. Hierdoor kunnen reizigers beter verspreid worden over de volledige lengte van de trein (300m), waardoor de capaciteit beter benut wordt. Er zijn proeven geweest met meerdere perrons open zetten en ook de noodtrappen daarvan, dit zijn nog geen standaard procedures
- Hoe kunnen deze bevindingen in de toekomst meegenomen worden?
    - De trappen werken goed. De trappen moeten per evenement bekeken worden, zoals aangegeven richting Utrecht ligt de maatgevende bottleneck. Als er veel internationaal publiek op een evenement afkomt, dan slapen ze richting Amsterdam. Het ligt dus aan het publiek.
    - Daarnaast is het de vraag of de evenementen vaker gaan samen vallen of niet. Dan wordt het belangrijk om naar de volledige modal split te gaan kijken..
- Hoe wordt op dit moment de mensenmassa gedistribueerd en komt daar verandering in de toekomst?
    - De wachtruimte is niet meer in het station zelf, maar met name buiten. Er zit dan een soort logica in om loopstromen te verdelen. We proberen hierdoor zo vroeg mogelijk de keuze bij de mensen te laten maken, zodat de stromen buiten worden verdeeld.
    - Of daar verandering in komt? In het huidige concept, heb je globaal 3 reisrichtingen, spoor 6-8 Utrecht en verder, 4-5 metro, 1-3 trein naar Amsterdam. Dat is de splitsing die nu gemaakt wordt.
- Hoe verandert het informatie aanbod tijdens evenementen? Of zijn er standaarden waar jullie aan houden (borden, wayfinding, schermen etc.)?
    - Er worden nieuwe vaste schermen aan de spoorbak gehangen en daarop gaan de 3 fases geprojecteerd worden. Op deze manier kunnen mensen op de JC Boulevard al goed zien waar ze heen moeten. Daarnaast zijn er tekstkarren rondom het station te vinden. Verder zijn er dus ook luidsprekers aanwezig die groepen mensen kunnen sturen. Buiten de evenementen om, dan zullen de schermen voornamelijk op zwart staan en afhankelijk van de situatie kan er andere informatie weergegeven worden.
    - Het is nu wel zo, dat iedere keer als er een evenement is, dat er tijdelijke maatregelen zijn, en we willen nu toe gaan werken naar vaste maatregelen. Op deze manier wordt het allemaal een veel robuuster systeem (zonder grote aanpassingen van het station te doen).
- Maken jullie gebruik van crowd simulation technieken en komen daar interessante bevindingen uit?
    - Nee gebruiken ze niet. Ze kijken naar reallife stromen.

**Vervoersmiddelen:**

- Hoe werken jullie samen met de GVB over het metroperron? Levert dit vooral veel opstoppingen op in de samenwerking voor het nieuwe station?
    - Beheer en onderhoud van de hal is op gelijk niveau. De samenwerking is niet anders dan bij andere stations. Twee vervoerders waar afspraken mee worden gemaakt en aan beide vervoerders lever je een functionerend station. En alle stations in Nederland worden dan aangepakt.
        - ProRail zijnde faciliteert de in en uitcheck en het maakt niet uit welke vervoerder er is.
        - ‘’Bijlmer is in die manier niet bijzonder”

- Hoe denken jullie dat de integratie met de metro verbeterd kan worden?
    - Als de metro reiziger wil overstappen, moet die een lange afstand omlaag en omhoog. Zou er een tussen overstap mee gewerkt te worden. Op de langetermijnvisie wordt hier gekeken naar hoe je een soort 'tussenoverstapniveau' kan krijgen om minder hoogte te overbruggen. Echter gaat dit hoogstwaarschijnlijk een erg dure verbetering zijn.

**Multimodaliteit:**

- Wat is jullie aandeel in het verbeteren van de kwaliteit van het overstappen?
    - De sporen liggen bouwkundig heel hoog en dat zorgt ervoor dat de overstap. Onze visie is om dit echt pas op lange termijn aan te pakken, want het kost veel geld. Ook kan er gekeken worden naar hoe je op een andere manier kan overstappen, maar zoals aangegeven is dit een plan van aanpak in de toekomst.

**Governance en organisatie:**

- Hoe is de interne besluitvorming gestructureerd omtrent Amsterdam Bijlmer ArenA?
    - Hoe dragen jullie dit af naar de besprekingen bij MIRT processen?
    - In hoeverre doen jullie de besluitvorming samen met elkaar? Hebben jullie dezelfde doelen en belangen daarin?
- Wat is de gemiddelde doorlooptijd van de besluitvorming? En wat vind je van deze doorlooptijd zelf (lang, logisch, te kort)?
    - Het besluitvormingsproces is best ingewikkeld en dat duurt best lang. Met recente besluitvorming vanuit het ministerie is het er niet makkelijker op geworden. Ze koppelen vooral veel geld aan woningbouw, en dat is de verantwoordelijkheid van de gemeente. Als het station dan een aanpassing moet hebben, dan ligt het geld eerst bij de gemeente. Dat maakt het wel complex, want het station an sich is voor de woningbouw prima.
    - Hierdoor merk je wel dat er verschillende inzichten zijn → de gemeente een nieuwe hal voor de woningbouw; NS&Prorail zien daar voor de huidige reizigersstromen en evenementen minder het nu in.
- Welke samenwerkingen/processen zijn bijvoorbeeld erg bepalend / vertragend?
    - Werken aan stations zijn gewoon een hele hoop stakeholders. ProRail moet heel veel inplannen. Je bent pas laat aan de beurt door de schaarste van aannemers.
- Zijn er belemmeringen vanuit de spoorse kant die partijen vaak over het hoofd zien bij projecten als deze? En hoe zorgen jullie er voor dat iedereen jullie keuzes en meningen hierin begrijpt?
    - ProRail is de enige die mag bouwen aan de hoofd spoorweg infrastructuur. Daar heeft ProRail 2-3 jaar voor nodig. Planvorming moet al heel lang daarvoor af zijn. De belangen en de manier waar van ProRail vindt.

**Afsluitende vragen**

- Hoe zou je ABAS herontwerpen als je het volledig vanaf het begin/maaiveld mag doen? Wat is iets wat er absoluut zou veranderen?
    - ProRail: Wat er op dit station gebeurd is, IS dat het is ontworpen voordat de poortjes bestonden. Daarom zou ik de poortjes integreren in de vervoersmiddelen. Daarnaast is en station dat uit zichzelf en zonder alle maatregelen kan inspelen op de evenementenstromen een mooi iets als het station vanaf het begin herontworpen mag worden. Als laatste ook de schuine boulevard ook anders ontwerpen, de schuine ligging zorgt voor een rare toestroom wat niet ideaal is.

NS: Voor de reguliere situatie hoeft er wat ons betreft niet direct wat veranderd te worden. Het station functioneert goed en wordt door de reizigers goed gewaarderd.
In evenementensituatie zou het helpen als reizigers zich meer natuurlijk over de juiste entrees verdelen, afhankelijk van hun bestemming. Daarnaast zou het helpen om oplossingen te maken om stijgpuntcapaciteit en spreiding over het perron te vergroten. Dit is een ontwerpopgave die ook weer andere uitdagingen met zich meebrengt dus hier is nu niet 1 ‘juist’ antwoord op.

# Vervoerregio Amsterdam

**Algemene vragen:**

- Welke internationale evenementen stations kennen jullie waar jullie van zouden willen leren, en waarom?
    - persoon kent geen specifiek voorbeeld om van te leren, hoewel persoon er wel een aantal heeft bezocht. Elk voorbeeld waar iets van te leren valt is mooi meegenomen, maar er is geen "gouden standaard" die ze volgen. "Geen enkele casus is hetzelfde"
- Werken jullie op het gebied van verkenning voor zulke projecten wel eens samen met andere vervoerregio's?
    - Er zijn niet veel andere vervoerregio's, alleen MRDH. Wel is er contact met provincies en andere grote steden.
      Per project wordt dit ook wel eens afgestemd. Het is niet georganiseerd. Voor ABAS is dit niet specifiek gedaan. In Nederland is alles goed georganiseerd en op elkaar afgestemd. Er vindt afstemming en leren plaats.
    - Wel is er kruisbestuiving met andere soort projecten, geen stationsproject: een brugproject, werken samen met gemeente Rotterdam. Het is belangrijk om aan te geven dat geen enkele casus hetzelfde is.

**Positie in netwerk:**

- Gaat het station een andere rol spelen in de toekomst van het regionale en nationale netwerk? En op welke manier? En valt dit binnen de regionale mobiliteitsstrategie?
    - De positie van ABAS gaat niet zo zeer veranderen. Er zijn geen andere plannen voor treinlopen, al verschuift treinverkeer langzaam wat meer van centraal naar Zuid, wel/niet met stop op de Bijlmer.
    - Regionaal is ABAS erg belangrijk voor omliggende gemeente, zeker tussen Schiphol in de Haarlemmermeer. Er is meer groei geweest van snelle / metrobussen. De groei en druk zit hem vooral op het busstation. Bij ABAS specifiek veel woningbouw, wat die extra stromen op het station gaat geven. Hierdoor zullen de dag momenten nog drukker worden.
    - De toekomstvisie wordt nu gemaakt, met als vraag hoe kan het station toekomstbestendig blijven? Het treinstation functioneert namelijk goed. Het overstappen kan beter, maar de uitbreiding zit echt bij de bus en fiets.
- Wordt het station zo gebouwd dat het 2 vormen aan kan nemen: piek capacitieit tijdens evenementen, en een normale vorm?
    - Idealiter wel, het moeilijke is, is dat het een goed station is. Financiering is veel meer een vraagstuk. Als er geld is, dan kan er van alles gebeuren en als er geen geld is, dan kan niets gebeuren. De VRA heeft weinig middelen, maar zou dolgraag willen. Bus en metro zijn heel interessant, maar trein niet zo veel aan te doen. Vanuit het Rijk zal er dan meer bij moeten komen.
    - Als je iets moet doen, dan is het echt een vrij forse ingreep. Daar is nu nog geen geld voor.

- Hoe bepaalt de VRA prioriteiten bij investeringen in stations en andere OV knooppunten? Waar staat ABAS op jullie prioriteitenlijstje op dit moment?
    - Eigenlijk aan de voorkant wordt er niet geprioriteerd (“geen top 5 lijstje”), elke opgave pakken we op. De prikkel die zij kunnen uitdelen, het geld, die wordt wel op basis van belangen uitgedeeld. Deze belangen zijn bijvoorbeeld wel stations waar meerdere modaliteiten samen komen en locaties waar verstedelijking komt bovendrijven.
      Zon ABAS heeft veel punten van aanpak, en dan kan er fors op ingezet worden. Maar het is bijvoorbeeld wel even belangrijk als een Zuid of Schiphol.
    - Er wordt aan Duivendrecht en Purmerend gewerkt. Amsterdam Zuid ligt bijvoorbeeld niet in de weg, in tegendeel, ABAS is gewoon een heel belangrijk station. Dus alle knooppunten zijn voor de VRA van hetzelfde niveau.

**Geografische locatie:**

- Hoe belangrijk is de rol van stations zoals ABAS in de bredere regionale economie? En van ABAS specifiek?
    - De VRA hanteert gebiedstypologien; Metropolitaan of hoogstedelijk/laagstedelijk maar geeft geen specifieke waardering aan stations. Het is vooral belangrijk om te kijken welke rol een station vervult.
      ABAS is een economisch belangrijk station, waar ook veel studie- en evenementgelegenheden omheen liggen. Ieder station wel zijn eigen aspecten die vraagstelling interessant maken. De pendel van woon-werk/woon-school zijn daarin belangrijk voor de vervoersvraag waarop die economisch en geografisch worden behandeld.
- Het station wordt nu gezien als een barrière tussen de twee stadsdelen, hoe willen jullie dit aanpakken?
    - Op dit moment kan persoon zich daar weinig bij voorstellen, veel andere aspecten zijn een grotere barrière dan het station. Het station is open en transparant, de barrière wordt eerder gevormd door de bebouwing erachter (Hoekenrodeplein) en het feit dat het gebied een grote bouwput is. Met toekomstige woningbouw aan de andere kant, kan de barrière werking veranderen.
- Hoe kan het station een toevoeging geven aan ‘sponszones’ tijdens evenementen?
    - Het doel is vooral het activeren van de Johan Cruyff boulevard, het plein en de passage van het station, zodat hier mensen wat meer op een prettige manier kunnen wachten en verblijven.
      ‘Wachten’ tot het station in kan, ‘afwachten ‘totdat je kan blijven tot het rustiger is.
      Huidige situatie: Als evenementen zijn geweest, wordt alles dicht gegooid en wordt je zowat de trein in geduwd. Al is het maar een half uurtje, dat je even kan afwachten en dat is op dit moment onvoldoende.

Wensbeeld: Plekken creëren (horeca, leuke wachtvoorzieningen) waar men 30+ minuten kan verblijven om de piek te spreiden. Bijvoorbeeld het deel vastgoed van de GameHal kan daarin beter geëxploiteerd worden. Dit kan lastig zijn, omdat voetbalsupporters zich niet altijd leent, door de bui en gedrag, om gezellig op een plek te blijven.

- Je ontkomt er niet aan om het beter en fijner te maken om mensen er langer te laten blijven.

**Safety & Security:**

- Wat ziet de VRA als de belangrijkste veiligheidsuitdagingen rond grote knooppunten als de ABAS?
    - Tegenwoordig ligt sociale veiligheid onder een vergrootglas, zeker in deze omgeving. Dat is een hele belangrijke opgave, vooral vrouwen en kinderen. Tijdens evenementen maar ook op rustigere momenten.
      Het is ook een knooppunt waar veel verkeer op zit, dus hoe kan je langzaam verkeer over de bus corridors krijgen, met OV of met lichten. En op welke manier kan de uitstroom van het evenementengebied het veiligst gehouden worden.
      Voor andere partijen is het binnen het stationshal, maar voor de VRA ligt de rol ook echt bij bus en metro. Uitstroom is het treinspoor naar Utrecht waar de piek zit.
- Welke operationele ingrepen worden nu gebruikt om de veiligheid te waarborgen tijdens evenementen?
    - Een paar jaar geleden besloten om de hal rustiger te houden en daar draagt de BRA indirect aan bij, omdat de GVB mensen inzet en de VRA is de opdrachtgever. Er is een hele ambtelijke organisatie die evenementen en veiligheid plannen voor maakt en daar zit de VRA aan tafel. Hier is ook een convenant voor evenementveiligheid over.
- Hoe werken jullie samen met vervoerders en de gemeente om de veiligheid te verbeteren en te garanderen?
    - Vanuit het convenant, daar zitten de venues en de ontwikkelaars in, de vervoerders en de opdrachtgevers van de vervoerders. Hier proberen de partijen elkaar te vinden op infrastructurele aanpassingen. Het wensbeeld is dat je er wat samen van kan maken.
- Zit de VRA als ‘bemiddelaar’?
    - Nee, de VRA zit er niet als bemiddelaar, maar als verantwoordelijke/opdrachtgever voor het regionale OV en de veiligheid van personeel en reizigers. Zeker als opdrachtgever van bijna al het OV, metro en bus, moet volgens het huishoudboekje alles veilig en goed lopen. De VRA is hierin soms een beetje de vreemde eend in de bijt, maar wel voelen van verantwoordelijkheid, wel echt op gelijke schaal met de andere partijen.
- Dragen jullie bij aan de veiligheidsprotocollen en in welke mate?
    - Weet persoon niet. Als er nu een aangepast protocol moet komen, dan moet dat per instemming gedaan worden → inschatting.

**Event management:**

- Welke rol neemt de VRA in het voorbereiden en aansturen van evenement logistiek rond de ABAS?
    - Niet. Als het echt operationele vragen zijn, dan gaat dat via de GVB. Zitten niet op dat operationele vlak. De VRA zit meer op het strategische niveau (bv dmv de convenant).
- Hoe ervaart de VRA de samenwerking tussen alle partijen voor event management?

    - De laatste paar jaar is daar veel op ingezet om dat beter te maken. In het begin was het een autofeestje en gericht op parkeerplaatsen, de laatste jaren is de OV vraag daar goed bijgekomen, om zo meer mensen met OV te laten komen naar evenementen. Het wordt in de toekomst een sterk verstedelijk gebied met minder ruimte voor de auto.

- Wat zijn lessen van de afgelopen ~5 jaar omtrent evenementen die jullie meenemen tijdens evenementen management en het ontwerp van het station?
    - Jaren geleden niet goed met de uitstroom, soms raasden er wel eens goederentreinen door het station.
    - Er zijn situaties geweest dat er een treincrisis was, dat mensen in de ZiggoDome moesten overnachten. Geen treinverkeer omdat de GP van Zandvoort er was. Ook wel eens ongeregeldheden na Ajax. Al met al, veel momenten die lessen hebben opgeleverd. Vooral vanuit de NS zijn daar veel opdrachten en casussen gemaakt. Daardoor meer fuiken gekomen in het operationele systeem rondom evenementen.
- Wat zou volgens de VRA beter georganiseerd kunnen worden rondom events?
    - Er moet een betere spreiding van de uitstroom komen, zeker als de drie evenementen gebouwen binnen 15-30 minuten klaar zijn. Zeker dan, dan moet er meer afstemming of meer verblijfplaatsen komen waar mensen kunnen afwachten.

**Crowd management:**

- In hoeverre kan het netwerk oplossingen bieden om mensen massa's beter te handelen? Wat voor alternatieve routes zijn er beschikbaar en hoe kunnen die routes de mensen bereiken?
    - Dat is wel lastig, want er is maar één relevante spoorverbinding (richting Utrecht en Schiphol). Trein naar Amsterdam centrum of Noord Holland doen niet zo veel afwikkeling. Het enige ander station die echt een grote rol kan hebben is Duivendrecht, en daar zou flink in geïnvesteerd moeten worden in looproutes en pendels. Op dit moment is er 1 snelweg, 1 spoorlijn en 1 metro lijn. Het moet wel via deze manier.
- Hoe wordt op dit moment de mensenmassa gedistribueerd en komt daar verandering in bij het nieuwe ontwerp?
    - Scheiding van modaliteiten. Station wordt voor de hal verdeeld in stromen. Dagelijks wordt dit dus door NS gedaan.
      Waar ruimte zit, is het onderliggend wegennet naar en van het station, dat niet iedereen over de JCB moet lopen, dus eerder ook naar de bus, zodat niet alles langs Pathé gaat.
- Welke risico's ziet de VRA rond ABAS op de drukste momenten?
    - Kwetsbaarheid, als er toch eens iets aan stremming is. → zijn daar oplossingen voor? Is operationeel meer vanuit de NS.
- Hoe verandert het aanbod aan vervoer tijdens evenementen? Is dat iets waar aan te sleutelen valt?
    - Het verandert eigenlijk niet. De vervoerders zelf doen het wel goed, maar vooral hoeveel mensen er maximaal in de trein kunnen en bij de trein kunnen komen. Bij de trein is de bottleneck de ene opgang. Langere en meerdere treinen kan we, maar de verwerkingstijd zit hem in de opgangen.

Voor de metro gaat het opzich goed, alleen kan er iets meer gespreid worden als je station strandvliet extra kan inzetten. Mensen lopen niet zo ver door, dus eerste metrobakken zitten vol, maar andere blijven leeg. De bussen doen het qua capaciteit wel goed.
Er is daarnaast ook extra vraag en aanbod naar smart mobility, maar zou ook een touringcar hub kunnen worden, bv p&r.

**Vervoersmiddelen:**

- Op welke manier willen jullie fietsers en voetgangers integreren in het nieuwe ontwerp?
    - Bijlmer Station en de omgeving is werk-bestemmingsgebied. Historisch was het geen fietsgebied, maar dit verandert door de nieuwe woningbouw. De vraag naar modaliteiten op Bijlmer wordt heel groot.
      De fietsenstalling van 1600 plekken is te klein, dus daar moet ook wel veel meer bij. Prettigere fietsenstalling bij de venues, maar ook smart mobility hubs kunnen daar een betere rol spelen. Hoe kan bijvoorbeeld de route naar Amsterdam centrum prettiger gemaakt worden? Het is een vrij donker gebied. Op een grote schaalniveau moet er iets meer gebeuren, om de fiets echt aantrekkelijker te maken.
- Hoe werken jullie samen met de GVB, de NS en ProRail over het station? Hoe bevalt deze samenwerking? Zijn er opstoppingen tussen de partijen in de samenwerking voor het nieuwe station?
    - Opzich gaat dat goed. Merkt wel hoe de organisaties in zitten. Amsterdam zit er stevig in. Het is soms wel schakelen van wat je kan leveren, omdat VRA en NS/ProRail zo'n project als 'erbij' doen. Amsterdam kan soms iets rustiger aandoen. Infrastructuur aanpassen duurt gewoon lang, en zeker niet als genoeg geld is.

**Multimodaliteit:**

- Wat is jullie aandeel in het verbeteren van de kwaliteit van het overstappen? Hoe groot is bij jullie de noodzaak om dit aan te pakken?
    - De bekijkt de VRA vanuit de dagelijkse praktijk. Afstand van bus naar trein/station is hemelsbreed niet fijn, maar door de draaibeweging en de hoogte meters is dat niet normaal. Vanuit de verstelijking wel willen verbeteren, bijvoorbeeld met een tussen overstapje.
      De aansluiting tussen bus en fiets kan ook beter.
- Wat is jullie visie om de mobiliteit voor de multimodaliteit te verbeteren van het station? In hoeverre duwen jullie deze visie door aan de tekentafel?
    - Het voornaamste belang is op korte termijn een busplatform toe te voegen. Geld uittrekken om studies op het busstation te zitten. Dat is ook wat ten koste gegaan van de 'sponswerking'. Dat wordt in de komende jaren beter aangepakt. Een busstation met overstap is voornaamste doel, en dan zeker gericht op waar de nieuwe woningbouw zit.
- Zien jullie potentie om nog een modaliteit toe te voegen? Bijvoorbeeld een trambaan/lijn door de Bijlmer?
    - Nee tram niet, maar de metrobus komt er aan. Dat is een gekoppelde bus die autonoom kan rijden. Een lijn tussen Haarlem-Schiphol-Zuidoost.

Als het helemaal zelfrijdend is, dan moet hij een aparte baan hebben en anders hybride. Richting Amstelveen ligt de aparte baan wel. Hier wordt nog wel veel uitgezocht. Wat meer boemelbus van IJburg naar Amsterdam, soort snelle bus.

Er zit dusvVooral groei in het soort en type bus.

**Governance en organisatie:**

- In hoeverre doen jullie besluitvorming met de andere partijen samen?
    - Besluitvorming gaat in stuurgroepen, ambtelijk en bestuurlijk.
      Zo worden alle plannen en studies die stakeholders met elkaar uitwerken, allemaal op bestuurlijk niveau vastgelegd. Het beleid gebeurt op ambtelijk niveau.
- Wat is de gemiddelde doorlooptijd van de besluitvorming? En wat vind je van deze doorlooptijd zelf (lang, logisch, te kort)? Welke samenwerkingen/processen zijn bijvoorbeeld erg bepalend / vertragend?
    - Moeilijke vraag, want dat verschilt per casus. Bij ABAS gaat het heel langzaam en stroperig, maar dat komt door materie van de knoop en evenementen. Waarop je op het ene station altijd makkelijke keuzes kan maken, moet je hier altijd keuzes maken op 2 vlakken (dag en evenement). En de doorlooptijden van besluitvorming helpen daar niet bij, maar het ligt voornamelijk aan de overkoepelende complexiteit.
- Wat zijn typische bottlenecks die VRA in dit soort projecten mee maakt in de besluitvormingsprocessen? En welke zijn nu specifiek voor Amsterdam Bijlmer ArenA?
    - Belangen. Gemeente Amsterdam samenwerking op verkeer en vervoer, maar die hebben ook andere belangen. Al dat soort aspecten komen erbij om het complex te maken. En wat lastig is, dat NS/ProRail geen eigen geld hebben om hier in te verspijkeren, dus er zal altijd met het Rijk gedealt moeten worden om geld op te halen.
- Heeft VRA een bepaald ‘veto recht’ in besluitvorming?
    - Nee Veto is er niet. Maar wel een troefkaart en dat is financiering. Er kan veel geinvesteerd worden, met een busstation kan de VRA wel tussen de 50/70% van betalen, maar als er iets is in het ontwerp dat niet goedkomt, dan is er een soort ‘indirect veto’. VRA staat wel echt veel meer voor de samenwerking, dus wil dat eerder aanpakken.

**Afsluitende vraag**

- Hoe zou je ABAS herontwerpen als je het volledig vanaf het begin/maaiveld mag doen? Wat is iets wat er absoluut zou veranderen?
    - 2 dingen:
        - Extra trapopgangen, zeker op het Utrecht spoor
        - Iets meer vrije ruimte rondom het station, er kunnen nu gewoon veel dingen niet kwijt. Het is zo dichtgebouwd, dat er niet zoveel kan.
        - Overstap niveau tussen metro en trein

# Crowd-control Manager Municipality of Amsterdam

**Algemene vragen:**

- Van welke stations en stationsgebieden zou je willen leren?

De situatie bij Wembley. In tegenstelling tot Wembley, is het ArenA gebied uniek in NoordWest Europa, vanwege de enorme hoeveelheid parkeerplaatsetn rondom het station en het stadion. En dat terwijl er hier een station is die 3 verschillende richtingen bedient. Waar in Wembley dat maar grotendeels 1 richting is.

Nederland is daarnaast een echt 'regelland', er zit een verbruiksvergunning om die de maximale capaciteit in te overschrijden. Dat is iets wat knellend is en wat interessant is om te weten bij andere station.

- Zijn er evenementenclusters in Nederland waar jullie wel eens mee samen werken? En wat leren jullie hieruit?

De crowd-control manager heeft bij Ajax gewerkt, dus met alle eredivisie clubs samengewerkt. Van de 17 eredivisie clubs, zijn er 13 die vooral een lokaal publiek trekken. De grote stadions / clubs hebben veel meer mensen uit een bredere regio. De situaties zijn daardoor niet vaak vergelijkbaar met de schaal van de ArenA. Ze werken dus niet echt samen, omdat de situaties anders zijn.
Wel is noemenswaardig wat Amsterdam doet in het gebied, ze daarin koploper zijn. Er is namelijk een OMC (operationeel mobiliteit centrum) → dat is de key om het in goede banen te leiden. De crowd-control manager is hier de voorzitter, vanuit de gemeente. Er zit hier een man of 10/15 in de JCA die verantwoordelijk zijn voor de mobiliteit rondom het stadion. 2.5 uur voorafgaand aan een evenement monitoren ze de hele situatie. Daarin is dit uniek in Nederland.
Bij Ajax zijn het altijd dezelfde mensen die met het OV reizen, rond de 13.000 mensen die met het OV gaan, waarvan 40% metro.
Iedereen is binnen 45 minuten uit het gebied. Maar daarnaast 7-8k auto's in de buurt.
Door de tripel en Europese wedstrijden zijn er tot 20.000 mensen die met het OV rijden.

**Positie in netwerk:**

- Welke gevolgen heeft het transportnetwerk van Amsterdam als er evenementen zijn? Wordt er op evenementen gerekend met vervoer?

Er zijn zeker gevolgen, zo worden rond de tripels de frequentie van de metro's verhoogd. Er zijn dan altijd 3 metro's extra die klaar staan. Om de afvoer van het publiek sneller te laten lopen. De NS houdt er ook rekening mee, die zet vaak langere treinen in. Ook de Stoptrein naar Alkmaar die normaal gesproken niet stopt die stopt er nu wel.
De NS die zet 30 mensen in V&S (veiligheid en service) om alles in goede banen te leiden en bepalen ze vooraf ook of ze barrières gaan plaatsen of niet

- Op welke manier kan het station zo gevormd worden dat het 2 vormen aan kan nemen: piek capaciteit tijdens evenementen, en een normale vorm?

Volgens de gemeente is een fysieke aanpassing niet noodzakelijk. Tijdens normaal dagelijks gebruik lopen de in- en uitstroom gemoedelijk door elkaar heen. De grote uitstroompieken van evenementen (vaak rond 23:00 uur) worden probleemloos opgevangen door de reguliere dienstregeling, die van zichzelf al een zeer hoge frequentie heeft.

- Hoe is de afstemming met andere stations als er grootschalige evenementen zijn bij de Bijlmer?

De gemeente kijkt voornamelijk naar Duivendrecht en Amsterdam CS. Er is een verkeerscentrale vanuit de NS, die contact heeft met andere stations over heel Nederland. Daar bemoeit De crowd-control manager zich ook verder niet mee. NS en ProRail zijn autonome bedrijven en hebben zelf het contact met andere stations. Daar houden zij de contact over.  In de ogen van De crowd-control manager loopt dat bedrijfsmatig en daarom best prima.

**Geografische locatie:**

- Hoe wil de gemeente de integratie van de omgeving rond het station verbeteren?

Het gebied rondom het station was voorheen een kale vlakte, vergelijkbaar met een landingsbaan. Met de komst van AFAS Live, Ziggo Dome en nu de ontwikkeling van 40.000 nieuwe woningen, transformeert het gebied compleet . Het doel is om het gebied groener, leefbaarder en toekomstbestendiger te maken. Er komt een nieuwe parkeergarage en veel groenvoorzieningen . Dit levert wel een spanningsveld op: evenementen vinden slechts wekelijks plaats, terwijl bewoners en andere frequente gebruikers er dagelijks zijn. Meer bomen en parken kunnen echter conflicteren met de veiligheidseisen, zoals zichtlijnen voor camera's en aanrijroutes voor hulpdiensten en de ME

Al die ontwerpen voor voetgangers zijn nu bezig en in ontwikkeling voor het gebied, maar er zijn ook 10.000 auto’s te vervoeren. De wegen blijven nodig voor afvoer en bv ME en voor andere calamiteiten. Als deze allemaal door een park moeten lopen, of zigzaggen omdat het een mooi gebied moet zijn, dan is dat niet efficiënt en veilig.

- In hoeverre heb jij invloed op deze keuzes?

De crowd-control manager en zijn team worden aan de voorkant gevraagd om mee te denken. Ze zijn momenteel bezig met een 'lijnenspel': het afstemmen van zichtlijnen, looplijnen en bomenlijnen . De politie en hulpdiensten kijken hierin ook mee om de balans tussen leefbaarheid en veiligheid (safety & security) te bewaken.

- Als het een levendiger gebied wordt, gaan jullie ‘sponszones’ toevoegen in het gebied?

De maximale capaciteit van het station (de gebruiksvergunning) staat vast en verandert niet. De oplossing wordt gezocht in 'nudging' (sturing) en toegangscontrole om mensenstromen beter te reguleren. Daarnaast wordt er geëxperimenteerd met het inzetten van de noodtrappen om de perrons vanaf twee kanten te vullen en zo de capaciteit beter te benutten.

**Safety & Security:**

- Welke structurele en fysieke aspecten nemen jullie mee voor het ontwerp van het nieuwe station en het omliggende gebied? Welke zijn er nu en welke willen jullie in de toekomst hier hebben? En waarom?

Omdat station Duivendrecht vlakbij ligt, zal station Bijlmer niet fysiek uitgebreid worden met extra sporen . De focus ligt op het optimaal benutten van de bestaande capaciteit. Dit betekent zorgen dat essentiële voorzieningen zoals roltrappen en verlichting altijd werken om stagnatie te voorkomen. Daarnaast wordt er gewerkt met crowd barriers en schermen voor crowd control

- Welke operationele ingrepen worden nu gebruikt om de veiligheid te waarborgen tijdens evenementen?

De gebruiksvergunning is leidend; er mogen niet meer mensen in het station zijn dan toegestaan in verband met ontruimingsscenario's. Men zet sterk in op 'nudging': het op subtiele wijze verleiden van mensen om de juiste keuzes te maken, zoals wachten of een andere route nemen, zonder dwingend te zijn . Daarnaast is er de inzet van NS Veiligheid & Service medewerkers, politie en ME. De crowd-control manager benadrukt dat persoon incidenten (zoals vechtpartijen) liever buiten op straat heeft (openbare orde) dan in het station . Ook het tijdelijk sluiten van winkels helpt om de doorstroom te bevorderen.

- Wat zijn tijdens evenementen kritieke punten als het gaat om veiligheid?

Dat is altijd de uitstroom, de instroom loopt wel. Treinen en mensen komen vaak op tijd aan. Voorafgaand aan evenementen is alles netjes gereguleerd.
De uitstroom is een moment dat mensen gaan rennen. Het station gaat alle richtingen op en om 23:00 kom je niet meer heel ver, niet veel verder dan Eindhoven bijvoorbeeld. Mensen die dan nog gaan rennen en doen om zo ver mogelijk in het land te komen, dat zijn kritieke punten waar het mis kan gaan. Mensen willen ook altijd dringen. Er is al van alles geprobeerd om mensen langer in het gebied te houden, maar dat lukt gewoon niet.
Verder zijn er genoeg voorbeelden dat bij concerten dat computersystemen uitvallen en dat treinen niet kunnen rijden, dan kan de openbare orde overschreden worden.
De commercie neemt de overhand, vooral bij de voetbal. Ziggo Dome en AFAS ook een beetje.

- Hoe wordt het station en het gebied er om heen ingericht zodat het een fijn gebied is om te verblijven?

Dat is de struggle die ook een paar vragen terug werd benoemd. Het is d ekeuze tussen asfalt en geen bomen, dat is heel gechargeerd en daarin de beste modus te vinden.

<u>Overzicht en veiligheid vs. fijn verblijf dmv van bomen en bankjes etc.</u>
**Event management:**

- Wat zijn lessen van de afgelopen ~5 jaar omtrent evenementen die jullie meenemen tijdens evenementen management en het ontwerp van het station?

Er worden al langer dingen meegenomen. Er is een sterke overlegstructuur opgezet. Elke dinsdag is er het OZO (Operationeel Overleg Zuid Oost) met 30-35 partijen waarin een half jaar vooruit wordt gekeken en de afgelopen week wordt geëvalueerd. Daarnaast is er het TOZO (Tactisch Overleg) dat tot 3 jaar vooruitkijkt, en het 'Arena Portaal' waarin alle evenementen en werkzaamheden (ook aan het spoor) worden bijgehouden. Hierdoor kan er maanden van tevoren al geanticipeerd worden op bijvoorbeeld buitendienststellingen van de NS

- Welke organisaties en instituties zijn betrokken bij de governance van evenementen? Hoe gaat de samenwerking tussen deze partijen?

In het hele eventmanagement loopt dat goed, iedereen weet precies wie ze moeten bellen of moeten benaderen. Het is duidelijk wie er aan welke knoppen draait.
De crowd-control manager is voorzitter van het evenement mobiliteitscentrum. De crowd-control manager zit wel bij de meeste Ajax wedstrijden en tripels. De crowd-control manager is een verbinder en zorgt dat alle mensen in hun eigen omgeving en eigen wijze en eigen macht en rechten kan functioneren. De NS kan heel autonoom daar zitten, maar als het iedereen gaat treffen, dan moet de voorzitter daar beslissingen in maken. Het doel van de samenwerking bij de evenementen is voor iedereen de ‘customer journey’ zo goed mogelijk te laten lopen.

- Wat zou volgens de gemeente beter georganiseerd kunnen worden rondom events?

Op dit moment loopt het proces soepel omdat het een zelflerend systeem is. Door de wekelijkse evaluaties worden lessen direct in de praktijk gebracht voor het volgende evenement . Er wordt niet gewerkt met vaste draaiboeken, maar met maatwerk-draaiboeken per dag

**Crowd management:**

- Zijn er zogenaamde bottleneck punten aan mensenstromen tijdens evenementen? Hoe zijn jullie van plan deze te verhelpen in het ontwerp van het nieuwe station?

Een potentieel knelpunt is een grootschalige ontruiming, al is die situatie nog niet voorgekomen. Wel is de organisatie zo goed op elkaar ingespeeld dat bij de onlangs gestaakte wedstrijd direct kon worden opgeschaald met extra OV en communicatie . De fysieke bottleneck blijft de ingang van het station; niet iedereen past er tegelijk in. Dit wordt opgelost door te 'knijpen' bij de ingangen en mensen via schermen en borden te informeren (nudging) om even te wachten .

- Maken jullie gebruik van crowd simulation technieken en komen daar interessante bevindingen uit?

Ja daar wordt gebruik van gemaakt. Ook hoogover met ontruiming en hoe mensen lopen. Maar dat is wel testen tegen de best-practices. Want dat is niet altijd heel betrouwbaar.
Zo wordt er ook gespeeld met de zitbanken op de boulevard om die te ontmantelen en om meer loopruimte te krijgen.  Ook met de nieuwe woningbouw worden deze simulaties gebruikt. Andere interessante vragen worden ook gesimuleerd, zoals waar kunnen alle ME voertuigen en ambulances staan en nog steeds een goede doorstroom behouden? Ook qua auto's worden simulatieprocessen voor de parkeersituaties en stromen gedaan.
Hoewel simulaties niet altijd 100% overeenkomen met de werkelijkheid ("gevoel" speelt ook een rol), helpen ze wel bij beslissingen.

- Hoe wordt op dit moment de mensenmassa gedistribueerd naar het openbaar vervoer en komt daar verandering in?

Nudging en barrières. Op de korte termijn komt hier geen verandering in.

- Hoe verandert het informatie aanbod tijdens evenementen? Of zijn er standaarden waar jullie aan houden (borden, wayfinding, schermen etc.)?

Hier is in voorgaande vragen al antwoord op gegeven. De crowd-control manager voegt wel toe dat communicatie en belangrijk aspect blijft. Bijvoorbeeld door middel van de schermen. Hoe communiceer je met de mensenmenigte. Dat is enorm belangrijk.

**Vervoersmiddelen:**

- Hoe werken jullie samen met de vervoerders?

Via het OZO

- Wat vinden jullie van de integratie van alle vervoersmiddelen?

De crowd-control manager vindt de integratie goed, waarbij spreiding het sleutelwoord is. De capaciteit van de fietsenstalling is momenteel wel te klein. De gemeente zet in op deelmobiliteit

(scooters), waarbij gebruik wordt gemaakt van slimme 'geofencing' zodat scooters alleen op specifieke plekken geparkeerd kunnen worden en niet rondslingeren

**Multimodaliteit:**

- Wat is jullie aandeel in het verbeteren van de kwaliteit van het overstappen? Of houden jullie je daar niet mee bezig?

Dit ligt voornamelijk bij de spoorse partijen en de Vervoerregio. De gemeente wordt wel geïnformeerd, bijvoorbeeld over het ontvlechten van metrolijnen 51 en 53, wat nadelig kan zijn voor de directe verbinding, maar de beslissingsbevoegdheid ligt bij de vervoerders.

**Governance en organisatie:**

- Hoe werkt de samenwerking met stakeholders rondom evenementen? Hoe gaat het er aan toe in de controlroom? Zijn er hier nog belanghebbenden die een speciale rol hebben? Dus bijvoorbeeld heel sturend zijn in de wensen en eisen van het uiteindelijke ontwerp?

Iemand zitten vanuit sociale veiligheid, NS en ProRail. Die zijn autonoom. Die worden meegenomen bij alle calamiteiten. Er is niet iemand belangrijker dan de andere. Iedereen die is aangesloten voegt toe en draagt bij.

- Hoe werkt het besluitvormingsproces voor het nieuwe station en de omgeving?

Als gemeente zitten ze ook aan tafel, er zijn korte termijn en lange termijn maatregelen. Ook weer in die samenwerking, dan je aan de voorkant mee kan denken. Iedereen denkt mee. Je wordt goed op de hoogte gesteld. Maar ook met de venues. Je kan ook invloed uitoefenen op heel het proces.

- Wat is de gemiddelde doorlooptijd van de besluitvorming? En wat vind je van deze doorlooptijd zelf (lang, logisch, te kort)?

Gaat helemaal niet snel, duurt lang. Al die jaren bij Ajax gewerkt, daar gaat het om korte klappen, vrij platte organisatie.
Bij de gemeenten, NS en overheidsinstellingen duurt het allemaal wat trager. Heel veel partijen hebben wat over te zeggen, dat is goed, vele wetgevingsinstanties en partners waar je mee moet werken. Dat duurt lang, er wordt vooruitgekeken naar 2040, en dat is ook wel erg lang.
Korte termijnmaatregelen duurt ook lang, die nudging enzo kan ook lang duren. Iedereen moet er wat van vinden.

**Afsluitende vragen**

- Hoe zou je ABAS herontwerpen als je het volledig vanaf het begin/maaiveld mag doen? Wat is iets wat er absoluut zou veranderen?

Verder vanaf de Arena neerzetten. Met meer ingangen naar de juiste richtingen, niet alles vlak naast elkaar, maar meer spreiding. Busstation iets meer er van losgekoppeld.

# Appendix D: Interview Summary Rotterdam Stadionpark

This interview was conducted on the 11th of December, 2025 with a project manager of the Municipality of Rotterdam. This interview was conducted in Dutch and for transparency, the summary will be also in Dutch.

**Positie in netwerk:**

- Op dit moment is het een station dat enkel wordt geopend tijdens evenementen, maar het wordt een station die altijd gebruikt kan worden. Welke gevolgen verwachten jullie voor het station en het omliggende gebied?

Naast het station heeft ook de gebiedsontwikkeling veel invloed, er gebeurt van alles. Het is een station wat meerdere dingen gaat doen en betekenen. Er komt ook een nieuwe verbinding van langzaam verkeer. Waar je als voetganger dus gemakkelijk door heen kan lopen. Daarnaast komt er een nieuwe verbinding bij, er komt namelijk een nieuwe tramlijn van Kralingse Zoom naar Zuidplein. Verder loopt lijn 3 nu in de buurt van het station en die halte wordt verplaatst. Zodat deze beter bij het station ligt. Verder zal het station een betere aansluitingsknoop worden op het lokale fiets en busnetwerk.

- Welke rol gaat het station spelen binnen het lokale en het nationale netwerk?

Nationaal wordt het een sprinterstation. Er rijden meerdere sprinters, nu vooral die tussen Den Haag – Dordrecht en Rotterdam – Roosendaal, maar in de toekomst ook van de Oude Lijn.
Lokaal wordt het station een belangrijk knooppunt waar de bus, de tram, de fiets en ook voetgangers met elkaar verbonden worden.

- Hoe willen jullie het station toekomstbestendig maken? En wat zou je moeten doen om het toekomst bestendig te maken?

Dit wordt meegenomen door te kijken wat er ook nodig is om de sprong naar een intercity station te maken. Dit zijn bijvoorbeeld roltrappen in plaats van normale trappen. Het monitoren en voorspellen van de benodigde reizigers en platform capaciteit. Daarnaast ook hoe gemakkelijk er gewisseld kan worden tussen fiets parkeren en auto parkeren.

Er wordt gedimensioneerd naar de capaciteit van het station. Hier komt er een aparte evenementen toegang voor het station.
Daarnaast zal de traverse, de verbinding over het spoor, modulair gemaakt worden. Dat zijn stroken waarover gelopen kan worden van een meter of 8. Het is modulair, want er wordt gekeken naar de locatie waar relatief makkelijk een strook bij gemaakt kan worden als dat nodig is. Als dit gebeurt, dan wordt er een rij kolommen extra gebouwd te worden.

- Wordt het station zo gebouwd dat het 2 vormen aan kan nemen: piek capaciteit tijdens evenementen, en een normale vorm voor dagelijks gebruik?

Ja, de gedachte is nu om het station voor beide momenten te ontwerpen. Hier komt een evenementenhal buiten het spoorse gedeelte, waar genoeg ruimte is voor de poortjes. Hier zullen dan ook wachtruimtes en buffer ruimtes zijn, die noodzakelijk zijn tijdens evenementen.
Het is daarbij wel belangrijk om er voor te zorgen dat de evenementenentree ver genoeg is van de normale entree. De hoofd entree is op de kop van de perrons en de evenementen traverse ligt verder

weg dan de normale hoofd entree. Het wordt ook zo ingericht dat de treinen op een andere plek op het perron kunnen stoppen als dat gevraagd wordt bij evenementen.

**Geografische locatie:**

- Hoe is op dit moment de integratie van het station met De Kuip ingericht? En wat worden de belangrijkste veranderingen hierin? En waarom?

Er is nu alleen maar een evenementen uitgang. Die is wel gekoppeld voor een deel voor thuis en een deel voor uitsupporters. Het is zo gemaakt dat uitsupporters hun bussen kwijt kunnen, zodat zij gelijk met een aparte buis naar het station toe gaan.
In de toekomst komt hier verandering in: er komt een verandering in de positie van de traverse. De uitsupporters busvakken die gaan wat verplaatst worden. In het nieuwe ontwerp zal er meer ruimte voor die bussen zijn.

- Hoe wordt het station opgenomen in de stedelijke omgeving?

Op verschillende manieren: er is een west en oost kant.
Aan de west kant, daar loopt een route het park in, de trap hier wordt onderdeel van de nieuwbouw. Op de hoek van de nieuwbouw komt ook wat station commercie. Onder de trap komt gelijk de ruimte voor fiets parkeren.
Aan de andere kant, daar ligt een weg, en de traverse komt over de weg heen. Daar komt een stationsplein midden in de gebiedsontwikkeling.

- Wordt het station nu gezien als barrière tussen stadsdelen? Willen jullie dat voorkomen of zo houden?

Het spoor zelf is de barrière, juist niet het station. Het station is nu alleen aan de oostkant ontsloten. Het spoor is de barrière. Het station is een middel om de barrière op te heffen en om een interwijk verbinding te realiseren.

- Als het een levendiger gebied wordt, gaan jullie ‘sponszones’ toevoegen in het gebied?

Ja, door plekken hiervoor aan te wijzen. Leeg laten als het kan, daar is de projectmanager het niet mee eens. Het Olympiaplein is levendig als het druk is, maar we willen dit plein ook levendig maken als het niet druk is. Zo kunnen er bijvoorbeeld ook festivalletjes of andere kleine dagelijkse bezigheden komen. Je moet er juist voor zorgen dat als er geen evenementen zijn dat ze door anderen gebruikt kunnen worden.
Dag dagelijks ziet de projectmanager dat er veel activiteiten voor jongeren zijn, al nu en in de toekomst. Dit komt bijvoorbeeld doordat er klaslokalen in De Kuip zitten. Er wordt daardoor veel voor jeugd georganiseerd. Op dit moment nog rondom het stadion terrein, maar dit biedt potentie om het ook daar buiten te doen, en het stationsgebied daarvoor te gaan gebruiken. Het kan bijvoorbeeld een leuk plein met belijning of klapbare goaltjes worden. Zo kan er een kiosk met materialen neer worden gezet, die als er geen evenementen zijn open kan, zodat kinderen daar materiaal van kunnen gebruiken.

- Hoe wordt het station en het gebied er om heen ingericht zodat het een fijn gebied is om te verblijven

Er zijn 2 dingen heel belangrijk in: groen, ook op de traversen groen. Er gaat voor gezorgd worden dat er bomen op de traversen zijn. Door dat slim te doen kan daar iets mee bereikt worden. De nieuwe

Passerelle in Zwolle of de Paleisbrug in Den Bosch zijn hier vergelijkbare voorbeelden voor.
Daarnaast moet ervoor gezorgd worden dat er op de juiste plekken veel deuren en ogen zijn. Er is niets zo erg als dichte wanden en deuren.

**Safety & Security:**

- Welke structurele en fysieke aspecten nemen jullie mee voor het ontwerp van het nieuwe station om de veiligheid te vergroten/verbeteren? Welke zijn er nu en welke willen jullie in de toekomst hier hebben? En waarom?

Dat heeft te maken met een visuele afscheiding tussen uit en thuis supporters. Visueel contact leidt tot verbale agressie. Niet té hufterproof in te richten. Als je dat te veel doet, dan lok je dat namelijk uit. Er zijn plekken die zo op hufter gedrag ingericht, dat het wel eens fout gaat. Het gaat er om dat het nieuwe stationsgebied als normaal zacht gebied in wordt gericht. Dan gedragen mensen zich ook altijd normaler.
Daarnaast moet er heel veel nagedacht worden over capaciteit. Een aparte buffer ruimte voor personen die het station nog niet in kunnen bijvoorbeeld. Verder is het plaatsen en lokaliseren van de bevelposten belangrijk.

- Welke operationele ingrepen worden nu gebruikt om de veiligheid te waarborgen tijdens evenementen?

Dat gaat wel heel ver voor nu. Deels weten ze dat ook niet. De operatie bij een nieuw station zal anders zijn dan nu. Het station wordt nu zo ontworpen dat het verschillende manieren van operatie aan kan. De hoofdentree van het station kan in principe tijdens evenementen open zijn, maar misschien bij evenementen kan het dicht.

In het ontwerp nu nog zo ver voordat de operationele afwegingen mee worden genomen. Maar de opties worden wel open gehouden, een voor de hand liggende is bijvoorbeeld het veranderen van 1 naar 2 perrons die open zijn. Op dit moment zijn er twee dezelfde richtingen op één perron, dat is wel iets wat uit elkaar gehaald kan en moet worden.

- Werken jullie samen met andere mensen om deze ontwerpen te beoordelen?

Ja er is een veiligheidsoverleg, mensen van het station, politie, veiligheidsregio, ns-reizigers, ns-evenementen zitten hier aan de tafel. Hier zit de projectmanager ook bij aan tafel.

- Welk cijfer/ welke ervaringen hebben gebruikers van het station nu als het gaat om de algemene veiligheid?

Die is er niet echt. Dit komt doordat dit nog geen regulier station is, dus die gaat niet mee in de enquêtes van de NS.

**Event management:**

- Wat zijn lessen van de afgelopen ~5 jaar omtrent evenementen die jullie meenemen tijdens evenementen management en het ontwerp van het station?

Langer dan 5 jaar zelfs. Dit is wel een station die in deze omgeving trouw en loyaliteit uitstraalt. In de nieuwe wijken in de afgelopen jaren zie je veel ontwikkelingen die worden meegenomen in het ontwerp.
Daarnaast is er een traject met een nieuw stadion, waarop moderne dingen mee worden genomen. En

dat waait ook over tafel. Dus de dingen van een nieuw station, het gebied en ook een nieuw stadion die stapelen elkaar op als het gaat om ervaringen uit evenementen en daarbuiten die mee worden genomen in het nieuwe ontwerp.
Een van de belangrijke dingen is, waar gaan de service medewerkers staan op de perrons, zowel vanuit de politie als van de NS, daar is veel ervaring in opgedaan in de afgelopen jaren. Dit heeft impact op hoe de mensen stromen moeten gaan bewegen en hoe het ontwerp rond gaat komen.

- Welke organisaties en instituties zijn betrokken bij de governance van evenementen? Hoe gaat de samenwerking tussen deze partijen?

Veelal dezelfde partijen als eerder benoemd bij het veiligheidsoverleg. Daar bovenop komen ook een mobiliteit en bereikbaarheidsmanager vanuit de gemeente en van de Kuip. Soms zitten er ook mensen van de RET aan tafel die een rol spelen. Tijdens een wedstrijd staat 60/70% van de deelscooters van Rotterdam bij het stadion. Dat is echt een zee aan scooters. Ook die partijen spelen een rol.

- Welke partij neemt tijdens evenementen management de voorzittersrol in?

Dat is een mobiliteit coördinator van de Kuip → dat is een vermoeden.

De projectmanager is van de plannen voor de lange termijn en houdt zich hier minder mee bezig.

**Crowd management:**

- Zijn er zogenaamde bottleneck punten aan mensenstromen tijdens evenementen? Hoe zijn jullie van plan deze te verhelpen in het ontwerp van het nieuwe station?

Een beetje. Vooral die 2 locaties voor uitsupporters bussen. Beperkt, er zitten wel bottlenecks, maar die zitten verder in het gebied.
De bottlenecks is een combinatie. Het probleem zit hem waar stromen samen komen. Het belangrijkste wat je moet doen in een gebiedsontwerp, is ontvlechten. Stromen uit elkaar halen en daarmee de bottlenecks.

- Maken jullie gebruik van crowd simulation technieken en komen daar interessante bevindingen uit?

Op dit moment nog niet. Ook niet gaan doen. De situatie kennen ze goed genoeg. Het is veel werk om dat goed in elkaar te zetten en het is de vraag of dat meerwaarde heeft voor dit gebied.

Bij het nieuwe stadion hebben ze dat wel al gedaan, en daar is veel kennis uit gehaald. Hoe stromen ze verdelen en uitdunnen. Als je verder weg van het stadion komt, dan lopen mensen niet meer allemaal even snel.

- Hoe wordt op dit moment de mensenmassa gedistribueerd en komt daar verandering in? Hoe nemen jullie dat mee in een nieuwe knoop?

Ze gaan gewoon naar de evenementen traverse. En naar de normale traverse als ze naar de tramhalte gaan. Daar zit niet veel distributie in. Dat is meer kanaliseren. De rest wordt gestuurd naar fietsenstalling.
Er moet voldoende ruimte zijn, bv 1 kiest de fietsenstalling dicht bij het vak, want er is geen 1 ingang bij het stadion. De ander kiest een fietsenstalling zo goed mogelijk liggend bij de fietsroute.

De grootste valkuil voor dit soort projecten is denken dat je dat gedrag kan sturen.

- Hoe verandert het informatie aanbod tijdens evenementen? Of zijn er standaarden waar jullie aan houden (borden, wayfinding, schermen etc.)?

Omroepen gebeurt sowieso, tijdens evenementen zijn er altijd stewards. Vaste wayfinding en borden komt ook in het nieuwe ontwerp. Hoe dat precies vorm krijgt, komt in de volgende ontwerpfases pas aan de orde.
Andersom is belangrijker: Als de Kuip opgeknapt wordt, dan gaan ze kijken of er iets gezegd kan worden over de drukte bij de vervoersmiddelen. Bijvoorbeeld op een eerder moment aangeven of het heel druk is bij een bepaald vervoersmiddel. De uitstroom krijgt veel meer aandacht dan de instroom.

- Gebruiken jullie input van de gebruikers die ervaringen hebben tijdens de grote pieken?

Ja, maar ook beperkt. Dat zijn de interviews die de Kuip onder zijn supporters houdt. NS heeft alle enquêtes gehouden over het nieuwe station met folders en flyers om te achterhalen wat potentiële reizigers belangrijk vinden.
Er was vorige week nog een avond en dan komen er ook 200 mensen die ook een beeld geven. Dat lukt alleen maar, omdat je zoveel mensen bereikt omdat het niet alleen over het station ging, maar ook over andere onderwerpen van de gebiedsontwikkeling.

- Nemen jullie design principes van andere stations mee? Bijvoorbeeld van Zuidplein?

Ja vooral andere NS stations, dat gaat via NS. De NS kent de goeie voorbeelden beter.

**Vervoersmiddelen:**

- Willen jullie het station zo toekomst bestendig maken dat er ooit een metro kan gaan rijden? En waarom wel/niet? En hoe neem je de adaptiviteit mee?

Nee, het is niet dat die er niet kan gaan rijden. Dat is gewoon niet realistisch. De vraag is wat je daarvoor zou moeten doen. Er zou dan een koppeling moeten maken.
De enige waar dat is gebeurt is bij Lombardijen, die ligt er al 40 jaar maar is nog niet gebruikt. Ze zijn niet aan het werken onder het spoor en dat is dus niet zinvol.

- Er zit ook een tram en busstop in de buurt, nemen jullie die mee in het herontwerp van het station?

Ja uiteraard de bussen ook meenemen. De bushaltes goed projecteren en stroken inrichten op de omliggende richtingen. Ook waar en hoe de bussen moeten parkeren voor het station. De verbinding naar de tram wordt ook omgelegd, zodat het meer een knoop wordt in plaats van losstaande modaliteiten.
Dit alles moet nog verder uitgewerkt worden.

- Op welke manier willen jullie fietsers en voetgangers integreren in het nieuwe ontwerp?

Nieuwe voetgangersoversteken. Meer ruimte voor parkeerplekken voor de fiets.

**Multimodaliteit:**

- Zodra het station ook een station voor dagelijks gebruik wordt, komen er plekken van transfers? Bv tussen trein/tram en trein/bus? Hoe wordt hier inrichting aan gegeven?

Dat wordt natuurlijk het doel van het station. In de gebiedsontwikkeling gaat het station een belangrijke rol spelen, dus daar hoort intermodaliteit bij.

- Hoe is de samenwerking tussen deze openbaar vervoer aanbieders?

Die is best wel goed. Er zijn 2 wekelijkse integrale ontwerpsessies. Deel van het stationgewijs. Wat hier bijzonder bij is: je hebt het station, maar ook veel deelprojecten en daar boven zit een manager, die zorgt dat de samenhang en integraliteit bewaard blijft.

- Hoe willen jullie het nieuwe station inclusief maken en technisch modern? Bv liften, trappen etc.

Ja er komen roltrappen. Daarnaast de optie tot evenemententree en hoofdentree.

**Governance en organisatie:**

- Hoeveel stakeholders zijn er bij het nieuwe project betrokken? Zijn er hier nog belanghebbenden die een speciale rol hebben? Dus bijvoorbeeld heel sturend zijn in de wensen en eisen van het uiteindelijke ontwerp?
- Hoe is de afstemming met de RET en de Kuip? En met jullie als gemeente? Hoe bepaal je welke ingrepen voor het uiteindelijke stations ontwerp nodig zijn? En wie bepaalt dat uiteindelijk?
    a. Hoe is de besluitvorming gestructureerd? En hoe adaptief is het besluitvormingsproces?

De besluitvorming gaat met een integraal afstemmingsoverleg. Met ProRail en hun ontwerpconsortium, er is een heel MIRT traject, gezamenlijk met openbare vervoerders, rijk, provincie en MRDH. Dit is daarom ook hoe de besluitvorming verloopt.

Hoe adaptief? Ingewikkeld. Er is 1 ervaring: als je aan de voorkant al vertraging inplant, dan krijg je alsnog vertraging.

# Appendix E: Interview Summary Metro de Madrid

Interview conducted with the Manager of Operational Support, Manager of Infrastructure and stations and the COO of Metro de Madrid on the 19th of January 2026 in Madrid.

**General**

- Do you look at other stations in Spain or perhaps across the borders for inspiration for new design elements for a station?

The Santiago Bernabéu station is currently undergoing a major renovation primarily because it needs to adapt to a massive increase in passenger volume. Originally built for the 1982 World Cup, the station has an outdated design with long, narrow hallways that are no longer sufficient. While it was initially designed for football matches, the stadium will now host many concerts and events throughout the year, making a total redesign necessary.

The renovation uses a "top-down" construction system to minimize city disruption. The design is heavily influenced by the experience gained from the Metropolitano station (Atlético Madrid), which handles large event crowds using four tracks. Although Bernabéu does not have enough space for four tracks, Metro Madrid is applying similar crowd management logic here. The project is ambitious, with a strict timeline of 15 months to complete the works. → now just started with the excavation works

**Position in network:**

- What role will the station play within the local and regional network? What role does the station play in relation to the stations connected to this one? (relieve / stress)

The station is a key node on a major North-South line, serving passengers from both inside and outside Madrid. During events, the inflow is managed "drop by drop." To ensure safety, a maximum of 2,400 people are allowed in the station at once, otherwise it is not safe (more on this at the safety aspect). With trains arriving every three minutes (each carrying about 1,000 to 1,200 people), the station can efficiently clear the platforms. Nearby major stations, Plaza de Castilla and Nuevos Ministerios, serve as vital hubs that help relieve the pressure on Bernabéu, especially after events.

- Is the station developed for two different roles: peak capacity during events, and a normal shape?

The physical structure remains the same regardless of the day, but it is designed for the "worst-case scenario" (the peak of a 70,000-person event). On normal days, the station will feel very spacious. During events, the bigger platform space will be perfect to enable the growth of the station. The platforms are also being widened to three times their current size to accommodate more people safely.

A unique feature is the Real Madrid-themed customization, as the stadium's museum is the third most visited in Madrid. The station will act as an information point (for tourists) and a tribute to the club's history. The addition of a large mezzanine and multiple levels allows staff to manage large crowds much better than before.

- In what ways will the station's adaptability be considered in the future/design of the new station? Meaning: how flexible is the growth of the station from daily use to event use?

Adaptability is built into the design by allowing a high frequency of trains (one every 3 minutes) and providing massive amounts of space. All designs are done "in-house" by Metro Madrid. While the physical layout is fixed for the highest possible demand, meaning that the design is made for the

‘worst day’, and thus there is space for the future. The main thing changing in the growth and flexibility is the number of staff members working at the station changes depending on whether it is a normal day or an event day.

- How will the station be developed to connect with the surrounding neighbourhoods?

The station will have four main access points. One old entrance will be removed and replaced with a larger, more efficient one. This new entrance will be connected directly to the boulevard next to the stadium. There are three other access points around the Plaza de Lima, one of which will be incorporated into an office building.

**Economic & Urban Integration:**

- How is the integration with event area currently set up (walkway)? And what will be the most important changes in this? And why?

The current walkway is being completely rebuilt. The most significant change is the introduction of a large mezzanine between the main hall and the tracks. This creates a buffer zone where crowds can be managed before they reach the platform. More escalators are also being added to speed up the vertical movement of passengers.

- How will the station be integrated into the urban environment?

The design focuses on environmental respect, such as using specific tunneling techniques to protect the large trees in the area. Most of the expansion happens underground to minimize the impact on the street level, while one of the new entrances is designed to blend into an officie building, one other is designed to integrate with the promenade next to the Bernabeu stadium.

- Is the station now seen as a barrier between city districts? Do you want to prevent it or keep it that way?

Station is underground, so question is obsolete.

- If it becomes a livelier area, will you add 'sponge zones' to the area? This means that there will be areas that people can 'absorb' in order to reduce the pressure on transport?

The focus is on safety and flow rather than these sponge zones. The large mezzanine will acts as an functional area to absorb and regulate the pressure on the platforms.

- How will the station and the area around it be designed so that it is a nice area to stay in?

The main focus is underground, where safety is the priority. However by creating some open spaces in the mezzanine, the station becomes a more pleasant environment for passgeners to pass through or wait in.

**Safety & Security:**

- What structural and physical aspects will you take into account for the design of the new station? Which ones are there now and which ones do you want to have here in the future? And why?

The primary change is tripling the size of the platforms. More square footage directly translates to higher safety. The design follows strict regulations for fire safety on escalators and follows a "universal concept" used by Metro Madrid, scaled up for event sizes. The concept is translated

from a regular station in the middle of the city with upgrades for the event sized nature. The same concept, but just enlarged in size.

The open layout allows security staff to have a clear view of the entire station and to manage crowds better. There will also be improvements for disabled people to travel safe. Making the station too big is not an option, due to the Nuevos Ministerios station nearby.

- What operational interventions are now being used to ensure safety during events?

Metro Madrid uses a "philosophy" rather than just a set of rules. They have copied the successful protocols from the **Metropolitano station**. A key intervention is stopping people at the street level to ensure they only enter the station when the platforms are empty and safe. This will be done on the promenade around the stadium, and with the new designed entrance there. Stopping the people outside, so they wait before going into the station.

- How will you ensure social safety at the station?

Social safety is improved by creating more open spaces and eliminating dark corners or narrow passages. Bright lighting and extensive CCTV coverage are standard in the new design.

**Event management:**

- What will change at the station in its design and in the operational situation during events?

The main change is the physical capacity (escalators and platform width). Operationally, the most important intervention is the "hold and release" method at the entrances. Metro Madrid is also studying whether the Pink Line (Line 8) needs a new station closer to the stadium to further improve accessibility for the area.

- What are lessons from the past ~5-10 years about events in the area that you take with you during event management and the design of the station?

Actually there is not a big problem after the football matches. They come in drop by drop. Most people also know the area well. While these football crowds usually arrive gradually, concert crowds often arrive all at once. The lessons learned from handling these different flows are used to improve the design. They have noted that most football fans know the area well, but concert-goers might need more guidance and better accessibility.

In the end, there are lots of studies on how to improve accessibility of the station. In the future there will be a lot of events. So all the lessons from the last events will be considered.

- Which organisations and institutions are involved in the governance of events? How is the cooperation between these parties going?

For big events, a coordination meeting is held with the Central Government, the Mayor of Madrid, the Police, Metro Madrid, and the Railroad Company (Cercanías). These parties coordinate everything from transport frequency to public order. These meetings happen regularly for major events and during busy seasons like Christmas.

When there is a big event, the central government calls Metro de Madrid, as the police depends on them regarding the outflow of people. Metro de Madrid moves 2,5 million people daily. So they say that a concert of 100,000 is not a problem, if you manage it well. Line 6 alone moves 5 concerts each day in total of how many people use the metro.

**Crowd management:**

- Are there so-called bottleneck points in the flow of people during events? How do you plan to remedy these in the design of the new station?

The primary bottleneck was the narrow platform and halls. This is remedied by tripling the platform width and adding a mezzanine.

- Do you use crowd simulation techniques and do you find interesting findings?

Yes, they use advanced simulation software to test the design. This helps them assess how changes in civil engineering or operations will affect safety and passenger flow.

- How is the masses distributed at the moment and will that change? Is there a difference between distribution during events and during normal day time?

During events, staff and security are heavily deployed. A specific tactic is to **force the use of only one entrance** to control the crowd, while other entrances are kept clear for emergencies and for the outflow of arriving passengers. All four escalators will be set in one direction (downward) to move people quickly to the tracks (this will be done in the future at the new entrance).

Important note again, is that people can only go downstairs when the station is empty.

- How does the information on offer during events change? Or are there standards that you adhere to (signs, wayfinding, fencing, etc.)?

Before the Operation, when people arrive for the match

- Two hours before, public address announcements are broadcast throughout the entire network advising passengers to purchase their tickets in advance to avoid unnecessary waiting times.
- The same message is also displayed on the screens were available i.e. at Estadio Metropolitano station.
- Tensabarriers are placed in front of the exit turnstiles, creating a guided pathway toward the turnstiles themselves.

End of the match – operational deployment

- Depending on the screen, the station displays show:
    - Directions of the next train, both on the outer gateway displays and on the internal screens, for both Line A and Line B.
    - Manual or automatic ticket sales.
    - Recommendations for passengers to spread out along the entire platform.
- Tensabarriers are used to guide passengers toward the ticket sales area, separating manual sales on one side and automatic sales on the other, directing them to the machines.
- As a complement to the information provided on the screens—which most passengers do not read—more traditional tools such as megaphones are used to direct and guide the public.

**Transport:**

- How are you going to make the station future-proof to ensure new methods and ways of transportation? How do you want to make the new station inclusive and technically modern? E.g. elevators, stairs, etc.

The station is built to be modern and inclusive, with new lifts, elevators and wide stairs. The proximity to Nuevos Ministerios (a major transport hub) makes it easy for passengers to transfer to other lines or long-distance trains

- How is the integration with other modes organised? And are there bottlenecks between these systems?

Above ground there are some bus stops, but during events the buses are not driving here. There are no bottlenecks in the transfer.

- How do you want to integrate cyclists and pedestrians into the new design?

Not relevant for this station.

**Governance and organization:**

- Which are the main stakeholders that are involved in the new project? Could you provide a limited evaluation of their respective agency in the project? What are they responsible for and how much is their perspective driving the project? So, for example, be very guiding in the wishes and requirements for the final design?

Metro Madrid is the main stakeholder and is responsible for the design, civil works, and technical installations. The station is designed and defined by Metro de Madrid. They will ask the government what they think of it, but the final decision is made by Metro de Madrid.

While the regional government (Community of Madrid) decides on network extensions, Metro Madrid handles the renovation and the technical infrastructure themselves (climatization, energy, installation of subsystems etc.).

- How is the decision-making structured in Spain? (In the Netherlands we use the MIRT process + small explanation)

It depends on the administration / department of the government, they are not all the same. Especially the state government, they have different processes. In the end, the main decisions lie on what the politicians want. Therefore the decision-making is often driven by political priorities but follows a legal process: a feasibility study → an environmental study (done by the central government, and mandatory) → a public inquiry (to listen to complaints) → and then the tender for civil works.

The entire planning process for a new station can take 5 to 10 years. For renovations like Bernabéu, the process is fast-tracked because the city cannot afford long closures of major roads or stadiums. It is therefore important in the design and decision making process, that the design of the new station can be made in a couple of years, the design needs to be fast, not always too expensive.

- How adaptive is the decision-making process? For example, if new cases occur such as delays, new stakeholders, or public resistance?

Really depends on the specific ministry and administration in charge.

- What is the average turnaround time of decision-making? And what do you think of this lead time itself (long, logical, too short)?

Comparable projects take also 5-10 years.

**Complete Station**

- Will you invest in making the station/station area alone attractive, or will it be focused more on the area development?

The station renovation is inseparable from the stadium and area development. Without the modernization of the area, the extension of the metro's capacity would not be possible or effective

- Would you consider the station as ‘more than only a public transport centre’?

Yes, this is due to the information point for the Real Madrid museum. Also, because the theme of the station is based on that of the stadium, it comes with culture as well.

- How does the station contribute to the social and economic or cultural dynamics in the area?

The station is essential for the economic and cultural health of the neighbourhood. If the station couldn't handle the crowds, the entire area would suffer from congestion and reduced accessibility, making it harder for people to live there or visit events. It is a critical piece of the local infrastructure (during events)

# Appendix F: Interview Summary Wembley Park

This Appendix contains the interview met the station manager of Wembley Park Station. The interview was conducted on the 20th of January 2026 in London at the office of Wembley Park Station.

**General**

- Do you look at other stations in England or perhaps across the borders for inspiration for new design elements for a station?

Due to the age of the network, many London stations are protected as "listed buildings," meaning their structural profiles and historical features cannot be easily altered. Wembley Park was an exception because TfL owned the surrounding land, allowing for more extensive modern development. While architects seek inspiration from elsewhere, such as the accessibility elevator 5 which exits directly on to council land, as well as across borders such as the glass canopy materials sourced from Germany or escalator designs from France, they must strictly comply with the physical constraints of available space. Modern renovations also face stringent sustainability and carbon footprint regulations; however, these sometimes require a balance between environmental goals and financial costs.

**Position in network:**

- What role will the station play within the local and regional network? What role does the station play in relation to the stations connected to this one? (relieve / stress)

Wembley Park acts as a primary catalyst for local development, as the local council (Brent) uses the transport network to drive growth in their respective borough. For instance, the Brent Council gave planning permission a residential building over a car park next to the station to capitalize on this hub. The station's role changes significantly within the network; while Wembley is a high-traffic hub with a lot of influx during the day, stations just a few stops away remain purely residential. Consequently, any regional development is dictated by the station's specific location and economic potential.

- Is the station developed for two different roles: peak capacity during events, and a normal shape?

The station is designed to accommodate the maximum capacity required for major events at the stadium. While it is heavily underused during off-peak months (typically December to March), it remains open to serve the local residents and daily commuters. Operationally, TfL does not shut off specific areas of the station during normal operations, as the complexity of reconfiguring the space for different roles would be too high. It does shut down spaces during events, but that is due to other purposes.

- In what ways will the station's adaptability be considered in the future/design of the new station? Meaning: how flexible is the growth of the station from daily use to event use?

The station's physical growth is largely limited by its existing infrastructure. The bridge over the tracks is a fixed structure, and the entry and exit points are difficult to change. Therefore, there is little flexibility to grow the station's physical footprint further to adapt to future increases in demand.

- How is the station developed to connect with the surrounding neighbourhoods?

The station has multiple entries, however the main one is towards Olympic Way. The other entries, mainly on Bridge Road, connect the station with the residential area on the north side of the station.

**Geographic Location:**

- How is the integration with event area currently set up (walkway)? And why was this done?

The integration was designed specifically with event flows in mind, most notably through the construction of the stairs leading to Olympic Way. This peripheral design was intended to move large masses of people directly between the station and the stadium area, a feature that was missing before the Olympic Way was established.

- How is the station be integrated into the urban environment?

The station is designed to blend into the surrounding neighborhood, though the focus remains on its functionality as a transit point. It serves as the gateway to the Wembley district, connecting the local residential areas to the larger event area and commercial area.

- Is the station now seen as a barrier between city districts? Do you want to prevent it or keep it that way?

The station is generally not viewed as a physical barrier between districts. However, functional barriers can arise when services end for the day. Since train timetables do not change for event days, a lack of available transport links can effectively isolate the area once the last train has departed, creating a temporary barrier for those trying to leave the district.

- Are there ‘sponge zones’ in the area and in the stations? This means that there will be areas that people can 'absorb' in order to reduce the pressure on transport?

"Sponge zones" do not function effectively for return traffic. On event days, people arrive early to soak up the atmosphere on Olympic Way, which naturally spreads out the pressure on the "forward" traffic. However, after an event, the "return" traffic is highly concentrated as everyone wants to get home immediately, as the concert or football game often late in the day/ evening. Aside from early-afternoon football matches which reduce pressure slightly, there is currently no effective way to "absorb" or delay this return surge.

- How is the station and the area around it designed so that it is a nice area to stay in?

The Olympic Way offers a lot of cafes and restaurants. The station itself merely functions as a transit node.

**Safety & Security:**

- What structural and physical aspects will you take into account for the design of the new station? Which ones are there now and which ones do you want to have here in the future? And why?

From a structural perspective, the station is not vastly different from others; for example, platforms cannot be widened without shutting the entire railway for a year. Security is maintained through total CCTV coverage and a dedicated control room. Uniquely, Wembley Park has " staff attendance points on the platforms, to provide safety, compared to other stations. These are designed for normal operations but become vital hubs for staff during major events.

- What operational interventions are now being used to ensure safety during events?

Safety is driven by strict "minimum safe manning levels" and evacuation protocols, with fire risk being the primary concern. The station is covered with staff during events, with hourly checks being

increased to every hour of their own area. They staff are all spread across the area so they have eyes everywhere. Teams in each area have a team leader and only team leaders can communicate with control room to reduce unnecessary radio traffic so critical messages can get through. Of course, the latter depends on the nature of the crowds as well.

Each of the stations of TfL has congestion control and evacuation plan. These determine how many staff there will be on the station and safety to manage safe evacuation of the station in an emergency. There are minimum numbers of staff which have to be present on the station . The driver for minimum numbers is the evacuation protocol of the station, mainly set up with risks like fire , that is a main determinant.
In normal operations, Wembley is a "Category B" station (checked every two hours), but during events, it upgrades to "Category A" (checked every hour). For events, TfL deploys approximately 50 additional staff members who are spread across platforms and ticket hall to ensure safe operations. During events the control room maintains contact with the stadium control room to ensure critical information can be shared between them.

- How will you ensure social safety at the station?

We have a presence from the British Transport Police (BTP) in our control room, responsible for policing within the station perimeter who have their own communication arrangements with their officers and maintain safety of all users of the station.

BTP officer in the control room liaise with the Metropolitan Police who are responsible for maintain safety outside the station, including the event footprint and surrounding areas.

**Event management:**

- What will change at the station in its design and in the operational situation during events?

The operational profile changes completely for return traffic, as there are different circumstances for safety & security.
While inbound passengers naturally exit the station, return traffic must be held in the Olympic Way to prevent overcrowding on the platforms, which would compromise evacuation safety and risk. On the return traffic, the operational management is crucial. The operational profile of the station changes completely in this set-up.
The Olympic Way is used as a holding area, afters normal events. Entrance CDE (picture) is exit only that is way. This way TfL avoids the conflict of two different streams of customer traffic crossing paths and pinch points. TfL's responsibility ends at the station boundary; the "last mile" and the Olympic Way holding areas are managed by the Metropolitan Police and Brent Council stewards. The police controls this last-mile, cordons put in place by the police controlling the flow of traffic entering the station. People. The station control room liaises with the police to allow customers through the cordon and enter the station.

- What are lessons from the past ~5-10 years about events in the area that you take with you during event management and the design of the station?

After every event, the management review their actions and sees whether change is necessary for the next event. So every event and its lessons contribute to the current event management.

- Which organisations and institutions are involved in the governance of events? How is the cooperation between these parties going?

Governance involves a collaboration between TfL, the Metropolitan Police, the British Transport Police, the stadium's operation team, and the Brent Council. These parties meet regularly to review and plan for events. Within these meetings there were never any issues, the cooperation is going well. They review the event planning in advance, and do this continuously. There is also the potential of having staff of TFL presence in the stadium control room during events, this is not yet done.
While cooperation is generally strong, clear communication is vital; if the station has to close, the responsibility for the crowd shifts immediately to the police and the council in the outside area. Abdul hasn't been involved in those meetings yet, as he has just joined the team but intends to take part in future meeting. First discussing on how to manage the events and then on how the collaboration works.
The responsibilities of the crowds are luckily already very clear. If people cannot get on the station, they will be stuck on Olympic way. When the station closes the responsibility of the people will be for the brent council and the police, and how they are dispersed from the area. The policing strategy outside the station is determined by the profile of supporters attending the event, so for football it is more robust then for concerts.

**Crowd management:**

- Are there so-called bottleneck points in the flow of people during events? How do you plan to remedy these in the design of the new station?

The primary bottleneck is the "CDE" exit/entry point (see picture), where counterflows often occur when people attempt to enter while others are exiting. Also, some far exits close at event days. In addition, one platform that is usually closed for daily use is opened specifically for events. Additionally, a "hard stop" for trains at 00:30 (or earlier on Sundays) creates a critical bottleneck; if events run late due to artist delays, staff face potential problems from crowds who are stranded after the last service.
There will be some empty trains in a depot which are / can be requested AS AN EXTRA when there is a lot of people. These trains they go to Baker Street, a bit further away, for short window. They are time tabled to run in between scheduled trains.

There are no other bottle necks to be aware of. Not a real bottleneck but contraflow of travellers.

- Do you use crowd simulation techniques and do you find interesting findings?

While TfL has the expertise for simulation modelling, it is rarely done for Wembley Park because the station's capacity is physically fixed. Most simulations were conducted during the 2012 Olympics. However, simulation remains crucial for determining staff deployment levels and understanding how crowds might move during an emergency evacuation. Abdul might do it extra for own understanding of the complexity.

- How is the masses distributed at the moment and will that change? Is there a difference between distribution during events and during normal day time?

See answer on how the Police uses the Olympic Way as a holding area.
There is therefore not a big difference between events and during normal day time. During non-event times, if we have hold customers, staff do it using the congestion control plans we have and there is no support from any of the police services as these instances not planned, just used in response to crowd build up

- How does the information on offer during events change? Or are there standards that you adhere to (signs, wayfinding, fencing, etc.)?

The physical wayfinding and signage are designed to be "static," meaning they are built for event-level crowds and stay in place year-round. However, dynamic communication changes; if a connecting line (like the Jubilee line) is suspended, staff at Wembley must immediately communicate with other stations to divert passengers, as they cannot risk sending people toward a closed hub.

**Transport:**

- How are you going to make the station future-proof to ensure new methods and ways of transportation?

TfL's focus is on connectivity and controlling more of the overground network to lower costs and improve transfers. While light rail and trams are mostly located in Southeast London and do not reach Wembley, TfL has introduced the "Superloop", bus services which increases connectivity between different parts of London in around Wembley and likewise, for other parts of London. For example, superloop This connects areas like Greenford which has no direct Metro connection with the Wembley Park, although they are neighbouring boroughs.

- How is the integration with other modes organised? And are there bottlenecks between these systems?

The integration and transfer are getting better. The bus service are not operated by the TFL. They are getting quite some bus hubs in this area of London. Where the  station is a hub for buses, there connectivity improves.  The Superloop helps with improving this connectivity.

- How do you want to integrate cyclists and pedestrians into the new design?

Currently, integration for cyclists is poor in this part of London compared to other parts of London where there has been significant improvement on cycle lanes. While there have been discussions about adding cycle lanes to Bridge Road, this is complicated by the fact that narrowing car lanes would cause significant traffic congestion.

Important empirical notice: Metropolitan Line has different services operating on it where there are local services stopping at every station, and then services that do not stop at a number of stations, as this improves journey times, especially on branch services as Metropolitan line is a very long line.

**Governance and organization:**

- Which are the main stakeholders that are involved in the new project? Could you provide a limited evaluation of their respective agency in the project? What are they responsible for and how much is their perspective driving the project? So, for example, be very guiding in the wishes and requirements for the final design?

Any project begins with a project sponsor who assembles a team of engineers, managers, and sustainability experts. They move from a "concept design" (which can take 18 months) to a "detailed design" where costs and materials are finalized. Once the financial department releases the funds and a tender is put out, the project is ready to go live. Design is continuously tweaked by the technical and sustainability teams on feedback received from operational team, customer experience team and health safety managers. Once detailed design is complete, the project is locked in and only varied if there are technical issues that arise during delivery.

- How is the decision-making structured in England? (In the Netherlands we use the MIRT process + small explanation)

The process follows a sequence: Concept Design -> Detailed Design -> Tender -> Financials. Similar to the Dutch system, large railway projects must be backed by Parliament. Infrastructure work must also comply with strict CDM (Construction Design and Management) regulations regarding safety and land use.

- How adaptive is the decision-making process? For example, if new cases occur such as delays, new stakeholders, or public resistance?

As a public organization, TfL must be highly adaptive because its income streams can fluctuate significantly. However, the fixed nature of the existing Victorian infrastructure often limits how much the organization can change the physical setup, regardless of changing needs.

- What is the average turnaround time of decision-making? And what do you think of this lead time itself (long, logical, too short)?

The lead time is big. Before we enter concept design, a whole host of consultation tackles place with members of the public, regulatory bodies, council boroughs, NGO's and interested stakeholder bodies and commercial parties.  The concept design is then shared with all interested and impacted parties and tweaked before it goes to detailed design which can take up a lot of time

**Complete Station**

- Will you invest in making the station/station area alone attractive, or will it be focused more on the area development?

Infrastructure improvements are often tied to local area development. Specific rules allow TfL to seek funding from private developers to improve station accessibility and capacity as new residential or commercial areas are built. This ensures the station evolves alongside the neighbourhood.

- Would you consider the station as 'more than only a public transport centre'?

Yes. Because people are here more than 24/7. A lot of people who are working here need to make it their home.

- How does the station contribute to the social and economic or cultural dynamics in the area?

The station is more than a transit hub; it is the economic engine of the district. Local retail depends heavily on the station's output, and for the staff who work there 24/7, the station is effectively a "home." Improving the station's aesthetics and services has a direct, positive impact on the cultural and social wellbeing of the Wembley area

# Appendix G: Interview Summary Stratford Station

This Appendix contains the interview met the station manager of Wembley Park Station. The interview was conducted on the 20th of January 2026 in London at the office of Wembley Park Station.

**General**

- Do you look at other stations in England or perhaps across the borders for inspiration for new design elements for a station?

A significant portion of the current design logic is a legacy of the 2012 OG. The station was heavily remodeled to handle bigger volumes, and those lessons continue to inform how new elements, such as high-capacity gatelines and wider concourses, are integraed to manage modern demand.
A major interchange node to get inspiration from could be King's Cross in this context.

**Position in network:**

- What role does the station play within the local and regional network? What role does the station play in relation to the stations connected to this one? (relieve / stress)

Stratford serves as one of the most critical interchange hubs in the UK. In numbers it is the 7th biggest station in the UK, however, by including the transfers within the station, it might very well be the 1st biggest station by number of total travellers.
The station connects the London Underground, the DLR, London Overground, Elizabeth Line and National Rail services. Regionally, it facilitates the regeneration of East London by buses. In relation to the wider network, it acts as a secondary 'international' gateway, relieving pressure from King's Cross by providing high-speed links to Stratford International.
Therefore, the role of this station is critical to the national, regional and local network.

- Is the station developed for two different roles: peak capacity during events, and a normal shape?

Yes, the station operates under two distinct profiles. For standard daily operations, it functions in "Business As Usual" (BAU) mode. However, for events at the London Stadium, a specific "Event Plan" is activated approximately 2.5 to 3 hours prior to the start. This involves a coordinated effort between London Underground, Stratford Regional Station, and the British Transport Police (BTP). An enhanced unit of BTP officers is deployed to participate in briefings and support crowd safety until BAU is called again after the event.
The station is not necessary developed for two different roles, but it can surely act like it.

- In what ways will the station's adaptability be considered in the future/design of the new station? Meaning: how flexible is the growth of the station from daily use to event use?

Adaptability is largely managed through operational flexibility and passenger behavior. For regular events like West Ham football matches, fans demonstrate "learned behavior," following established routes instinctively. This makes the transition from daily to event use smoother. For non-football events where visitors are less familiar with the layout, the station relies more heavily on staff presence, PA announcements, and temporary routing to manage the increased footfall.

- How is the station developed to connect with the surrounding neighbourhoods?

The station is central to the ongoing regeneration of the area. It serves as a bridge between the historic Stratford town center and the new developments in the Olympic Park and the Westfield shopping complex. The design prioritizes high-permeability through multiple ticket halls, ensuring that the station acts as a connector rather than an obstacle for the surrounding residential and commercial districts.

**Geographic Location:**

- How is the integration with event area currently set up (walkway)? And what will be the most important changes in this? And why?

Unfortunately, how the operational plan works, there is not a specific route within the station.
During the arrival phase, passengers are often directed through the Northern Ticket Hall or the Western Subway. If the mall is open, people are directed through there.
For the return the majority of returning people are routed through one ticket hall. This is through the northern ticket hall, to prevent conflicting flows within the station.
The most important change for the future is to optimize how these halls and corridors are connected well so that they can handle the increasing density.

- How will the station be integrated into the urban environment?

The station is seamlessly embedded into the urban fabric, particularly through its direct links to the Westfield mall. It functions as an extension of the public realm, with entrances that lead directly into major shopping streets and the park, making the transition from the transport network to the city environment almost invisible for the user.

- Is the station now seen as a barrier between city districts? Do you want to prevent it or keep it that way?

Historically, the vast railway lands at Stratford acted as a major barrier. However, the 2012 redevelopment and the construction of high-level walkways and subways have largely bridged this gap. The goal of the current governance is to continue removing these physical and perceived barriers to ensure East London feels like a unified district.

- If it becomes a livelier area, will you add 'sponge zones' to the area? This means that there will be areas that people can 'absorb' in order to reduce the pressure on transport?

The Westfield Mall can be a natural ‘sponge zone’, however, this is will be often closed after the events. Often after events, people want to go home quicker (similar as at Wembley Park and other sites).

- How is the station and the area around it be designed so that it is a nice area to stay in?

The focus of the station is providing high-quality transportation. Within the ticket halls, there are coffee corners and small cafes to quickly grab something or to wait for your transport. The wider ticket halls are light and provide a nice area to stay in.

**Safety & Security:**

- What structural and physical aspects will you take into account for the design of the new station? Which ones are there now and which ones do you want to have here in the future? And why?

Design is governed by the Congestion Control and Emergency Plan. Structurally, the station utilizes a mixture between wide and narrow concourses, to prevent the "tunneling effect" where crowds become dangerously dense. In addition, the station uses a mezzanine level as a command-and-control point, offering a bird's-eye view of passenger flows. This allows managers to align plans in real-time and manage volumes safely across different levels. There is often one manager from the London Underground/TfL to manage the situations in daily and event moments.
The thunneling effect: a wide expense of the jubilee concourse and to enable and manage that maximum and safely. Although that is monitored throughout. There is a mezzanine level which the people are managed through. That overview of all the events. There is one event manager from the London underground perspective. Both plans are aligned and one complements the other.

- What operational interventions are now being used to ensure safety during events?

develops onto the congestion control and emergency plan. There are documents what to do in times of congestion. Some of those is to slow down the arrival profile (smaller halls, funneling). With the return, there are marshalls between London stadium and the station and the put on periodic stop and holds. Letting people into the station in groups improves the general safety level and stop the station from overcrowding.

- How will you ensure social safety at the station?

-

**Event management:**

- What will change at the station in its design and in the operational situation during events?

Most critical and often used are the gates in the hallways. On daily use, they are at the 50/50 border of the passageways (picture). During events, they shift to 70/30% before the event, meaning that there is more space for going towards the Queen Elizabeth Olympic Parc, and after events the gates are situated at 30/70%.

This station shift in multi-directional flows is highly managed. Signage and staff is used on specific positions at gatelines and platforms to provide guidance and reassurance to the crowd.

- What are lessons from the past ~5-10 years about events in the area that you take with you during event management and the design of the station?

The primary lesson is the importance of "learned behavior." The management team has found that football fans are much easier to manage than concert-goers because they know the station's "nooks and crannies." This has taught management that for non-sporting events, they must double their efforts in terms of visual wayfinding and PA announcements.

- Which organisations and institutions are involved in the governance of events? How is the cooperation between these parties going?

Governance is managed through the Safety Advisory Group within the Borough of Newham. This group includes TfL, London Underground, the Metropolitan Police, London Stadium, West Ham United, and Westfield. This cooperation is described as excellent, as the group enables all parties to discuss the wider landscape and align their individual operational plans into a single, cohesive strategy.

**Crowd management:**

- Are there so-called bottleneck points in the flow of people during events? How do you plan to remedy these in the design of the new station?

The bottlenecks occur at the gates and at some narrow subways/corners of the station, especially during the peak return flow. The masses are therefore distributed within the operational plans of the ‘stop-and-holds’. . By slowing down the crowd before they enter the building, the internal bottlenecks are kept manageable, ensuring that the platforms remain a safe environment.

- Do you use crowd simulation techniques and do you find interesting findings?

-

- How is the masses distributed at the moment and will that change? Is there a difference between distribution during events and during normal day time?

Answer is given above.

- How does the information on offer during events change? Or are there standards that you adhere to (signs, wayfinding, fencing, etc.)?

Not really. But what will change is the announcements being made should there be a difference to what customers do ordinary. This is only done, so that people should be routed to a different way. There is some switchable signage. They are more relied to the PA broad cast.

**Transport:**

- How are you going to make the station future-proof to ensure new methods and ways of transportation?

There is the ambition to redesign the station in such a way that there is one big mezzanine level on top of all the tracks, similar like Utrecht Centraal. This will ensure that the station has a better overview of all available modes of transportation.

- How is the integration with other modes organised? And are there bottlenecks between these systems?

Integration is managed through a complex series of subways and overbridges that connect the various rail and bus networks. The primary bottleneck is the physical distance between some platforms (e.g., between the high-level and low-level tracks), but the high frequency of services across all modes helps mitigate the impact of these transfer times.

- How do you want to integrate cyclists and pedestrians into the new design?

The wider regeneration area includes segregated cycle lanes and pedestrianized zones. The station design supports this by providing multiple step-free access points and ensuring that pedestrian routes from the park and the mall are wide, safe, and clearly signed.

**Governance and organization:**

- Which are the main stakeholders that are involved in the new project? Could you provide a limited evaluation of their respective agency in the project? What are they responsible for and how much is their perspective driving the project? So, for example, be very guiding in the wishes and requirements for the final design?

The main stakeholders are TfL, London Underground, the London Legacy Development Corporation (LLDC), and private partners like Westfield. Each has a driving perspective: TfL focuses on safe railway operation, while the LLDC and Westfield focus on the broader economic and social regeneration of the area.

- How is the decision-making structured in [country]? (In the Netherlands we use the MIRT process + small explanation)

Decision-making for station operations is anchored in the Congestion Control and Operation Plan. These documents are reviewed annually to respond to changes in the area. Strategically, decision-making is collaborative, involving the Safety Advisory Group to ensure that transport plans complement the needs of the stadium and the surrounding commercial interests.

- How adaptive is the decision-making process? For example, if new cases occur such as delays, new stakeholders, or public resistance?

They are very good. The station staff has courses to familiarize the station, during daily and peak moment. They know everything in the layout. Every location on the station gets a team leader. So that everybody has an understanding of the complete situation. This allows for fluent real-time decision making during events.

- What is the average turnaround time of decision-making? And what do you think of this lead time itself (long, logical, too short)?

Not relevant for this case/station.

**Complete Station**

- Will you invest in making the station/station area alone attractive, or will it be focused more on the area development?

The investment is entirely focused on area development. The station is seen as the heart of the "Olympic Legacy" regeneration. By making the station attractive and efficient, it drives the value of the surrounding residential buildings and the success of the leisure and retail sectors in East London.

- Would you consider the station as ‘more than only a public transport centre’?

Absolutely. Stratford is a very busy, varied hub. It is a center for leisure, a gateway to a world-class park, and a shopping destination. The usage is incredibly varied; it serves everyone from the daily office commuter to families visiting the mall or fans attending a match. It is a multi-functional community and economic engine.

- How does the station contribute to the social and economic or cultural dynamics in the area?

The station is the single most important factor in the transformation of East London. It has turned a once-industrial wasteland into a thriving cultural and economic dynamic. By providing the connectivity needed for the mall, the park, and the new residential towers, it has created thousands of jobs and established Stratford as a major new "heart" for London.

# Appendix H: Interview Summary Transportation Department Stockholm

This interview was conducted on the 7th of January 2026 with the project manager of the Slakthusområdet station from Region Stockholm.

**General**

- Do you look at other stations in Sweden or perhaps across the borders for inspiration for new design elements for a station?

For this specific station, there wasn't an extensive global search for inspiration. However, for stations incorporating high-capacity elevators (like Gullmarsplan), the team conducted study visits. Very early in the planning process, study visits were made to both Spain and Hong Kong to observe their systems and design solution.

**Position in network:**

- What role will the station play within the local and regional network? What role does the station play in relation to the stations connected to this one? (relieve / stress)

It will be a station on the Hagsätra line which will be concerted to the Blue Line. It is crucial for the new residential area (3,000 homes) and the 14,000 new working spaces developed. Therefore it will be an important station for the people who move there, but also for all the stadiums. In addition for a lot of smaller scenes in the area as well.
It is located near to Gullmarsplan (Stockholm's third-largest statin), roughly between 5-10 minutes' walk away. Over there it provides connections to the Green Lines, trams and buses. The station willl mainly be important for the closest areas around the station and also the event area.
Furthermore, the expansion of the Blue Line into the southern part of Stockholm will increase capacity of the public transport by approximately 50%. Currently there are three lines, all going on the same tracks. So when it opens there is a new track and that will increase the capacity, allowing for more frequent journeys.

- Is the station developed for two different roles: peak capacity during events, and a normal shape?

Normally the design of the station is in line with the general evacuation rules of a station. You should be in a safe area in a certain amount of time. That is the general design of the station. When there are (big) events, the station will be full quick due to the arrival of many people. Therefore, this station features 4 escalators (instead of the usual  3) and a wider platform to handle bulk arrivals before and after events.
While an arena can take 2 hours to fill, it can be emptied in just 15 mintues. To manage this, the station entrance is placed at a distance from the arena to spread the crowd, and queues are manages on the surface rather than the platform for safety. This has definitely affected the distance from the arena to the entrance of the metro in the design process.

- How will the station be developed to connect with the new surrounding neighbourhoods?

There are two entrances, one on the ground level of an office building, which enters the north side of the station. The second entrance is on the south side of the station, which is located near a park. This

entrance is the closest to the event area. Around these entrances there are pathways for pedestrians to enter the new neighbourhood.

**Geographic Location:**

- How is the integration with event area currently set up (walkway)? And what will be the most important changes in this? And why?

  Stockholm Stad plans to rebuild Arenavägen road to even out the elevation levels (the event area is currently higher). They are also planning to build more connected bridges over this road to improve integration, though this is the city's responsibility

- How will the station be integrated into the urban environment?

See answer in the previous section.

- If it becomes a livelier area, will you add 'sponge zones' to the area? This means that there will be areas that people can 'absorb' in order to reduce the pressure on transport?

Not really, there have been considerations for the entrance, but they didn't want it closer to the stadium. Just ordinary streets. The city did make some simulations regarding the pedestrian streams and how long you might have to wait and the choices of the people towards which station. Today as it is, it is very crowded, so some people choose to walk into the city.

- How will the station and the area around it be designed so that it is a nice area to stay in?

However, the city (so not where Anna works) aims to create a "shopping street feel" in some parts of the area with squares, restaurants and an Art School, all to encourage people to stay longer before and after concerts.

The company who is building the offices they have the right to built a big part on the area, when they purchased that right there was an article that compared it to Kings Cross in London.

**Safety & Security:**

- What structural and physical aspects will you take into account for the design of the new station?

The station is a rock tunnel with concrete structures designed for a 110-year lifespan. The core safety requirement is that two full trains must be evacuated within 8 minutes.

- What operational interventions you use to ensure safety during events?

Arena operators are responsible for crowd safety outside. Anna has learned that it is not safe to have too many people on the platform, therefore, for the station, the priority is keeping crowds on the surface. In the south park area, there have been discussions with the police to ensure free sightlines between entrance buildings to prevent illegal activities. The city is planning to place the park. Authorities responsible for safety in the area do not want to place constructions too close to the station in which case they will provide hiding places etc.

- How will you ensure social safety at the station?

The design prioritizes light and visibility with no hidden angles, no weird passage ways and no dark corners. There are cameras in elevators and on platforms. The design strictly follows regulations for disabled access, including tactile surfaces on floors. The city is also discussing "Kiss & Ride" zones to drop off passengers safely. The daily safety in the area, and thus the station, is also the responsibility of the city.

**Event management:**

- What will change at the station in its design and in the operational situation during events?

For the station itself, there is only a small change at the southern entrance. The one closest to the event area is for the visitors, while the other entrance if used by police, safety stewards and ambulance (part of the plan in the planning process). Furthermore, the waiting area of the metro becomes on the surface instead of in the station.

- What new and special design elements are considered with an event area around the corner?

From the platform up to surface level. There are 4 escalators, except of 2. And a wider platform. That is the only thing that has been changed at the station with regard to the event area. The positions of the entrance shouldn't be too close. Otherwise it is very similar to other metro stations in Stockholm.

- What are lessons from the past ~5-10 years about events in the area that you take with you during event management and the design of the station?

-

- Which organisations and institutions are involved in the governance of events? How is the cooperation between these parties going?

Cooperation involves the Municipality of Stockholm and the companies running the arenas. The arena companies are responsible for managing the crowd outside the station.

**Crowd management:**

- Are there so-called bottleneck points in the flow of people during events? How do you plan to remedy these in the design of the new station?

They would like to empty the arena by 15 minutes. So many people would leave the area. She doesn't know if people are managed well, but people start to be waiting on the streets. Even if there are extra trains, it would not take away people quicker than you would like.

- Do you use crowd simulation techniques and do you find interesting findings?

Yes crowd simulation techniques is used by the muncipality

The city of Stockholm have reports on this how that looks like.

- How is the masses distributed at the moment and will that change?

Right now people walk towards Globen or Gullmarsplan, or even 3km into the city center. When the future station is there, the people streams will divert and divide over these stations.

- How does the information on offer during events change? Or are there standards that you adhere to (signs, wayfinding, fencing, etc.)?

Signage is mostly fixed and ordinary. During special events like the Hockey World Championships, more advertisements and wayfinding (e.g., dots on the ground) might be added to guide people toward Gullmarsplan.

- Do you use input from the users who have experiences during the big peaks?

The design proposal was put on public display 5–6 years ago, allowing the public and stakeholders to leave remarks and opinions, which were considered in the final "Railroad Plan".

**Transport Modes & Transfers**

- Do you want to make the station so future-proof that multiple metro lines can run through the new station?

Not everything can be designed for that, of course the concrete and structures are for 110 years. The station is not future proof to include a new metro line. There are no platform doors as of right now, but the platforms should be able to handle the platform doors in the future.

- There is also a tram stop nearby, will you include the integration of this mode with the station/development area?

Its too far away.

- How do you want to integrate cyclists and pedestrians into the new design?

When it comes to parking bikes and such things it is also up to the city. They haven't planned for it, but the city has planed for it. Between the two entrances on the south side of the station.

**Governance and organization:**

- Which are the main stakeholders that are involved in the new project?Could you provide a limited evaluation of their respective agency in the project? What are they responsible for and how much is their perspective driving the project? So, for example, be very guiding in the wishes and requirements for the final design?

Of course the city of Stockholm is a major party → they have been discussing with them continuously along the way. The city is also a major funder and therefore a very important stakeholder.

The organization who will be running the metros in the station in the future Trafikförvaltningen. They only pay if they want something extra from what is originally decided. They wanted to be it future proof with more elevators so they pay the difference from what they had planned.

Both parties have been reviewing all the documents in the system etc. at different moments in the decision-making process.

- How is the decision-making structured in Stockholm / Sweden? (In the Netherlands we use the MIRT process + small explanation)

The project stems from a Stockholmsförhandiungen 2013 agreement, signed 2014. Unusually, the Railroad Plan (land use) and the Environmental Law process (court decisions on water/noise) were

handled in parallel to save time. Construction often begins on finished design parts before the entire extension's design is finalized.

When they made the agreement to extent the metro system in 2014, back then it was very time-critical, meaning they wanted to let this happen as soon as possible. They had 2 different planning processes.

Usually there are two separate processes, the ‘Rail Road Plan’ and the ‘Environmental Law process’. First the Rail Road, with the aim to secure the right to use the land for railroad purposes, to know what this area needs you have to make some initial design work including the how the station will look like and where the entrances should be, while the environmental law process is afterwards. Here they go to court to see how much water/pollution/noice the construction is allowed to make.
However, because it was time-critical, these processes were done simultaneously/parallel, which is very unusual for a construction this big.

They don’t have a really pre-planning etc. for constructions like this. But it has been divided so that preparation processes also done simultaneously. When it comes to the planning process, there is a law they have to follow.

- How adaptive is the decision-making process? For example, if new cases occur such as delays, new stakeholders, or public resistance?

Public resistance has been low as the project is very popular. Most complaints are about construction noise. Because the project is divided into many contracts, the region acts as a "puzzle master," taking more responsibility as a client to manage delays and changes.

- What is the average turnaround time of decision-making? And what do you think of this lead time itself (long, logical, too short)?

Yes it would be shorter than usual, because the municipality thought it was so time critical. The main permits were ready in 2019. Compared to projects this sized it was very fast.

**Complete Station**

- Will you invest in making the station/station area alone attractive, or will it be focused more on the area development?

Without the development, there wouldn’t be a station. If they wouldn’t have developed the area. The extension of the metro line is part of the whole area development and not merely the station. It has a major impact on the whole southern part of Stockholm. So the line, and thus the station and the surrounding areas, will be very critical for the whole area development.

- Would you consider the station as ‘more than only a public transport centre’?

Just a metro station for the area and the event area. The public space is not included in the station, the story about King’s Cross is separate from the station.

- How does the station contribute to the social and economic or cultural dynamics in the area?

If the existing station were closed without building the new one, the long walking distances would make the area much less attractive for residents and businesses. It is essential for the economic and cultural dynamics of the former Meatpacking District.

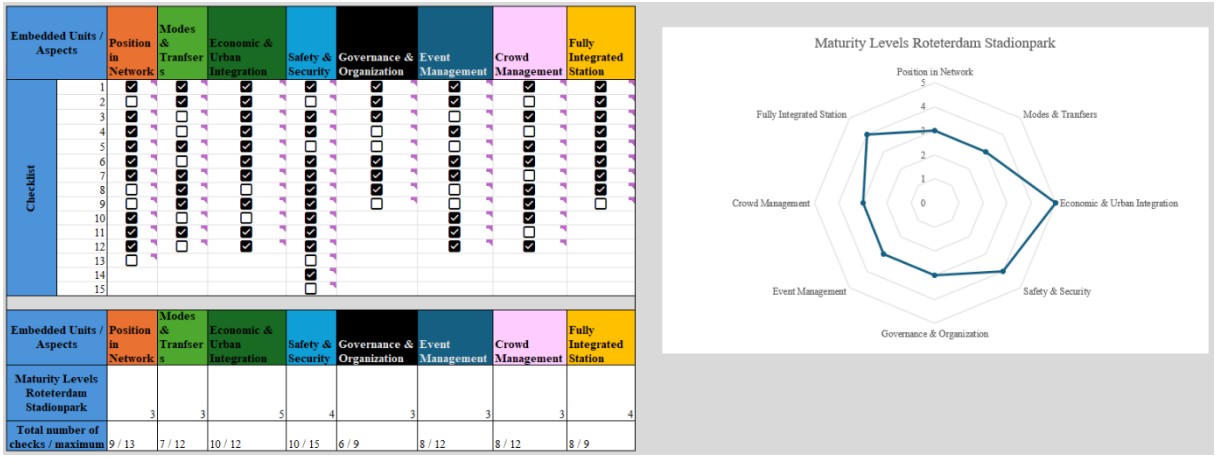
# Appendix I: Maturity Scores of other researched stations

In this appendix the results of the application of the tool to every station in the research can be found. Every result will include a small summary of the station and the tool.

**Rotterdam - Stadionpark**

The future station Stadionpark is assessed in the tool. The position in the network of the station is average, as it will be a Sprintertrain station and not an intercity station. If the station gets a direct connection to an airport, for instance Rotterdam The Hague or Schiphol, the position in network would increase to maturity level 5. This would be a recommendation to improve the position in network of Stadionpark. Concerning Modes & Transfers, the station misses out on quantity to evolve to maturity level 4. A reasonable improvement could be an 'express line', which connects to other smaller hubs in Rotterdam Zuid, or a high-frequency boost after events.

Concerning Governance & Organization, it is advised to incorporate more public-private partnerships, as the regeneration around the future station is interesting for companies to establish their business. In addition, a periodical lessons learned after events would improve the organization as well. Moreover for events, the event management could improve if there is going to be a centralized organization. In addition tactics like stop-and-go or different in- and outbound strategies are recommended. Furthermore, the future station could include big internal halls to separate streams of crowd better to improve the crowd management.



| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Checklist 1 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 2 | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ |
| 3 | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| 4 | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ | ☐ | ☑ |
| 5 | ☑ | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ | ☑ |
| 6 | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 7 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ |
| 8 | ☐ | ☑ | ☐ | ☑ | ☑ | ☐ | ☑ | ☑ |
| 9 | ☐ | ☑ | ☑ | ☑ | ☐ | ☐ | ☑ | ☐ |
| 10 | ☑ | ☐ | ☐ | ☑ | | ☑ | ☑ | |
| 11 | ☑ | ☑ | ☑ | ☑ | | ☑ | ☐ | |
| 12 | ☑ | ☐ | ☑ | ☑ | | ☑ | ☑ | |
| 13 | ☐ | | | ☐ | | | | |
| 14 | | | | ☑ | | | | |
| 15 | | | | ☐ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Roteterdam Stadionpark | 3 | 3 | 5 | 4 | 3 | 3 | 3 | 4 |
| Total number of checks / maximum | 9 / 13 | 7 / 12 | 10 / 12 | 10 / 15 | 6 / 9 | 8 / 12 | 8 / 12 | 8 / 9 |



*Figure 69 - Tool applied to Rotterdam Stadionpark*

### Madrid Bernabeu

Right now, the station could improve its position in network the best if it either adapts a peak load infrastructure or a direct connection to the airport. The other criteria are less applicable to the station under its current circumstances. For Modes & Transfers, it would help to include more modes, for example on extending the regional train line which also goes underground. This is less feasible though, as it is primarily a metro station with some buses above ground. For other aspects, the event management could make some more steps; the most important one to rise in maturity would be a centralized organization, for example similar to the OMC in Amsterdam. Otherwise, the station could learn from a different in-and outbound strategy with regard to events.

With crowd management, the two lessons applicable to this station are real-time monitoring and dynamic wayfinding. The latter is a little less useful, as the metro is directly next to the stadium. Although, there could be way finding to diverge the crowds towards the Nuevos Ministerios to relief the pressure on the Bernabéu metro station. Lastly, the Fully Integrated Station aspect could improve to integrate more soft design elements and aesthetics.

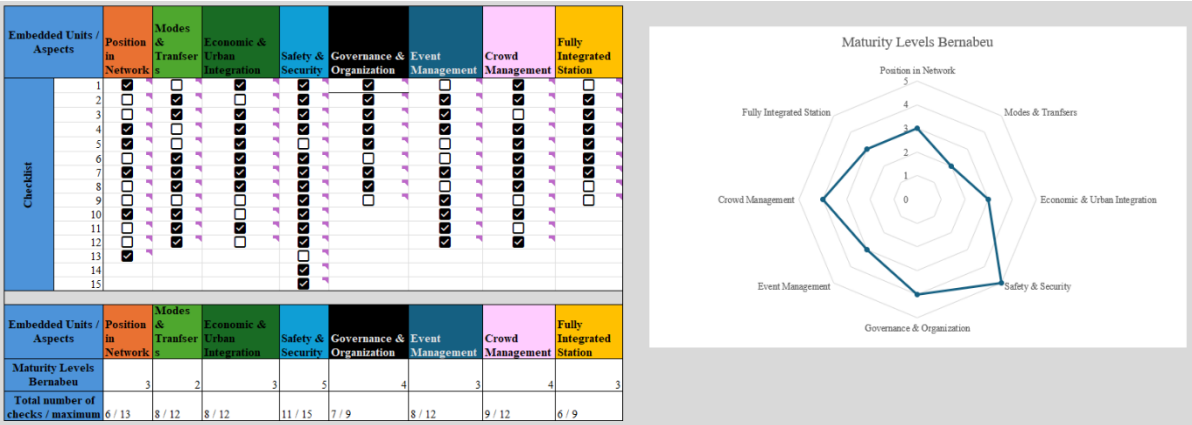



*Figure 70 - Tool applied to Madrid Bernabéu*

### Wembley Park Station

With regard to Position in Network, Wembley Park could improve on a direct connection to an airport, or by integrating some national trains. However, that is less feasible, as it is primarily a metro station. Integrating one more mode could work, as there is enough rail capacity. That is also one of the reasons why Modes & Transfers remains on maturity level 1. An other important one is integrating high-capacity access points. The station now has a singular lift from Olympic Way and a huge staircase. A main recommendation would be to introduce big escalators or more elevators. Compared to other stations, the Wembley park station could learn from the advanced bike infrastructure around some of the other stations. In addition, there is some potential for shared mobility, although this wouldn't be advised around major events, but for daily usage it would be profitable.

The other aspects score either a 4 or 5, but for Economic & Urban Integration, bridging the track as barrier would improve the station and its area as a whole. Adding some more pedestrian bridges above the tracks, or enlarging the sidewalks around Bridge Road, would connect the two city parts better together. This would also increase the Fully Integrated Station, but only if another criteria is checked as well. A potential good recommendation would be the cultural gateway. Including more assets of the Wembley area in the station, and acting that the station is the main entrance is very feasible and would work in this context.

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Checklist 1 | ☐ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ | ☐ |
| 2 | ☐ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ |
| 3 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 4 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 5 | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ |
| 6 | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 7 | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| 8 | ☐ | ☑ | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ |
| 9 | ☐ | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| 10 | ☐ | ☐ | ☐ | ☐ | | ☑ | ☑ | |
| 11 | ☑ | ☐ | ☐ | ☑ | | ☐ | ☐ | |
| 12 | ☐ | ☑ | ☑ | ☑ | | ☑ | ☑ | |
| 13 | ☐ | | | ☐ | | | | |
| 14 | | | | ☑ | | | | |
| 15 | | | | ☑ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Wembley Park | 3 | 1 | 4 | 4 | 4 | 5 | 5 | 3 |
| Total number of checks / maximum | 6 / 13 | 6 / 12 | 8 / 12 | 10 / 15 | 8 / 9 | 10 / 12 | 11 / 12 | 5 / 9 |

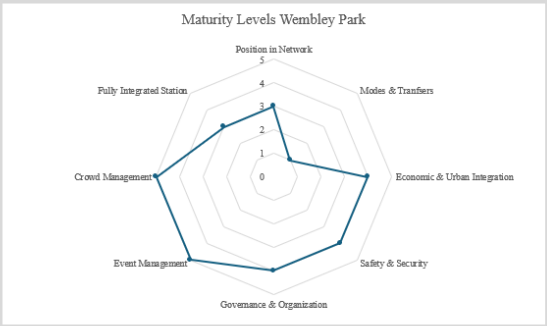



*Figure 71 - Tool applied to Wembley Park Station*

### Stratford Station

Even though Stratford's Modes & Transfers is on maturity level 5, it is feasible to check the last box, as this is the capacity increase, activating extra tracks during events. The station is big enough to do so. With regard to safety, a major improvement would be to improve the sightlines and transparency of the station. As right now it is a maze of tunnels, the ambition to grow to a complete immense mezzanine over all the tracks would help to overcome this. Furthermore, an operational plan to segregate streams of fans towards the stadium could be done, by using the Pudding Mill Lane station on the south side of the Olympic Park.

To improve the crowd management, implementing simulation techniques is feasible and useful for the station and its area. Especially in predicting on how to use the mall as a natural buffer before and after events is interesting. Furthermore, the behaviour of destinations for travellers could gain insights into how the future possible mezzanine level could look like and what tracks/lines are preferred by the majority of visitors. Increasing the outbound capacity to events is the last crowd management technique which is a reasonable lesson from the cross-case comparison. This would also enhance the multi-modal harmony. As it is a huge and crucial node for the UKs transportation system, arranging and enhancing all time tables would be profitable to make connections even better.

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Checklist 1 | ☐ | ☑ | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ |
| 2 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 3 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 4 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 5 | ☑ | ☐ | ☑ | ☐ | ☐ | ☑ | ☑ | ☑ |
| 6 | ☐ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| 7 | ☑ | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ |
| 8 | ☑ | ☑ | ☐ | ☑ | ☑ | ☑ | ☐ | ☑ |
| 9 | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | ☐ |
| 10 | ☑ | ☑ | ☑ | ☐ | | ☑ | ☐ | |
| 11 | ☑ | ☑ | ☑ | ☑ | | ☐ | ☑ | |
| 12 | ☐ | ☑ | ☑ | ☑ | | ☑ | ☑ | |
| 13 | ☑ | | | ☐ | | | | |
| 14 | | | | ☑ | | | | |
| 15 | | | | ☑ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Stratford Station | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 4 |
| Total number of checks / maximum | 10 / 13 | 11 / 12 | 11 / 12 | 9 / 15 | 8 / 9 | 10 / 12 | 10 / 12 | 8 / 9 |

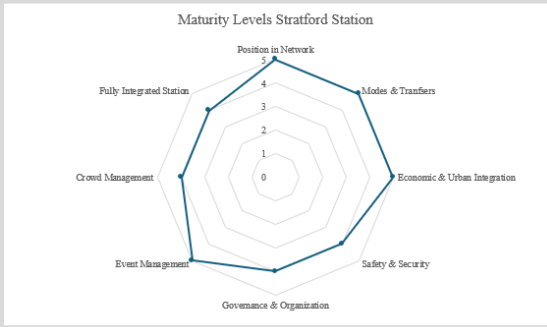



*Figure 72 - Tool applied to Stratford Station*

### Slakthusområdet Stockholm

Even though the station is a metro-only station, the score for position in network is high. A criteria it could learn from is the regional accessibility. If for example above ground the station gets busses, it could be connected way better to its surroundings in the new neighbourhood and the city parts around it. This would in that case, also enhance the number of modes available. With regards to Modes and Transfers, the station could improve on multiple fronts. Especially on including more modes above ground or by integrating a bicycle structure in the new neighbourhood.

With regards to safety & security, the station and its management should include hot links between the transport operators, emergency services and the event area. Moreover, enhancing the area inside the station, so not only the platforms, but for instance also a small mezzanine level, as the station will be very deep into the ground, would improve the safety features as well. Lastly, as it will be a very new station, platform doors are interesting to consider.

Within event management, a different in- and outbound strategy is a lesson from other stations that could be included. Furthermore, the centralized organization who managed events and crowds is a recommendation to the stations and the area towards the event sites. For crowd management, the internal buffering comes back as well. Lastly, for fully integrated station, it being a cultural gateway as potential, because of the Slakthusområdet neighbourhood.

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Checklist 1 | ✓ | | ✓ | ✓ | ✓ | | ✓ | |
| 2 | | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| 3 | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| 4 | | | | ✓ | ✓ | ✓ | ✓ | |
| 5 | ✓ | | ✓ | | ✓ | | ✓ | ✓ |
| 6 | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 8 | | | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 9 | | | ✓ | ✓ | | ✓ | | |
| 10 | ✓ | | | | | ✓ | ✓ | |
| 11 | ✓ | | ✓ | | | | ✓ | |
| 12 | ✓ | | | ✓ | | ✓ | | |
| 13 | ✓ | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | ✓ | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Stratford Station | 4 | 2 | 5 | 3 | 4 | 3 | 4 | 3 |
| Total number of checks / maximum | 7 / 13 | 3 / 12 | 9 / 12 | 7 / 15 | 8 / 9 | 8 / 12 | 10 / 12 | 5 / 9 |

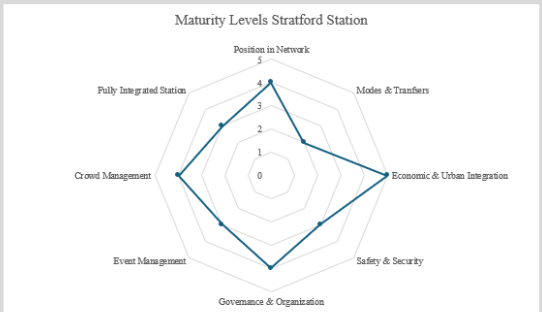



*Figure 73 - Tool applied to Stockholm, Slakthusområdet*

### St Denis-Pleyel / Stade de France

Due to limited information, the recommendations would not be viable.

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Checklist 1 | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| 2 | ✓ | ✓ | | | | ✓ | | |
| 3 | ✓ | ✓ | ✓ | | | | ✓ | ✓ |
| 4 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| 5 | ✓ | | | | | | | |
| 6 | | | | | | ✓ | ✓ | ✓ |
| 7 | ✓ | ✓ | | ✓ | | | | |
| 8 | | ✓ | ✓ | | ✓ | | ✓ | |
| 9 | ✓ | ✓ | | ✓ | | | | |
| 10 | ✓ | | ✓ | | | | | |
| 11 | | | | | | | | |
| 12 | ✓ | ✓ | | ✓ | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |

| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels St Denis | 4 | 4 | 2 | 2 | 2 | 1 | 1 | 1 |
| Total number of checks / maximum | 9 / 13 | 8 / 12 | 4 / 12 | 6 / 15 | 4 / 9 | 2 / 12 | 5 / 12 | 4 / 9 |

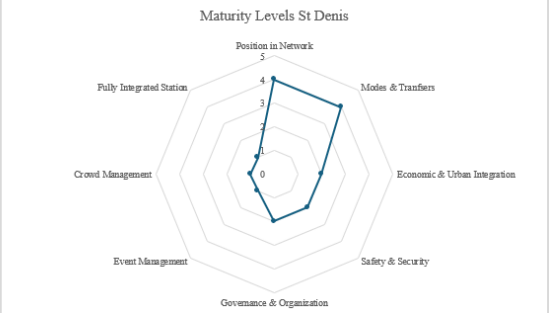
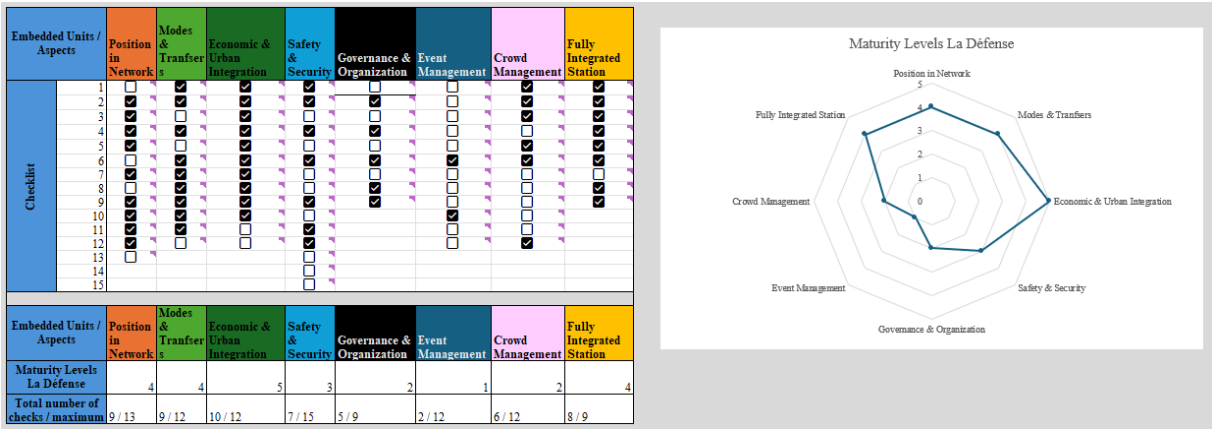



*Figure 74 - Tool applied to St Denis Pleyel - Stade de France Station*

### La Defense

Due to limited information, the recommendations would not be viable.

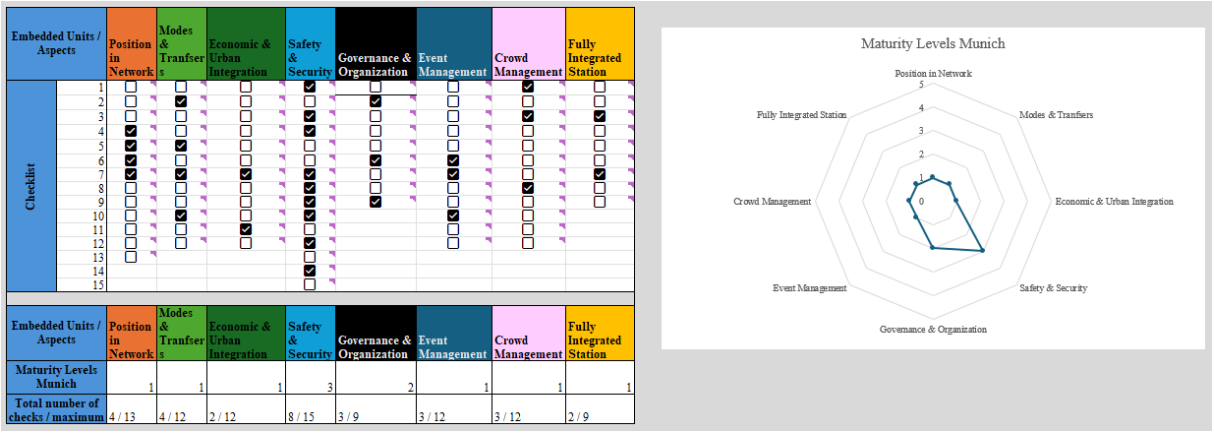



| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels La Défense | 4 | 4 | 5 | 3 | 2 | 1 | 2 | 4 |
| Total number of checks / maximum | 9 / 13 | 9 / 12 | 10 / 12 | 7 / 15 | 5 / 9 | 2 / 12 | 6 / 12 | 8 / 9 |

*Figure 75 - Tool applied to La Défense Paris*

### Munich - Frötmanning

Due to limited information, the recommendations would not be viable.




| Embedded Units / Aspects | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Maturity Levels Munich | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 1 |
| Total number of checks / maximum | 4 / 13 | 4 / 12 | 2 / 12 | 8 / 15 | 3 / 9 | 3 / 12 | 3 / 12 | 2 / 9 |

*Figure 76 - Tool applied to Munich Fröttmaning station*

### Maturity levels compared to Amsterdam

| | Position in Network | Modes & Tranfsers | Economic & Urban Integration | Safety & Security | Governance & Organization | Event Management | Crowd Management | Fully Integrated Station |
|---|---|---|---|---|---|---|---|---|
| Rotterdam Stadionpark | 3 | 3 | 5 | 4 | 3 | 3 | 3 | 4 |
| Bernabeu | 3 | 1 | 3 | 5 | 3 | 3 | 4 | 3 |
| Wembley | 3 | 1 | 4 | 4 | 4 | 5 | 5 | 3 |
| Stratford Station | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 4 |
| Stockholm | 4 | 1 | 5 | 3 | 3 | 3 | 4 | 3 |
| St Denis | 4 | 4 | 2 | 2 | 1 | 1 | 1 | 1 |
| La Defense | 3 | 4 | 5 | 3 | 1 | 1 | 2 | 4 |
| Munchen | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 |
| ABAS | 5 | 4 | 4 | 3 | 5 | 4 | 4 | 3 |

*Figure 77 - Maturity levels compared to ABAS with coloured scheme*