Lotte van der Horst

Successful Innovation District Development

The Role of Spatial Quality

Graduation Research Report

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Colophon

L. van der Horst

Faculty of Architecture and the Built Environment, TU Delft

Julianalaan 134

2628 BL Delft

Graduation research report
Lotte van der Horst – 5087538
City of the Future – AR4CFM010

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The Role of Spatial Quality

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Author

Lotte van der Horst

Studio City of the Future - AR4CFM010

Supervisors

Karel van den Berghe (UDM) & Agnes van der Meij (ADC)

Natalie Yakovleva (Dev_ real estate)

Abstract

This research evaluates the role of spatial quality in the development of Dutch urban areas into successful innovation districts. While innovation districts represent a promising urban development model combining research, business, housing, and services, their implementation faces governance fragmentation, displacement risks, and the prioritization of economic goals over spatial integration. Drawing on literature, a Dutch case selection, site visits, a comparative spatial and innovation capacity analysis, the study examines three cases to identify which spatial characteristics support innovation and where they fall short. Results show a distinction between the three case studies in terms of spatial quality as well as innovation capacity, identifying necessary spatial elements, and identity-dependent enhancers. However, spatial quality alone does not guarantee success: non-spatial factors influence and often determine performance. By linking spatial quality to measurable innovation capacity, the study addresses a critical knowledge gap, moving beyond conventional approaches that overlook the essential interplay between form and function. Through the synthesis of theoretical frameworks and empirical observations, this research develops evidence-based, identity-specific recommendation grounded in management and development practices for guiding the future development of innovation districts. These recommendations provide actionable guidance to support municipalities and developers with successful innovation district development practices.

KEY WORDS – Innovation district development; innovation district success; spatial quality, innovation capacity; urban development

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1. Introduction

In the Netherlands, the concept of innovation districts is on the rise (Kooij & Wolf, 2025). In the 2010s, the term *innovation district* emerged as a new policy and planning concept for urban development (Kalliomäki et al., 2024), described by Katz & Wagner (2014) as 'a new geography of innovation' comprising compact inner-urban areas that combine research, business and innovation with housing and services such as leisure, with the emphasis on innovation. Innovation districts are characterized by their open and integrated nature, housing an ecosystem of numerous companies, knowledge institutes and start-ups, where people work, live and innovate, with the aim to apply knowledge into practice (Charnock et al., 2025). The economic growth of innovation districts is stronger than in other comparable areas due to the investment in both the physical area as well as the people active within an innovation district (Kooij & Wolf, 2025). The interplay of knowledge, technology and talent in innovation districts through the combination of living, working and digital technology is crucial for fulfilling the preferences of starters. Additionally, innovation districts pose the perfect opportunity for the exploration, development and testing of certain products and services close to the market and can act as hubs for international collaboration and can provide the cooperation between different industries (Kooij & Wolf, 2025).

However, the success of these transformations is not a given (Team Stadszaken.nl, 2025). Since innovation districts must integrate living, working and innovation, cities and regions still struggle with innovation district initiatives' focus and boundaries. One could say that no innovation district in the Netherlands is actually fully developed (Kooij & Wolf, 2025). Often, the economic importance is prioritized over the spatial one, missing the integration between form and function and society (Bol, 2024; Kalliomäki et al., 2024). Moreover, risks of disruption displacement and degradation are commonly associated with inner-city redevelopment and with that the chance of failure to produce more inclusive and resilient urban environments grows (Charnock et al., 2025). The integration of planning, design and innovation-driven development policies in innovation district development is needed to ensure success (Kalliomäki et al., 2024).

Few literature can be found on the strategic spatial planning and design processes of innovation districts, even though the strategic importance of the development and management of innovation districts as physical and spatial environments in which innovative interactions are enabled is emphasized by Kalliomäki et al. (2024). This research therefore aims to contribute by exploring the role of strategic planning and design in the redevelopment of existing urban areas into successful innovation districts.

The objective of this research is to evaluate and compare three mature Dutch innovation districts, with a particular focus on the relationship between an innovation district's spatial quality and success. With this analysis, the research aims to assess the extent to which the spatial character of a district leads to high levels of innovation intensity, performance and impact, together describing the innovation capacity. It serves as a basis for understanding how quantitative, measurable, and qualitative, non-measurable elements of the spatial quality influences the innovation capacity and how future innovation districts development processes can learn from these examples.

This research is relevant as it aims to contribute to the literature on the essential and innovation identity-specific spatial elements, drawing from best practices of Strijp-S in Eindhoven, VU-kwartier in Amsterdam and Spoorzone in Tilburg. Through a structured analysis of these cases, together with the analysis of innovation capacity data and a literature study, this research aims to generate a set of empirically grounded spatial standards and innovation identity-specific characteristics for the development of innovation districts, and thereby to address the current knowledge gap. The set of standards and characteristics is shaped through a management and planning perspective. The recommendations aim to align innovation district development strategies with the overarching goal of developing a fitting space in which innovative interactions are enabled, and are intended to support municipalities, developers, planners and other stakeholders in guiding the transformation of urban areas into successful innovation districts. Therefore, the main research question is:

> *What is the role of spatial quality in the development of successful innovation districts?*

To answer this question, it is important to firstly understand what an innovation district is and when one can be considered successful. Then, it is essential to understand which spatial characteristics are currently applied in Dutch innovation district. Subsequently, the research shifts its focus to the extent in which these spatial characteristics actually lead to successful innovation district development. Lastly, it explores how the design principles and learned lessons from the case studies can be applied to develop more successful innovation districts in the future. Therefore, the sub-question are:

1. *What is an innovation district and when can an urban area be defined as one?*
2. *When can the development of an innovation district be considered successful and when not?*
3. *Which spatial characteristics are essential for the development of innovation districts and to what extent do they facilitate its success?*
4. *How can the spatial qualities and learned lessons from case studies from existing Dutch innovation districts be applied to develop successful innovation districts in the future?*

For the visualization of the structure of the paper, see Figure 1. To answer the main and sub-question, a framework, guided by theoretical background, forms a foundational base from which the analytical and explorative approach is developed. This framework first outlines the definition and characteristics of an innovation district, after which the value is determined on different spatial scales, followed by a description of the way innovation districts are currently developed. This is followed by an elaboration of what defines a successful innovation district, to then dive deeper into essential place characteristics which lead to higher place quality. Lastly, a critical note on innovation districts, describing challenges and causes of failure, is given. From the research questions and the theoretical framework, a conceptual model is developed to show the key components of the research and how they relate to each other. This aids in visualizing and guiding the research.

Then the paper presents the methodological framework together with the research instruments used. The first method used is the theoretical framework based on an literature study. To translate the dimensions of current development practices, an inventory of various existing

Dutch innovation districts is developed, analyzing various characteristics such as development phase and model type in order to be able to make an informed selection for the comparative case study.

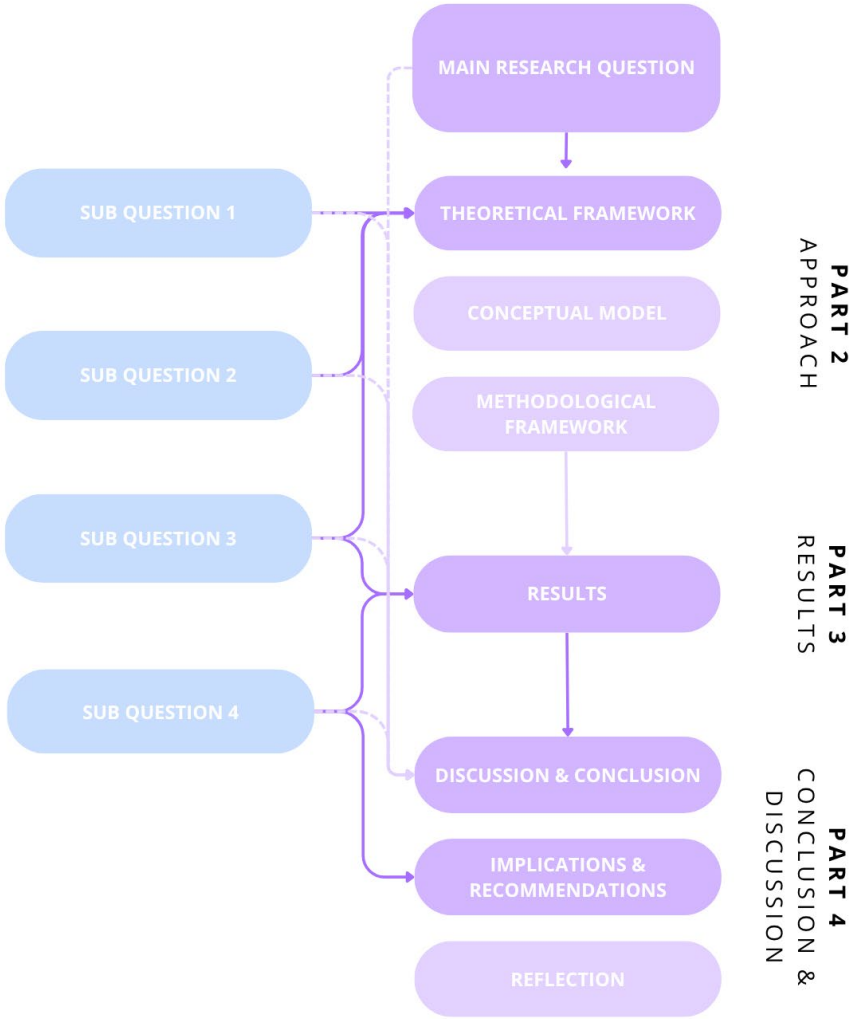

Figure 1 Visualization of the structure of the paper (own work)

Then site visits as well as a spatial, geographical and architectural analysis are conducted, which take form in and observation descriptions and drawings as well as an atlas containing spatial aspects of each innovation district case. Moreover, the analysis of quantitative data on the innovation capacity is carried out. The paper then presents the findings, followed by the discussion summarizing and comparing the findings of the three cases. The conclusion then answers the main research question. Lastly, theoretical implications and practical recommendations are described based on the discussed literature and research findings, followed by the researcher's overall reflection on the study.

This research examines innovation district development specifically through the lens of spatial quality, while incorporating a management perspective, with the aim to contribute

to the literature on the essential and innovation district-specific spatial conditions that support innovation. The study focuses explicitly on three Dutch cases: Strijp-S Eindhoven, Spoorzone Tilburg, and VU-Kwartier Amsterdam, representing the three most matured innovation districts in the Netherlands. Within this scope, 'success' is operationalized as innovation capacity, measured through innovation intensity, performance and impact. This aligns with the emphasis in the literature that innovation districts are 'the new geography of innovation', where people work, live and innovate, with the aim to apply gained knowledge into practice (Charnock et al., 2025; Katz & Wagner, 2014). Although the literature acknowledges additional dimensions of success, these fall outside the scope of this study, and are considered as contextual contributors. The focus of the study remains on understanding the relationship between spatial quality and innovation capacity, with the ultimate aim to contribute to more successful innovation district development practices.

2. Theoretical Framework

2.1 Defining an innovation district

According to Paul Jansen, from a historical perspective, the concept of innovation districts started with so-called Science Parks, where people solely came to work or study, after which they returned to their homes often in the city (Jansen, 2025). They were situated on the borders of a city around a university or hospital. Examples of these parks are Science Park Amsterdam and Leiden Bio Science Park. Later on, innovation campuses with a more industrial character were developed, often oriented around a corporation. An example of such a campus is the Philips High Tech Campus. Then, in the 2010s, the term *innovation district* was born as a new policy and planning concept for urban development (Kalliomäki et al., 2024).

Katz & Wagner (2014) described an innovation district in their influential policy paper as 'a new geography of innovation' in the shape of compact inner-urban areas which combine research, business and innovation with housing and services such as leisure. In their words: 'These districts … are geographic areas where leading-edge anchor institutions and companies cluster and connect with start-ups, business incubators, and accelerators. They are also physically compact, transit-accessible, and technically-wired and offer mixed-use housing, office, and retail.' (Katz & Wagner, 2014). According to them, all innovation districts contain economic assets, such as firms, institutions and organizations, physical assets – buildings, open spaces, streets etc. – and networking assets, the relationships between individuals, firms and institutions. Figure 2 (Wagner et al., 2024) illustrates the dynamic between these three assets and how they together form the core of an innovation ecosystem. The central overlap represents the synergistic relationship between the three assets from which idea generation and commercialization acceleration emerge (Katz & Wagner, 2014).

Building on this conceptual foundation, literature further characterizes innovation districts as open and integrated urban areas (Charnock et al., 2025). Innovation districts are the opposite of the formerly enclosed and remote innovation campuses, due to these characteristics. They house an ecosystem of numerous companies, knowledge institutes and start-ups, not just one. Within these areas, people work, live and innovate, with the aim to apply gained knowledge into practice. Moreover, the expectation is that this gained knowledge is used to generate and develop marketable innovations (Charnock et al., 2025). Therefore, an innovation district could be identified as an area development with a social-economic character as integrated part of the city (Jansen, 2025; Kooij & Wolf, 2025). The concept of innovation districts envisions a balanced dynamic between the built environment, governance, public and private investment, urban aesthetics, knowledge and people (Charnock et al., 2025). The people working in innovation districts are theoretically not only attracted to the employment opportunities of innovative organisations, but also to the lifestyle opportunities the various facilities offer (Esmaeilpoorarabi, Yigitcanlar, & Guaralda, 2018; Kalliomäki et al., 2024).

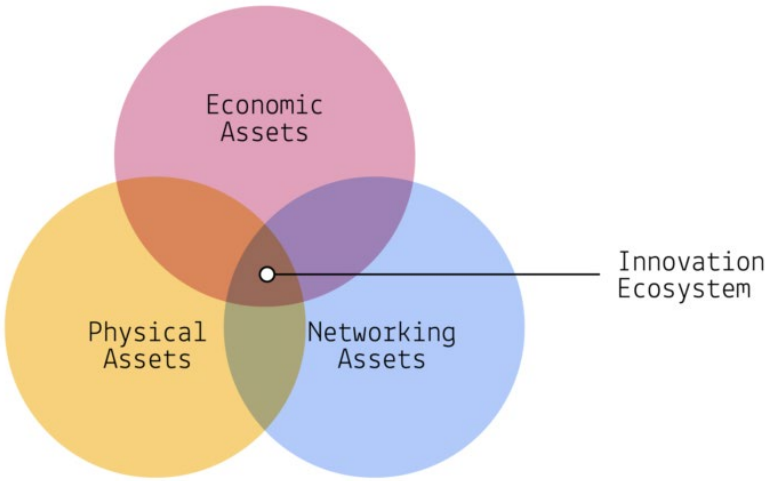

Figure 2 "As a starting point, innovation ecosystems require economic, physical, and networking assets working in concert." (Wagner et al., 2024)

Based on these definitions and characteristics, the research uses the following operational definition of innovation districts:

> *Inner-city, mixed-use areas which house an ecosystem of numerous companies, knowledge institutes and start-ups, in which people work, live and innovate, with the aim to apply gained knowledge into practice.*

The physical assets from Figure 2 refer to both public and private spaces, such as buildings, streets, open areas and supporting infrastructure, that are intentionally designed and arranged to foster connectivity, collaboration, and innovation within the district (Katz & Wagner, 2014). This research focuses specifically on these physical assets and their spatial qualities, exploring how the design and configuration of the built environment influence the success of an innovation ecosystem (Figure 3).

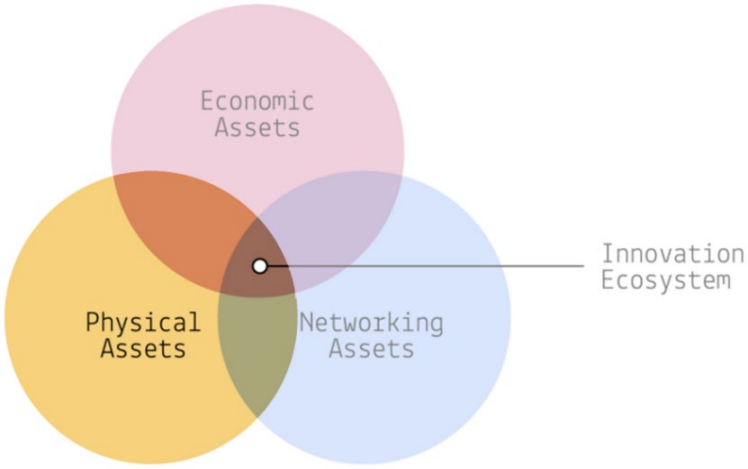

Figure 3 Research's focus, diagram adaptation from Wagner et al. (2024)

2.1.1 Innovation district classification

The BCI has identified criteria which indicate whether or not an area could be classified as an innovation district (Kooij & Wolf, 2025). The first criterium is that the area should be a multi-functional, inner-city environment, attractive for talent with multiple shared innovation facilities and open spaces which enable coincidental meetings and a connecting infrastructure. So, not solely a single building. Secondly, the area must sustain an active ecosystem in which companies, knowledge institutes, students and residents interact with one another, supported by networking events which foster knowledge-sharing, incubation and acceleration of start-ups and innovation. Then, a robust governance structure should be established which directs the area's development as well as the development of the ecosystem. This governance structure should be established with the involvement of companies and knowledge actors in the area. Lastly, a clear vision an strategy on both the spatial development as well as the innovative development must ensure the effective collaboration between various actors.

However, these four criteria should be regarded as preliminary, as no established scientific criteria yet exists (Kooij & Wolf, 2025). Moreover, the development of not a single innovation district is completely finished. Most innovation districts lack unity, like in the Central Innovation District in The Hague, or a well-structured and central governance structure, like for the development of the whole Amsterdam's Life Sciences District ecosystem (Kooij & Wolf, 2025).

2.1.2 Innovation district types

Multiple frameworks define innovation district types. This research follows the identification of innovation district according to Katz & Wagner's (2014). Their definition of three general models describe what most innovation districts adhere to; anchor plus model, re-imagined urban areas and urbanized science parks.

Anchor plus model

- Primarily found in downtown and mid-towns of central cities
- Large scale mixed-use development centered around major anchor institutions and a rich base of related firms, entrepreneurs and spin-off companies involved in the commercialization of innovation
    - Anchor institutions are research universities and research-oriented medical hospitals with extensive R&D
- *Examples: Kendall Square in Cambridge, Philadelphia's University City (anchored by universities or hospitals)*

Re-imagined urban areas

- Often found near or along historic waterfronts, where industrial or warehouse districts are undergoing a physical and economic transformation to chart a new path of innovative growth
- Change powered by transit access, a historic building stock, their proximity to downtowns in high rent cities, which is then supplemented with advanced research institutions and anchor companies.
- *Examples: Boston's South Waterfront, San Francisco's Mission Bay, Seattle's South Lake Union area, 22@ Barcelona*

Urbanized science park

- Commonly found in suburban and exurban areas, is where traditionally isolated, sprawling areas of innovation are urbanizing through increased density and an infusion of new activities (including retail and restaurants) that are mixed as opposed to separated
- *Example: North Carolina's Research Triangle Park*

2.2 The value of an innovation district on different scales

To strengthen the global competitive position of Europe and increasing the European economic growth, according to the Draghi-report of The European Committee (2024), the role of innovation is crucial (Kooij & Wolf, 2025). This report underpins the importance of innovation for the transition to a digital and circular economy. The development of innovation districts poses the prefect opportunity to foster this transition and with that the spatial characteristics of the Netherlands. On a smaller scale, in order to improve the city's overall economic competitiveness, the development of an innovation district aims to attract and hold on to investment, entrepreneurs and skilled workers to stimulate innovation (Charnock et al., 2025).

The economic growth of innovation districts is stronger than in other comparable areas due to the investment in both the physical area as well as the people active within an innovation district (Kooij & Wolf, 2025). Because of the interdependency of an innovation district and its surrounding urban fabric, capital flows and investments in one area can lead to either competitive or synergetic dynamical effects in another. Therefore the effects of this spatial interdependency need to be taken into account in urban development.

(Kooij & Wolf, 2025) have identified three important trends which determine the future value of innovation districts. Firstly, the interplay of knowledge, technology and talent in urban environments through the combination of living, working and digital technology is crucial for fulfilling the preferences of starters. Therefore, the attraction and preservation of talent is an essential task for innovation districts, as the current scarcity of young talent has big consequences for the Dutch economy. Secondly, technological development need to be aligned with the wishes and needs of humans. innovation districts pose the perfect opportunity for the exploration, development and testing of certain products and services close to the market. Lastly, cross-sectoral collaboration is essential, but has become a challenge in an increasingly closed-off world. innovation districts can act as hubs for international collaboration and can provide the cooperation between different industries.

2.3 The development of innovation districts

2.3.1 Rethinking Urban Economic Development for Innovation Districts

To understand the development of innovation districts, it is required to reconsider traditional approaches to urban economic development. The sector-based understanding of urban development and planning is challenged by the development of innovation districts. According to Kalliomäki et al. (2024), traditional economic development thinking relied on cluster-based assumptions, that innovation emerges within sectoral clusters. However, the diversity of sectors and clusters present in innovation districts oppose this traditional idea, as new connections between previously unrelated activities across clusters often spark innovation. In order to achieve this Kalliomäki et al. (2024) state the importance of the spatial

facilitation of relations between clusters in an innovation district, as well as their interactions and integration with the surrounding urban context. Therefore, in order to create these new connections, an integrated strategic planning approach is needed.

Literature describes certain development practices for innovation districts, giving insights in how they should actually be developed in practice. According to Yigitcanlar et al. (2024), there is a need for mixed-use developments. This strengthens innovation districts through the balanced combination of functions, with the aim to connect social and economic life, attract a dense and diverse group of users, and supports long-term socioeconomic growth. Additionally, Bol (2024) underscores the importance of giving clear direction to development of innovation districts, while simultaneously keeping flexibility in development strategies to give space for change. It is important to keep in mind that it is unclear what the end-result will look like, since development often span over multiple decennia. Therefore, the conventional "hit-and-run" approach of project-based construction will prove itself ineffective for innovation districts, requiring instead a fundamental shift in developer's attitude towards more extensive management practices, long-term investments and attention to community and socio-economic aspects.

2.3.2 The role of placemaking and soft conditions in enabling innovation

Spatially, besides the development of the physical 'hard' conditions, the transformation of an area into an innovation district requires the development of social 'soft' conditions, such as sociability, vibrancy, and livability, a process called *placemaking* (Charnock et al., 2025). The consideration of both these physical and economic conditions as well as place and lifestyle conditions 'encourages the clustering of creative and knowledge-based activities' (Esmaeilpoorarabi, Yigitcanlar, Guaralda, et al., 2018), which in turn will help attract and retain creative and skilled people to the innovation district. Subsequently, an 'open innovation' ecosystems is able to emerge, in which these people share their knowledge and creativity (Esmaeilpoorarabi, Yigitcanlar, Guaralda, et al., 2018).

2.3.3 From heritage site to innovation district

Heritage sites have become attractive places for the development of innovation districts, due to their transitional nature (Yildiz & Hetemoglu-Venedik, 2024). Due to decentralization (cities spreading), deinstitutionalization (closing of public institutions), and deindustrialization (loss of manufacturing), cultural heritage sites, among which industrial terrains, are abandoned and left increasingly vacant (Remøy et al., 2025; Yildiz & Hetemoglu-Venedik, 2024). The transformation of these vacant sites into innovation districts can reconnect them to the surrounding urban fabric and contemporary life (Yildiz & Hetemoglu-Venedik, 2024), simultaneously making a contribution to Sustainable Development Goal (SDG) 11 of 'sustainable cities and communities'. Furthermore, Lawrence et al. (2019) state that the re-use or polish-up of old buildings, diversity in districts could be increased by giving low- and no-profit uses an affordable place. The identity such historical buildings form for a district is an additional advantage of re-using buildings in the existing urban fabric. While these buildings are under development, temporarily use is of high importance in order to maintain the liveliness and attractiveness of the area during transformation, and for innovative companies to settle in the district while supporting the transformative development of the district. The importance of this temporary use is

emphasized by Dutch development manager Olga Wagenaar (Ravensteijn, 2025) and support placemaking activities.

2.3.4 Inclusive innovation

Enabling inclusive innovation with the development of innovation districts is essential. Morales et al., (2025) define inclusive innovation as 'the co-creation of new ideas, practices or technologies with local communities, businesses and organisations to address societal challenges, ensuring equitable benefit distribution and fostering community empowerment'. Development strategies must aim to prioritize inclusive innovation, and moreover be tailored to the existing spatial qualities of the area to adhere to the local socio-economic needs, as they can differ based on the type of place and challenge (Morales et al., 2025). Innovation districts need to be organically integrated into the existing fabric, and therefore inclusivity should be a predetermined and clear goal rather than an afterthought or byproduct (Chayka, 2014; Lawrence et al., 2019). Even though inclusive innovation is already an inherent goal of most innovation district developments, the failure to include socio-economic needs to benefit local communities in an equal way shows tensions between economical and inclusivity objectives. Morales et al., (2025) therefore suggest innovation districts to not only focus on creating jobs, but to integrate long-term and city-wide inclusivity strategies into their development policies with a diffusion of benefits to surrounding communities. They mention among others the importance of addressing economic inactivity, gender inclusivity and the promotion of education and integration.

2.4 Innovation district success

2.4.1 defining success for innovation districts

In literature, several determinants of innovation district success are identified. Vey et al. (2018) conclude five key elements that constitute a healthy innovation ecosystem, which are critical mass, innovation capacity, inclusivity and diversity, space quality and lastly leadership. They use an operationalization which states that every innovation district has a different starting point and thus requires strategies that match that distinctiveness based on analyses through the five key elements, even though all innovation districts combine economic, physical and networking assets (Vey et al., 2018; Wagner et al., 2024). Since the main aim of an innovation district is to produce new knowledge and to apply this gained knowledge into practice, this study uses the operationalization that more innovation means more success. Therefore success in this study is equated with a district's innovation capacity, as defined by Vey et al. (2018).

2.4.2 What is innovation capacity?

Vey et al. (2018) define innovation capacity as "a district's capacity to translate ideas into new products and services that improve the quality of life for residents and workers of the city and region" and, potentially, generate broader global societal benefits. This capacity can be assessed by examining several indicators, from measuring the amount of research being produced by industry and non-industry anchors to evaluating the connections between those anchors and their commercial activities to counting how many start-ups there are and what resources are available to them. To get a grip on what exactly to measure to determine a district's innovation capacity, these indicators can be re-grouped into three categories, following Burke & Gras' (2019) framework on key performance indicators of innovation districts; innovation intensity (concentration of knowledge-intensive employment),

innovation performance (outputs such as patents, research papers, and other R&D activity), and innovation impact (economic and social spillovers, e.g., employment growth and economic throughput). The results of measuring these KPI's determine innovation districts' health and maturity. These KPI's provide most effective insights on the district level, because they relate most to activities which directly happen inside of an innovation district.

2.5 Place quality and the design of innovation districts

2.5.1 The importance of high place quality

The integration of both soft and hard factors in innovation districts is essential for the growth of innovative ecosystems. Literature additionally revealed that place quality is important for ensuring the success of innovation districts on a socioeconomic and competitive basis (Esmaeilpoorarabi, Yigitcanlar, Guaralda, et al., 2018). High place-quality is additionally important to innovation district development because of various reasons (Vey et al., 2018). Successful innovation districts have, for instance, multiple options for connecting people within and to the district. Moreover, the level of physical concentration and mix of people, amenities and services is what differentiates a successful innovation district from an unsuccessful one. Furthermore, well-connected, welcoming and comfortable public spaces within a district determine the level of social interaction and exchange of ideas and therefore the level of success of the innovation district. Lastly, inclusive innovation districts engage in public participation and community-based processes to understand local needs.

2.5.2 Place quality KPI's

Earlier, the assumption was made that knowledge industries could locate anywhere. However, in practice, knowledge-based industries often cluster with universities and research institutes in specific geographic locations. These locations facilitate the sharing of knowledge and resources. The study of Esmaeilpoorarabi, Yigitcanlar, Guaralda, et al. (2018) defines five themes with several categories and KPI's which can be described as the essential place characteristics of an innovation district. The themes are context (urban quality), form (location, urban form and structure, design, amenities), function (services, land use, company profile, work conditions), ambience (public spaces and events, public engagement, diversity, creativity) and image (buzz of place, sense of safety, sense of place, place identity), describing the key place characteristics that could be generalized and implemented by other innovation districts in order to be successful. These include spatial, functional, experiential and identity-related attributes of an innovation district. Together, these characteristics describe the tangible and intangible, physical and social conditions that enable interaction, support knowledge exchange, and attract skilled workers and innovative firms. Yigitcanlar et al. (2024) build on earlier work by translating these essential place characteristics into a comprehensive place quality assessment framework which allows researchers to empirically valuate and compare innovation districts on the regional, city and cluster scale (Figure 4). They refined and prioritized indicators for each scale through a Delphic Hierarchy Process with international experts, identifying which aspects of place quality practitioners and scholars regard as most critical when planning and evaluating innovation districts. The results showed that the cluster scale is of the highest importance when planning, designing, developing, and ultimately managing innovation districts in order to encourage high place quality.

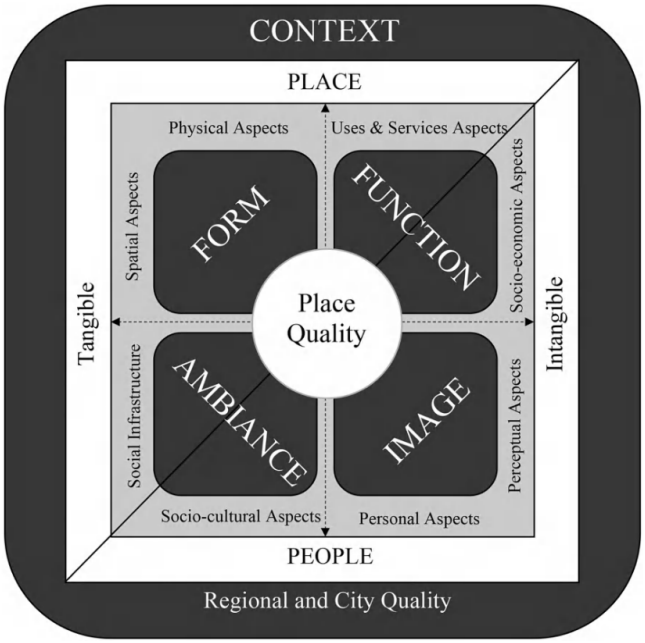

Figure 4 Conceptual framework for characterizing place in innovation districts (Yigitcanlar et al., 2024)

Additionally, the clustering of knowledge-based industries and research institutes is defined by Yun et al. (2018) as a model which consists of three elements. They give the example of a factory (or R&D), a house (or market), and a museum (or public space). The way these three elements are clustered determine the level of innovation that is enabled to happen within the cluster. They define a cluster on three levels: closed, half-open and fully open, with little to maximum chances of interaction between house and factory.

2.6 Critique, challenges and why innovation districts fail

According to Buck Consultants International (BCI), the development of innovation districts in the Netherlands is increasing (Kooij & Wolf, 2025). However, these developments are not guaranteed for success. One of the studies of BCI argues that cities and regions struggle with focus and governance when it comes to the development of innovation districts.

There are certain qualitative and quantitative factors which determine the success-rate of the (re)development of an area into an innovation district, defined by Kooij & Wolf (2025). Quantitative prerequisites are often determined by the spatial and infrastructural qualities of an area, like the accessibility and centrality of an area. These are often referred to as agglomeration advantages. The talents of the people working in an innovation district define the qualitative prerequisites. Often, with the development of innovation districts, the assumption is made that when the quantitative aspects of an area are there, the qualitative (the people) will automatically follow. Therefore, the importance of the interaction between people and place is generally overlooked. Moreover, traditional innovation strategies often cause distributional problems due to the lack of inclusivity within innovation (Morales et al., 2025).

Additionally, Charnock et al. (2025) offer a critical perspective on innovation districts, stating that they do not function as the way they were intended. Once an innovation district is developed to a certain extent that buildings, infrastructure, and ‘third places’ such as cafés

and coworking spaces are established, these assets become very attractive for investment. Charnock et al. (2025) says that therefore a successful innovation district can be developed to work like one big investment package that gives investors long-term value appreciation and returns and inhabitants and users of the innovation district long-lasting advantages. However, this only works if the local government makes sure the capital actually creates real benefits for people living and working there, and not just generates profits for investors. In practice innovation districts often serve primarily as real estate speculation projects which accumulate capital, instead of enablers of innovation. There is a strong relationship between global capitalism and innovation district development, leading to speculative, growth-oriented, finance-driven and competitive development, excluding and displacing current residents and replacing them with knowledge workers, tourists and real estate investors. This results in gentrification effects, failing to address community needs and well-being. These are not unfortunate side effects of innovation district development, but are embedded in every innovation district project, contradicting with the claim to serve societal aims and genuine innovation.

2.7 Conceptual model

The conceptual model of this research can be seen in Figure 5.

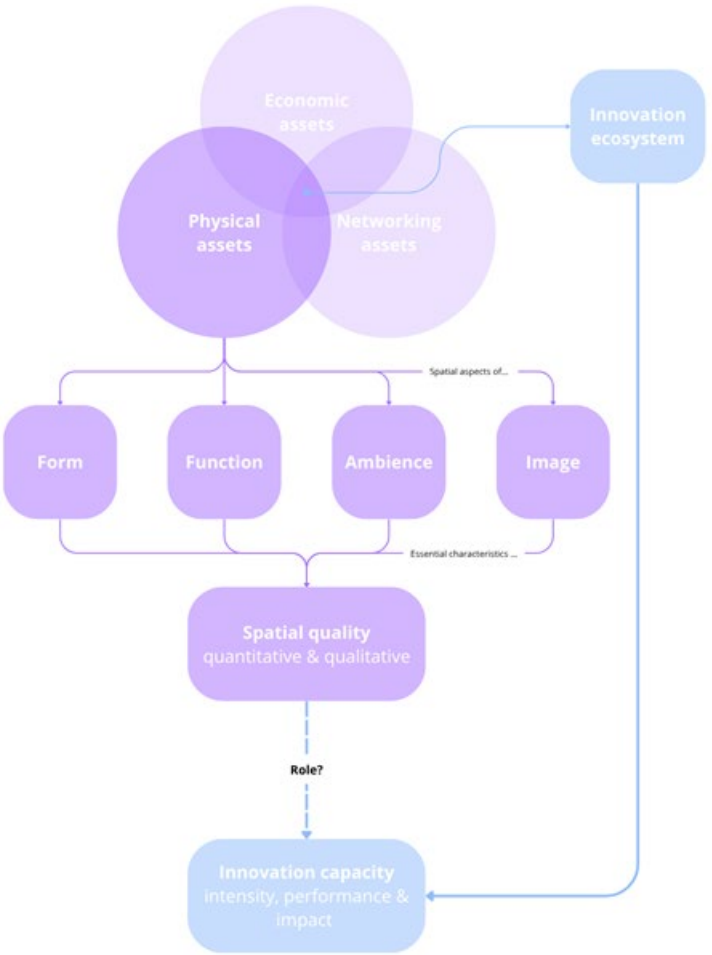

Figure 5 Conceptual model (own work)

3. Methodological framework

For this research, a mixed method approach will be applied to answer the research question on *what the role of strategic planning and design in the redevelopment of existing urban areas into a successful mixed-use, inner-city Innovation District is*.

The research will be using an embedded mixed method design (Blaikie & Priest, 2019), to study different aspects of the research topic through complementary qualitative and quantitative approaches. The primary investigative method consists of a qualitative case-study analysis of spatial design strategies across selected Dutch innovation districts, supplemented by embedded quantitative indicators, such as housing supply metrics, floor-area ratios, land-use distributions, to facilitate systematic comparison across cases.

Furthermore, the research mainly uses an abductive research strategy, as it aims to identify optimal solutions within a relative uncertain context. The research iteratively alternates between the theoretical framework and empirical observations. Specifically, the research examines existing Dutch innovation districts to evaluate how spatial planning and design choices function in practice, identify planning and design strategies that succeed or fail, and ultimately refine strategic planning and design principles based on the differences between theory and what actually happens in practice.

Additionally, the research incorporates a substantial inductive angle. From the empirical analysis of case studies, the research derives generalizable design lessons and spatial planning principles applicable beyond the specific Dutch context, addressing gaps in innovation district literature. Critically, this research adopts a more theory-based inductive approach, in which an existing theoretical framework guides the conceptual definitions and analytical lens applied during site visits and the comparative case study. At the same time, the framework remains open to refinement and modification in response to empirical evidence found during the research.

3.1 Research instruments

3.1.1 Literature study

A literature study forms the foundation for creating the theoretical framework which guides the research. The study is selective and conceptually guided, focusing on studies considered most relevant to the theoretical and empirical objectives of this research. Studies were chosen based on their contribution to a broader understanding of innovation district development.

The study serves three primary functions. Firstly, it establishes a conceptual explanation to SQ1 and SQ2, answering the questions of what an innovation district is and when an area can be defined as one and when the development of an innovation district can be considered successful and when not based on their level of innovation capacity. Secondly, it addresses SQ3 by identifying essential place characteristics to structure the comparative case study analysis. Lastly, it functions as a establishment of criteria for the analytical matrix, comparing and evaluating different success and failure indicators for various existing innovation districts.

Through this comprehensive synthesis, the literature study translates theoretical knowledge into operational criteria for empirical investigation, ensuring that site analyses and spatial

evaluations are systematically grounded in an established scholarly framework while remaining open to refinement through observations.

3.1.2 Inventory on Dutch innovation districts and case selection

An overview of existing and emerging Dutch innovation districts was made to make an informed decision for the case selection. The aim of the overview was to identify a concise set of cases that are sufficiently developed for a fair analysis as well as comparison of spatial quality and innovation capacity. Each district was checked against the definition of an innovation district established in section 2.1. It furthermore assessed its development phase and maturity level, ranging from emerging to early realization to more operational contexts.

Additionally, the overview mapped several descriptive and analytical characteristics to further help the case selection. These included the district's model type as described by Katz & Wagner (2014) (a re-imagined urban area, an anchor-plus or an urbanized science park), the presence of anchor institutions, governance structure and main innovation field. It also captured whether the district is inner-city of not, its approximate size, the starting year of developments and the closest transport hubs. Together, these variables form a strong basis for case selection.

The selection logic focused on districts that are already in the (partly) operational or matured phase, to ensure the presence of a tangible spatial structure and identifiable innovation ecosystem. This is important because the analysis of solely planned projects or projects which find themselves in the early development stages would not allow for a meaningful assessment of how spatial quality relates to actual innovation performance. Table 1 shows an overview of the three selected cases for the comparative case study analysis.

Table 1 Dutch innovation districts – case selection

	District	City	Development stage	Develop-ment year	Model type (Katz & Wagner, 2014)	Size (ha)	Innovation field / goal
Case selection	Strijp-S	Eindhoven	Mature and emerging – operational / realization stage	2002	Re-imagined urban area	27	**Creative industries & design and Digital / technology** with knowledge-intensive services
	VU-kwartier	Amsterdam	Mature and emerging – operational / realization stage	2008	Anchor-plus	46	**Human Health + Life Science**
	Spoorzone	Tilburg	Emerging – partly operational / realization stage	2010	Re-imagined urban area	24	**Human Centered AI en Data Science** with the focus on two application areas: Health & Care and Manufacturing & Logistics

Ultimately, Strijp-S, VU-Kwartier and Tilburg Spoorzone were selected based on their compliance with the definition of an innovation district as well as the suitable development stage for analysis. Strijp-S is the most mature case, with an operational and largely complete development of the former industrial *Philips* site into a vibrant and creative, mixed urban district. The VU-Kwartier represents the subsequent district with a more advanced realization phase, characterized by the *Vrije Universiteit Amsterdam* (VU) serving as a strong anchor institution from which surrounding developments have emerged. Lastly, the Tilburg Spoorzone was selected as an emerging and partly operational district, where the former workshop of the *Nederlandse Spoorwegen* (NS) is being transformed into a spatially open and modern mixed-use urban area. Together, these cases offer a structured contrast in maturity level while remaining comparable as existing, partly operational districts. The following maps show their geographical location.

The case selection focused on similarity in development phase, but simultaneously lacked the ability to diversify the selection in innovation focus area, creative industries (Strijp-S), life sciences (VU-kwartier), and human-centered AI (Tilburg Spoorzone), and spatial contexts, Eindhoven, Amsterdam and Tilburg. While this enabled various sectoral and contextual insights, the risk of spatial quality and innovation capacity being attributed to sector-specific drivers (e.g., funding, demand) or spatial factors (e.g., talent availability, agglomeration economies) emerges. Districts in stronger regional economies like Amsterdam may outperform others due to pre-existing contextual advantages. For future work sector-matching cases across similar regions could be considered to minimalize these external effects.

The same accounts for the innovation district type defined by Katz & Wagner (2014). While three models exist (reimagined urban area, anchor plus, urbanized science park), the selection was limited to the more mature reimagined urban areas Strijp-S and Spoorzone, and anchor plus VU-kwartier, excluding less operational urbanized science parks.

3.1.3 Space quality analysis

The quantitative space quality analysis adopts the multiscale place quality framework from Yigitcanlar et al. (2024), who developed a framework to measure the place quality of innovation districts. The study identifies a large pool of indicators organized by category and theme on three distinctive levels: region, city and cluster. The indicators were identified through a comprehensive study of the literature, which was then evaluated on their suitability through an international Delphi survey involving 43 experts. This resulted in the classification of suitable indicators for the assessment of place quality in innovation districts.

The framework functions as an evaluation tool, in which the highest importance is that of the cluster scale. Therefore, this study focused only on the cluster scale, due to limited time available to conduct the research. The context level (region and city) were treated qualitatively because all cases share the same national system and the primary interest is in district-level place qualities. The four themes for the cluster-level are form, function, ambiance, and image. Yigitcanlar et al. (2024) make a distinction between people and place,

tangible and intangible indicators (Figure 6). However this research adapts a different differentiation of the indicators making a distinction between spatial, economic and networking assets (based on the framework of Wagner et al. (2024)) and quantitative (measurable) and qualitative (non-measurable) indicators (Figure 7). Because of the scope of the research, it solely focuses on the spatial indicators of essential place characteristics of innovation districts, while other indicators are treated as contextual factors rather than components of spatial quality. Therefore, these spatial characteristics comprise of twelve quantitative indicators, based on observable and quantifiable data, and four qualitative ones, based on perceived qualities and research observations.

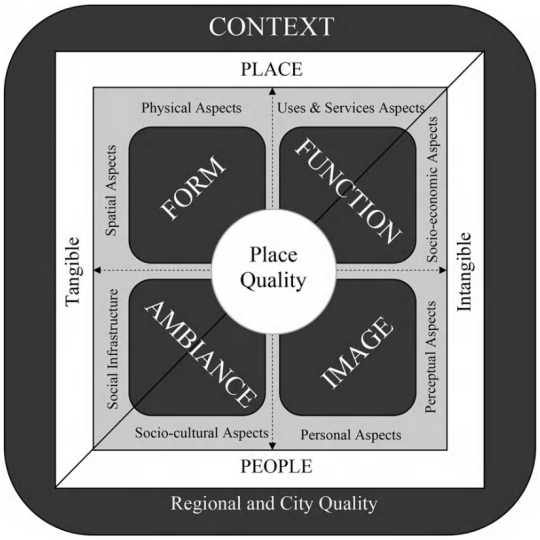

Figure 6 Conceptual framework for characterizing place in innovation districts (Yigitcanlar et al., 2024)

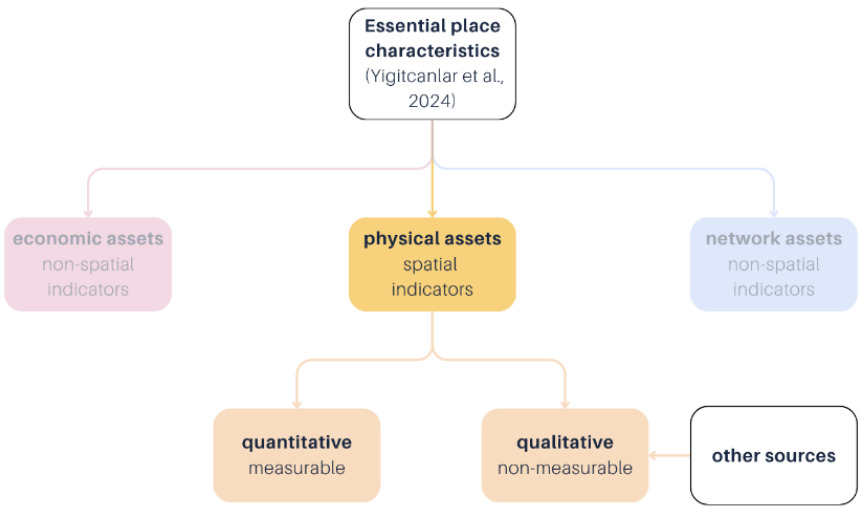

Figure 7 Research's adaptation on Yigitcanlar et al. (2024) based on Wagner et al. (2024)

Each indicator has a certain weight. These weights are assigned via equal weighting (EW) or analytic hierarchy process (AHP)-based expert priorities (AW), with a rank order (RA) highlighting critical factors such as urban mobility, work climate and creative communities.

The equal weighting approach evaluates the performance of an innovation district considering every indicator is critical and is mainly useful to determine weak and strong attributes of the innovation district, while the AHP-based weighting approach is more suitable for evaluating the general place quality performance of an innovation district and thus for a comparative case analysis.

Quantitative space quality analysis

The quantitative cluster-scale indicators were empirically assessed through district-specific atlas (see appendix 1). Indicators were measured using tools such as Google Maps, GIS-data, policy documents, masterplans, governmental open data, and other open data from institutions such as the *CBS*. The data was then normalized to a 0-5 Likert scale. The AHP-weighting was adapted to only include the twelve quantitative spatial indicators derived from Yigitcanlar et al.'s (2024) place quality framework, giving indicators that were not spatially quantitative a weight of zero, while the proportional relationships between included indicator weights were maintained. Consequently, the weights of the included indicators scaled up proportionally to produce a final score within the 0–5 range. See Table 2 for an overview of the selected indicators and their description. For every final score per indicator, multiple sub-indicators were included, which can be found in the results section.

Table 2 Quantitative space quality indicators (own table; based on Yigitcanlar et al. (2024))

Centrality	Closeness to important parts of the city: inner-city, suburban, close to the airport, universities, research centres.
Unique surroundings	Surrounding by unique natural or human-made environment: waterfront locations, bushlands, national parks, historical sites.
Urban structure	The arrangement of urban spaces. The degree of connectivity and accessibility: accessibility to public and private spaces, land uses.
Urban design	The style of designing unbuilt spaces: landscape, parks, streetscape, landmarks, spatial diversity.
Essential amenities	Accessibility to basic facilities: schools, hospitals and elderly/child care, well-served stores.
Advanced amenities	Accessibility to advanced facilities: outdoor sports, cycling, jogging, café, restaurant, bars, Wi-Fi, hotels.
Urban mobility	All modes and forms of transport: public transportation, traffic, connections, parking.
Mixed-use development	A combination of residential, commercial, cultural, institutional, and industrial uses.
Property availability and value	Value and availability of residential and commercial properties: renting and purchasing rates.
Public and cultural spaces	Public and cultural spaces that are open or accessible to people of all levels of society: meeting places, cinemas, libraries, theatres …
Objective safety and security	How safe is to live in this place: the risk of going around late evening, street safeness for pedestrians and cycling, noise.
Place attachment	Passion for staying in the place: considering the intended location as an ideal place.

Qualitative space quality analysis

The qualitative cluster-scale indicators were assessed through observations during site visits of the selected cases based on Yigitcanlar et al.'s (2024) indicators enriched with definitions and indicators of other sources (Kalliomäki et al., 2024; Lawrence et al., 2019; Vey et al., 2018). See Table 3 for an overview of the selected indicators and their description. During these visits, each site was experienced and captured through notes, photographic documentations, sketches and drawings. Then a subjective assessments of the overall atmosphere was made, followed by a descriptive analysis per indicator.

Table 3 Qualitative space quality indicators (own table; based on Yigitcanlar et al. (2024))

Urban form & structure	The physical characteristics that form built-up areas: the shape, size, density and configuration of settlements The arrangement of urban spaces. The degree of connectivity and accessibility: accessibility to public and private spaces, land uses.
Urban & architectural design	The style of designing unbuilt spaces: landscape, parks, streetscape, landmarks, spatial diversity. The style of designing buildings and other physical structures: appearance, well-made details, the convergence of old and new.
Creative atmosphere	Artistic, cultural, technological and economic creative atmosphere: art streets, high-tech exhibitions, openness to new ideas.
Authenticity & brand	The quality of being novel or unusual: monuments, historic buildings, distinctive music scene. Creating a unique name and image in users' mind: representing well-known companies and brands.

3.1.4 Innovation capacity analysis

Data analysis forms the quantitative research instrument for validating spatial configurations through economic and demographic indicators. The LISA database, *Landelijk Informatiesysteem van Arbeidsplaatsen*, is the Dutch national employment locations database and contains records of all Dutch establishments including Company location, Employment numbers, Sectoral classification & Temporal changes. The database analysis serves as a way to evaluate the economic innovation development within the selected case studies.

Building on the end-note of Vey et al. (2018, p. 88), stating their guide "should be considered as advice more than edict, and a work in progress rather than the final word", this study combines indicators from their audit guide with the more operational key performance indicators proposed by Burke & Gras (2019). The assessment of their KPI's is tailored to what is empirically feasible with the available LISA microdata and complementary open datasets. The LISA database (Stichting LISA, 2024) provides geocoded establishment-level records, including location, employment, sectoral classification through SBI 2008 coding, firm size alongside municipal and provincial identifiers per observing year (1996 – 2024). The following will be measured.

Innovation Intensity

The innovation intensity is measured by the number of innovative jobs and establishments per district, the compounded percentage of innovative jobs versus total employment in an innovation district. Innovative jobs are defined by Eurostat's indicators on high-tech industry and knowledge – intensive services based on NACE Rev. 2 (Eurostat, 2024). The SBI 2008 is equal to NACE Rev. 2 up to and including the class level (four digits), with a few exceptions (CBS, n.d.). The indicators range from high-technology to low-technology, and from knowledge-intensive services (KIS) to less knowledge-intensive services (LKIS).

- Total employment E_{tot} = ΣBANEN in LISA.
- Innovation employment E_{inn} = ΣBANEN in selected SBI08 sectors in LISA.
- Innovation Intensity = E_{inn}/E_{tot}

Innovation Performance

According to Burke & Gras (2019) products of innovation-related solutions such as "patents, new products, new services, new processes, R&D, and scientific publications" indicate the innovation performance. They measure it through three innovation phases: research and academia, technology transfer, and high value-added production. However, for this research, the innovation performance will be measured by assessing the growth of knowledge-intensive establishments and jobs over time, due to the absence of turnover-data in the LISA database. Therefore the innovation performance will be measured via employment. Furthermore, an assessment will be made of the current number of present scale-ups and start-ups.

- Growth of E_{inn} and number of innovative establishments ES_{inn} over time (using year and LISA-number to derive entry and/or exit date and approximate firm age).
- Number of innovative start-ups ST_{inn} (multiple definitions available: often younger than 5 years old, less than 10 employees, no phase of fast growth)
- Number of innovative scale-ups SC_{inn} (older than 3 years old, more than 10 employees, average annual growth more than 20% in employees over a period of 3 years)

Innovation Impact

According to Burke & Gras (2019) the innovation impact could be measured in two ways: the employment generation and sales per employee and sales per resident. Because the LISA data-base does not give any financial insights, the last two indicators will not be taken into assessment.

- Employment Generation: E_{inn}/resident per district, E_{inn}/resident per municipality, E_{inn}/ resident per region

3.1.5 Comparative case study analysis

A comparative case study analysis is the primary empirical research instrument for systematically evaluating the spatial quality and their functional innovation outcomes across selected Dutch innovation districts. This is done by plotting the quantitative analyses into different figures to visualize the differences. Then, together with the qualitative space quality analysis, it serves as a way to indicate if and how space quality influences the level of innovation capacity in a district. This will be elaborated on in the discussion.

4. Results

4.1 Spatial quality

4.1.1 Quantitative spatial quality

The first analysis made was that of the quantitative space quality. The selected quantitative cluster-scale indicators were empirically assessed through a district-specific atlas (see appendix 1). Indicators were measured using tools such as Google Maps, GIS-data, policy documents, masterplans, governmental open data, and other open data from institutions such as the *CBS*. The data was then normalized to a 0-5 Likert scale using Excel. For every final score per indicator, multiple sub-indicators were included. For Spoorzone, the measured sub-indicator scores of the four neighborhoods were added up and then divided by 4 to get the average district score.

Centrality

Definition:

> *"Closeness to important parts of the city: inner-city, suburban, close to the airport, universities, research centers"* *(Yigitcanlar et al., 2024)*

The *centrality* indicator was measured by six sub-indicators. The different sub-indicators, such as *closeness to nearest airport, universities, city center* etc. were measured from the average mid-point of the district to e.g. the "city center" as defined in Google Maps. The shortest route in km over the road (walking, biking or car) was taken.

To provide a clear overview of the district-level results, Table 4 presents the three *centrality* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. All measured values were normalized to a score between 0 and 5, based on the set minimum and maximum value, shown in a radar chart (Figure 8), where each axis represents one sub-indicator. In this chart, the larger the surface area covered by a district's polygon, the higher its overall score for the *centrality* indicator. Then, the mean score per district was measured and visually displayed in Figure 9.

Table 4 Measured value per sub-indicator per district for centrality

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Centrality	Closeness to city centre (km)	5	0	1,8	5,8	0,75
	Closeness to nearest university (km)	30	0	2,6	0,13	3,7
	Closeness to nearest UoAS main campus (km)	30	0	2,1	5,1	2
	Closeness to nearest design / art school (km)	30	0	0,27	1,3	1
	Closeness to nearest hospital (km)	30	0	4,1	0,3	3,05
	Closeness to nearest airport (km)	100	5	6,1	14	28,7

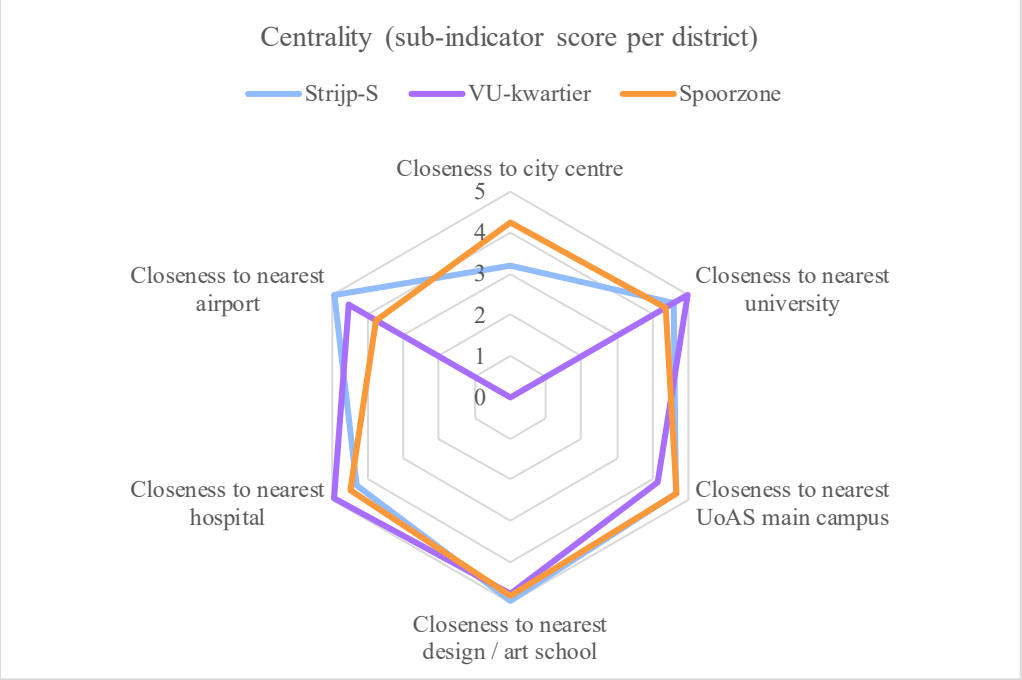

Figure 8 Sub-indicator score per district for centrality

From the research data, Strijp-S (4,582) and Spoorzone (4,478) show higher *centrality* values than VU-kwartier (3,771). See Figure 9. This indicates that both Strijp-S and Spoorzone have a more central location than VU-kwartier, which is mainly due to the location of the district relative to Amsterdam city center. According to Yigitcanlar et al. (2024), both inner-city as well as more suburban district have benefits, depending on the type of districts. Creative districts, such as Strijp-S and Spoorzone, are more likely to excel in inner-city areas, as there they benefit from the urban atmosphere and variety of amenities, while tech- and research-based districts, such as VU-kwartier, could also be located in the more affordable and tranquil suburbs, as long as they are well-connected to more central parts of the city. However, fully isolated districts have low chances of flourishing, since connectivity and accessibility are key priorities for innovation districts. None of the case districts have this characteristic. Additionally, all three case districts score high on their closeness to the nearest university, University of Applied Sciences and design or art school, giving the opportunity to benefit from collective facilities and encourage knowledge spill-overs (Yigitcanlar et al., 2024).

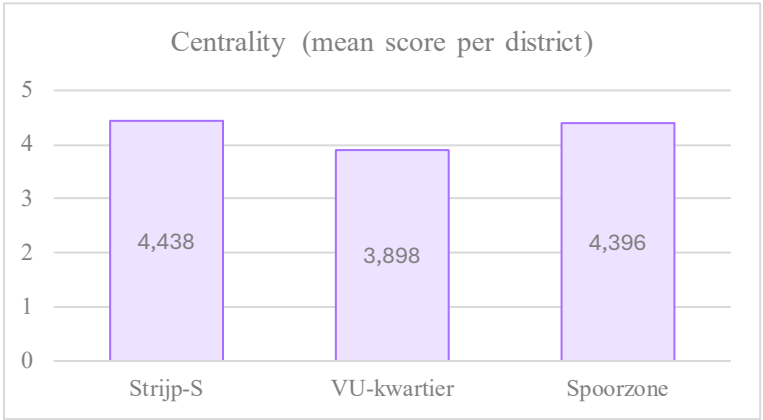

Figure 9 Mean score per district for centrality

However, the interpretation must consider scale differences. The municipality of Amsterdam's size is significantly bigger with 24.365 ha, than the size of the municipality of Eindhoven (8,936 ha) and Tilburg (12,846 ha), leading to distances to comparable locations being inherently larger, even though for Amsterdam standards it is still central and well-connected. Therefore, Strijp-S and Spoorzone benefit from more compact urban areas.

Unique surroundings

Definition:

> *"Surrounding by unique natural or human-made environment: waterfront locations, bushlands, national parks, historical sites."* *(Yigitcanlar et al., 2024)*

The unique surroundings indicator was measured by one sub-indicators. The score between 0 and 5 per district was determined by the following criteria:

- 0–1 = no distinctive natural/historical features
- 2–3 = some local character but typical for Dutch urban areas
- 4 = clear, city-wide distinctive setting (e.g. single major monument or waterfront)
- 5 = regionally or nationally unique cluster of heritage/natural assets that define the district's identity

By giving all districts a score between 0 and 5, based on the determined criteria, the mean score per district for unique surroundings was measured (Figure 10). Scores were assigned using a comparative rule in which districts with similar unique surroundings are differentiated by the degree of national recognition of their setting. Therefore results show clear variation in the degree to which each district is surrounded by distinctive natural or human-made environments. Strijp-S receives the highest score for this indicator (5.0), due to its nationally significant industrial-heritage identity, formed by the former industrial Philips estate. With a score of 4.0, Spoorzone scores second-highest, due to its NS railway industrial heritage and the presence of several cultural landmarks such as *LocHal* and *Hall of Fame*. Sequentially, VU-kwartier scores lowest with a score of 3.0. This is due to its character, more typical of a Dutch office district, while housing several notable institutional building such as the *O|2 Lab Building* and *Amsterdam UMC*. However, VU-kwartier lacks the regionally or nationally distinctive character, which can be found in Strijp-S and Spoorzone.

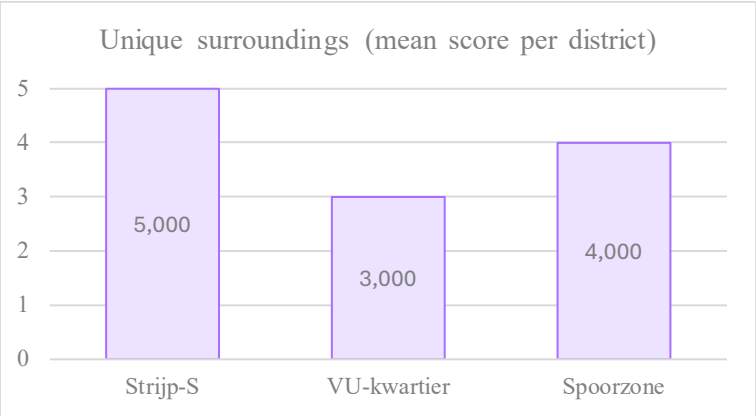

Figure 10 Mean score per district for unique surroundings

Because the indicator for *unique surroundings* was measured using a single sub-indicator, which relied on broad criteria, the results are less nuanced than indicators which were assessed with multiple various sub-indicators. In other words, the complex spatial characteristic of the uniqueness of the surroundings is simplified into one sub-category and therefore may lack accurate representation of this quality. Additionally, the scoring is partly qualitative. Therefore, these limitations must be taken into account when interpreting the differences in final scores between districts.

Urban structure

Definition:

> *"The arrangement of urban spaces. The degree of connectivity and accessibility: accessibility to public and private spaces, land uses."* *(Yigitcanlar et al., 2024)*

The urban structure indicator was measured by four sub-indicators. The first half of the sub-indicators measured how movement-friendly the district was. This indicates how much the environments encourages people to move. The more recreational green and blue spaces, sports facilities, playgrounds, walking and biking paths and other facilities, the higher a district scores on a scale of 0 to 100.

The second half of the sub-indicators – the arrangement of urban spaces, the connectivity and permeability within the district and to the surrounding urban fabric, the land-use structure and accessibility to public and private spaces – is explored in the qualitative space quality analysis (chapter 4.2.2).

A clear overview of the district-level results are shown in Table 5 below and presents the four urban structure sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. All measured values were normalized to a score between 0 and 5, based on the determined minimum and maximum value. This is shown in a radar chart in Figure 11, where each axis represents one sub-indicator. The larger the surface area covered by a district's polygon, the higher its overall score for urban structure. Then, the mean score per district was measured and visually displayed in Figure 12.

Table 5 Measured value per sub-indicator per district for urban structure

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Urban structure	Recreational green and blue	0	100	36	33	5,25
	Sports facilities	0	100	54	78	65
	Sports and play areas	0	100	66	15	69,5
	Proximity to facilities	0	100	83	73	94

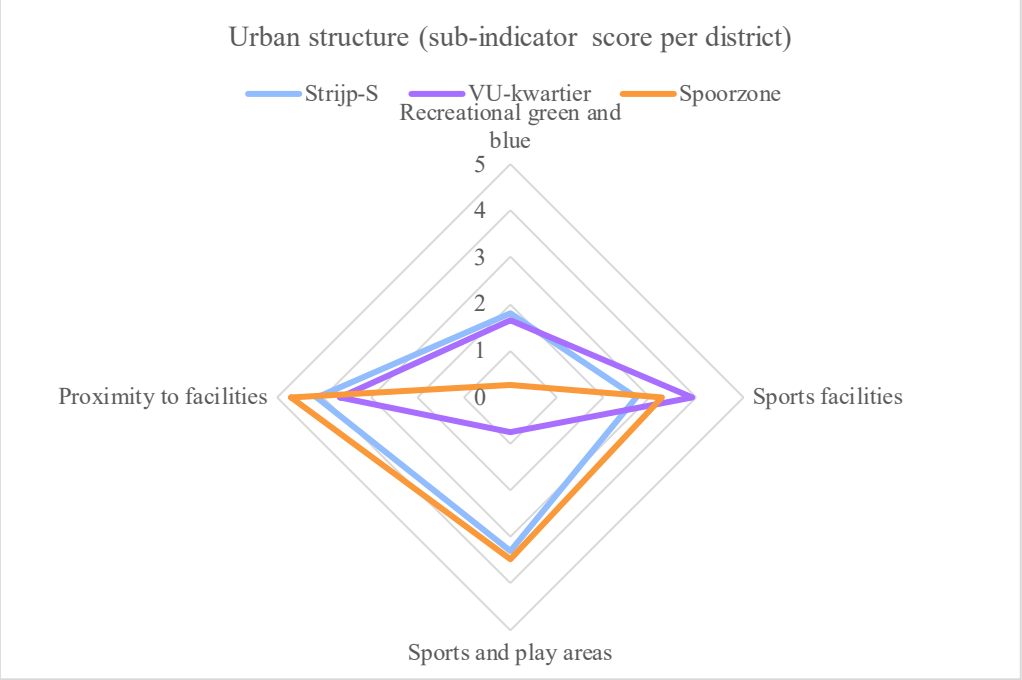

Figure 11 sub-indicator score per district for urban structure

From the research data, Strijp-S (2,988) and Spoorzone (2,922) show higher values for *urban structure* than VU-kwartier (2,488). This indicates that both Strijp-S and Spoorzone have a better urban structure than VU-kwartier. However, all districts show relatively low mean scores for *urban structure* indicator, especially because of the lack of recreational green and blue in the area. Additionally, Vu-kwartier scores the lowest on the number of (outdoor) sports and play areas, resulting in under-average scores for Vu-kwartier on *urban structure*.

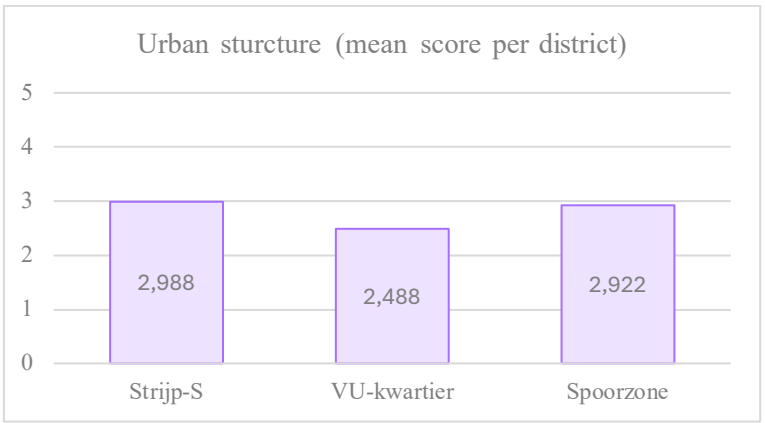

Figure 12 Mean score per district for urban structure

The relatively low scores across all three districts mainly reflect the accessibility to public spaces and land use, focusing primarily on movement-friendliness, recreational green and blue space, sport facilities and play areas. The results of the quantitative assessment for this indicator suggest that these features are generally less present in innovation districts. However, the quantitative results underrepresent the full *urban structure* indicator, as the other qualitative aspects of the urban structure, such as the arrangement of urban spaces,

connectivity and permeability, are not included. Therefore, when interpreting the quantitative results, these limitations must be considered.

Urban design

Definition:

> *"The style of designing unbuilt spaces: landscape, parks, streetscape, landmarks, spatial diversity."* (Yigitcanlar et al., 2024)

The *urban design* indicator was measured by three sub-indicators. The first half of the sub-indicators measured the percentage of people content with green in the environment, the amount of green and blue within 500 m and if the spatial layout design encourages open innovation, based on the framework of Yun et al. (2018) on architectural design and open innovation. This indicator is rated on a scale from -1 (closed layout), to 0 (semi-open layout), to 1 (open layout). Additionally, the amount of green and blue within a 500 m radius (79 ha) is measured from the center of the district and is rated based on a scale from 1 (poor, less than 30% of the surface area) to 5 (very good, more than 60% of the surface area), based on the *Check je plek* (check your location) tool of the government of the Netherlands (Rijksoverheid, Ministerie van Infrastructuur en Waterstaat, n.d.). The rang of valuation indicating the percentage of green within a radius of 500 meters from the selected location is shown in Figure 13.

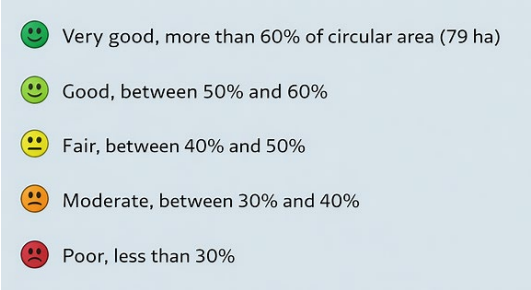

Figure 13 Range of valuation indicating amount of green (Rijksoverheid, Ministerie van Infrastructuur en Waterstaat, n.d.)

The second half of the sub-indicators – the style of designing the unbuilt spaces, streetscape, landmarks and spatial diversity in terms of design – is explored in the qualitative space quality analysis (chapter 4.2.2).

Table 6 presents the three *urban design* sub-indicators, their minimum and maximum possible values, and the measured values for the three districts. All measured values were normalized to a score between 0 and 5, based on the set minimum and maximum value, shown in a radar chart (Figure 14). In this chart, each axis represents one sub-indicator, and the surface area covered by a district's polygon represents the height of the mean score. The mean score per district for *urban design* was measured and shown in Figure 15.

Table 6 Measured value per sub-indicator per district for urban design

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Urban design	Content with green in environment (%)	0	100	69,6	68,6	61,85
	Green/blue within 500 m	1	5	1	1	1
	Spatial layout design encouraging open innovation system (open, semi-open, closed)	-1	1	1	1	1

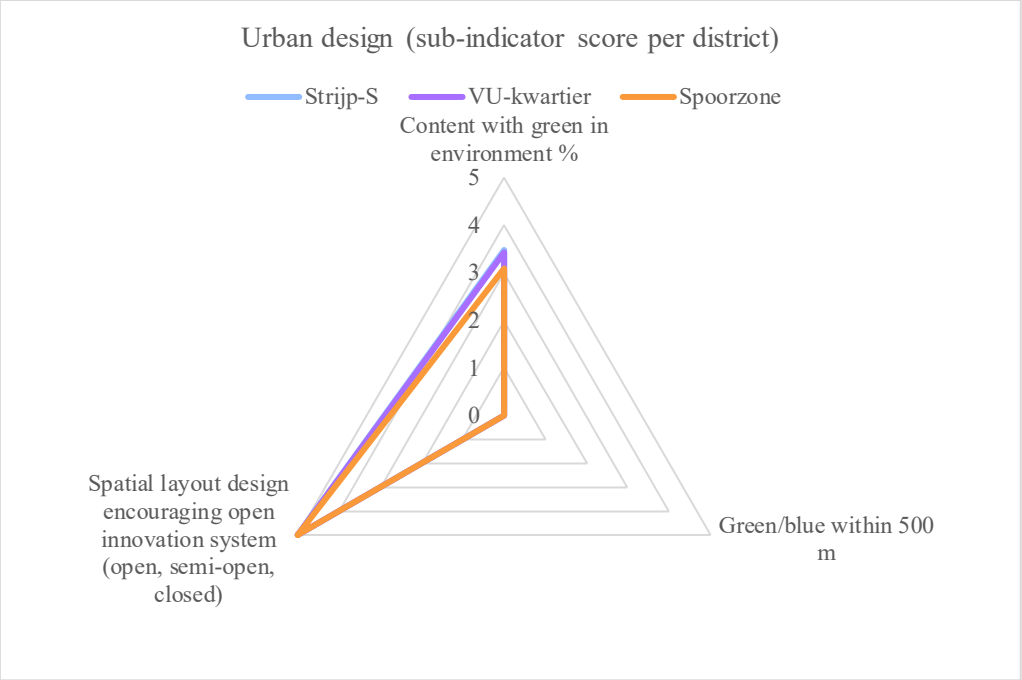

Figure 14 Sub-indicator score per district for urban design

The results across the three districts are relatively similar, with Strijp-S (2,827) and VU-kwartier (2,810) scoring slightly better than Spoorzone (2,698). All three scores, however, are rather low, due to all three districts scoring the minimum possible value for green and blue within a 500-meter radius, indicating a general lack of green space within all districts. However, this does not mean there is no green space at all, with values ranging across the districts between 15 to 30% of green space within that 50-meter radius. With this green space, between 60 to 70% of the people is actually content, with Strijp-S and VU-kwartier scoring slightly higher than Spoorzone. In contrast, all districts score the maximum value on the openness of their spatial layout, suggesting each district has an open innovation system, in which interaction and openness are supported. However, the landscape components remain limited.

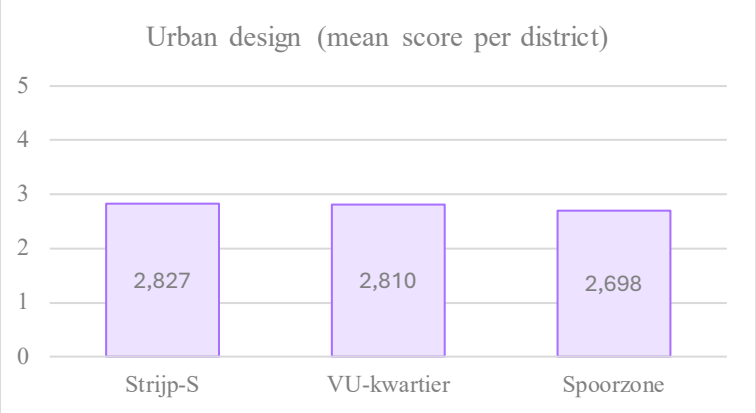

Figure 15 Mean score per district for urban design

By measuring the urban design indicator in this way, a multifaceted characteristic is highly simplified into only three measurable sub-indicators. Additionally, all districts scored the minimum value for green and blue within 500 meters, not considering qualitative differences in landscape, streetscape, and spatial diversity. Then, for the openness of the spatial layout the district is categorized into three general sections: house, factory and museum. While in reality, no harsh distinction into three section can be made as some areas and building blocks within the districts are mixed. As a result, the scores should be interpreted in a way that acknowledges that the indicator captures only part of the broader *urban design* qualities, and that the other part is further explored in the qualitative analysis (chapter 4.2.2).

Essential amenities

Definition:

> *"Accessibility to basic facilities: schools, hospitals and elderly/child care, well-served stores."* *(Yigitcanlar et al., 2024)*

The *essential amenities* indicator was measured by eight sub-indicators. The different sub-indicators, such as distance to general practitioner, child day-care, primary school, grocery store, sport and movement possibilities and public transport hubs, were measured using the *Check je plek* (check your location) tool of the government of the Netherlands (Rijksoverheid, Ministerie van Infrastructuur en Waterstaat, n.d.). The distance of different amenities was measured from the center of the district and is rated based on a scale from 1 to 5. Table 7 of Rijksoverheid, Ministerie van Infrastructuur en Waterstaat (n.d.) shows the distances on which these scores are based. This means that the measured values are not distances in e.g. kilometers, but assessments based on a valuation of very good (green smiley) to bad (red smiley).

Table 7 Range of valuation indicating distance to several amenities (Rijksoverheid, Ministerie van Infrastructuur en Waterstaat, n.d.)

Indicator	Eenheid	Zeer goed (groene smiley)	Goed (lichtgroene smiley)	Redelijk (gele smiley)	Matig (oranje smiley)	Slecht (rode smiley)
Afstand tot een huisartspraktijk (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een kinderdagverblijf (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een basisschool (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een supermarkt (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Sport- en beweegmogelijkheden	indicator - getal tussen 0 en 100	≥ 80	≥ 60 en < 80	≥ 40 en < 60	≥ 20 en < 40	< 20
Afstand tot treinstation, metro- of tramhalte	km	< 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4 en < 8	≥ 8
Afstand tot bushalte	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4
Afstand tot oprit hoofdweg	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4

To provide a clear overview of the district-level results, Table 8 below shows the eight *essential amenities* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. In the radar chart, shown in Figure 16, each axis represents one sub-indicator and their normalized score between 0 and 5. In this chart, the larger the surface area covered by a district's polygon, the higher its overall score for *essential amenities*.

Table 8 Measured value per sub-indicator per district for essential amenities

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Essential amenities	Distance to GP	1	5	5	5	4
	Distance to child day care	1	5	3	4	5
	Distance to primary school	1	5	3	3	4
	Distance to grocery store	1	5	5	4	5
	Sport and movement possibilities	1	5	4	3	3
	Distance to train / metro / tram	1	5	5	5	5
	Distance to bus	1	5	5	5	5
	Distance to main road	1	5	3	4	2

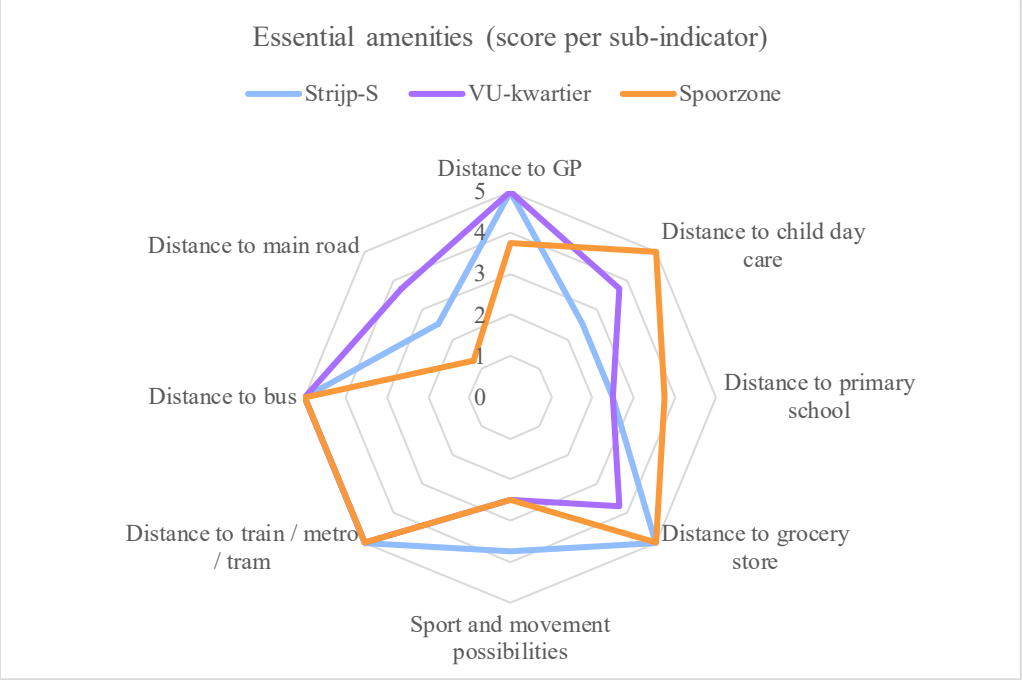

Figure 16 Sub-indicator score per district for essential amenities

The mean score per district for *essential amenities* was measured and visually displayed in Figure 17. All three districts show the same mean score for the *essential amenities* indicator (3.906), indicating that Strijp-S, VU-Kwartier, and Spoorzone offer a broadly comparable level of access to basic daily facilities. They score high on sib-indicators such as proximity to a general practitioner, grocery store and public transportation. Differences between the districts appear for sub-indicators such as the distance to child day care, primary school, sport and movement possibilities, and the main road. Strijp-S and VU-kwartier score lowest for child-care facilities, reflecting limited support of everyday family-oriented amenities, whereas Spoorzone performs better on this aspect. However, Strijp-S scores higher on sport and movement possibilities, while VU-kwartier has a significant lead in proximity to a main road, due to the adjacent A10 ring road.

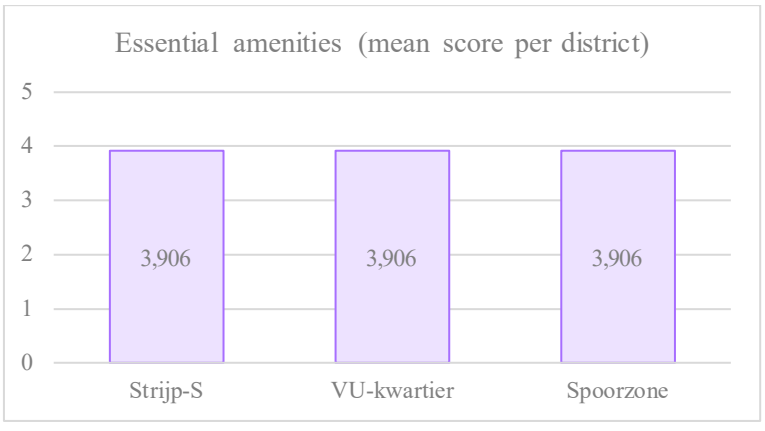

Figure 17 Mean score per district for essential amenities

the scores for the indicator *essential amenities* relies on eight measurable sub-indicators based on distance and proximity, but do not fully capture other aspects of accessibility, since

it does not measure and include capacity, service quality or user experienc. Furthermore, the *Check je plek* (check your location) tool of the government of the Netherlands (Rijksoverheid, Ministerie van Infrastructuur en Waterstaat, n.d.) is based on standardized national minima and maxima, which may not reflect more city or region scale conditions and differences in district scale. These limitations should be considered when interpreting the final results.

Advanced amenities

Definition:

> *"Accessibility to advanced facilities: outdoor sports, cycling, jogging, café, restaurant, bars, Wi-Fi, hotels."* (Yigitcanlar et al., 2024)

The *advanced amenities* indicator was measured by six sub-indicators. The different sub-indicators, such as distance to café, restaurant, hotel, swimming pool and ice-skating rink were indicated using the *kerncijfers wijken en buurten 2025* data-set (CBS, 2026). This data-set indicates distances to several different amenities in kilometers. The distances relevant for this indicator were selected. Even though, the description of the indicator states that under advanced facilities we understand "outdoor sports, cycling and jogging", these sub-indicators were not included in the measurement of *advanced amenities* due to the fact they have already been measured for *essential amenities* and partially for *urban structure*.

To provide a clear overview of the district-level results, table 9 below presents the three *advanced amenities* sub-indicators, their minimum and maximum values similar to the standardized threshold set by Rijksoverheid, Ministerie van Infrastructuur en Waterstaat (n.d.) (see Table 7), and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. All measured values were normalized to a score between 0 and 5, based on the minimum and maximum value, which are visualized in a radar chart in Figure 18. Each axis represents one sub-indicator. In this chart, the larger the surface area covered by a district's polygon, the higher its overall score for *advanced amenities*.

Table 9 Measured value per sub-indicator per district for advanced amenities

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Advanced amenities	Distance to café (km)	5	0	0,5	0,5	0,5
	Distance to cafeteria (km)	5	0	0,2	0,2	0,3
	Distance to restaurant (km)	5	0	0,2	0,3	0,1
	Distance to hotel (km)	5	0	0,5	1,1	0,9
	Distance to indoor swimming pool (km)	5	0	4,3	3,4	2,7
	Distance to ice rink (km)	5	0	4,8	7,3	2,9

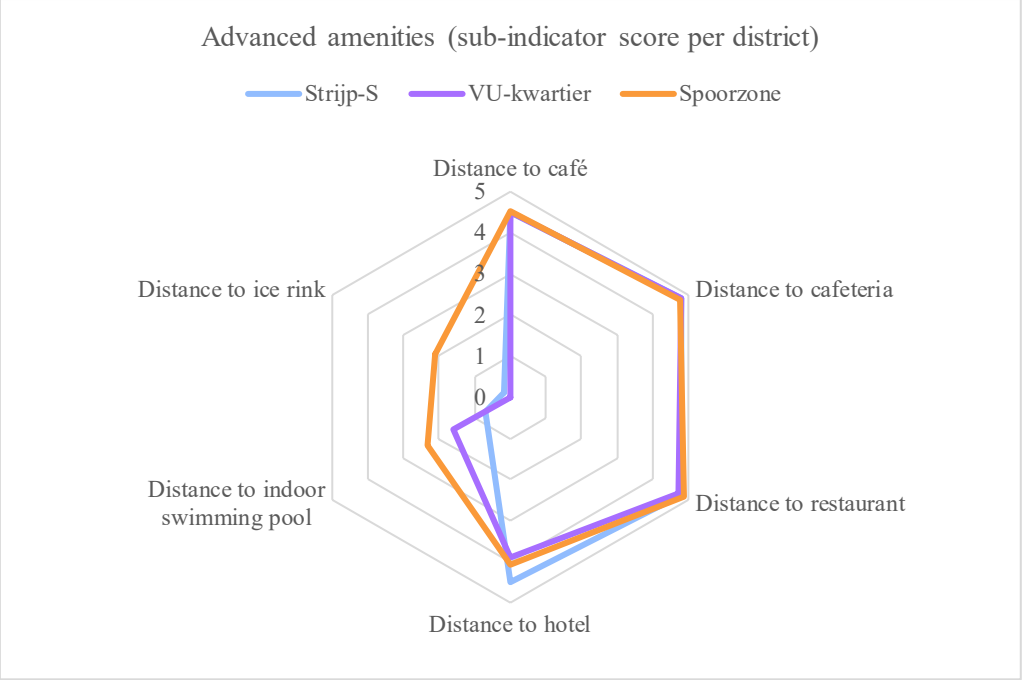

Figure 18 Sub-indicator score per district for advanced amenities

Based on the measurement, the mean score per district for *advanced amenities* was determined and visually displayed in Figure 19. The mean scores show similar levels of access to advanced amenities for Strijp-S and VU-kwartier (3,250), and a slightly higher level for Spoorzone (3,779). The results show that all districts perform well on proximity to the nearest café, cafeteria, restaurant and hotel, reflecting an urban character and integration of leisure facilities. However, for more specific sports and leisure amenities, such as an indoor swimming pool or ice rink, district scores are lower except for Spoorzone. The higher mean score for Spoorzone could be explained due to its closer proximity to both an indoor swimming pool and ice rink. Overall, the results of this indicator suggest that while all three districts offer strong access to leisure amenities, Spoorzone has an advantage in indoor recreational and sports facilities.

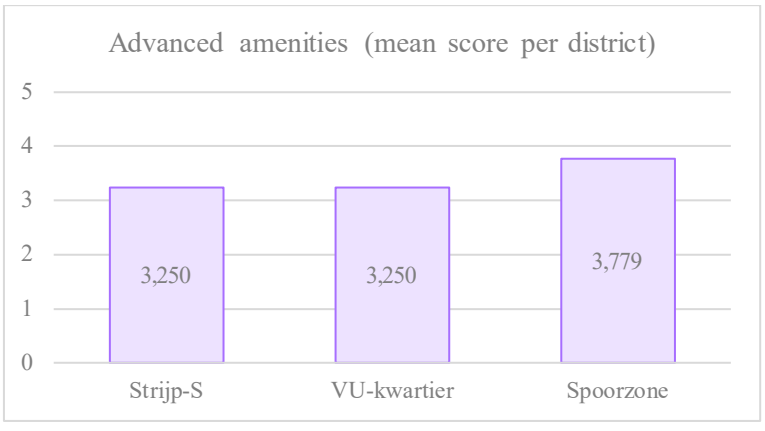

Figure 19 Mean score per district for advanced amenities

The *advanced amenities* indicator captures six sub-indicators, from which the scoring is based solely on proximity. Similar to the indicator *essential amenities* (chapter 4.2.1), this

simplifies accessibility to distance and does not account for amenity quality, capacity, or user experience. Additionally, because the thresholds for distance to amenities is based on national standards, city or region scale conditions may not fully be reflected in the results. These limitations should be considered when interpreting the scores across the three districts.

Urban mobility

Definition:

> *"All modes and forms of transport: public transportation, traffic, connections, parking."* (Yigitcanlar et al., 2024)

The urban mobility indicator consists of four sub-indicators: public transport, parking, cycling and walking, and road traffic and connections. Each sub-indicator is scored on a 0 to 5 scale based on observable, comparable mobility characteristics, such as the presence of a train station, cycling permeability, pedestrian friendliness, parking supply, and the strength of road connections. Although the scoring involves expert judgement, the method is systematic and transparent, and applied consistently across all districts. Table 10 shows a detailed overview of the scoring criteria per sub-indicator.

Table 10 Scoring criteria per sub-indicator for urban mobility

Score	Public transport	Parking	Cycling & walking	Road connections
5 Excellent	Direct access to major multimodal hub	Fully structured, high-capacity system	Highly permeable, continuous, safe network with minimal car dominance	Outstanding regional and citywide connectivity
4 Very good	Strong access, high quality but not a full hub	Well-organized, sufficient supply	Very good network with minor limitations and limited car dominance	Strong access with minor limitations
3 Good	Functional but limited in frequency/coverage	Available but reduced or less central	Good network with noticeable limitations and some car dominance	Functional access with notable constraints
2 Moderate	Limited or indirect access	Insufficient or poorly organized	Disconnected or unsafe routes with clear car dominance	Weak external connectivity overall
1 Poor	Minimal transit access	Very limited parking provision	Poor active-mode conditions due to strong car dominance	Poor road accessibility conditions
0 Very poor	No substantial transit access	No substantial parking provision	No active-mode infrastructure; fully car-dominated environment	No substantial road access

To provide a clear overview of the district-level results, Table 11 presents the four *urban mobility* sub-indicators, their minimum and maximum possible values, and the measured

values for all three districts. The measured values were normalized to a score between 0 and 5, shown in the radar chart, where each axis represents one sub-indicator. In this chart, the larger the surface area covered by a district's polygon, the higher its overall score for this indicator (Figure 20).

Table 11 Measured value per sub-indicator per district for urban mobility

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Urban mobility	public transport	0	5	4	5	4
	parking	0	5	4	4	3
	cycling and walking	0	5	5	3	5
	road traffic and connections	0	5	4	5	4

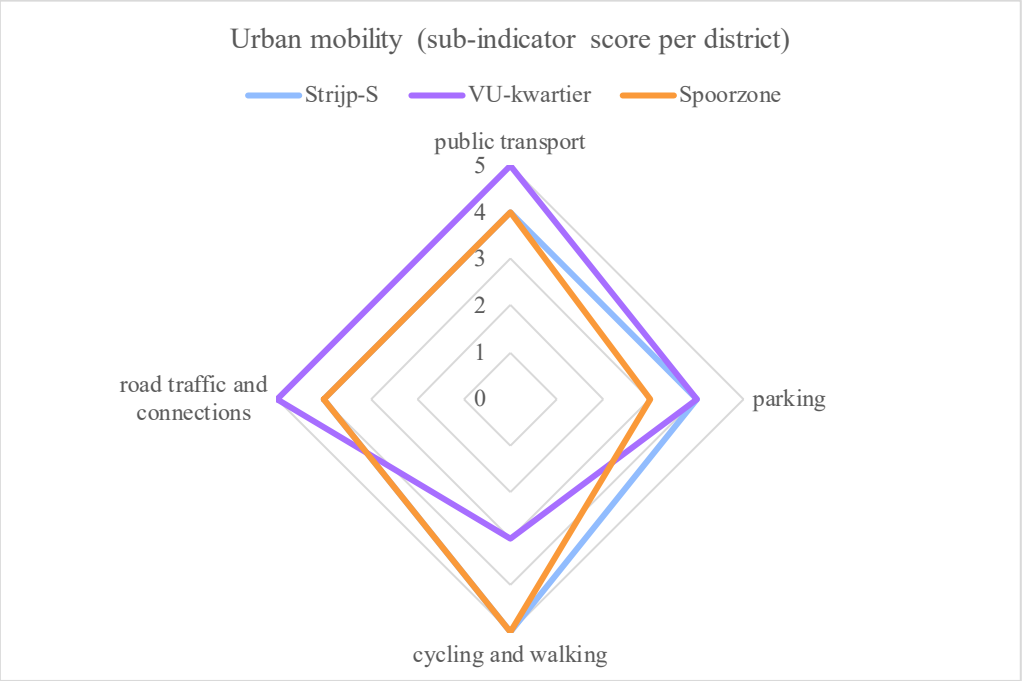

Figure 20 Sub-indicator score per district for urban mobility

The mean score per district for *urban mobility* was measured and visually displayed in Figure 21. The results show high performance on this indicator, with mean scores of 4,250 for Strijp-S and VU-kwartier, and 4,000 for Spoorzone. Most Dutch urban environments have good mobility and public transportation systems, which is reflected by these high values. However, some differences between districts still appear, with Strijp-S and Spoorzone scoring highest on walkability, and VU-kwartier on traffic connections and public transport.

Strijp-S shows a balanced mobility provision, with very good scores for most sub-indicators, and one excellent score for cycling and walking. The district's walking and cycling accessibility is at a high, reflecting it's car-free and low-traffic zones and separate lanes dedicated to walking and cycling. Similar to Strijp-S, Spoorzone shows high scores for its walkability and cyclability, shaped by redevelopment of the area prioritizing permeability

with new underpasses and reduced car dominance. Spoorzone lower parking scores reflect its reduction of space for cars, and its focus on public and non-motorized transport. VU-kwartier excels in public transportation, with options for travelling to and from the district by train, tram, metro and bus, increasing regional accessibility. It additionally shows strong road and traffic connections, making the district accessible but less permeable, which in turn lowers its score for cycling and walking.

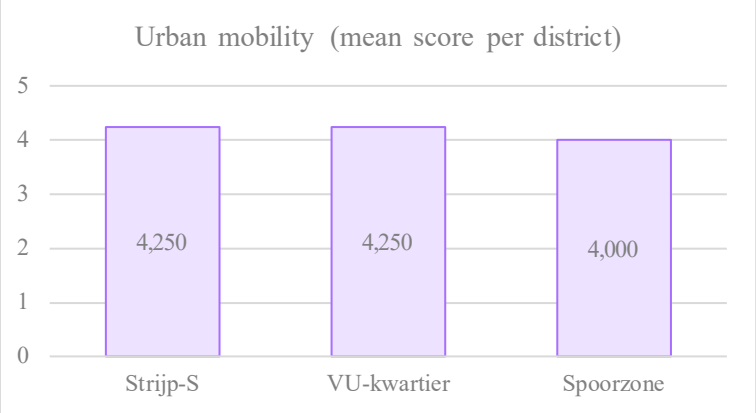

Figure 21 Mean score per district for urban mobility

This indicator is based on observable characteristics, made comparable through the 0 to 5 scoring scale, making a more qualitative assessment into measurable sub-indicators. However, this causes the representation of the *urban mobility* indicator to be simplified to expert judgement, which may not capture smaller differences and does not include long-time consistent measurements such as pedestrian counts through the day or "walk scores", which measures the pedestrian experience (Vey et al., 2018). Previously noted, the interpretation of parking scores and road traffic connections seem lower in districts with higher cyclability and walkability scores. However, this does not automatically mean that a district has poorer mobility performance, since walkable, transit-focused districts may have pre-planned this deliberately to increase non-motorized transport and reduce car dominance. Therefore, it is important to note that this scoring method only captures availability and quality, not if these factors were pre-planned or reduced on purpose. Additionally, all districts were measured by an equal weighting system, disregarding districts' size and regional context and connectivity requirements. For instance, the framework treats the VU-Kwartier identically to Strijp-S or Spoorzone, while its peripheral character in the capital of the Netherlands inherently requires higher public transport capacity than central districts in smaller cities.

Mixed-Use Development

Definition:

> *"A combination of residential, commercial, cultural, institutional, and industrial uses."* (Yigitcanlar et al., 2024)

The *mixed-use development* indicator was measured by three sub-indicators, the Mixed-Use Index (MXI) and Simpson's Diversity Index (SDI). The MXI is an indicator of the degree to which residential and non-residential functions are mixed at a location (functional mix). An MXI of 1 means that the entire floor area of a building block is used for residential purposes. An MXI of 0 means that the entire building block is used for non-residential functions.

Therefore, an MXI of 0,5 means a balanced mix between housing and non-housing. Comparable to the MXI is the SDI, which expresses the degree of variation within a building block across three functions: residential, employment/office, and amenities. An SDI of 2/3 indicates that the three functions are present in equal proportions within the block. An SDI of 0 means that only one of the three functions is present, and therefore no functional diversity exists. Creating a functional mix is important for innovation district development; Yigitcanlar et al., (2024) emphasize that, in order to link community-based and economic values, create a dense and diverse community and stimulate socioeconomic growth, a diverse and balanced supply of functions is needed.

Table 12 presents the three *mixed-use development* sub-indicators with their minimum and maximum values, and the measured values for the three districts. All measured values were normalized to a score between 0 and 5, visualized in Figure 22. Then, the mean score per district for *mixed-use development* was measured and visually displayed in Figure 23.

Table 12 Measured value per sub-indicator per district for mixed-use development

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoorzone
Mixed-use development	MXI (2024) more residential	1	0,5	-	-	0,559
	MXI (2024) more non-residential	0	0,5	0,439	0,018	-
	SDI (2024)	0	0,66	0,592	0,306	0,360

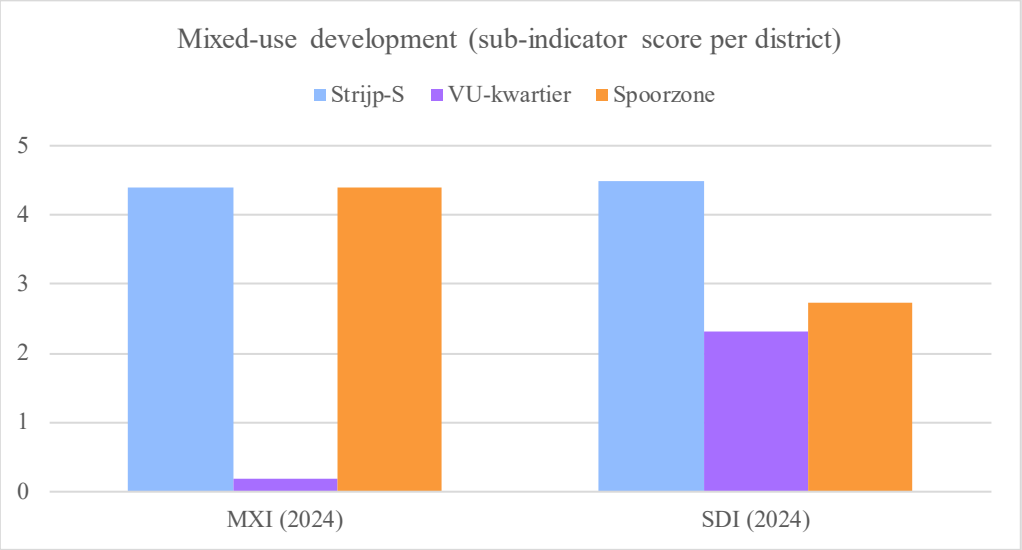

Figure 22 Sub-indicator score per district for mixed-use development

The findings demonstrate a high variety in score for *mixed-use development* between the three districts, with Strijp-S showing the highest score (4,437) and VU-kwartier the lowest (1,249). Spoorzone scores an average 2,729, with a relatively balanced MXI of 0,559, and a lower SDI of 0,360, showing that the overall district is well-mixed, but lower mix of functions within building blocks. Similar to Spoorzone, the score for Strijp-S indicate a well-balanced overall mix of functions on the district-level, however, the mix of functions on block-level is substantially higher than Spoorzone and VU-kwartier. VU-kwartier scores lowest, due to its

predominantly institutional and office character, with lower functional diversity within the district and a strong mono-functional, non-residential identity.

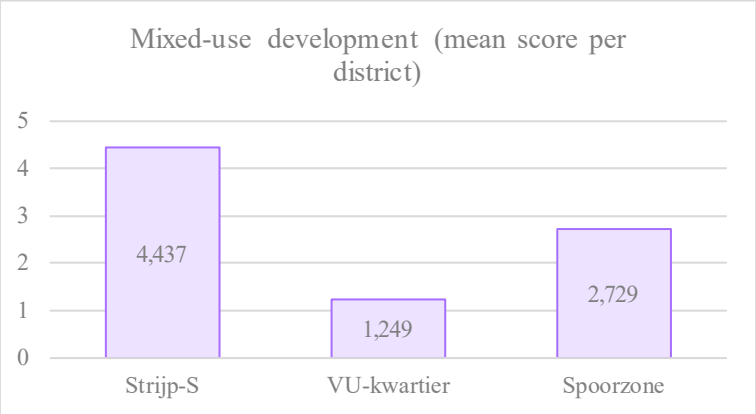

Figure 23 Mean score per district for mixed-use development

The main limitation to these results is the fact that they represent the situation of the year 2024, meaning the data were already two years old at the time of analysis. However, previous developments in the past two years may significantly alter the values for MXI and SDI per district. Additionally, SDI values capture function diversity per block, but not the vertical or horizontal spatial arrangement of those functions within that block. Lastly, the level of mixed-use development within each district is based on a general number representing the whole district, while MXI and SDI values vary considerably depending on the location within the district. Therefore, the results may underrepresent local differences and should be interpreted as a general score for *mixed-use development*.

Property availability and value

Definition:

> *"Value and availability of residential and commercial properties: renting and purchasing rates."* *(Yigitcanlar et al., 2024)*

The *property availability and value* indicator was measured by three sub-indicators. The first sub-indicator is the absolute deviation from a balanced distribution of tenure within the district. The data distinguishes between (1) owner-occupied and rental dwellings. Rental homes are divided into (2) dwellings owned by a housing association or other institution, and (3) rental dwellings owned by companies, private individuals, or investors. The more the distribution deviates from 0,33 – 0,33 – 0,33, the lower the score between 0 and 5.

The other two indicators are the average *WOZ*-value, an estimate of a property's market value, and the housing stock sub-indicator according the *Leefbaarometer*, describing among others the composition, quality, and other characteristics of dwellings in a neighborhood. (Mandemakers et al., 2021, pp. 114–119). The minimum and maximum values of the average WOZ value were derived from the housing price segments defined in the official *Omgevingsprogramma Volkshuisvesting* of the city of Amersfoort (Gemeente Amersfoort, 2026b), which aligns affordability thresholds with national policy and specifies the 2025 price limits for social rent, mid-rent, and affordable purchase, as shown in Table 13.

Table 13 Dutch national affordability thresholds 2025 (Gemeente Amersfoort, 2026)

Segment	Nieuw (prijspeil 2025)	Oud (prijspeil 2025; Deltaplan)
Sociale huur	Laag: 683 euro/ maand Hoog: 900 euro/ maand	Laag: 683 euro/ maand Hoog: 900 euro/ maand
Middenhuur	1.185 euro/maand (Nieuwbouw: +10% tot 2028)	Laag: 1.070 euro/ maand Hoog: 1.259 euro/ maand
Betaalbare koop	Laag: 328.000 euro Hoog: 405.000 euro	Laag: 283.000 euro Hoog: 328.000 euro

To provide a clear overview of the district-level results, Table 14 below presents the three *property availability and value* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. All measured values were normalized to a score between 0 and 5, based on the set minimum and maximum value, shown in the radar chart in Figure 24, where each axis represents one sub-indicator. In this chart, the larger the surface area covered by a district's polygon, the higher its overall score for *property availability and value*. Then, the mean score per district for *property availability and value* was measured and visually displayed in Figure 25.

Table 14 Measured value per sub-indicator per district for property availability and value

	Sub-indicator	Min value	Max value	Strijp-S	Vu-kwartier	Spoor zone
Property availability and value	Dwellings owned by a housing association (%)	-	33	46	5	49
	Rental dwellings owned by companies, private individuals, or investors (%)	-	33	44	42	50
	Owner-occupied dwellings (%)	-	33	10	53	1
	Absolute deviation from 1/3 – 1/3 – 1/3	1,3333333	0	0,47	0,57	0,64
	Average WOZ property value (€)	328000	405000	364000	720000	311000
	Housing stock (Leefbaarometer)	-2	2	-0,49	0,24	-0,275

According to the results, there is a clear variation in *property availability and value* across the three districts. Spoorzone scores highest with a mean scores of 3,250, Strijp-S follows with a mean score of 2,492, while de data for VU-kwartier indicate a very low score of 1,892.

All districts score between 2 and 3 out of 5 for the sub-indicators housing stock, reflecting lower levels of composition, quality, and other characteristics of dwellings for Strijp-S and Spoorzone, and above average scores for VU-kwartier. Additionally, while Strijp-S and Spoorzone show high numbers of dwellings owned by a housing associations, they indicate low numbers of owner-occupied dwellings, deviating strongly from a balanced distribution of property types in the district.

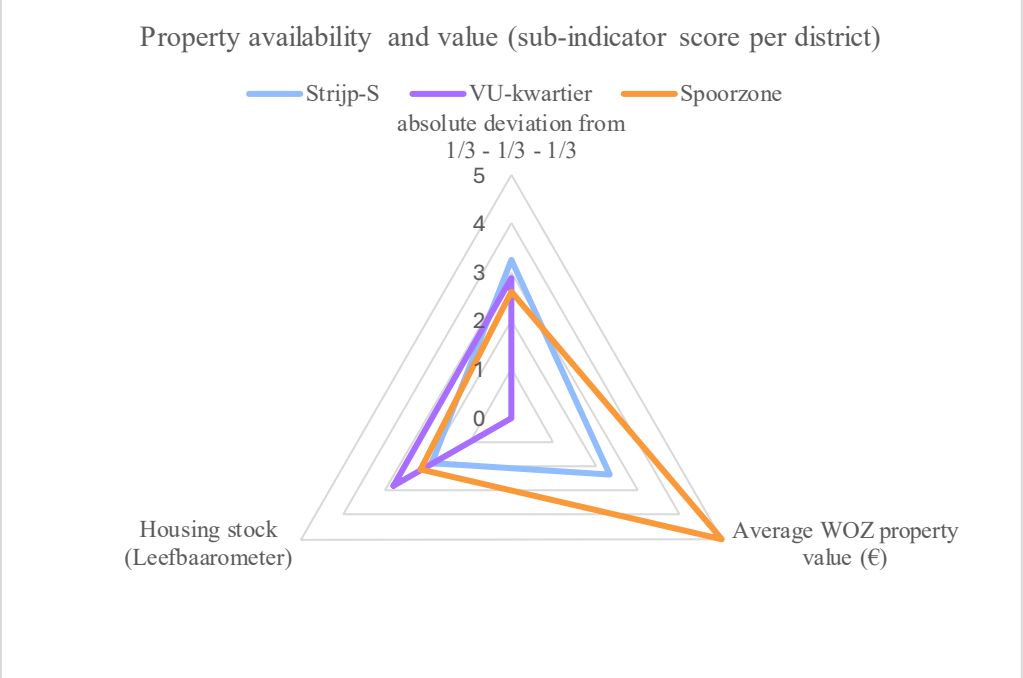

Figure 24 Sub-indicator score per district for property availability and value

In contrast to these finding, VU-kwartier presents a completely opposite outcome, with high numbers of owner-occupied dwellings and a very small number of dwellings owned by a housing association. Ultimately, all three districts show a disbalance in property type distribution.

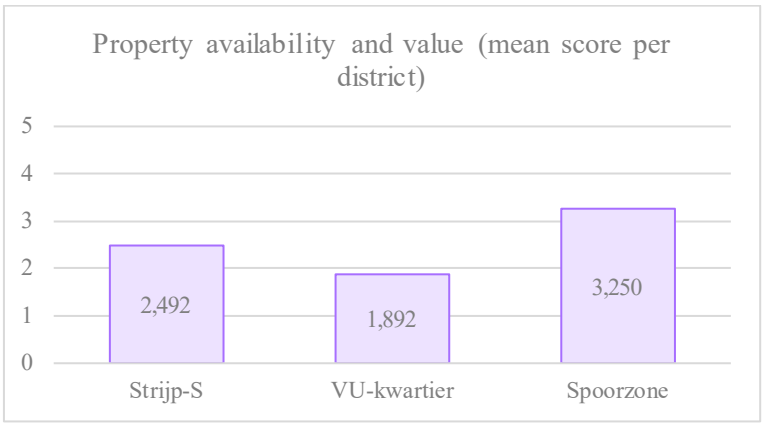

Figure 25 Mean score per district for property availability and value

Spoorzone scores highest overall, primarily due to its low average WOZ value for housing (€311.000). This value is below the minimum national affordability threshold. Strijp-S has and average WOZ value of €364.000, which lies within the minimum and minimum affordability thresholds, scoring on average lower than Spoorzone, while still complying to the national standards for affordable housing. In contrast, the average WOZ value of VU-kwartier of €720.000 indicates a notable expensive and less accessible housing market.

A significant limitation of these results lies in the classification of housing tenure. Instead of using the more widely used standard of affordability categories, the dataset is divided based on ownership type. Analyzing distribution levels based on affordability segments (social rent,

mid-rent, higher segment) would result in greater insights on affordability. Secondly, the average WOZ value is used as a sub-indicator for affordability. However, WOZ values represent an estimated market value for properties, and not actual housing prices, and does not account for the average household financial capacity. Additionally, current housing availability is not included in the data. However, overall availability in Dutch municipalities remains low, which is a direct consequence of the systemic housing shortage. Lastly, no commercial property data was available for analysis.

Public and cultural spaces

Definition:

> *"Public and cultural spaces that are open or accessible to people of all levels of society: meeting places, cinemas, libraries, theatres …" (Yigitcanlar et al., 2024)*

The *public and cultural spaces* indicator was measured by seven sub-indicators. The different sub-indicators, such as distance to library, museum, performing arts venue, cinema etc. were indicated using the *kerncijfers wijken en buurten 2025* data-set (CBS, 2026). This data-set indicates distances to several different amenities. The distances relevant for this indicator were selected. Other potential sub-indicators, such as the number of visitors to cultural performances or residents' satisfaction with available cultural facilities, were excluded from the selection, because of lack of comparable available data between the three districts.

Table 15 presents a clear overview of the three *public and cultural spaces* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone. All measured values were normalized to a score between 0 and 5, based on the threshold, shown in Figure 26, where each axis represents one sub-indicator. The larger the surface area covered by a district's polygon, the higher its overall score for *public and cultural spaces*.

Table 15 Measured value per sub-indicator per district for public and cultural spaces

	Sub-indicator	Min value	Max value	Strijp-S	VU-kwartier	Spoor zone
Public and cultural spaces	Distance to library	5	0	2	0,95	0,975
	Distance to museum	5	0	1,8	1,4	0,5
	Distance to performing arts venue	5	0	1	4,2	0,25
	Distance to cinema	5	0	0,7	0,28	1,225
	Distance to sauna	5	0	2,9	0,9	2,9
	Distance to tanning salon	5	0	1,9	2,2	2

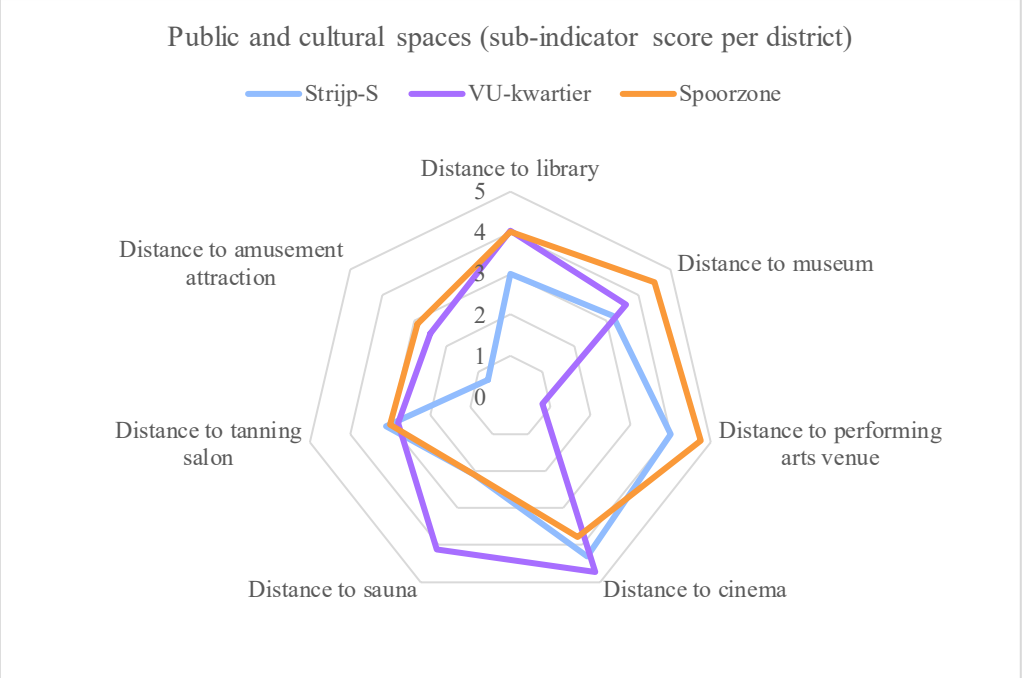

Figure 26 Sub-indicator scores per district for public and cultural spaces

The mean scores per district for *public and cultural spaces* are displayed in Figure 27 and show relatively small variation across the three districts. Spoorzone achieves the highest score (3,488), but is very close to the score of Strijp-S (3,342). This reflects generally short distances to key cultural and leisure amenities, such as a library, a museum, a performing arts venue and a cinema. Though, both show longer distances to a sauna and Strijp-S to amusement attractions. Vu-kwartier shows the lowest mean score (3,184), due to longer distances to mainly cultural amenities, such as a museum and performing arts venue, despite high proximity to a library or cinema. VU-kwartier is the only district which scores high on proximity to a sauna. Overall, Spoorzone shows the most consistent proximity to a variety of public and cultural facilities, Strijp-S performs also well, though with moderate variation between sub-indicators, while VU-kwartier shows the weakest accessibility to these amenities, however still scoring above average.

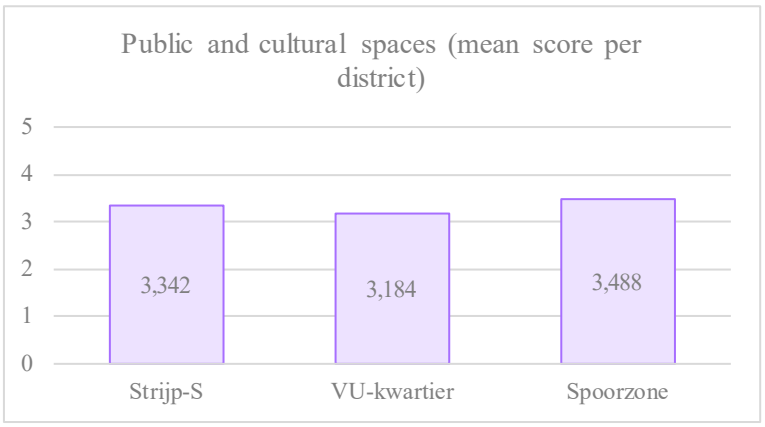

Figure 27 Mean score per district for public and cultural spaces

Main limitations to the measurement method of this indicator are among others the fact that the indicator relies fully on proximity, excluding other important sub-indicators such as the attendance levels of cultural amenities, and resident satisfaction with the supply an quality of facilities. Not including these sub-indicators was the result of significance absence of such data and difficulty in determining thresholds for these type of measurements. Lastly, some parts of the dataset reflects conditions form as far as three years prior. These limitations should be taken into consideration when interpreting the results for the *public and cultural spaces* indicator.

Objective safety and security

Definition:

> *"How safe is to live in this place: the risk of going around late evening, street safeness for pedestrians and cycling, noise."* (Yigitcanlar et al., 2024)

The *objective safety and security* indicator was measured by district-specific sub-indicators. Because the number and type of available safety- and security-related sub-indicators differed between the three districts, this research incorporated all available safety- and nuisance-related variables for each district, under the condition that they fell within the same conceptual domain of safety and nuisance. Restricting the analysis to only the overlapping sub-indicators would have removed a large share of relevant information and produced an incomplete representation of local safety conditions.

The sub-indicators for Strijp-S are derived from research of the Gemeente Eindhoven (2025) and include a broad set of neighbourhood-level safety measures from the Leefbaarometer and resident surveys. These cover themes ranging from experienced nuisance such as graffiti, loitering youth, hospitality-related nuisance, to perceived safety, such as feeling unsafe in the neighbourhood, to environmental or social disorder, such physical deterioration, litter and vandalism. Then, for VU-Kwartier, the data come from (Gemeente Amsterdam, 2025). Because neighborhood-specific data for VU-Kwartier is unavailable, the Zuidas district is used as a representative alternative, as VU-Kwartier is a neighborhood located within the Zuidas district. The sub-indicators here focus on changes in crime or nuisance over time, experienced nuisance, such as hospitality-related nuisance, drug-related nuisance, nuisance from mentally disturbed individuals and perceived safety, such as feeling unsafe in the neighborhood. Lastly, for Spoorzone, the sub-indicators are derived from Gemeente Tilburg (2026) and include a combination of objective crime statistics, such as property crime, violent crime and organized crime, reported nuisance, such as alcohol- and drug-related nuisance and traffic or parking nuisance, and perceived safety, such as feeling safe during the day or evening.

To provide a clear overview of the district-level results, Table 16, Table 17 and Table 18 present the *objective safety and security* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone separately. All measured values were normalized to a score between 0 and 5, based on the set minimum and maximum value, shown in Figure 28, Figure 29 and Figure 30.

Table 16 Measured value per sub-indicator for objective safety and security Strijp-S

	Sub-indicator	Min value	Max value	Strijp-S
Objective safety and security	Nuisance and unsafety (Leefbaarometer)	-2	2	-0,52
	Physical deterioration (%)	100	0	35
	Social nuisance (%)	100	0	21
	People who perceive high levels of crime in their neighbourhood (%)	100	0	18
	Feels unsafe at times in their own neighbourhood (%)	100	0	32
	Share of people experiencing nuisance from graffiti (%)	100	0	5
	Share of people experiencing nuisance from drunk people on the street (%)	100	0	8
	Share of people experiencing nuisance from loitering youth (%)	100	0	10
	Share of people experiencing nuisance from people being harassed on the street (%)	100	0	4
	Share of people experiencing nuisance from neighbours (%)	100	0	3
	Share of people experiencing nuisance from dog fouling (%)	100	0	5
	Share of people experiencing nuisance from litter on the street (%)	100	0	31
	Share of people experiencing nuisance from vandalism of street furniture (%)	100	0	2
	Share of people experiencing nuisance from hospitality venues (%)	100	0	8
	High nuisance from drug use and/or drug dealing (%)	100	0	6
	Experiences high nuisance from mentally disturbed individuals (%)	100	0	9
	Experiences high nuisance from parking problems (%)	100	0	19
	Experiences nuisance from bicycles parked on the pavement (%)	100	0	11
	Feels unsafe due to the presence of hazardous materials (%)	100	0	11
	Feels unsafe due to the presence of radiation (%)	100	0	5
	Feels unsafe due to air pollution (%)	100	0	28
	Feels (very) unsafe due to hazardous materials / radiation / air pollution (%)	100	0	28
	(Highly) satisfied with the approach to liveability and safety (%)	0	100	54
	Overall grade for neighbourhood safety	0	10	7,2

Figure 28 Sub-indicator scores for objective safety and security Strijp-S

The results for Strijp-S show a high safety-profile (4,092), with notable levels of everyday nuisance. The scores reflect moderate issues with environmental order such as litter, social nuisance and livability and safety concerns, with a share of residents feeling unsafe at times in their neighborhood. Additionally, the *Leefbaarometer* score shows deviant values for nuisance and unsafety, compared to other sub-indicators. The overall grade for neighborhood safety is an above-average 7,2. Overall, Strijp-s performs high on the indicator of *objective safety and security*, and reflects an neighborhood where some nuisance is present.

Table 17 Measured value per sub-indicator for objective safety and security VU-kwartier

	Sub-indicator	Min value	Max value	VU-kwartier
Objective safety and security	Nuisance and unsafety (Leefbaarometer)	-2	2	0,05
	Thinks crime in the neighbourhood has increased in Zuidas	100	0	12
	Feels unsafe at times in their own neighbourhood in Zuidas	100	0	10
	Thinks nuisance in the neighbourhood has increased in Zuidas	100	0	9
	Percentage experiencing severe nuisance from hospitality venues in Zuidas	100	0	2
	Percentage experiencing severe drug-related nuisance in Zuidas	100	0	1
	Percentage experiencing severe nuisance from mentally disturbed individuals in Zuidas	100	0	6
	Percentage experiencing severe nuisance from loitering youth in Zuidas	100	0	2
	Neighbour safety grade in Zuidas	0	10	7,7

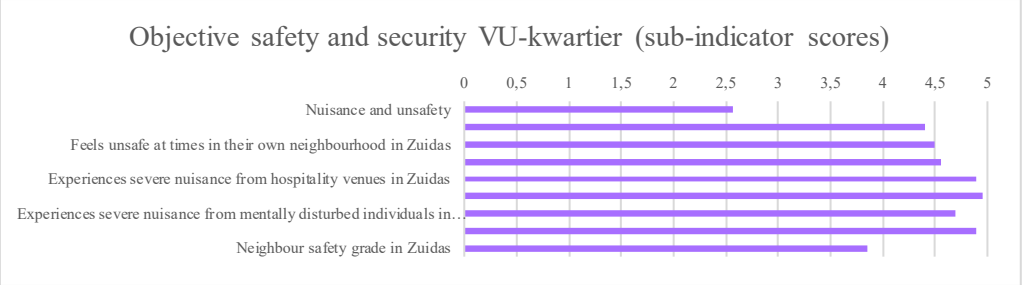

Figure 29 Sub-indicator scores for objective safety and security VU-kwartier

The results for VU-kwartier, represented through data of the bigger Zuidas neighborhood, show the highest *objective safety and security* profile (4,368). The district's results show no severe nuisance levels, and the neighborhood received a grade of 7,7 out of 10 for neighborhood safety, suggesting that residents generally view the area as safe and secure. Only the *Leefbaarometer* score shows deviant values for nuisance and unsafety, compared to other sub-indicators. Perceptions of increased crime and nuisance exist, but remain low. While the reliance on Zuidas data introduces some uncertainty, the available sub-indicators suggest that VU-Kwartier, as part of the Zuidas, benefits from the safe urban environment.

Table 18 Measured value per sub-indicator for objective safety and security Spoorzone

	Sub-indicator	Min value	Max value	Spoor zone
Objective safety and security	Nuisance and unsafety (leefbarometer)	-1	1	-1,1625
	Property crimes	-3	3	-1,5
	Violent crimes	-3	3	-0,75
	Nuisance reports	-3	3	-1,25
	Organised crime	-3	3	-1
	Fixi safety reports	-3	3	-0,75
	Feels safe during the day	-3	3	-1
	Nuisance from crime	-3	3	-2,5
	Feels safe in the evening	-3	3	-2,25
	Afraid of becoming a victim of crime	-3	3	-2,5
	Nuisance from alcohol and drug use	-3	3	-3
	Parking nuisance	-3	3	1,75
	Traffic nuisance	-3	3	-0,75
	Nuisance from the behaviour of others	-3	3	-2,25

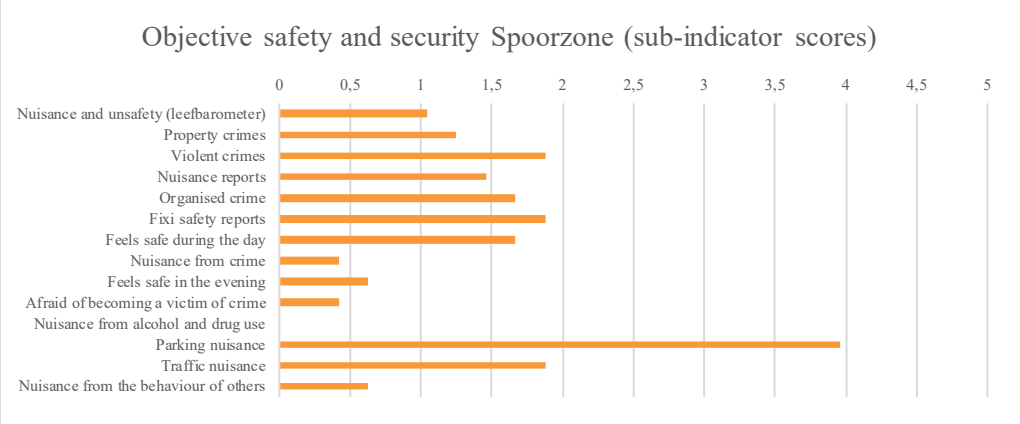

Figure 30 Sub-indicator scores for objective safety and security Spoorzone

Spoorzone shows the lowest scores across all districts (1,340), with consistently low scores for all sub-indicators, reflecting shortcoming for both nuisance and safety. Crime-related sub-indicators, such as property crimes, violent crimes, organized crime and nuisance from crime, score very low. Additionally, the results reflect residents feeling unsafe in the evening, feeling afraid of becoming a victim of crime and experiencing nuisance from antisocial behavior. The district scores lowest (0 out of 5) on nuisance from alcohol and drug use. These patterns suggest a neighborhood where both structural safety issues and negative resident perceptions are present. In both the Spoorlaan and Spoorzone Noord-Oost neighborhoods, part of the Spoorzone district, feelings of unsafety are mainly linked to the station environment, where respondents report perceiving certain groups of people as unpleasant, as well as indirect nuisance from alcohol and drug use (Tilburg University, 2026). In addition, poor lighting and dark corners contribute to a heightened sense of unsafety, especially in Spoorzone Noord-Oost with the number of bars and nightlife venues.

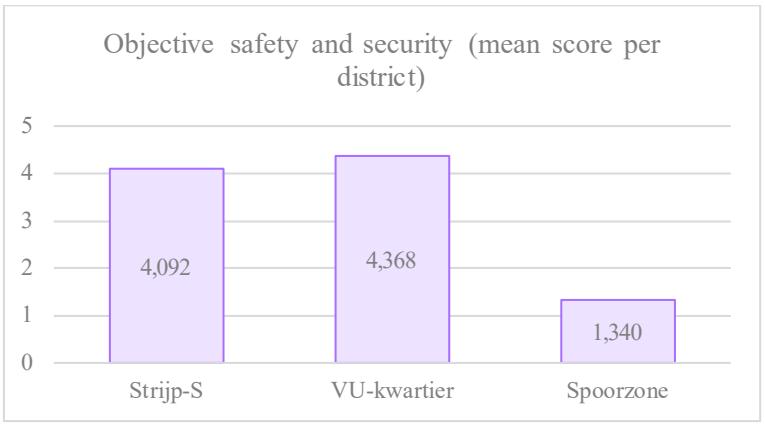

Figure 31 Mean score per district for objective safety and security

The mean scores per district for this indicator were measured and visually displayed in Figure 31. The overall scores reveal a clear distinction between safety and security among the three districts. VU-kwartier performs the strongest (4,368), followed by Strijp-S (4,092), reflecting low nuisance levels and positive residents perceptions on safety. On the contrary, Spoorzone scores far below average, with a low 1,340 mean score, reflecting a backlog regarding safety and security compared to the other two cases. The mean scores provide a useful comparative

overview, but they should be interpreted with the variation in sub-indicators between districts in mind.

Place attachment

Definition:

> *"Passion for staying in the place: considering the intended location as an ideal place." (Yigitcanlar et al., 2024)*

The *place attachment* indicator was, similar to the *objective safety and security* indicator measured by district-specific sub-indicators. Because the number and type of available place-attachment-related sub-indicators differed between the three districts, this research incorporated all available variables for each district, under the condition that they fell within the same conceptual domain of place attachment, such as satisfaction with neighborhood, number of movers and score of physical environment. Restricting the analysis to only the overlapping sub-indicators would have removed a large share of relevant information and produced an incomplete representation of the sense of attachment residents have to the district.

The sub-indicators for Strijp-S are derived from research of the Gemeente Eindhoven (2025) and include a broad set of neighborhood-level data, from which two indicators were selected suitable for indicating the place attachment of residents (see Table 19). Then, for VU-Kwartier, the data come from the *Basisbestand Gebieden Amsterdam*, BBGA (Gemeente Amsterdam, 2026). Because neighborhood-specific data for VU-Kwartier is unavailable, the Zuidas district is used as a representative alternative, as VU-Kwartier is a neighborhood located within the Zuidas district. The sub-indicators focus mainly on neighborhood satisfaction, neighborhood experience and social involvement (see Table 20). Lastly, for Spoorzone, the sub-indicators are derived from Gemeente Tilburg (2026) and include population dynamics public space and neighborhood cohesion (see Table 21).

Table 19, Table 20 and Table 21 present the *place attachment* sub-indicators, their minimum and maximum possible values, and the measured values for Strijp-S, VU-Kwartier, and Spoorzone separately. All measured values were normalized to a score between 0 and 5, based on the set minimum and maximum value, visualized for Strijp-S in Figure 32, for VU-kwartier in Figure 33 and for Spoorzone in Figure 34. All results together were calculated into mean scores in Figure 35.

Table 19 Measured value per sub-indicator for place attachment Strijp-S

	Sub-indicator	Min value	Max value	Strijp-S
Place attachmen	Rating how pleasant it is to live in their neighborhood	0	10	8,0
	Scale physical quality of neighborhood facilities	0	10	6,8

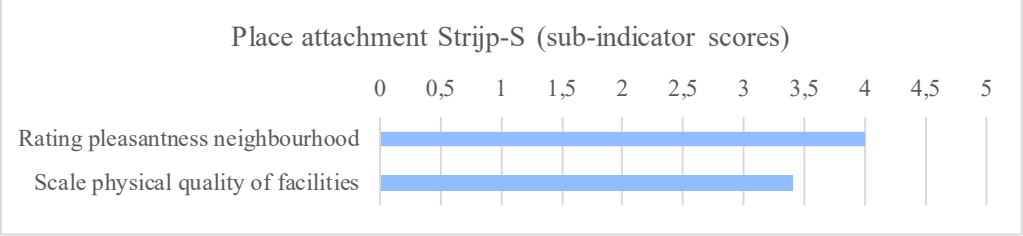

Figure 32 Sub-indicator scores for place attachment Strijp-S

Strijp-S scores relatively high for the indicator *place attachment*, reflecting a neighborhood where residents feel at home and want to stay. The neighborhood is rated as pleasant, with a grade of 8,0 out of 10,0. However, the physical quality of facilities scores lower, reflecting a moderate lack of maintenance. Overall, the districts scores highest of the three cases (3,700). This score could provide more insights by including more sub-indicators to determine the level of place attachment.

Table 20 Measured value per sub-indicator for place attachment VU-kwartier

	Sub-indicator	Min value	Max value	VU-kwartier
Place attachment	Zuidas – share of residents intending to move (%)	0	100	49
	Zuidas – satisfaction with own neighbourhood (1–10)	0	10	7,7
	Zuidas – pleasant living (1–10)	0	10	8
	Zuidas – neighbourhood development (1–10)	0	10	7,6
	Zuidas – feeling at home (1–10)	0	10	7,4
	Zuidas – involvement of neighbourhood residents (1–10)	0	10	5,5

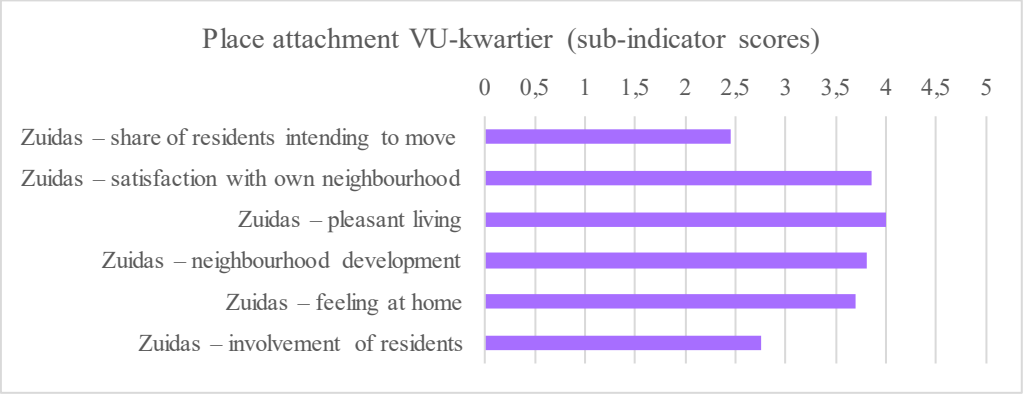

Figure 33 Sub-indicator scores for place attachment VU-kwartier

The results for VU-kwartier, represented through data of the bigger Zuidas neighborhood, show the second highest *place attachment* profile, with a score of 3,425. The neighborhood is rated as pleasant, with a grade of 8,0 out of 10,0. However, the involvement of residents and their intentions to move score lower, reflecting a moderate lack of attachment to the neighborhood. Overall, the districts scores above average with a score of 3,425. This score could provide a more holistic reflection of place attachment by including more sub-indicators.

Table 21 Measured value per sub-indicator for place attachment Spoorzone

	Sub-indicator	Min value	Max value	Spoor-zone
Place attachment	Departing residents (people who moved out of the neighbourhood)	-3	3	-1,75
	Attractiveness of public space	-3	3	1
	Satisfaction with population composition	-3	3	-0,5
	Assessment of resident involvement in the neighbourhood	-3	3	-1,25
	Fixi reports – physical and social living environment	-3	3	-0,5
	Overall neighbourhood assessment	-3	3	-1,25

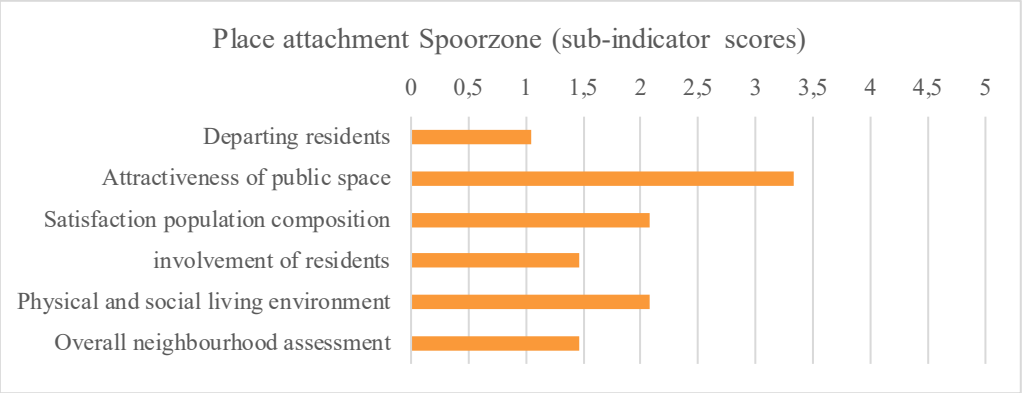

Figure 34 Sub-indicator scores for place attachment Spoorzone

The results for Spoorzone show the lowest *place attachment* profile, with a score of 1,910. The neighborhood is rated low overall, showing minimal scores for the satisfaction and involvement of residents, moving-rates and the physical and social living environment. Spoorzone only scores above average for the attractiveness of the public space. Overall, the neighborhood scores far below average, suggesting people do not feel attached to the district. This score could provide a more holistic reflection of place attachment by including more sub-indicators.

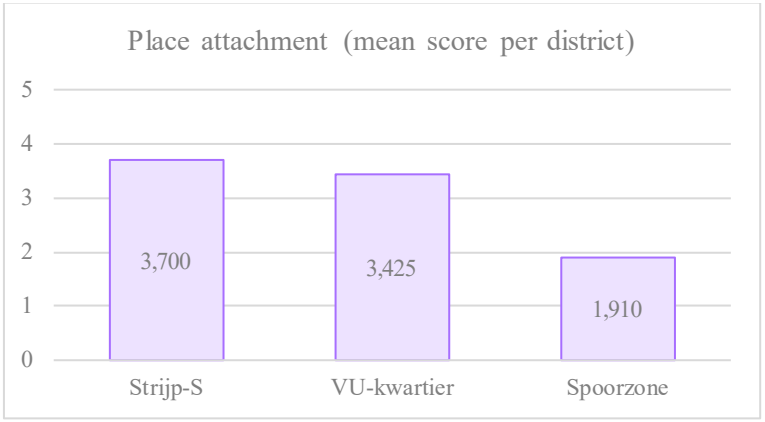

Figure 35 Mean score per district for place attachment

4.2.2 Qualitative space quality

The research used Yigitcanlar et al.'s (2024) indicators enriched with definitions and indicators of other sources (Kalliomäki et al., 2024; Lawrence et al., 2019; Vey et al., 2018), to assess the qualitative spatial indicators on the district scale through observations during site visits of the selected cases. During these visits, each site was experienced and captured through notes, photographic documentations, sketches and drawings. Then a subjective assessments of the overall atmosphere per district was made, followed by a descriptive analysis per individual indicator.

The first site that was visited was Strijp-S. The overall atmosphere was calm, with high pedestrian and biking accessibility. Additionally, the accessibility with public transport was high, with multiple buses leading to the district as well as a separate train station on the district. Even though there were not a lot of people on the street, the district looked lively, with lots of street art and urban references to the district's historical industrial character.

The atmosphere at VU-kwartier was contrasting with that of Strijp-S, meaning that the pedestrian accessibility was lower, with cars dominating the district. However, accessibility with public transport was higher, because of the nearby *Amsterdam Zuid* train station. The district was more crowded, with students and hospital-attendants coming from and going to the VU and AUMC. The district, however, did not show a lot of creativity on the streets, with little to no street art or other displays of artistic creativity.

Lastly, Spoorzone showed more similarities with Strijp-S, referring back to the historical industrial past through urban and architectural design. Because the Tilburg central station is situated in the center of the district, the number of people in the street was high. The district therefore is pedestrian and cyclist friendly, with some roads and the train track intersecting the district. However, these did not dominate the district, as multiple pedestrian crossings and underpasses were present to maintain movability.

Urban form & urban structure

Definition urban form:

> *"The physical characteristics that form built-up areas: the shape, size, density and configuration of settlements."* (Yigitcanlar et al., 2024)

Definition urban structure:

> *"The arrangement of urban spaces. The degree of connectivity and accessibility: accessibility to public and private spaces, land uses." (Yigitcanlar et al., 2024)*

Starting with Strijp-S, the district is bordered by the train tracks in the north-east, the *Glaslaan* in the east, the *Kastanjelaan* in the south, the *Schootsestraat* in the south-west, and the *Beukenlaan* in the north-west. The hard borders are marked by bold red lines in Figure 36, which are high speed, vehicle-oriented edges that define the district, with either a 50 km/h or 70 km/h speed-limit. The bolder the line, the harder the edge and the higher the speed-limit. The orange lines mark the internal, pedestrian and cyclist friendly streets and pathways such as the *Torenallee* and the *Philitelaan* , that create a more accessible network within the district which safely integrates low-speed bus and car traffic (speed-limit 30 km/h). See also Figure 37.

Figure 36 Map of Strijp-S showing hard (red) edges and soft internal (orange) structure (own work)

Figure 37 Speed map Strijp-S (Gemeente Eindhoven, n.d.)

Figure 38 displays a map of Strijp-S, showing where picture of the district were taken during the site visit. The pictures show elements of the indicators *urban form* and *urban structure*, showing the physical characteristics which form the area as well as the arrangement of urban spaces and the degree of permeability. On the west side of Strijp-S, the *Beukenlaan* has been lifted, allowing for intersecting streets to pass underneath, softening the hard edge by creating a permeable underpass at ground level (Figure 38; 1). The columns carrying the bridge are decorated with street art, reinforcing the district's creative identity, and additionally making the underpass feel more welcoming, contributing to a sense of safety, place and legibility (Figure 38; 1). This intervention transforms what could be an oppressive barrier into a semi-open entrance into the district. The side of the underpass, as well as the overpass of the train tracks intersecting the *Beukenlaan* are decorated with art (Figure 38; 2 & 3). The *Torenallee* is pedestrian- and cyclist-friendly by separating the pedestrian and cycle path from the 30 km/h road with green structures (Figure 38; 4 & 6). The *Anton* and *Gerard* building form harsh barriers going through the district, but maintain their permeability by allowing pedestrians and cyclist to pass through the buildings (Figure 38; 5). The *Schootsestraat* is the only district border with a speed-limit of 30 km/h, forming a soft district-edge, allowing by-passers to easily enter the district from the south-east (Figure 38; 7). It is a calm street, with

green structures separating the pedestrian path from the cycle path and 30 km/h road. Then, the *Glaslaan* forms a busy intersection with the *PSV-Laan* and *Philitelaan*, creating a hard, less permeable, edge for Strijp-S in the east (Figure 38; 8). Lastly, within the district, the *IR Kalffstraat* firstly runs alongside the and then crosses the *Philitelaan* as a 30 km/h bus lane, covered by the historical pipe corridors (Figure 38; 9 & 10). Overall, Strijp-S is a district with strong internal walkability, creative placemaking, and intentional permeability solutions, but still constrained by infrastructural borders along its edges.

Figure 38 Site visit photographs of Strijp-S for urban form & structure (own work)

Continuing with VU-kwartier, the district is bordered by the train tracks and *A10* ring road in the north, the *Parnassusweg* and *Buitenveldertselaan* in the east, the *Arent Janszoon Ernststraat* and the *Botanische Tuin Zuidas* in the south, and the *Amstelveenseweg* in the

west. The hard borders are marked by bold red lines in Figure 39, which are vehicle-oriented edges that define the district, with a 50 km/h speed-limit. The bolder the line, the harder the edge or the higher the speed-limit. The orange lines mark the internal, pedestrian and cyclist friendly streets and pathways such as the *Gustav Mahlerlaan* and the *Van der Boechorststraat*, which create a more accessible network within the district or safely integrates low-speed car traffic (speed-limit 30 km/h). However, the district is split in two by the 50 km/h, 4-lane, including tram tracks, *De Boelelaan*, which creates a harsh separation between the north and the south of the district. See also Figure 40.

Figure 39 Map of VU-kwartier showing hard (red) edges and soft internal (orange) structure (own work)

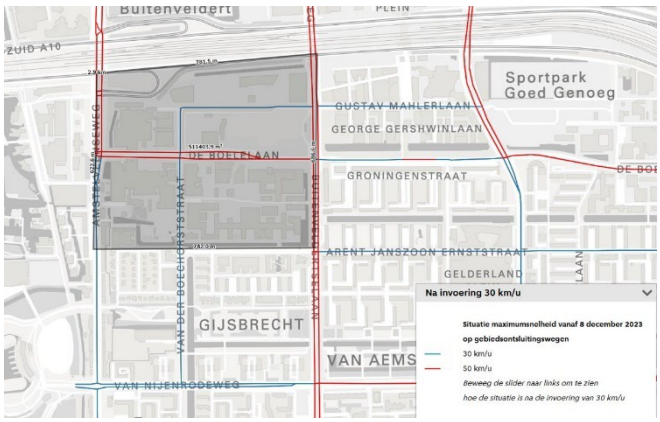

Figure 40 Speed map VU-kwartier (Gemeente Amsterdam, n.d.)

Figure 41 displays a map of VU-Kwartier, showing where picture of the district were taken during the site visit. The pictures show elements of the indicators *urban form* and *urban structure*, displaying the physical characteristics which form the area as well as the arrangement of urban spaces and the degree of permeability. In the center of the district, there is a busy crossing between *De Boelelaan*, the *Gustav Mahlerlaan,* and the *Van der Boechorststraat*, facilitated with pedestrian crossings, though this remains a car-oriented, less pedestrian-friendly part of the district (Figure 41; 1). The *De Boelelaan* then proceeds and intersects with the *AUMC*. The AUMC is lifted over the *De Boelelaan*, and therefore allows for the intersecting street to pass underneath, softening an otherwise hard edge by

creating a permeable underpass for cars, public transport, cyclists and pedestrians (Figure 41; 2 & 3). Then, the *Amstelveenseweg* creates another hard border on the western edge of the district, allowing for cars and public transport such as busses to drive at a speed of 50 km/h, further south slowing down to 30 km/h (Figure 41; 4 & 5). When entering the district again towards the *Botanische Tuin Zuidas*, the roads are more pedestrian-friendly and no cars are allowed (Figure 41; 6). Lastly, the *Gustav Mahlerlaan* entering the district from the east, forms a broad 30 km/h street with separate pedestrian and cycle paths on both sides (Figure 41; 7). Overall, VU-kwartier is a district with harsh border, within and around the districts, with some permeability solutions and pedestrian friendly street. However, VU-kwartier is primarily car-oriented.

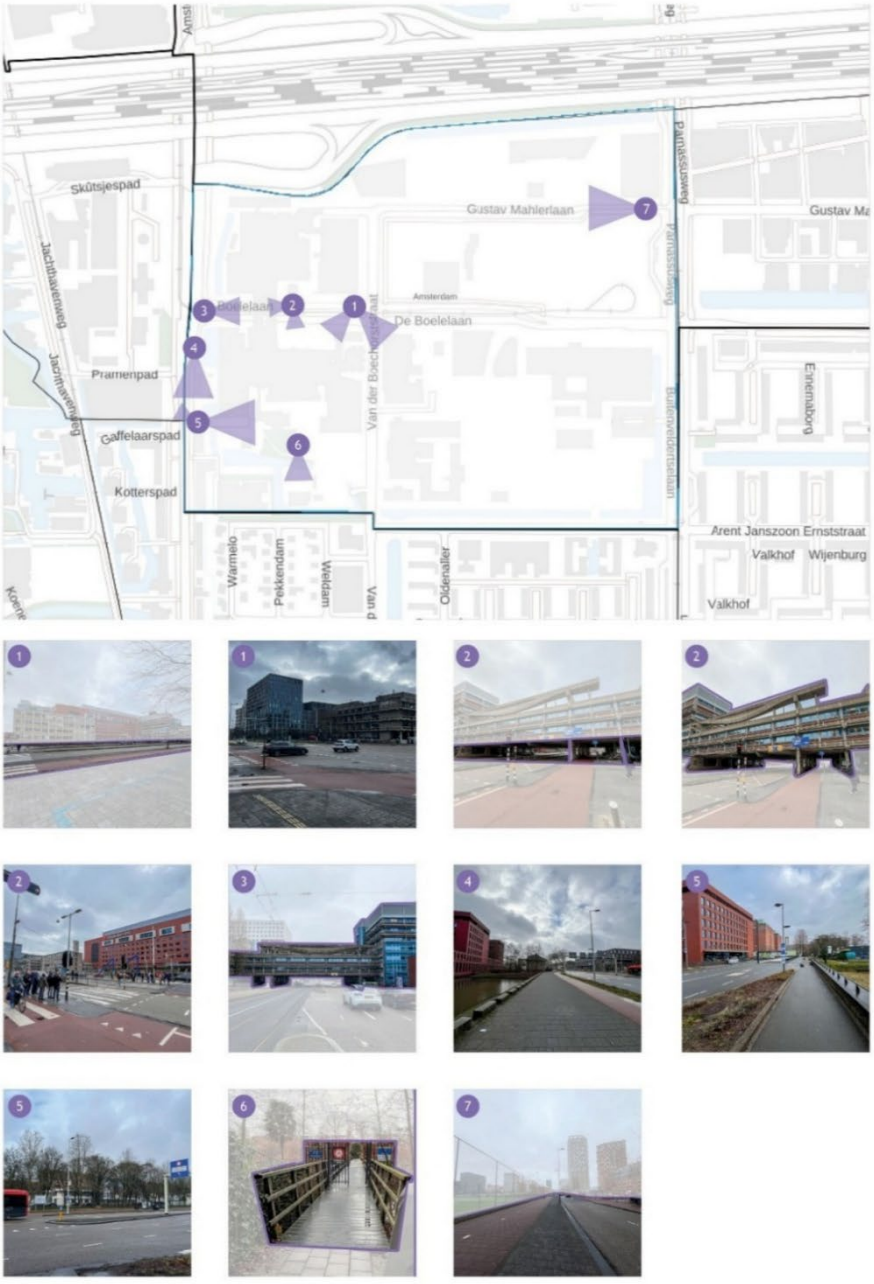

Figure 41 Site visit photographs of VU-kwartier for urban form & structure (own work)

Lastly, the Spoorzone district is bordered by the *Burgemeester Brokxlaan* in the north, *NS Plein* in the east, the *Spoorlaan* and *Hart van Brabantlaan* in the south, and the *Sint Ceciliastraat* in the west. The hard borders are marked by bold red lines in Figure 42, which are vehicle-oriented edges that define the district, with a 50 km/h speed-limit. The bolder the line, the harder the edge. The orange lines mark the internal, pedestrian and cyclist friendly streets and pathways, such as the *Locomotiefboulevard,* which create a more accessible network within the district. However, the district is split in two by the railroad and the Central station, which creates a harsh separation between the north and the south of the district. See also Figure 43.

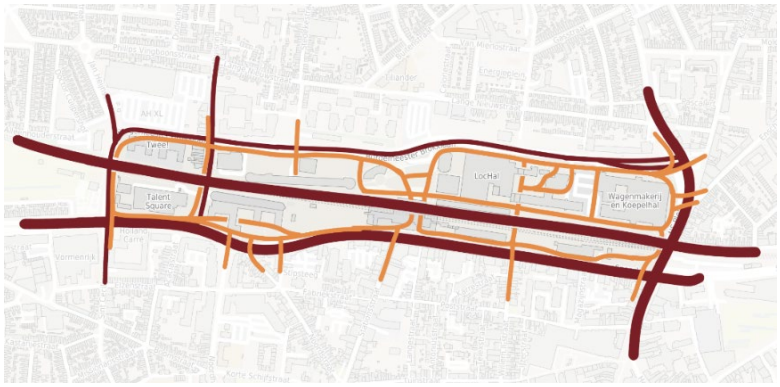

Figure 42 Map of Spoorzone showing hard (red) edges and soft internal (orange) structure (own work)

Figure 43 Speed map Spoorzone (Rijkswaterstaat, 2026)

Figure 44 displays a map of Spoorzone, showing where picture of the district were taken during the site visit. The pictures show elements of the indicators urban form and urban structure, displaying the physical characteristics which form the area as well as the arrangement of urban spaces and the degree of permeability. The *Gasthuisring* creates a separation between the eastern *Spoorlaan* and *Spoorzone-Noord-Oost*, and the western *TalentSquare* and *Spoorzone-Noord-West* neighborhoods of Spoorzone, which is made permeable by including pedestrian crossings. Additionally, the *Gasthuisring* as well as the *Sint Ceciliastraat* pass under the railroad, as well as multiple other pedestrian paths, to ensure permeability within the district (Figure 44; 1, 2, 4, 7 & 8). These underpasses, especially the *Willem-II Passage* display Spoorzone's creative character through street-art and interactive light-design (Figure 44; 2 & 8). Even though the *Spoorlaan* and *Hart van Brabantlaan* are

busy 50 km/h streets, the pedestrian and cycle path have been separated by greenery in order to ensure safety, walkability and cyclability (Figure 44; 3 & 6). Then, the mixed-use office and housing building *De StadsHeer* creates an obstacle when walking from west to east in the southern part of the district. As pedestrians could walk around the building, they could also walk underneath it through a underpass intersecting *De StadsHeer*, making it more permeable and less of a harsh border (Figure 44; 5). Lastly, the *Burgemeester Brokxlaan* shows similar characteristics to the *Spoorlaan* and *Hart van Brabantlaan,* although it being a less busy 50 km/h street (Figure 44; 9). Overall, Spoorzone shows a connected relationship with the surrounding city, maintaining permeability, despite the presence of the railroad.

Figure 44 Site visit photographs of Spoorzone for urban form & structure (own work)

Urban design & architectural design

Definition urban design:

> *"The style of designing unbuilt spaces: landscape, parks, streetscape, landmarks, spatial diversity."* (Yigitcanlar et al., 2024)

Definition architectural design:

> *"The style of designing buildings and other physical structures: appearance, well-made details, the convergence of old and new."* (Yigitcanlar et al., 2024)

Strijp-S is a district with a strong, recognizable design language rooted in its industrial heritage. Buildings such as *Ketelhuis*, *Trudo Toren*, and *Klokgebouw* exhibit a robust, expressive architectural character, which aligns with the district's creative identity, mixing heritage with modern architectural aspects. The adaptive reuse of industrial structures contributes to a unique identity, reinforcing the district's branding as a creative and entrepreneurial place. The streetscape design appears active and diverse, with cafés, bars, and creative workspaces visible at ground level. The presence of outdoor seating and public terraces indicates a deliberate effort to attract people to the district and encourage visitors to linger. Furthermore, spatial diversity is evident in the mix of narrow pedestrian passages, the wider *Ketelhuisplein*, and the broader *Torenallee*, which collectively motivate movement through the district. Additionally, from an industrial brick glass factory to a contemporary vertical forest, Strijp-S's high variety in architectural design creates a layered environment that supports both visual interest and functional diversity. The following buildings, all with their own distinctive architectural style, are displayed in the corresponding images in Figure 45 (Strijp-S, n.d.-b).

- (1) Spaces-S
- (2) S-West
- (3) Sas-3
- (4) Sas-3
- (5) Microlab
- (6) Glasgebouw
- (7) Lux (right) and Sixty5 (left)
- (8) Blok 59
- (9) Trudo Toren
- (10) Klokgebouw
- (11) Ketelhuis and Lighthouse
- (12) Klokgebouw and Lighthouse

Overall, Strijp-S demonstrates a place-specific urban and architectural design strategy, where industrial heritage, creative and contemporary design, and active ground floors combine to produce an interesting and vibrant innovation district.

Figure 45 Site visit photographs of Strijp-S for urban & architectural design (own work)

VU-Kwartier depicts a district dominated by large institutional buildings such as *ACTA* and *Amsterdam UMC*. These buildings are architecturally significant and interesting, though large and imposing, with long monotonous façades and little activity at street level. This results in a streetscape that feels formal, functional, and inward-oriented, rather than dynamic or diverse. The open spaces between buildings appear spacious but under-programmed, lacking a variety of outdoor spaces and streetscapes. While the architecture is contemporary and sophisticated, it does not consistently translate into street-level vibrancy. Additionally, VU-kwartier buildings are clearly separated, with wide setbacks and often controlled private entrances. The spatial layout is mainly large-scaled and mono-functional, with major buildings occupying large blocks. This reduces the permeability of the public environment and limits opportunities for spontaneous interaction. The architectural design emphasizes institutional identity rather than creativity, more often associated with innovation districts. The small set of *rijtjeshuizen* (row houses), situated between the *Amstelveensweg* and the AUMC form an exception on the architectural language of the majority of the district. Although the district contains high-quality architecture, the urban design lacks diversity, resulting in a district that functions efficiently but less vibrancy. The following buildings are displayed in the corresponding images in Figure 46 (Zuidas, n.d.).

- (1) Step Stone (left), The Pulse of Amsterdam (middle) and Noma House (right)
- (2) The Pulse of Amsterdam
- (3) The Pulse of Amsterdam (left) and Step Stone (right)
- (4) VU Onderzoeksgebouw
- (5) The Edge / Deloitte
- (6) O|2 (left) and ACTA (right)
- (7) Research Diagnostisch Centrum Adore (left) and Imaging Center (right)
- (8) Amsterdam UMC
- (9) *Rijtjeshuizen* (row houses)
- (10) *Rijtjeshuizen* (row houses- left) and AUMC Spoedeisende Hulp (right)
- (11.1) Nieuw Universiteitsgebouw / NU (left) and OZW (right)
- (11.2) OZW (left) and VU Hoofdgebouw (right)

Overall, VU-Kwartier presents a coherent but highly institutional urban and architectural landscape, creating an efficient yet inward-oriented district that lacks the spatial diversity, permeability, and street-level vibrancy.

Figure 46 Site visit photographs of VU-kwartier for urban & architectural design (own work)

Lastly, Spoorzone is a district with a highly distinctive and culturally expressive design identity. Buildings such as *LocHal*, *MindLabs*, *Plan-T*, and the *Hall of Fame* demonstrate a strong commitment to adaptive reuse, where industrial structures are transformed into public and entrepreneurial spaces. The urban design shows rich spatial diversity, with plazas and interesting pedestrian routes, that blur the boundaries between public and private space. *LocHal*, in particular, functions as a landmark building, drawing people into the district and supporting a wide range of cultural and artistic activities. A variety of street-level activity is visible in cafés such as the *RAW* café, co-working spaces such as *Plant-T*, cultural venues, and student housing around Talent Square. Additionally, the open and flexible design of unbuilt spaces such as the *Burgemeester Stekelenburgplein* and *Locomotiefboulevard* encourages spontaneous interactions. The combination of heritage architecture and contemporary interventions creates a visually layered environment that enhances the district's creative identity. However, much of the contemporary architecture lacks expressive distinctiveness and is somewhat monotonous and bland. Spoorzone shows a clear architectural split between its heritage-rich eastern section and the increasingly contemporary yet character-poor developments toward the west, where the decrease of industrial buildings results in a more generic and less distinctive urban identity. The following buildings are displayed in the corresponding images in Figure 47.

- (1) Gebouw 90, Hall of Fame
- (2) Koepelhal
- (3) Gebouw 88
- (4.1) MindLabs
- (4.2) LocHal
- (5) Parkeergarage Spoorzone Zwijsen
- (6) UWV
- (7) *Rijtjeshuizen* (row houses)
- (8) Twee!
- (9) Talent Square
- (10.1) M*ixed-use building*
- (10.2) de StadsHeer

Overall, Spoorzone combines a culturally expressive heritage character with lively public spaces, yet less distinctive atmosphere toward the west, where contemporary but architecturally bland buildings result in a less significant urban and architectural identity.

Figure 47 Site visit photographs of Spoorzone for urban & architectural design (own work)

Creative atmosphere

Definition:

> *"Artistic, cultural, technological and economic creative atmosphere: art streets, high-tech exhibitions, openness to new ideas."* (Yigitcanlar et al., 2024)

Strijp-S exhibits a strong and highly visible artistic and cultural creative atmosphere, expressed directly in the public environment (see Figure 48). The district's industrial heritage forms a distinctive context for street art, murals, creative façades, and cultural installations, collectively creating a recognizable creative identity. Anchors such as *Natlab*, and *Sint-Lucas*, recurring events like *Dutch Design Week* (DDW) and *Playgrounds International Film Festival* (PIFF), and the *Eindhoven Design District* route, reinforce a continuous cultural presence in the streetscape. This creative environment is further strengthened by the *Leidingstraat*, the former elevated energy pipeline structure of the Philips factories that runs through the district. This structure is Covered with plants and decorated with experimental lighting, and offers a sense of intimacy in-between the high-rise buildings. Additionally, it is a 550-metre industrial pergola that acts as an urban wayfinder and connects the district internally (Strijp-S, n.d.-a). Together with the *ReuringStrijp-S* organisation and the district's industrial character, these elements embed creativity and artistic expression into the physical environment of Strijp-S.

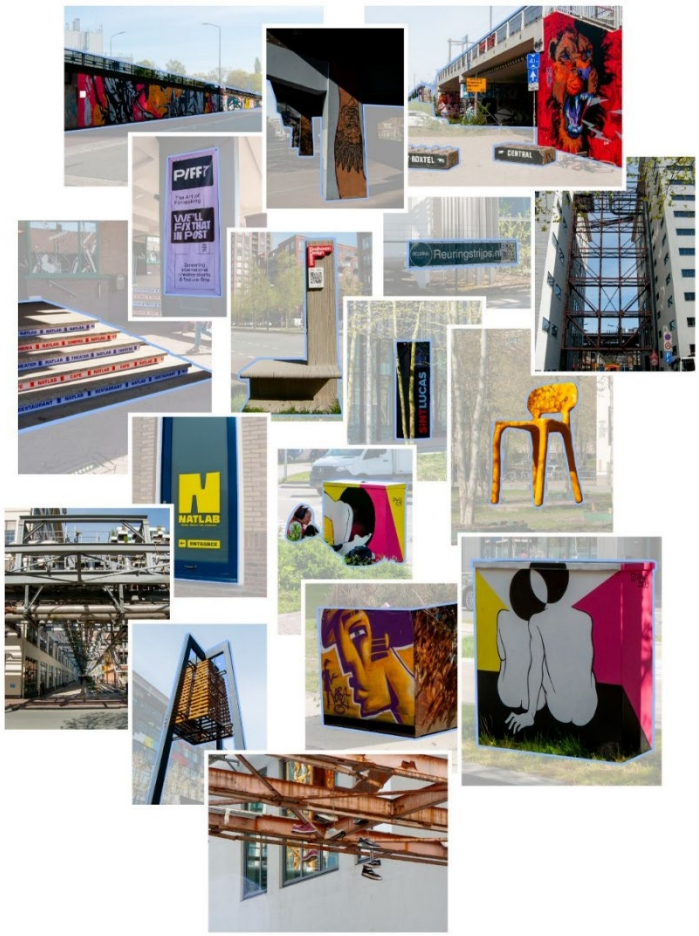

Figure 48 Site visit photographs of Strijp-S for creative atmosphere (own work)

VU-Kwartier expresses a more knowledge-based form of creativity, rooted in science and research rather than in artistic or cultural expression. The district's creative atmosphere is therefore mainly visible in the public realm through high-tech buildings and research infrastructures (Figure 49). Facilities such as the *O|2 Lab*, the *NU Building*, and the *Onderzoeksgebouw VU*, with their reflective or transparent façades revealing laboratories and offices, make scientific activity physically legible in the streetscape. The *StartHub* adds a more accessible layer of visible innovation, as its modular container architecture and bright façade symbolize entrepreneurship, and early-stage technological creativity through the housing of start-ups, even though the atmosphere remains institutional rather than artistic. Public spaces such as the *VU Campusplein* are designed to support interdisciplinary encounters through greenery, outdoor sport-facilities, and outdoor seating facilities, yet they do not carry artistic or cultural expression. VU-Kwartier lacks art streets, murals, creative façades, cultural installations, or artistic events, and its cultural amenities, such as the theatre, cinema, and bookstore, are located inside buildings which are not specifically tailored to these functions. As a result, the district demonstrates a moderate creative atmosphere, driven almost entirely by visible knowledge production and technological innovation, with minimal artistic or cultural spatial expression.

Figure 49 Site visit photographs of VU-kwartier for creative atmosphere (own work)

Lastly, Spoorzone demonstrates a rich cultural and artistic creative atmosphere, strongly rooted in its industrial heritage and adaptive reuse (Figure 50). The *LocHal* houses a library and *Kunstloc*, and facilitates cultural programming, and thus acts as a major cultural anchor that visibly shapes the district's public environment with its distinctive roof. Elements such as the *Hall of Fame*, street art, the *Willem II-passage*, and the presence of festival props for hosting events such as *Kroongetuige*, creates a lively and expressive streetscape. The *RAW* café and *Loc Brewery* contribute to an environment where cultural production and heritage come together in the form of hospitality. Spoorzone therefore scores high on artistic and cultural atmosphere, with a spatial identity that is both heritage-driven and culturally vibrant with flexible and adaptable spaces, supporting openness to new ideas.

Figure 50 Site visit photographs of Spoorzone for creative atmosphere (own work)

Authenticity & brand

Definition of authenticity:

> *"The quality of being novel or unusual: monuments, historic buildings, distinctive music scene."* *(Yigitcanlar et al., 2024)*

Definition of brand:

> *"Creating a unique name and image in users' mind: representing well-known companies and brands."* *(Yigitcanlar et al., 2024)*

Strijp-S demonstrates the strongest and most coherent branding strategy. The recurring "-S" suffix, in for example *office-s*, *codemaker-s*, *s-west*, and *spaces-**s***, creates an instantly recognizable brand identity across buildings and companies. This contemporary branding is complemented by strong references to the district's industrial Philips heritage. Historic buildings such as *Klokgebouw*, *Ketelhuis*, *Glasgebouw*, *Apparatenfabriek*, and the *Anton* and *Gerard* buildings carry names tied to their original industrial functions or founders (Anton and Gerard Philips). These references give Strijp-S a layered identity that blends modern creative with authentic industrial branding.

VU-Kwartier's naming practices reflect its academic and institutional character, with many buildings carrying functional titles such as *VU Onderzoeksgebouw*, *Nieuw Universiteitsgebouw (NU)*, *O|2 Labgebouw*, and *OZW*, which create organizational clarity rather than place branding. Alongside these more institutional names, the district additionally incorporates contemporary branding through buildings like *NoMa House*, *The Edge*, *Step Stone* (a temporary, affordable "stepping stone" for those beginning their careers in Amsterdam), and *The Pulse of Amsterdam* (symbolizes 24/7 fusion of living, working, studying and leisure). Together, these branding strategies create a combination of institutional and modern identity, representing the contemporary and academic ecosystem of the VU.

Spoorzone employs a more blended approach between heritage-driven and contemporary branding, with fewer district-wide branding, but strong authenticity rooted in its railway past. Buildings such as *Koepelhal*, *Wagenmakerij*, *LocHal*, and *De Houtloods* retain names that directly reference their historical uses, such as train repair halls, wagon workshops, maintenance spaces, and storage facilities. These names communicate Spoorzone's authentic industrial history and its transformation into cultural and public spaces. Contemporary branding is represented through the *Hall of Fame*, which is a monumental industrial hall, but carries a modern name representing its current function as skate-, dance- and music hall. Also *Plan-T* is one of the few contemporary naming examples, using the "-T" suffix referencing to the city of Tilburg, and to indicate that it is the place where plans are developed and executed, specifically focused on innovation. Overall, Spoorzone's identity is shaped by both a heritage and modern branding style.

4.2 Innovation capacity

To indicate the innovation capacity, the research builds on Vey et al.'s (2018) indicators from their audit guide with the more operational key performance indicators proposed by Burke & Gras (2019). The assessment of their KPI's is tailored to what is empirically feasible with the available LISA microdata and complementary open datasets. The following KPI's for innovation capacity were measured:

- Innovation intensity
- Innovation performance
- Innovation impact

The following section will elaborate on the results of the analysis.

4.2.1 Innovation Intensity

The innovation intensity describes the number of knowledge-intensive jobs per district, and the compounded percentage of knowledge-intensive jobs versus the total amount of employment in an innovation district. Knowledge-intensive jobs were defined by Eurostat's indicators on high-tech industry and knowledge-intensive services based on NACE Rev. 2 (Eurostat, 2024). The SBI 2008 is equal to NACE Rev. 2 up to and including the class level (four digits), with a few exceptions (CBS, n.d.). The indicators range from high-technology to low-technology, and from knowledge-intensive services (KIS) to less knowledge-intensive services (LKIS). Including low-technology industries and LKIS would give a distorted representation of knowledge intensive jobs by adding large volumes of employment whose performance is only weakly related to R&D and knowledge production. Low technology industries and LKIS's are therefore excluded from this KPI, since the focus of this research is specifically on innovation success. The following sub-indicators were measured:

- Total employment E_{tot} = ΣBANEN in LISA.
- Innovation employment E_{inn} = ΣBANEN in selected SBI08 sectors in LISA.
- Innovation Intensity = E_{inn}/E_{tot}

Innovation employment (E_{inn}) consists of:

- High-technology manufacturing jobs (Eht)
- Medium-high-technology manufacturing jobs (Emht)
- Medium-low-technology manufacturing jobs per district (Emlt)
- Knowledge-intensive services jobs per district (Ekis)

Table 22 Job characteristics per district for innovation intensity

	Etot	Einn	Erest	Eht	Emht	Emlt	Ekis
Strijp-S	4.944	3.764	1.180	313	5	3	3.443
VU-kwartier	20.235	19.757	478	5	224	0	19.528
Spoorzone	2.637	2.136	501	0	3	0	2.133
Total	**27.816**	**25.657**	**2.159**	318	232	3	25.104

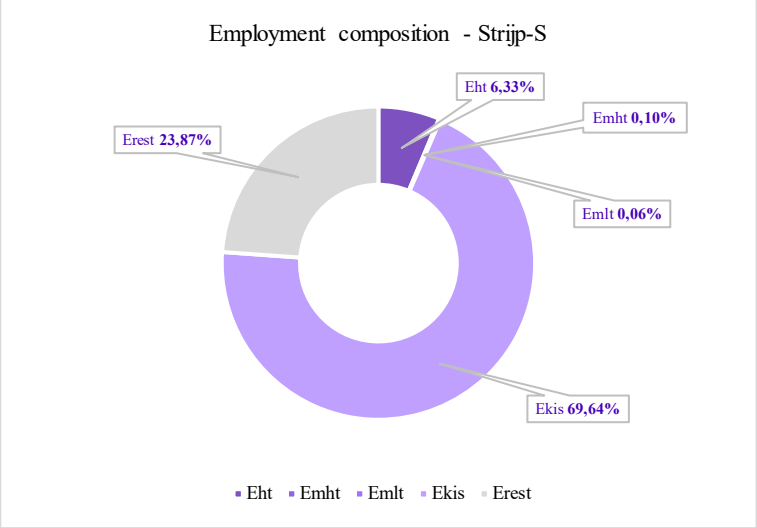

Figure 51 Employment composition Strijp-S

Strijp-S is strongly innovation oriented, with 76% of its total jobs (3.764 out of 4.944) classified as innovative in 2024 (Table 22; Figure 54). The district's employment combines 6,33% high technology manufacturing jobs with 69,64% knowledge-intensive services (Figure 51). Medium high-technology and medium low-technology manufacturing jobs play only a minor role. The employment composition therefore reflects a hybrid profile: the industrial legacy of Eindhoven remains visible, yet the district is increasingly driven by service-based and knowledge-intensive activities. The relatively high share of knowledge-intensive services jobs indicates a successful shift toward creative, technological, and R&D-oriented functions.

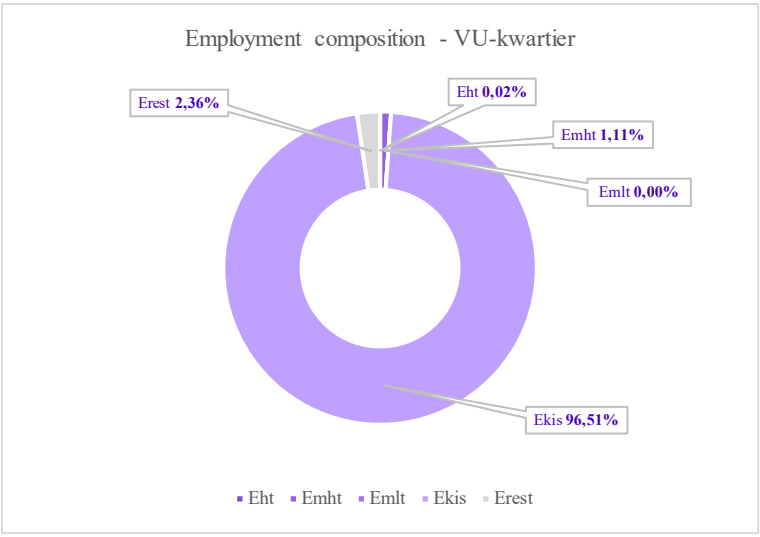

Figure 52 Employment composition VU-kwartier

VU-Kwartier (represented by Zuidas) exhibits the highest innovation intensity with a score of 98%, with 19.757 of 20.235 jobs classified as innovative (Table 22; Figure 54). The district's employment composition is dominated by knowledge-intensive services jobs (96,51%), complemented by smaller shares of medium-high-technology manufacturing (1,11%) and high-technology manufacturing jobs (0,02%), see Figure 52. This near-total

concentration of innovation employment emphasizes VU-kwartier's role as a knowledge-service district, where human health and life-sciences R&D drives economic activity. There is a minimal presence of non-innovation employment, highlighting a highly intensive innovation ecosystem.

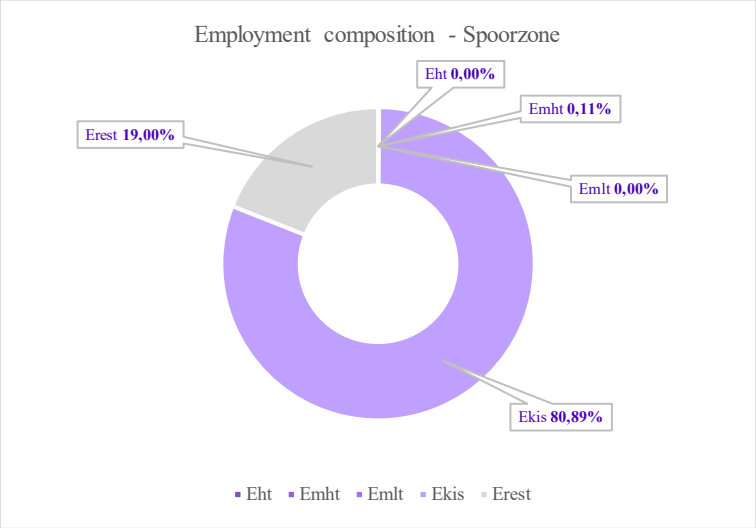

Figure 53 Employment composition Spoorzone

Spoorzone has an innovation intensity of 81%, with 2.136 of 2.637 jobs classified as innovative (Table 22; Figure 54). The district's innovation employment composition is primarily composed of knowledge-intensive services (80,89%), with small shares of medium-high-technology manufacturing jobs (0,11%), see Figure 53. The proportion of knowledge-intensive services employment is high, suggesting an emerging innovation ecosystem, where industrial innovation is still limited.

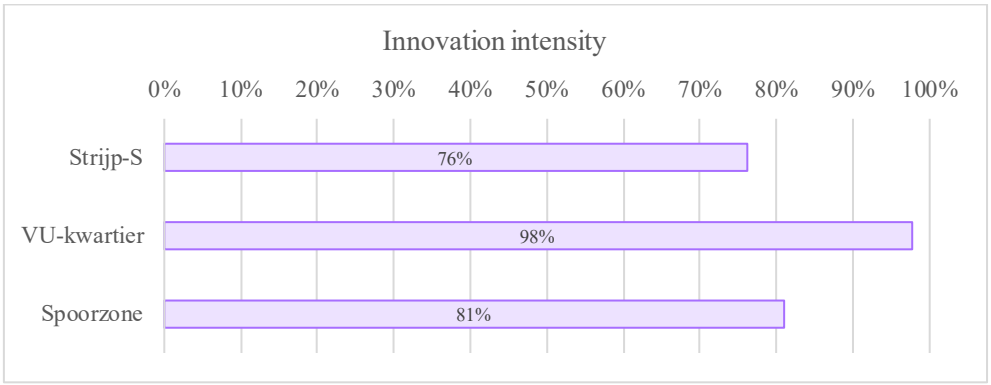

Figure 54 Innovation intensity per district

4.2.2 Innovation Performance

The innovation performance was measured by assessing the growth of innovative establishments and jobs over time. Furthermore, an assessment was made of the current number of present scale-ups and start-ups.

- Growth of number of innovative jobs E_{inn} and establishments ES_{inn} over time (using year and LISA number to derive entry and/or exit date and approximate firm age).
- Number of innovative start-ups ST_{inn} (multiple definitions available: often younger than 5 years old, less than 10 employees, no phase of fast growth)
- Number of innovative scale-ups SC_{inn} (older than 3 years old, more than 10 employees, average annual growth more than 20% in employees over a period of 3 years)

Growth (CAGR) E_{inn} & ES_{inn}

The total employment in innovative sectors (Einn) and the total number of innovative establishments (ESinn) in the different districts were compared in Figure 55 & Figure 56.

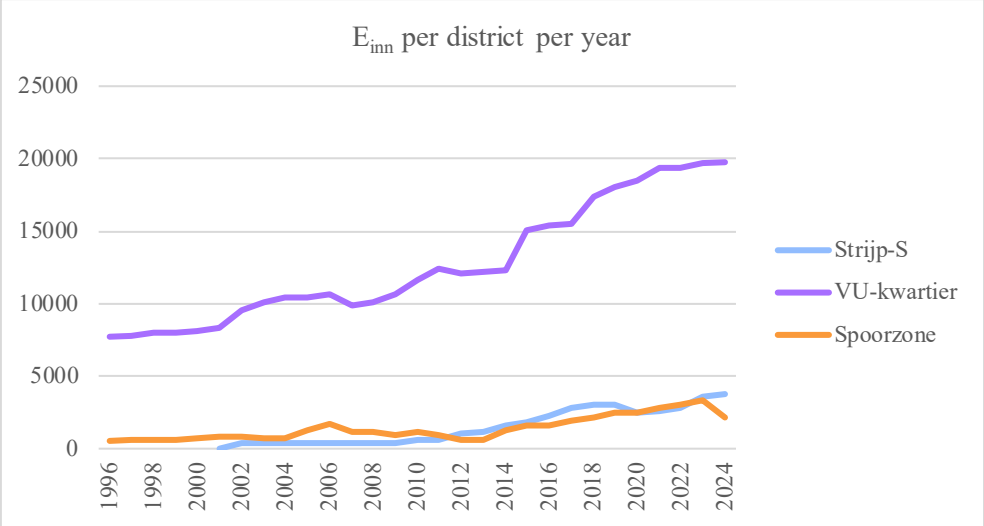

Figure 55 E_{inn} per district per year for innovation performance

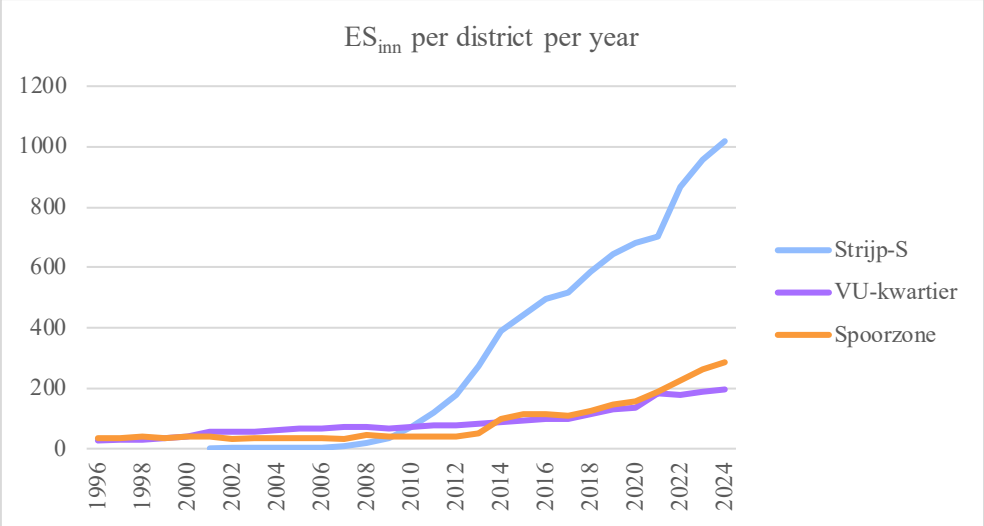

Figure 56 ES_{inn} per district per year for innovation performance

For fair comparison, the compound annual growth rate (CAGR) was calculated for each district. The CAGR is a measure for the average annual percentage growth over a period.

$$CAGR = \left(\frac{y_{end}}{y_{start}}\right)^{\frac{1}{n}} - 1$$

In this equation, y_{end} and y_{start} are the final and starting E_{inn} or ES_{inn}, and n is the number of years between y_{end} and y_{start}. The CAGR was calculated starting from 2002 for Strijp-S, 2008 for VU-kwartier, and 2010 for Spoorzone, reflecting their corresponding start of development years. The results are shown in Figure 57.

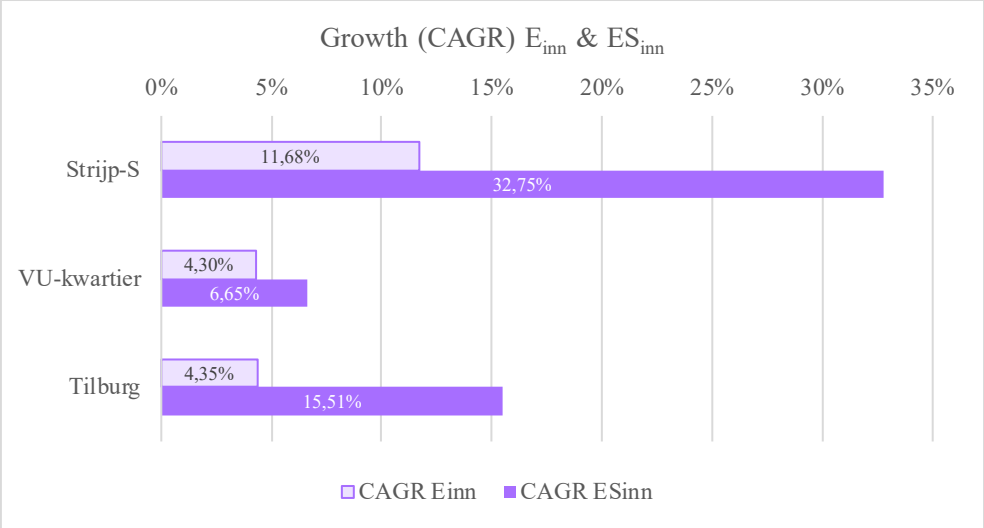

Figure 57 Growth (CAGR) E_{inn} & ES_{inn} per district

Strijp-S shows the highest growth of E_{inn} and ES_{inn}. However, this is mainly driven by its very low base-values at the start of the initial development year. Because the district had almost no jobs or establishments initially, even small absolute increases translate into very high percentage growth. However, even in absolute terms, Strijp-S increased the number of innovative establishments more than the other districts, meaning the growth in establishments is not just a percentage illusion. Additionally, in absolute terms VU-kwartier increased the most in number of innovative jobs of all the districts.

Number of start-ups

The number of knowledge-intensive start-ups (ST_{inn}) was calculated for each district over time (Figure 58). With 703 knowledge-intensive start-ups in 2024, Strijp-S has the highest number of ST_{inn}., followed by 213 in Spoorzone and 106 in VU-kwartier. However, the total number of ES_{inn} in Strijp-S is also higher than Spoorzone and VU-kwartier. Therefore, looking at the ratio of the amount start-ups compared to the total number of innovative establishments, Spoorzone has the highest relative number of ST_{inn} (See Figure 60, Figure 61 &Figure 62).

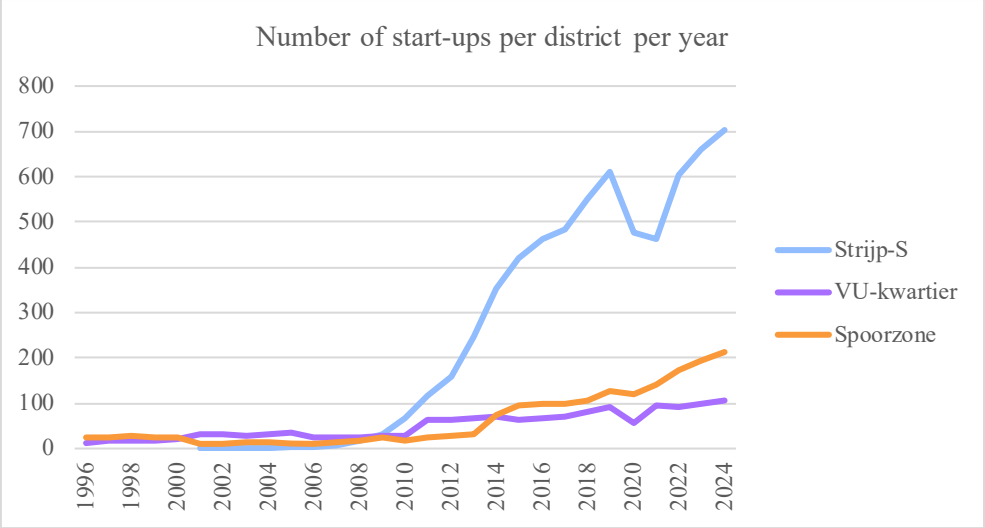

Figure 58 Number of start-ups per district per year for innovation performance

Number of scale-ups

The last measurement of innovation performance is the number of knowledge-intensive scale-ups. Figure 59 shows the number of SC_{inn} over time for each district. The number of scale-ups never reaches above one for VU-kwartier and Spoorzone. The highest value for Strijp-S is seven knowledge-intensive scale-ups in 2023. In 2024, the total numbers of SC_{inn} are four, one, and zero for Strijp-S, VU-kwartier and Spoorzone respectively. The low amounts of scale-ups is partly due to the strict requirements of the definition of a scale-up.

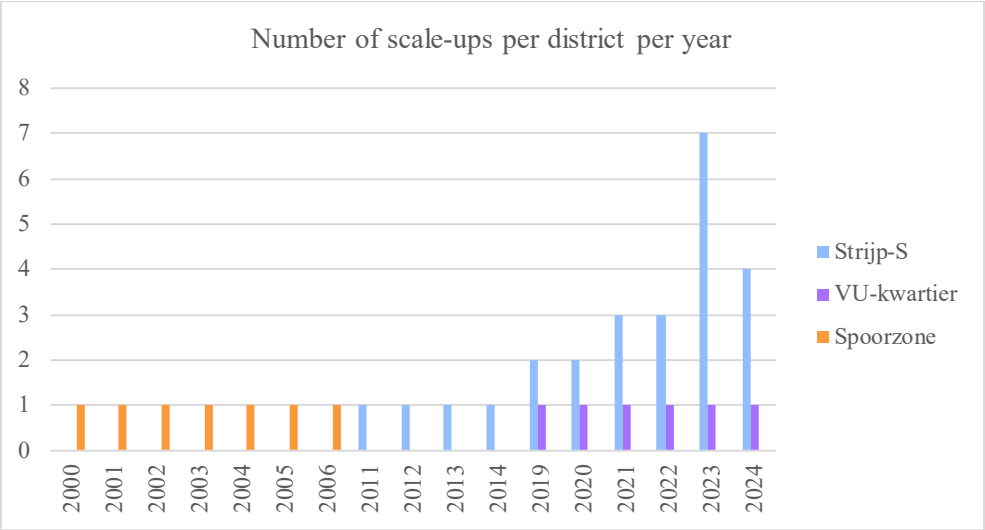

Figure 59 Number of scale-ups per district per year for innovation performance

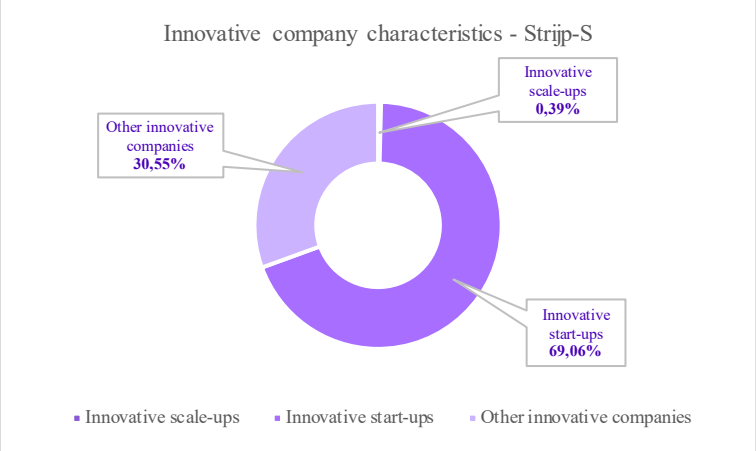

Figure 60 Innovative company characteristics Strijp-S

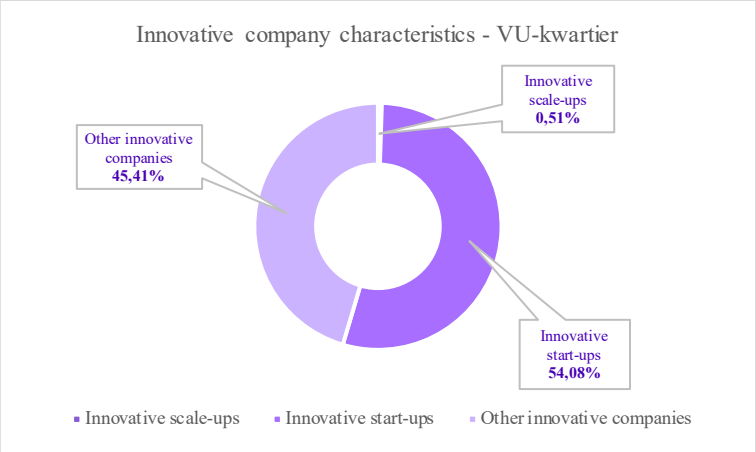

Figure 61 Innovative company characteristics VU-kwartier

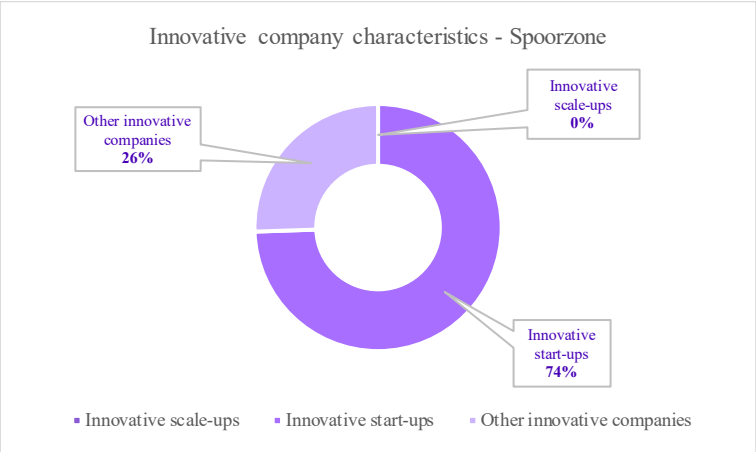

Figure 62 Innovative company characteristics Spoorzone

4.2.3 Innovation Impact

According to Burke & Gras (2019) the innovation impact could be measured in two ways: the employment generation and sales per employee and sales per resident. Because the LISA data-base does not give any financial insights, the last two indicators will not be taken into assessment.

- Employment Generation: E_{inn}/resident per district, E_{inn}/resident per municipality, E_{inn}/ resident per region

	Einn	Residents district	Residents city	Residents region
Strijp-S	3.764	3.590	249.783	819.169
VU-kwartier	19.757	637	941.927	1.490.752
Spoorzone	2.136	1.704	230.746	513.856

By dividing the total number of innovative jobs per district (Einn) by the number of residents, the innovation impact was calculated. The following shows these results:

Strijp-S

- 1,05 jobs per resident Strijp-S
- 1,51 jobs per 100 resident Eindhoven
- 4,59 jobs per 1000 residents Zuidoost-Noord-Brabant

VU-kwartier

- 31,02 jobs per resident VU-kwartier
- 2,10 jobs per 100 resident Amsterdam
- 13,25 jobs per 1000 residents Groot-Amsterdam

Spoorzone

- 1,25 jobs per resident Spoorzone
- 0,93 jobs per 100 resident Tilburg
- 4,16 jobs per 1000 residents Midden-Noord-Brabant

These numbers show the highest employment generation for VU-kwartier.

5. Discussion and conclusion

5.1 Discussion

5.1.1 Spatial quality comparison

To combine and compare all the results for the spatial quality, Figure 63 shows the overall mean scores per main indicator per district for the quantitative space quality. Figure 64 shows the overall score of all main indicators combined per district for the quantitative space quality.

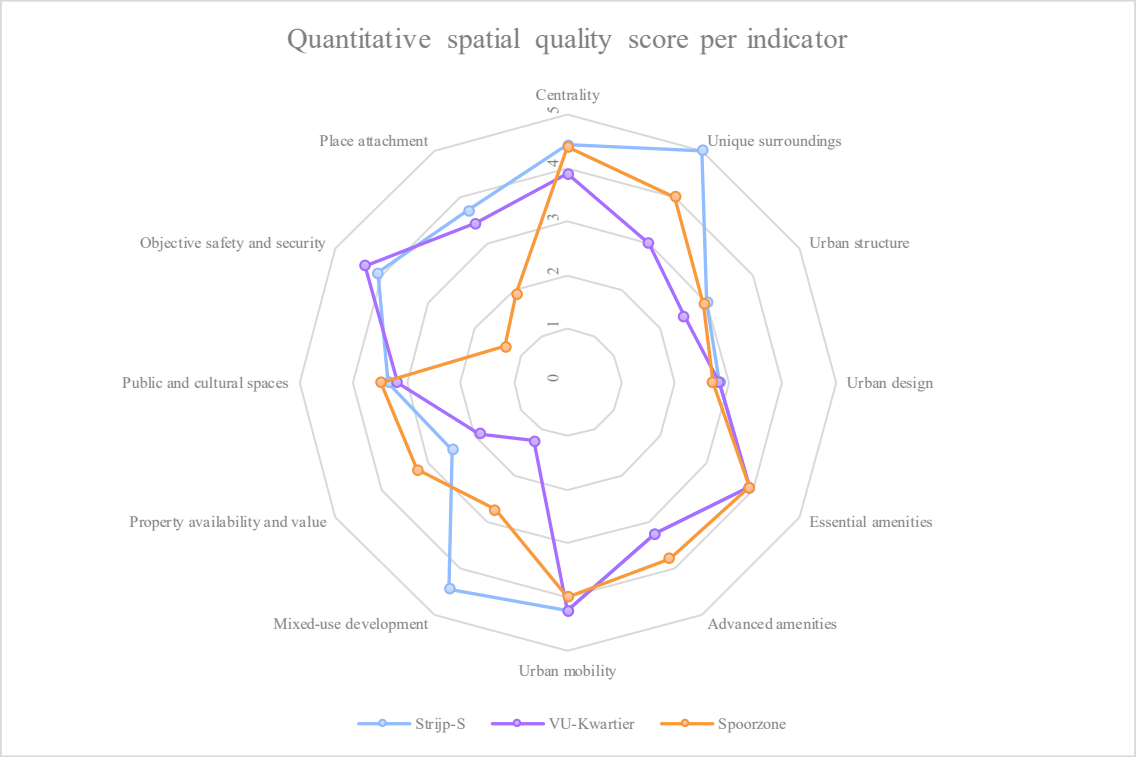

Figure 63 Overall quantitative spatial quality score per indicator per district

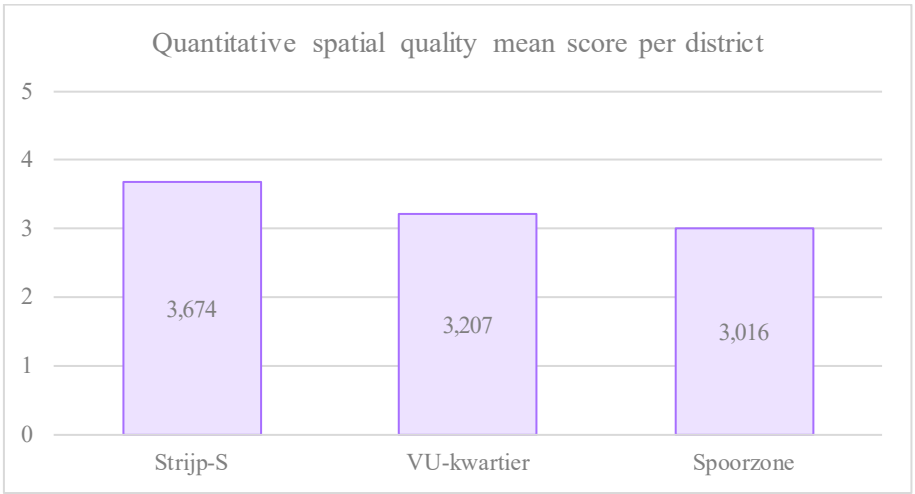

Figure 64 Overall mean score for quantitative spatial quality per district

The overall results for the qualitative spatial quality are textually described per district. Therefore, the next section contains a summary and exploration of the quantitative and qualitative spatial quality results, and compares the three districts.

Strijp-S achieves the highest quantitative spatial quality score overall (3.674), with consistently good performance across most indicators. One of its strongest aspects is its high score for mixed-use development, while urban green space scores somewhat lower. The district benefits from a central location and highly unique surroundings due to its industrial heritage character, originating from the former Philips factory site, including monumental buildings such as *het Klokgebouw, het Veemgebouw, Anton, Gerard* and *de Apparatenfabriek* (together known as *de Hoge Rug*), together with a distinctive historical urban structure. Urban structure and design scores are somewhat reduced by lower values for green-blue space within 500 meters and limited recreational green and blue infrastructure. Accessibility to amenities is above average, although proximity to primary schools, childcare facilities, and potentially main roads could be improved. Lower scores for swimming pools and ice rinks are notable but may be less relevant in practice. Urban mobility performs well, whereas property availability and value are somewhat lower. Public and cultural spaces score highly, particularly the proximity to arts venues, while safety and place attachment also perform positively.

Qualitative observations showed the district is highly walkable with very limited car presence. Although barriers exist around the edges of Strijp-S, these remain relatively permeable, although interventions could further improve accessibility into the area. The district creatively reuses industrial pipeline structures, the *Leidingstraat*, to shape urban space, for example by incorporating pedestrian routes and public transport corridors, decorated with greenery and lights. Street art and a strong creative atmosphere are clearly present, while a mix of modern and heritage architecture creates a balance between old and new. However, some residents indicate that recent developments reduce the iconic Strijp-S character. The area avoids a mono-functional or gloomy atmosphere and offers many publicly accessible spaces for social interaction, including makerspaces, a central square, coworking facilities such as *Microlab*, educational institutions like *SintLucas*, and cultural venues including *Area51* and *Klokgebouw*. Supported by events such as festivals and *Dutch Design Week*, Strijp-S has developed into a nationally recognized brand with a strong sense of authenticity based on both its historical and contemporary identity.

VU-kwartier achieves a somewhat lower quantitative spatial quality score compared to Strijp-S (3,207). The district is less centrally located and has a more suburban character, although it still maintains a urban inner-city character. Its surroundings are less unique, as there is little heritage or other unique natural or human-made environments present, except for some architecturally notable buildings. The score on urban structure is particularly low, due to the near absence of recreational green- and blue-spaces and limited sports and play areas, while urban design performs quantitatively similar to Strijp-S. Essential and advanced amenities score highly, and urban mobility is strong. However, walkability is reduced by hard borders around the district and a busy 50 km/h road, de *Boelelaan*, running through the district. Additionally, cars are more dominantly present in the urban environment. Mixed-use development scores low, as the district largely consists of non-residential functions and shows limited functional diversity within building blocks. Additionally, the property value of

available housing is very high and there is little to no social housing. Scores for proximity to public spaces are high, although scores are significantly lower for proximity to cultural spaces. Safety and security indicators reflect positive score, however perceptions during nighttime may differ, as these data are not included in final scores. The place attachment appears string, due to the district's national recognition through associations with Amsterdam and the Zuidas.

Qualitatively, however, the district feels less pedestrian-friendly due to hard, non-permeable borders and its more car-oriented character. Broad streets, limited green structures, and hard borders contribute to a somewhat institutional atmosphere. Architectural design is characterized by glass façades, closed plinths, and a functional appearance that can feel gloomy and monotonous, dominated by grey and blue tones. The creative atmosphere is mainly institutional-oriented, rather than artistic. Unlike Strijp-S and Spoorzone, there is little to no street art or creative urban structures or architecture, except for some unique buildings such as the *O|2 lab* and the *OZW building*. Additionally, the *VU StartHub* container building for start-ups contributes to the display of an innovative character. Furthermore, authenticity is lower than in Strijp-S or Spoorzone, and although Zuidas is well-known nationally, branding through events and placemaking activities seems more limited. Due to the presence of the university and hospital, a large daily presence of people is attracted to the district. Lastly, the variety of amenities seemed less apparent, with the district retaining a mainly functional atmosphere.

Spoorzone records the lowest quantitative spatial quality score of the three districts (3,016). It benefits from a highly central location, with the central station of Tilburg situated within the district, and regionally unique surroundings due to the former NS railway workshops. Urban structure scores relatively low because of greater distances to recreational green- and blue-spaces. However, this indicator may not fully reflect actual conditions, as a big urban park is located west of talent square called *Spoorpark*, providing significant green space. Nevertheless, residents seem relatively content with greenery in the environment. Distance to main roads and sport and movement facilities scores relatively poorly, while most other amenities perform above average. Spoorzone scores highest for advanced amenities, including cafés and restaurants such as *LOC Brewery* and *RAW*, and performs better than both Strijp-S and VU-kwartier regarding distance to a swimming pools and ice rink. The urban mobility is strong, especially for public transport due to centrally situated bus and train station, walking, and cycling, although parking availability is lower. Spoorzone scores second highest for mixed-use development, particularly at district scale, although building function-mix on block-level remains below Strijp-S. The district also has the lowest average property value, making it the most affordable district regarding housing. Public and cultural spaces perform exceptionally well, with strong proximity to museums, arts venues, cinemas, and libraries. One key weakness, however, is safety and security, which score substantially lower than the other two districts (1,340). Feelings of unsafety are mainly linked to the station environment, where respondents report perceiving certain groups of people as unpleasant, as well as indirect nuisance from alcohol and drug use, poor lighting and dark corners. The low scores for safety, as well as place attachment due to higher residential turnover and lower resident involvement, appear to be a primary explanation for the lower overall score.

Qualitatively, Spoorzone has lots of hard boarders, due to major roads surrounding the district and the railway infrastructure. However, permeability has been improved through

multiple underpasses decorated with street art and pedestrian crossings, such as the Willem II passage with light installations, reinforcing a creative atmosphere. The district mixes different styles of architecture, combining original industrial heritage like the monumental roof of the station (*'t kroepoekdak*), the *Koepelhal* and *hall of fame*, with transformed heritage such as the *LocHal* and *MindLabs*, but also with relatively less interesting buildings such as the *UWV building*, *TalentSquare* and *TBV wonen - high lane*. Therefore, a very strong contrast exists between eastern and western parts of the district. There is a strong creative atmosphere, visible through industrial heritage, textile history, makerspaces, museums, and adaptive reuse projects. Additionally, *LocHal* functions simultaneously as a library, study place, event venue and makerspace. Although Spoorzone lacks the nationally recognized brand identity of Strijp-S, it appears highly authentic. Moreover, the districts has a lively atmosphere due to the high daily presence of people surrounding the central station.

5.1.2 Innovation capacity comparison

This section contains a summary and comparison of the overall results for innovation capacity for Strijp-S, VU-kwartier and Spoorzone.

Strijp-S has the lowest innovation intensity of the three districts, although it still scores above 75%. The district contains approximately 6% high-technology manufacturing jobs (Eht) and 70% knowledge-intensive service jobs (Ekis). Contrary to innovation intensity, Strijp-S shows the highest innovation performance. Since the start of the redevelopment in 2002, Strijp-S has experienced strong growth , both in employment (CAGR Einn) and establishments (CAGR ESinn), with job growth reaching 11.7% and establishment growth 32.8%. In 2024, the district recorded the highest number of start-ups and scale-ups of all three districts, with 703 start-ups and 4 scale-ups, making up 69% of all innovative companies in Strijp-S. Then, for the innovation impact, Strijp-S scores lowest together with Spoorzone, since the number of jobs per resident for Strijp-S is lower than for VU-kwartier, with 1,05 jobs per resident Strijp-S, 1,5 jobs per 100 resident for the city of Eindhoven, and 4,6 jobs per 1000 residents for the COROP-region of Zuidoost-Noord-Brabant. In practice, this means that Strijp-S currently contains roughly one job per resident. However, as additional housing is continuously being developed within the district, further employment growth is necessary to maintain a balanced live-work environment.

VU-kwartier, in contrast to Strijp-S, has the highest innovation intensity with a score of 98%, from which 97% are knowledge-intensive service jobs (Ekis) and 1% medium-high-technology manufacturing jobs (Emht). In terms of performance, however, VU-kwartier scores lowest, with low growth levels since the start of redevelopment in 2008. Even though VU-kwartier has the highest number of innovative jobs across the three districts, its number of innovative establishments stays under the number of Strijp-S as well as Spoorzone. With job growth of 4,30% (CAGR Einn) and establishment growth of 6,65% (CAGR ESinn), VU-kwartier is lacking behind on the other two districts. In 2024, the district shows low numbers, with only 106 start-ups and 1 scale-up, making up 55% of all innovative companies in VU-kwartier. For innovation impact, VU-kwartier scores highest overall, with 31,02 jobs per resident for VU-kwartier, 2,1 jobs per 100 residents for the city of Amsterdam, and 21,0 jobs per 1000 residents for the COROP-region Groot-Amsterdam. In practice, this means that VU-kwartier currently contains roughly 31 jobs per resident, which is high. However, as

additional housing is continuously being developed like in Strijp-S, this number may decline if the district's growth rate stays low.

Lastly, Spoorzone's scores range somewhere in-between scores of Strijp-S and VU-kwartier. Spoorzone has an innovation intensity of 81%, which is higher than Strijp-S, but significantly less than VU-kwartier, from which all innovative jobs are knowledge-intensive service jobs (Ekis), with the exception of three medium-high-technology manufacturing jobs (Emht). In terms of performance, Spoorzone scores high for innovative establishment growth (CAGR ESinn) with 15,51% since start of innovation district developments in 2010, while it scores similar to VU-kwartier for innovative job growth with 4,35% (CAGR Einn). In 2024, the district shows double the number of VU-kwartier with 213 start-ups, while having no scale-ups. However, the number of scale-ups make up 74% of all innovative companies in Spoorzone, scoring highest across the three districts. For innovation impact, Spoorzone scores higher than Strijp-S on district-level, with 1,25 jobs per resident for Spoorzone, but lower on city- and region-level, with 0,9 jobs per 100 residents for the city of Tilburg, and 4,2 jobs per 1000 residents for the COROP-region of Midden-Noord-Brabant. In practice, this means that Spoorzone currently has roughly one job per resident, similar to Strijp-S. However, as additional housing is continuously being developed like in Strijp-S, further employment growth is necessary to maintain a balanced live-work environment.

5.1.3 Relationship between space & innovation

After examining spatial quality and innovation capacity separately, the next step is to explore how they relate to each other within the context of innovation districts.

The spatial quality reinforces Strijp-S's goal and identity as creative, design and high-tech district, and therefore the space lends itself to the purpose of the district. Strijp-S's authentic, expressive and experimentative identity attracts creative and entrepreneurial people, which in turn supports a high number of start-ups and scale-ups, even if innovation intensity remains moderate.

VU-Kwartier's spatial quality supports innovation because it is intentionally aligned with its identity as a specialized health care and life-sciences district with labs, offices and a hospital. VU-kwartier's spatial quality supports innovation not by being creative, high mixed-use or culturally vibrant, but by enabling efficient and institutional work through functionality, high accessibility and predictability, which enables its identity. Therefore, more efficient space seems to relate to more innovation impact and intensity, but less innovation in terms of growth, start-up and scale-up generation.

Lastly, Spoorzone's spatial quality supports its emerging and hybrid, through its central station, cultural venues, heritage buildings, and event spaces. These create a constant flow of people and allow spontaneous and cross-disciplinary interactions to happen. Together with the availability of flexible and adaptable spaces, yet-to-be developed heritage properties and a future-focused, human-centered, AI and data-science learning environment, the district still contains a lot of potential for innovation. The current hybrid character, showing a lack of coherence, is reflected in its average innovation scores with no ultimate high or low intensity, performance or impact.

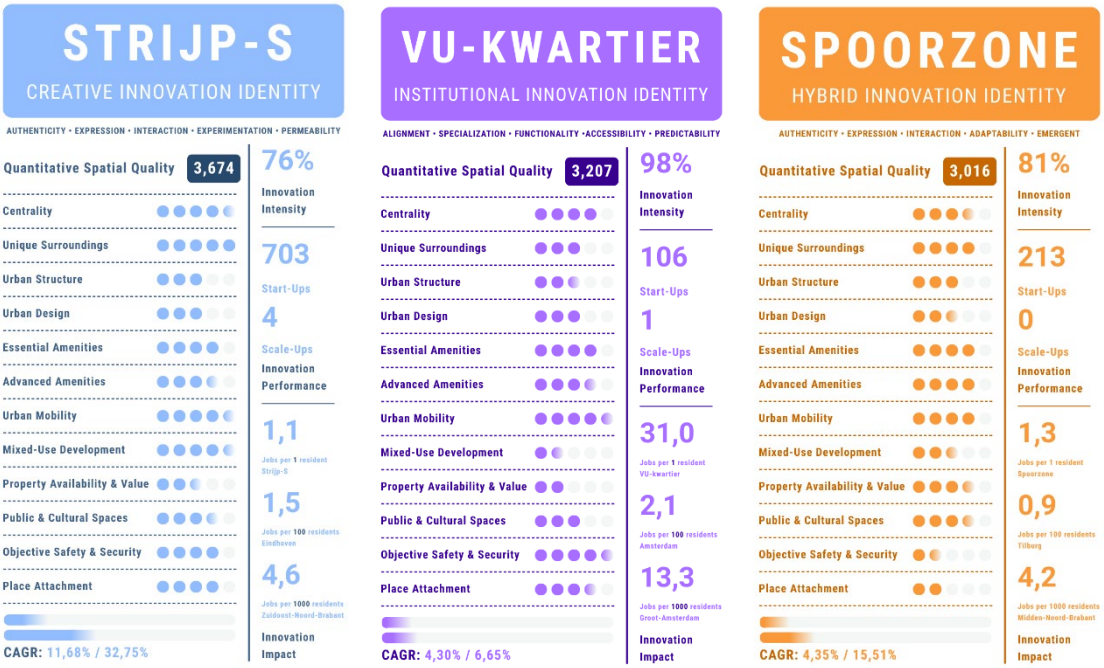

Figure 65 District infographic showing innovation identities

Therefore three different and unique innovation identities were distinguished: a creative innovation identity, an institutional innovation identity and a hybrid innovation identity. The three districts with different innovation identities embed its identity in space through unique spatial characteristics (Figure 65).

5.2 Conclusion

The objective of this research was to evaluate existing and emerging Dutch innovation districts with a particular focus on the relationship between the quantitative and qualitative space quality and innovation district success. For this research, innovation district success is defined as the innovation capacity, consisting of innovation intensity, performance and impact. With this analysis, the research aimed to assess the extent to which the spatial character of a district leads to high levels of innovation intensity, performance and impact. It served as a basis for understanding how quantitative, measurable, and qualitative, non-measurable elements of the spatial quality influences the innovation capacity of three case studies and how future innovation districts development processes can learn from these examples.

The main results show a distinction between the three case studies in terms of spatial quality as well as innovation capacity. However, even though not all spatial quality scores are similar, and differences show in innovation capacity, all districts could be perceived successful in their own way. Strijp-S shows higher quantitative spatial quality, together with VU-kwartier, however qualitatively, Strijp-S and Spoorzone show greater results. VU-kwartier has the highest innovation intensity and performance, followed by Spoorzone, however Strijp-S has significantly more scale-ups and start-ups compared to the other two districts.

The main research question of this study was:

> *What is the role of spatial quality in the development of successful Innovation Districts?*

To answer the research question: the role of spatial quality in the development of successful innovation districts is to embody and facilitate a district's intended aims, goals and identity in ways that are fitting to the existing context. This identity then needs to be embedded in the physical environment for an innovation district to thrive. Therefore three different and unique innovation identities were distinguished: a creative innovation identity, an institutional innovation identity and a hybrid innovation identity. The three districts with different innovation identities embed its identity in space through unique spatial characteristics.

When a district like Strijp-S has a creative innovation identity, it entails that the district's physical environment, such as architectural and urban structures, public spaces, design language, amenities and overall atmosphere collectively communicate and support a culture of creativity, design and experimentation. Its identity is created by the synergy between various spatial aspects: heritage buildings or distinctive architecture give the district authenticity, street-art and cultural venues give artistic expression, the mixed-use of space gives variety and the opportunity for interaction, maker spaces and co-creation hubs give experimentation and production, and a pedestrian- and cyclist-friendly environment gives a human-scale and permeable urban character. The coexistence of these elements reinforce attraction of the kinds of people and firms that fit a district with a creative innovation identity, ultimately reaching the district's intended goal an purpose.

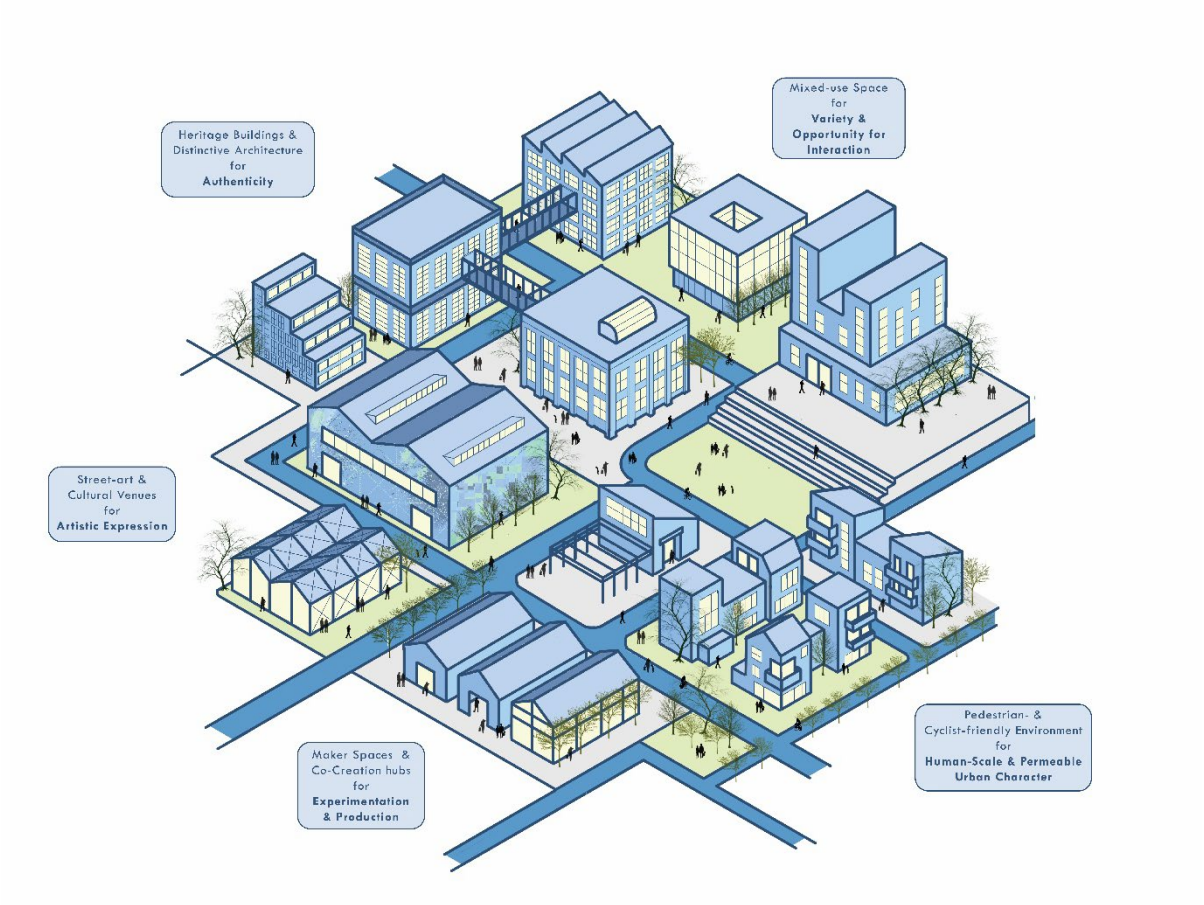

Figure 66 Visualization of creative innovation identity (own work)

Then, when a district like VU-kwartier has an institutional innovation character, it means that the district's physical environment communicates and supports a culture of specialization, efficiency and knowledge-intensive work. Its identity is created by the synergy between various spatial aspects: limited mixed-use environment gives alignment and predictability, academic and medical architecture give specialization, efficient and formal spaces give functionality, labs and translational facilities give experimentation and applied research, and high urban mobility and good car-connectivity give accessibility. The co-occurrence of these spatial elements enable the district's intended goal and purpose, fitting for an institutional innovation identity.

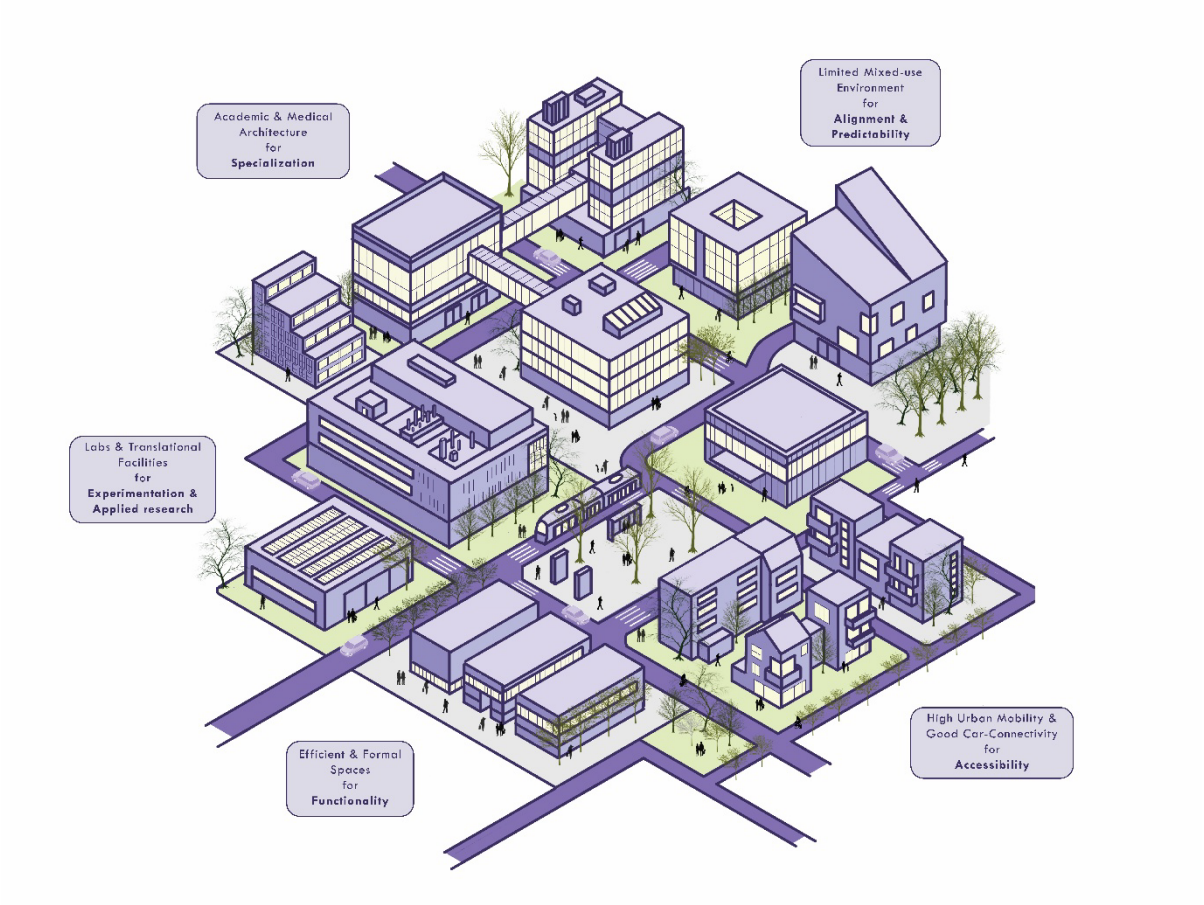

Figure 67 Visualization of institutional innovation identity (own work)

Lastly, when a district like Spoorzone has an hybrid innovation character, it means that the district's physical environment collectively communicates and supports a culture of openness, flexibility and emergence. Its identity is created by the combination of different spatial aspects: the transformed heritage buildings give authenticity, the cultural and artistic venues give social and creative expression, the mixed-use character and variety of amenities gives opportunity for interaction, flexible and temporary uses of space give adaptability and accessibility, and a collaborative and futuristic learning environment gives an emergent character. The coexistence of these spatial element create an environment which enables a hybrid innovation identity.

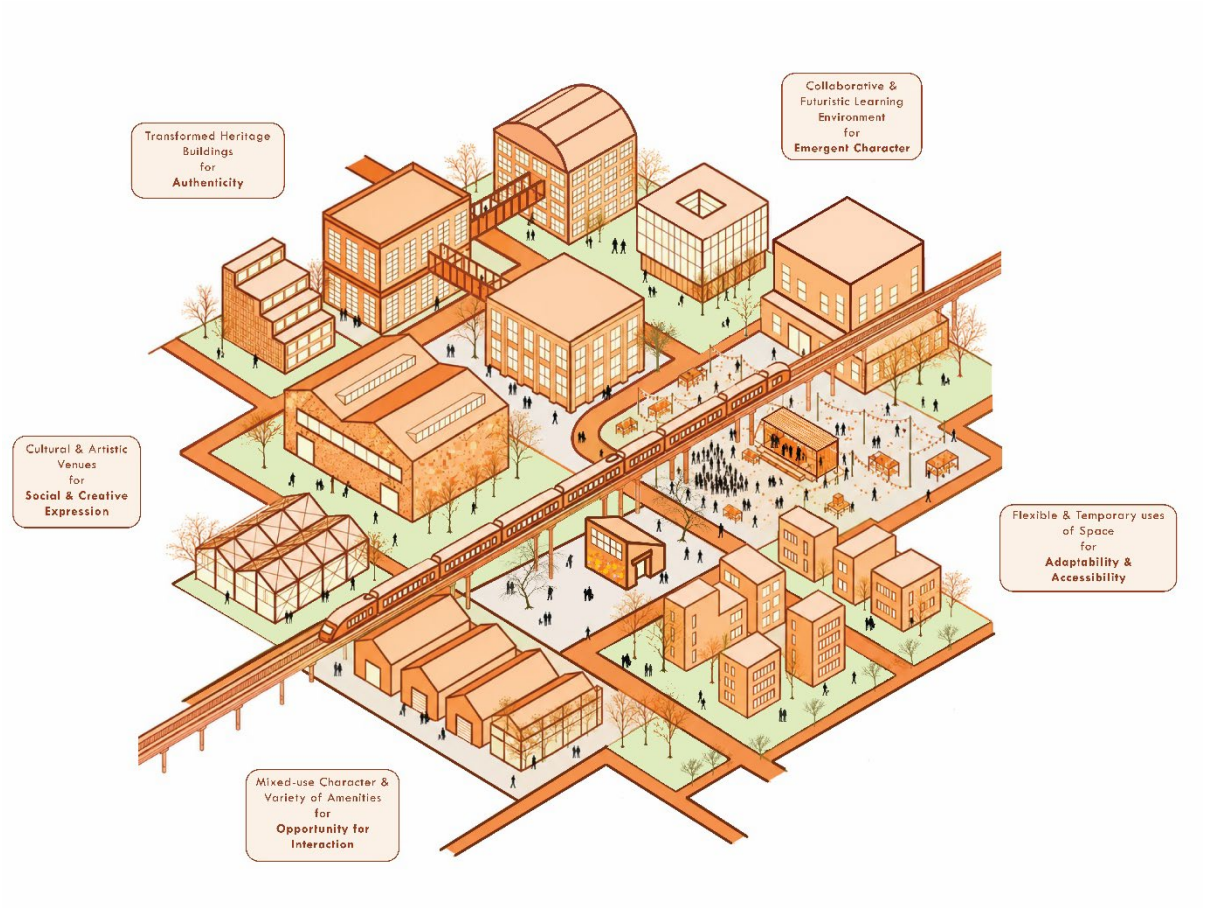

Figure 68 Visualization of hybrid innovation identity (own work, enhanced with AI)

The first sub-question; *"What is an innovation district and when can an urban area be defined as one?"* is answered in the theoretical framework. Innovation ecosystems require economic, physical, and networking assets. Together with various definitions and characteristics discussed in literature, the research defines innovation districts as inner-city, mixed-use areas which house an ecosystem of numerous companies, knowledge institutes and start-ups, in which people work, live and innovate, with the aim to apply gained knowledge into practice.

The second sub-question goes into when the development of an innovation district can be considered successful and when not. This is also answered in the theoretical framework. In literature, several determinants of innovation district success are identified. However, since the main aim of an innovation district is to produce new knowledge and to apply this gained knowledge into practice, this study stated that more innovation means more success. Therefore success could be equated with a district's innovation capacity, determined by a district's innovation intensity, innovation performance and innovation impact.

The third sub-question: *"Which spatial characteristics are essential for the development of innovation districts and to what extent do they facilitate its success?"* can be answered based on the results and discussion, exploring the contribution and limits of spatial quality.

Essential elements of spatial quality are centrality, essential and advanced amenities, urban mobility, and either public or cultural spaces, depending on the district's identity. All of these elements are highly present in the three examples cases, and can therefore be perceived as essential for daily use, interaction and innovation. Additionally, it is essential for the urban and architectural design to adapt to and reflect a district's identity, whether that is creative, institutional or hybrid. Furthermore, a safe and secure environment needs to be prioritized as basis in every district in order to create a pleasant environment for everyone, also at nighttime. Lastly, the branding of a district, spatially expressed through type of companies, company names, architectural and urban design and overall atmosphere, reinforces recognizability and contributes to the district's popularity.

Spatial quality could additionally contribute to a district's success through urban form and structure, which may include hard borders, but must remain permeable, either walkable or for traffic depending on a district's identity. Mixed-use development on district-level is important for all three district identity types. However, mixed-use development on block-level is less essential for an institutional one to keep the productive and effective character.

Additionally, property value may attracts more start-ups, while a high place attachment and a creative atmosphere, either creative or academic, may attract and retain people and companies within a district. A high variety of amenities can increase the opportunity for interactions, but is not essential for districts with an institutional identity. Additionally, being authentic is mainly important for a creative and hybrid innovation identity, and could also contribute to the success of an institutional innovation identity to increase recognizability and distinguish from science parks or campuses. Lastly, daily-use public anchors, such as libraries, hospitals, or study spaces, contribute to a constant flow of people and the liveliness of a district. However, people could additionally be attracted to a district by hosting weekly events.

Spatial quality alone cannot guarantee high innovation output, and has its limits. A strong spatially embedded innovation identity does not automatically translate to high innovation levels. Other factors play a role, and sometimes are even more decisive for innovation district success. Firstly, the broader context outside of the district level plays a

big role. The city and regional scale spatial and economic qualities define the districts context and could either limit or contribute to a district's success. Other non-spatial, economic or network factors on the district level are for example the maturity of the innovation ecosystem, the proximity to big tech or knowledge intensive multinationals, the presence of a major R&D anchor, national branding and hosting of widely known events, the management of the district development and the governance and operations of the district once it is developed.

Lastly, the sub-question: *"How can the spatial qualities and learned lessons from case studies from existing Dutch innovation districts be applied to develop successful innovation districts in the future?"* can be answered by exploring mechanisms linking space to innovation, and is illustrated more extensively in the practical recommendations.

5.3 Theoretical implications

The findings of this study confirm several theoretical claims in the innovation district literature. First, the results support Katz and Wagner's (2014) model that innovation districts rely on the interplay of economic, physical, and networking assets, as all three case studies demonstrate the presence of these components in different configurations. Second, the study reinforces place-quality literature of Yigitcanlar et al. (2024) and Vey et al. (2018), showing that spatial qualities, economic, physical and networking, contribute to the success of an innovation district. Third, the findings validate the theoretical claim that well-connected, welcoming, and socially active public spaces support knowledge exchange and innovation processes, aligning with the broader understanding of innovation districts as open, integrated urban areas. Lastly, the findings of the study confirmed what Yigitcanlar et al.'s (2024) argue, that creative districts are more likely to excel in inner-city areas, as there they benefit from the urban atmosphere and variety of amenities, while tech- and research-based districts could also be located within peripheral zones, as long as they are well-connected to more central parts of the city. However, fully isolated districts have low chances of flourishing, since connectivity and accessibility are key priorities for innovation districts.

While the literature emphasises that high place quality, combining spatial, economic, and networking elements, supports successful innovation districts, far less is known about how the spatial dimension specifically contributes to this process. This study addresses that gap by examining spatial quality as the physical and built component of place quality, responding to the persistent disconnect between form and function in current innovation district development. As recent studies note, cities and regions continue to struggle with defining the focus and boundaries of innovation districts, with economic importance often being prioritized over spatial importance (Bol, 2024; Kalliomäki et al., 2024). The findings therefore aim to extend the theoretical understanding presented in this research by introducing the concept of distinct innovation identities; creative, institutional, and hybrid. The results show that spatial quality contributes to innovation district development by expressing and enabling these identities through the coexistence of specific spatial characteristics, with each identity associated with different forms of innovation capacity. Rather than suggesting a hierarchy, this study adds that these identity-specific spatial characteristics operate alongside a set of essential spatial elements, which together form the baseline spatial conditions to facilitate daily use, interaction, and innovation. This distinction between essential and identity-specific spatial characteristics offers a more nuanced theoretical understanding of the role of spatial qualities in different types of innovation districts, moving beyond a one-size-fits-all perspective.

The study's insights also extend the argument made by Bol (2024), emphasizing that long-term, flexible development strategies are required because the end-result of an innovation district is uncertain and unfolds over multiple decades. By showing that different spatial identities correspond to different spatial priorities, this study contributes to how clear direction can be given to developments. Clear direction involves aligning development strategies with the district's intended innovation identity and ensuring that spatial decisions reinforce that identity over time. In doing so, it contributes to moving beyond project-based, economically driven development practices toward more spatially embedded identity-informed approaches.

The findings of this research nuance the existing theoretical claim about mixed-use development within innovation districts. While mixed-use is an inherent element of every innovation district in order for one to call itself an innovation district, this study shows that the relevance of the level of mixed-use on district as well as block level is identity-dependent rather than universal. In particular, districts with an institutional innovation identity suggest efficiency with less block-level mixed0use, where alignment and predictability are more important than spatial diversity. This modifies the broader assumption that mixed-use development accelerates socioeconomic growth in innovation districts. Literature does state that a right balance within mixed-use development is needed, this study suggests that this balance depends on the district's intended innovation identity.

5.4 Practical recommendations

Based on the empirical and theoretical insights presented by this study, a set of practical recommendations can be formulated to guide innovation district development. This section aims to describe practical steps on how to apply the learned lessons from the case studies from existing Dutch innovation districts to develop successful innovation districts in the future, answering the last sub-question.

Firstly, the study recommends to pay attention to a set of universal applicable and essential spatial characteristics during innovation district development. These essential characteristics are derived from a combination of argued spatial elements from place quality literature from Yigitcanlar et al. (2024) and the study's findings regarding these elements, and need to be applied early on in the development process to not only decide on a fitting location for a future district, but also to ensure a strong spatial basis regardless of the focus of the future district.

> *Centrality: Innovation districts should be located close to key urban anchors such as city centers, universities, research institutes, hospitals, or major mobility hubs.*

Centrality can take different forms: creative districts often benefit from inner-city settings, while tech- and research-oriented districts can also function well in peripheral areas as long as they remain well-connected to more central parts of the city. Fully isolated locations should be avoided, as innovation depends on accessibility and integration with the wider city.

> *Amenities: Innovation districts should offer a balanced and diverse mix of essential amenities and advanced amenities within walking or short-cycling distance.*

essential amenities, such as supermarkets , childcare or primary schools, and advanced amenities, such cafés, cultural venues and sports facilities need to be accessible for people living in the district as well as for people visiting. These amenities create the basic conditions for daily life, attract diverse users, and support informal encounters that contribute to innovation.

> *Urban mobility: Innovation districts should be highly accessible by multiple forms of transport, while maintaining walkability and cyclability.*

Innovation districts should provide clear, safe, and well-connected pedestrian and cycling routes, supported by efficient public transport possibilities. The district should additionally be connected to the surrounding city fabric, maintaining a highly permeable character. Car access should be considered but not prioritizes, ensuring that the district remains human-scale and attractive for daily users. A coherent mobility structure strengthens a district's accessibility and permeability.

> *Public or cultural spaces: Innovation districts should be provided with either accessible public or cultural spaces that are open to people of all levels of society.*

This can include meeting places, co-working spaces, cinemas, libraries, theatres, or other publicly accessible venues that offer opportunities for informal encounters. Furthermore, the availability of these places attract people form surrounding neighborhoods to the district, enhancing connections with the broader community.

Urban and architectural design: Innovation districts' design language should reflect the district's innovation identity, whether that is creative, institutional or hybrid.

The district's urban and architectural design must visually portray a district's aims and goals. A mismatch between a district's design language and identity, such as highly institutional architecture in a creative district or expressive adaptive-reuse buildings in a specialized health-science district, would undermine both identity and functionality.

Safety and security: Innovation districts should prioritize creating a safe and secure environment.

Ensure that the district offers a safe and comfortable daily environment. Safety should be supported through good visibility, clear routes, and well-maintained public spaces, enabling people to use the district throughout the day and night while feeling comfortable spending time there.

Branding: Innovation districts should spatially express their branding

Develop a recognizable district brand that creates a unique name and image in users' minds. Spatial branding should represent the district's well-known companies, institutions, and activities, while ensuring that the district's physical form and overall atmosphere also reflect and reinforce this brand. This two-way relationship strengthens recognizability and helps position the district clearly within the wider innovation landscape. Branding of a district reinforces recognizability and contributes to the district's popularity.

Then, the study recommends to pay attention to a set of identity-specific spatial characteristics during innovation district development. These characteristics draw on the general spatial elements identified in place quality literature by Yigitcanlar et al. (2024) and are further specified and operationalized into identity types through the study's findings. During development, these characteristics need to be considered early on, following the innovation identity decided by municipalities. Doing so enables the involvement of the right stakeholders and provide clear direction, helping to shift away from project-based, economically driven development practices toward more spatially embedded, identity-aligned strategies (Bol, 2024).

Firstly, a creative innovation identity is enabled by authenticity, artistic expression, variety and interaction, experimentation and production, and a human-scale permeable urban character. These spatial elements should coexist and reinforce one another to attract the people and firms that fit a creative innovation identity profile. Stakeholders such as cultural organisations, social housing corporations, designers and architects with experience in adaptive reuse, and developers who support mixed-use developments should be included early in the process to ensure alignment between the intended identity and development practices.

Then, an institutional innovation identity is enabled by alignment and predictability, specialization, functionality, applied research, and accessibility. These spatial elements should co-occur to support knowledge-intensive work and the district's institutional character. Stakeholders such as universities, medical centers, research institutes, and specialized design-build firms who handle both the architectural design, construction and

development, and should be included early on to ensure the development strategy aligns with the intended identity of the district.

Lastly, a hybrid innovation identity is enabled by authenticity, social and creative expression, interaction opportunities, adaptability and accessibility, and an emergent character. These spatial elements should coexist to create an environment that supports openness, flexibility, and the emergence of new activities. Stakeholders such as cultural institutions, educational partners, event organizers, designers and architects with experience in adaptive reuse, and developers experienced with temporary or flexible uses should be included at an early stage to guarantee coherence between the intended identity and the direction of development.

5.5 Limitations & future research

This study is subject to several limitations that influence the findings of this research. These limitations relate to the selectivity of the literature study, the availability and completeness of data, and the restricted number of cases examined.

Because this literature study was selective rather than systematic, selection bias may be present, and some relevant studies may have been omitted from the theoretical framework. Only three cases were analyzed in this research, of which one was more extensively developed that the others, limiting the comparability of case comparisons.

For the spatial quality analysis, quantitative limits were defined for each indicator in the results section. However, overall, not all data was publicly available and certain sub-indicators were not taken into consideration. Although some quantitative data originated from citizen surveys, relying solely on quantitative measures does not always provide a representative reflection of certain indicators. Conducting interviews or surveys with various stakeholders, such as residents, employees, visitors, the municipality or developers would have enriched the analysis with qualitative insights. Additionally, some open data were not up-to-date, with several sources being two to three years old.

Furthermore, the innovation capacity data portrays a simplified representation of innovation districts success. This is due to two main reasons. Firstly, many additional influences shape innovation district success. Economic factors, network dynamics, broader regional and city-scale context, and management and governance structures can play a decisive role. As concluded in this study, spatial quality alone cannot guarantee high innovation output. A strong spatially embedded innovation identity does not automatically translate into high innovation levels. Secondly, no financial data was included in the innovation capacity assessment, as the LISA-database provides only limited information. This omission restricts the ability to evaluate the economic dimension of innovation performance.

Future research should build on these limitations by expanding the empirical scope, refine methodological approaches and broadening the overall understanding of innovation district development.

Firstly, future studies should include more cases in the comparative analysis to strengthen the generalizability of the findings. Including a larger and more diverse sample, with various differing characteristics, would reduce case-selection bias and allows for stronger conclusions regarding essential elements of spatial quality to be drawn. Additionally,

extending the analysis to cases in other national and international districts would further test whether the findings identified in this study can be applied in different contexts.

Secondly, future research should incorporate the conduction of interviews with various key stakeholders. Including residents, employees, district visitors, municipalities, developers and anchor institutions, to validate the findings and enrich them with qualitative insights.

Then, future work should explore non-spatial contributors to innovation district success, such as financial performance, economic context, network possibilities, governance structures and management processes for development as well as operationalization. These factors were identified as potentially primary influences, but fell outside the scope of this study. Integrating these dimensions would provide a more holistic understanding of innovation district success.

Furthermore, further research could focus on more in-depth urban and architectural design analyses, such as building and plinth typologies, architectural decisions, greenery, materials, dimensions, furniture and so on, to examine how design decisions on different scale shape the spatial quality and influence innovation identity. these findings would compliment the essential and identity-specific spatial elements with more detailed interventions and aspects.

Lastly, future research should test the findings in early-stage innovation district developments to explore how the proposed framework performs in contexts where innovation ecosystems are still emerging. Doing so would enable researchers to outline what each spatially embedded innovation identity might look like in practice and to assess whether early development choices align with more successful innovations district outcomes.

6. Acknowledgements

First of all I would like to thank my supervisors from the TU Delft. My first supervisor, Karel van den Berghe, from the track Management in the Built Environment and part of Urban Development Management, for always believing in my process and putting trust in my work. Your enthusiastic and personal take on work and life are refreshing in this academic environment. My second supervisor, Agnes van der Meij, from the architecture track and part of Architectural Design Crossovers, for playing a key role in re-introducing me to spatial research, which ensured the interdisciplinary character of my study. Your patience, kindness and curious interest in my research helped me fulfill my wish to find a balance between management and spatial practices.

Then, I would like to give notice to my graduation internship company, Dev_ real estate. During my time here, I have gained valuable insights into professional practice, which has meaningfully supported my career orientation. A very special thanks to my supervisor at this amazing company, Natalie Yakovleva, who was my stable rock throughout this time, giving me very useful and sharp feedback and supporting me when in doubt. Lastly, I want to thank everyone at Dev_ real estate for their feedback, kindness and laughs during my graduation.

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7. Reflection

Academic and professional development

For this thesis I wanted to work more precisely than in my earlier research, which often focused on broader societal themes such as gentrification, displacement, livability, climate change, or pedagogical approaches. This time, I aimed for a more exact approach and tried to create a genuine crossover between management in the built environment and the spatial disciplines of urbanism and architecture. These fields often remain separated in practice, but I believe professionals benefit from more interdisciplinary ways of working. I also wanted to challenge myself to move beyond mainly conceptual answers and become more confident in producing specific conclusions. During this process, I learned that I can work with precision and detail, but I still enjoy the more overarching conceptual thinking most. Altogether, I am very content by how smooth the overall process turned out to be and that I ultimately carried out the thesis in the way I had envisioned from the start.

Interdisciplinary challenges

The interdisciplinary challenges mainly came from the different expectations around describing findings in words versus visualizing them in images. As a management student with a design background, I naturally work best with more diagrammatic and textual forms of explanation, while this study sometimes required more creative and expressive visualizations. I also struggled with deciding which disciplinary perspective should lead, although my intern supervisor helped me navigate that. The quantitative analysis felt secure and, which made it difficult to switch to qualitative spatial analysis, where I had to rely more on expert judgement and subjective interpretation. I often felt torn between being exact and being interpretive, and I noticed how uncertain the work can feel when relying on my own expertise.

Critical reflection on research design

Looking back at the research design, I recognize that the study mainly highlights the positive impacts of innovation districts. Important critical perspectives, such as gentrification, exclusion of people with lower socioeconomic status or lower educational attainment, and the broader late-capitalist dynamics of contemporary society, were not fully addressed. All three cases can be considered relatively successful, and analyzing a struggling or “failed” district might have produced different insights. Because of the scope, the focus on successful examples, and time constraints, these debates remained underdeveloped. This makes the conclusions more optimistic than what might is true in reality and limits the societal relevance of the recommendations, especially for groups who may be negatively affected.

Scientific and societal value

Despite these limitations, the research still offers scientific and societal value. It specifies how the role of spatial quality varies across innovation districts and shows that there is no one-size-fits-all approach. It also provides a structured way to analyze districts, although the weighting system for quantitative spatial quality could be refined for that specifically. Moreover, the study encourages practitioners to think more critically about spatial identity and supports municipalities in making more informed decisions.

Transferability of results

Finally, the transferability of the results is limited. Dutch planning culture is unique, and innovation districts elsewhere operate under different governance models and market conditions. It is uncertain whether the spatial quality framework would work the same way outside the Netherlands. However, the underlying idea that spatial identity must fit the aims and context of a district is likely more universal. Still, the small sample size restricts generalizability, and broader research would be needed to validate the conclusions.

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Appendix 1 – Atlas

Centrality

Indicator	Eenheid	Zeer goed (groene smiley)	Goed (lichtgroene smiley)	Redelijk (gele smiley)	Matig (oranje smiley)	Slecht (rode smiley)
Afstand tot een huisartspraktijk (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een kinderdagverblijf (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een basisschool (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een supermarkt (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Sport- en beweegmogelijkheden	indicator - getal tussen 0 en 100	≥ 80	≥ 60 en < 80	≥ 40 en < 60	≥ 20 en < 40	< 20
Afstand tot treinstation, metro- of tramhalte	km	< 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4 en < 8	≥ 8
Afstand tot bushalte	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4
Afstand tot oprit hoofdweg	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4

(Ministerie van Infrastructuur en Waterstaat, n.d.)

Unique surroundings

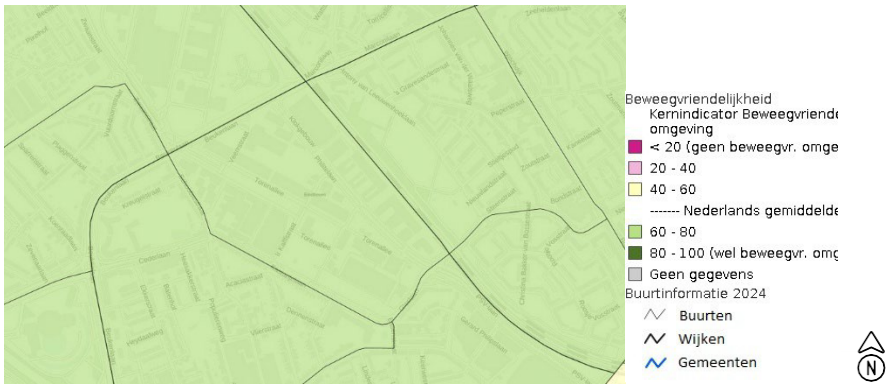
Strijp-S (West 8, n.d.-a)

VU-kwartier (Interprovinciaal Overleg, 2022)

Spoorzone (Interprovinciaal Overleg, 2022)

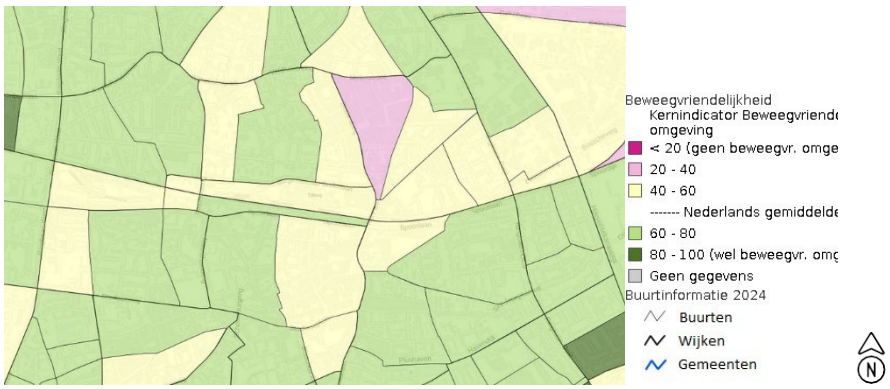
Urban structure

Movability



Strijp-S (Mulier Instituut, 2024)

VU-kwartier (Mulier Instituut, 2024)

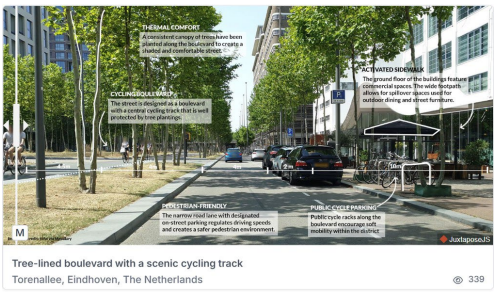


Spoorzone (Mulier Instituut, 2024)

Urban design

Strijp-S (West 8, n.d.-a, p. 8)

Strijp-S (West 8, n.d.)



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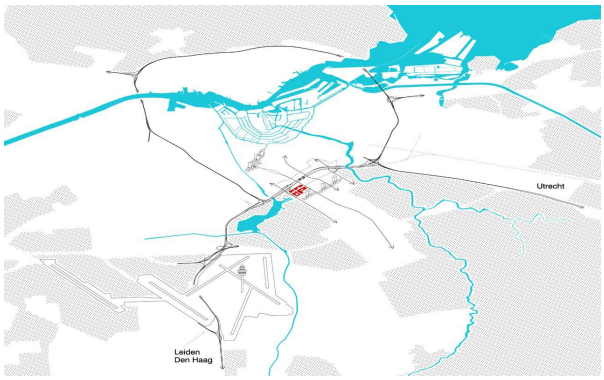
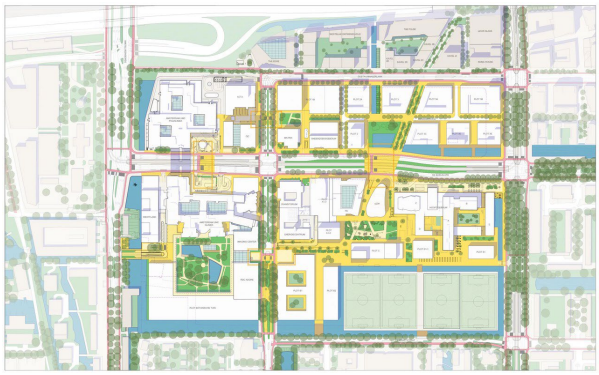
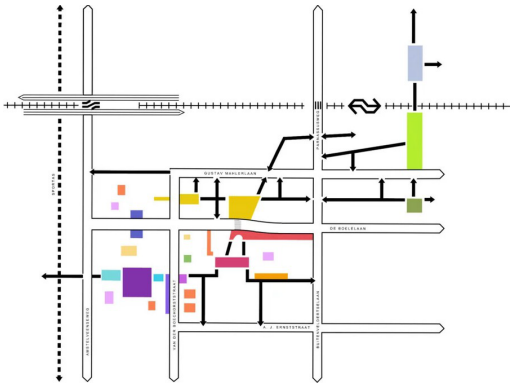
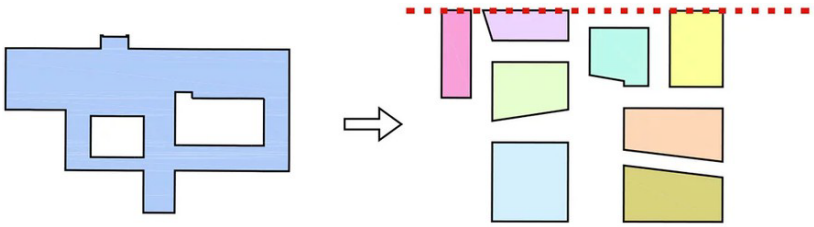


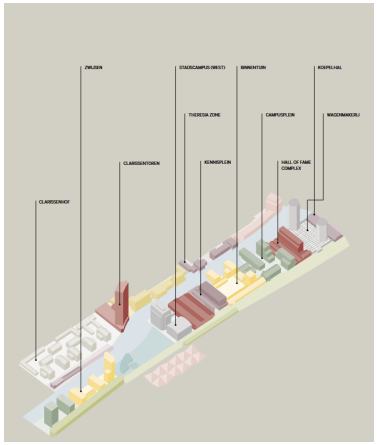


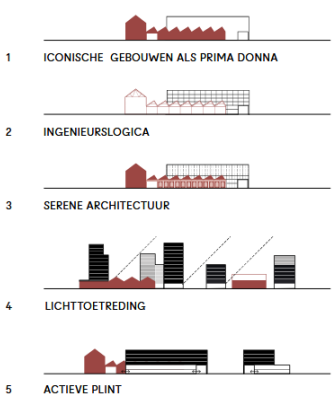


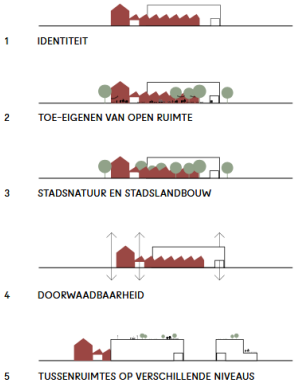


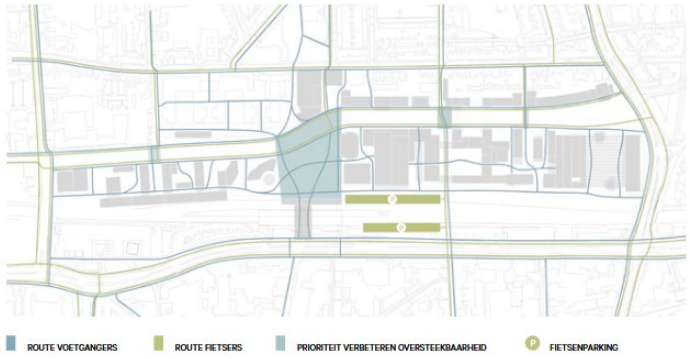
VU-kwartier (Studio Hartzema, n.d.)

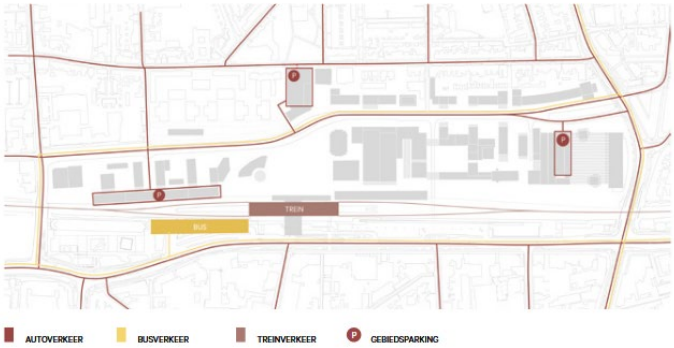
Spoorzone (Anouk Thijssen, 2019)





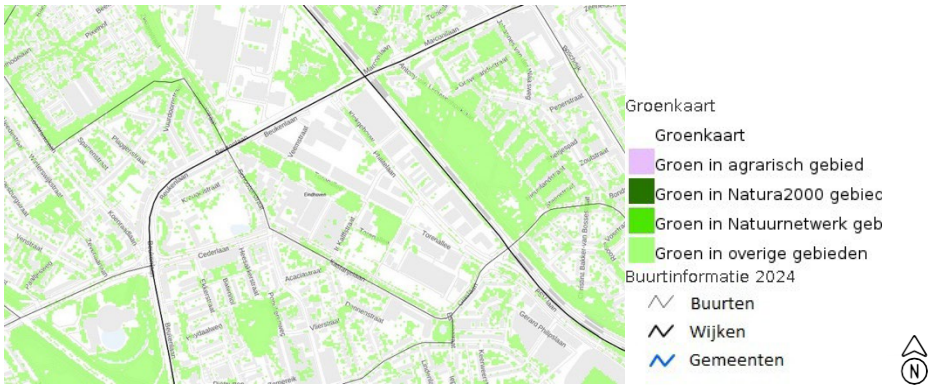






Spoorzone (Bogdan e.a., 2019)

Green map

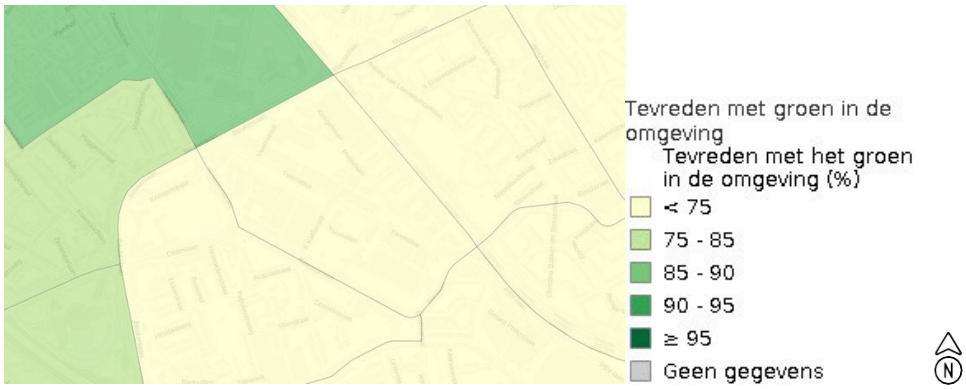


Strijp-S (Rijksinstituut voor Volksgezondheid en Milieu & Atlas Natuurlijk Kapitaal, 2022)

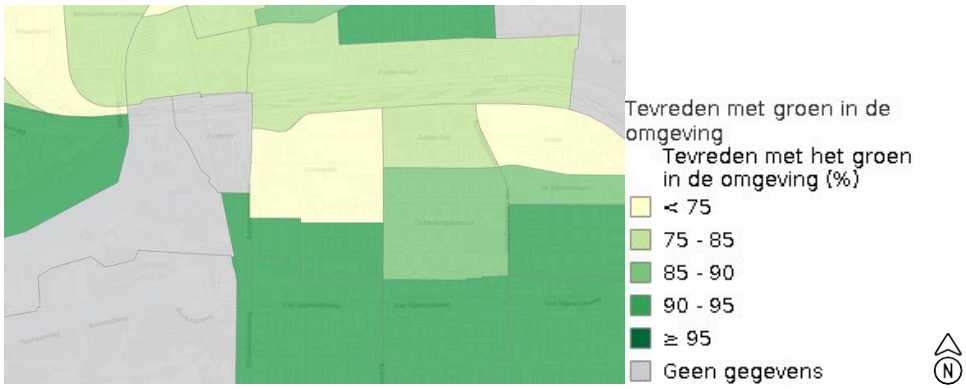
VU-kwartier (Rijksinstituut voor Volksgezondheid en Milieu & Atlas Natuurlijk Kapitaal, 2022)

Spoorzone (Rijksinstituut voor Volksgezondheid en Milieu & Atlas Natuurlijk Kapitaal, 2022)

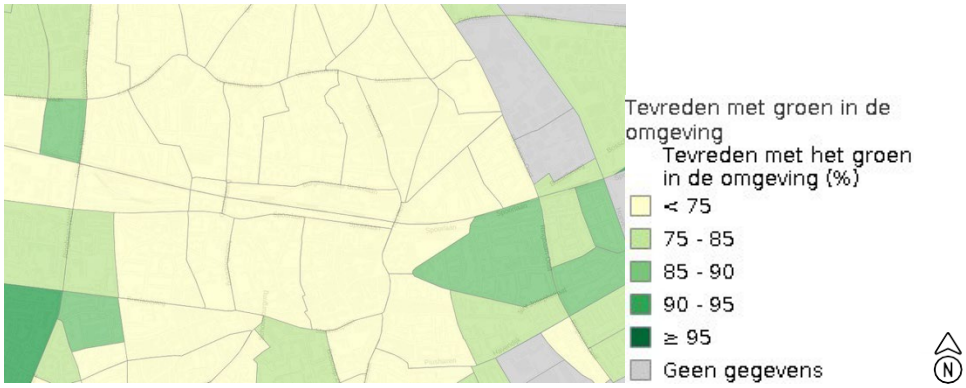
Content with green in environment



Strijp-S (Rijksinstituut voor Volksgezondheid en Milieu (RIVM), 2024)



VU-kwartier (Rijksinstituut voor Volksgezondheid en Milieu (RIVM), 2024)



Spoorzone (Rijksinstituut voor Volksgezondheid en Milieu (RIVM), 2024)

Neighborhood information (*Check je plek*)

1. Adresinformatie

Adres:	Torenallee 44 5617 BD Eindhoven
Gemeentenaam:	Eindhoven
Gebruiksdoel:	bijeenkomstfunctie,kantoorfunctie,winkelfunctie,woonfuncti
Bouwjaar pand:	1927
Energielabel pand:	A

2. Leefomgevingskwaliteit

Fijnstof in de lucht (2023):	9 µg PM2,5 / m^3
Stikstofdioxide in de lucht (2023):	14 µg NO_2 / m^3
Geluid in de omgeving:	54 dB
Zomerhitte in de stad:	+ 2.0 °C t.o.v. landelijk gebied
Schaduwrijke bomen binnen 500 meter:	6% van het oppervlak
Groen/blauw binnen 500 meter:	28% van het oppervlak
Kans op een overstroming:	Overstroomt niet / Oppervlaktewater
Hoe donker is het 's nachts?:	215 zichtbare sterren
Activiteiten met gevaarlijke stoffen binnen 1 km:	aardgasstation, buisleiding, vervoer gevaarlijke stoffen

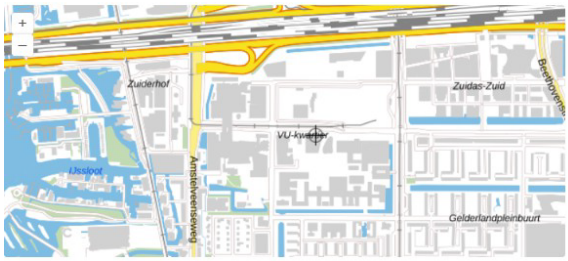
3. Buurtinformatie

Gemiddelde woningwaarde in 2023:	€ 320 000
Mate van stedelijkheid van de buurt:	Zeer sterk stedelijk
Afstand tot een huisartsenpraktijk:	0.3 km
Afstand tot een kinderdagverblijf:	1.0 km
Afstand tot een basisschool:	1.0 km
Afstand tot een supermarkt:	0.2 km
Sport- en beweegmogelijkheden:	Goed
Afstand tot treinstation, metro- of tramhalte:	0.3 km
Afstand tot bushalte:	0.1 km
Afstand tot oprit hoofdweg:	1.7 km

Strijp-S (Ministerie van Infrastructuur en Waterstaat, n.d.)

Adres: De Boelelaan 1111C, 1081

Of klik in de kaart om een locatie te kiezen



1. Adresinformatie

Adres:	De Boelelaan 1111C 1081 HV Amsterdam
Gemeentenaam:	Amsterdam
Gebruiksdoel:	overige gebruiksfunctie
Bouwjaar pand:	2021
Energielabel pand:	A+++

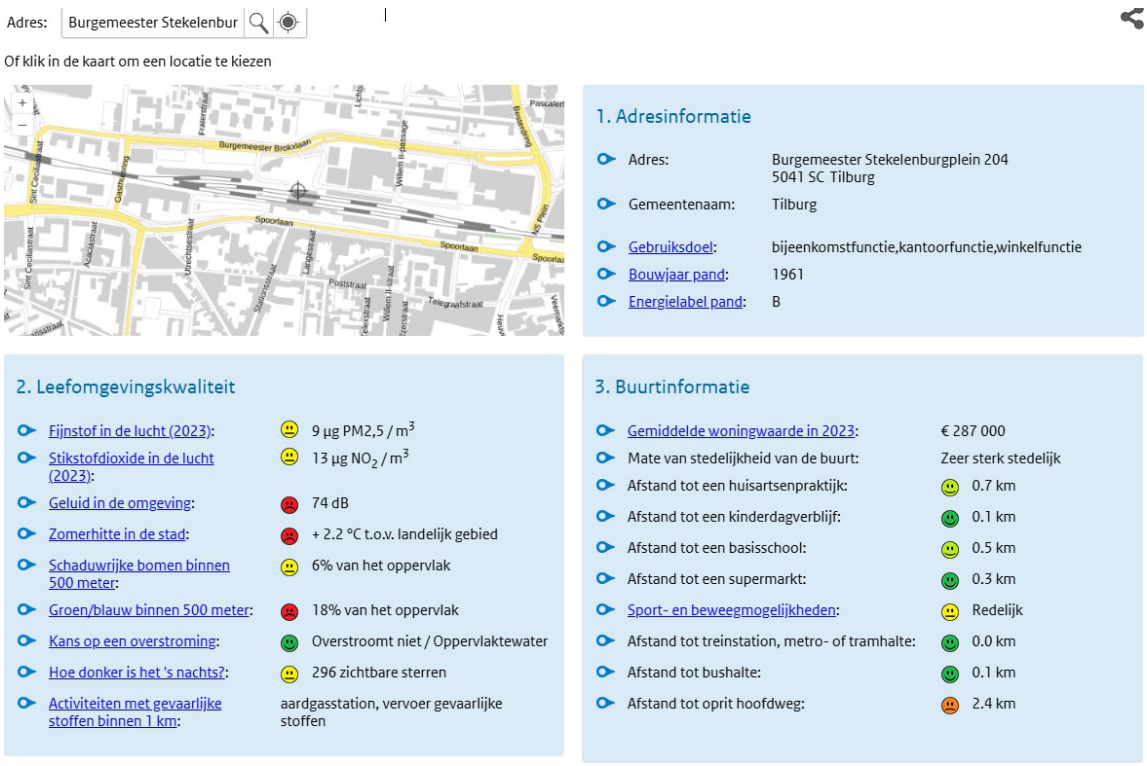
2. Leefomgevingskwaliteit

Fijnstof in de lucht (2023):	8 µg PM2,5 / m^3
Stikstofdioxide in de lucht (2023):	23 µg NO_2 / m^3
Geluid in de omgeving:	64 dB
Zomerhitte in de stad:	+ 1.6 °C t.o.v. landelijk gebied
Schaduwrijke bomen binnen 500 meter:	7% van het oppervlak
Groen/blauw binnen 500 meter:	28% van het oppervlak
Kans op een overstroming:	Overstroomt niet / Oppervlaktewater
Hoe donker is het 's nachts?:	232 zichtbare sterren
Activiteiten met gevaarlijke stoffen binnen 1 km:	buisleiding, vervoer gevaarlijke stoffen

3. Buurtinformatie

Gemiddelde woningwaarde in 2023:	€ 604 000
Mate van stedelijkheid van de buurt:	Zeer sterk stedelijk
Afstand tot een huisartsenpraktijk:	0.4 km
Afstand tot een kinderdagverblijf:	0.7 km
Afstand tot een basisschool:	1.3 km
Afstand tot een supermarkt:	0.7 km
Sport- en beweegmogelijkheden:	Redelijk
Afstand tot treinstation, metro- of tramhalte:	0.1 km
Afstand tot bushalte:	0.1 km
Afstand tot oprit hoofdweg:	0.5 km

VU-kwarier - (Ministerie van Infrastructuur en Waterstaat, n.d.)



Spoorzone (Ministerie van Infrastructuur en Waterstaat, n.d.)

The style of designing unbuilt spaces landscape, park, landmarks, spatial diversity

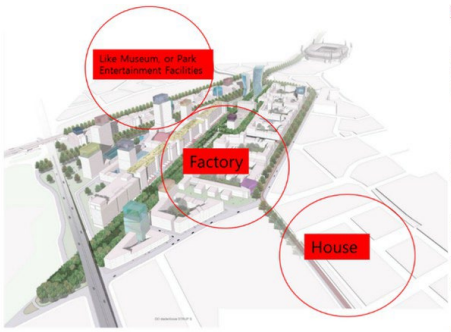
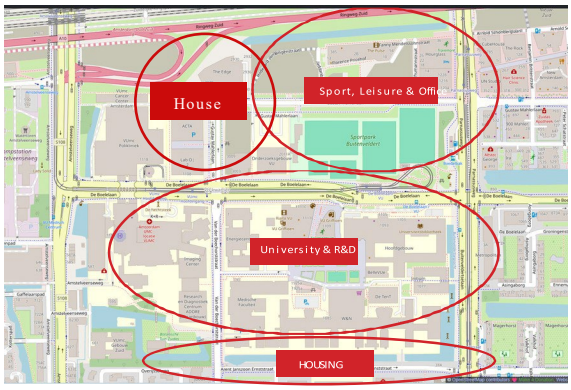


Figure 9. Strijp-S Innovation District: C-type open innovation cluster.

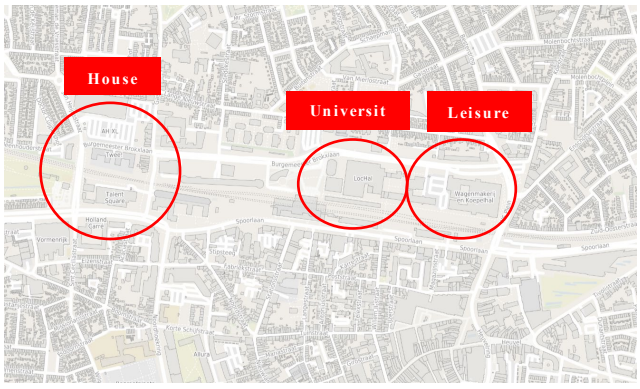
TABLE 11.3 An Exemplar Case Study Matrix of MTP

		A	B	C
Form				
Land-use mix	o1	Complex mixed	Mixed use	Single use
Space design	o2	Open	Semi-open	Closed
Built environment	o3	Strong	Moderate	Weak
Urban green and blue infrastructure	o4	Strong	Moderate	Weak
Feature				
Human capital	e1	Strong	Moderate	Weak
Skilled labor	e2	Strong	Moderate	Weak
Social amenity	e3	Strong	Moderate	Weak
Locality setting	e4	Inner city	Suburban	Regional
Function				
Investment type	u1	Multiple sectors	Two sectors	Single sector
Industry type	u2	Technology-intensive	Creativity-intensive	Business support
Company size	u3	Multinational	Large national	Small and medium
Property management	u4	District wide	Building level	None
Context				
Economic system	c1	Strong	Moderate	Weak
Societal system	c2	Strong	Moderate	Weak
Spatial system	c3	Strong	Moderate	Weak
Governance system	c4	Strong	Moderate	Weak

Strijp-S (Yun et al., 2018b)



VU-kwartier (own work, based on Yun et al. (2018))



Spoorzone (own work, based on Yun et al. (2018))

Essential amenities

Neighborhood information (*Check je plek*)

Indicator	Eenheid	Zeer goed (groene smiley)	Goed (lichtgroene smiley)	Redelijk (gele smiley)	Matig (oranje smiley)	Slecht (rode smiley)
Afstand tot een huisartspraktijk (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een kinderdagverblijf (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een basisschool (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een supermarkt (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Sport- en beweegmogelijkheden	indicator - getal tussen 0 en 100	≥ 80	≥ 60 en < 80	≥ 40 en < 60	≥ 20 en < 40	< 20
Afstand tot treinstation, metro- of tramhalte	km	< 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4 en < 8	≥ 8
Afstand tot bushalte	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4
Afstand tot oprit hoofdweg	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4

1. Adresinformatie

Adres:	Torenallee 44 5617 BD Eindhoven
Gemeentenaam:	Eindhoven
Gebruiksdoel:	bijeenkomstfunctie,kantoorfunctie,winkelfunctie,woonfunct
Bouwjaar pand:	1927
Energielabel pand:	A

2. Leefomgevingskwaliteit

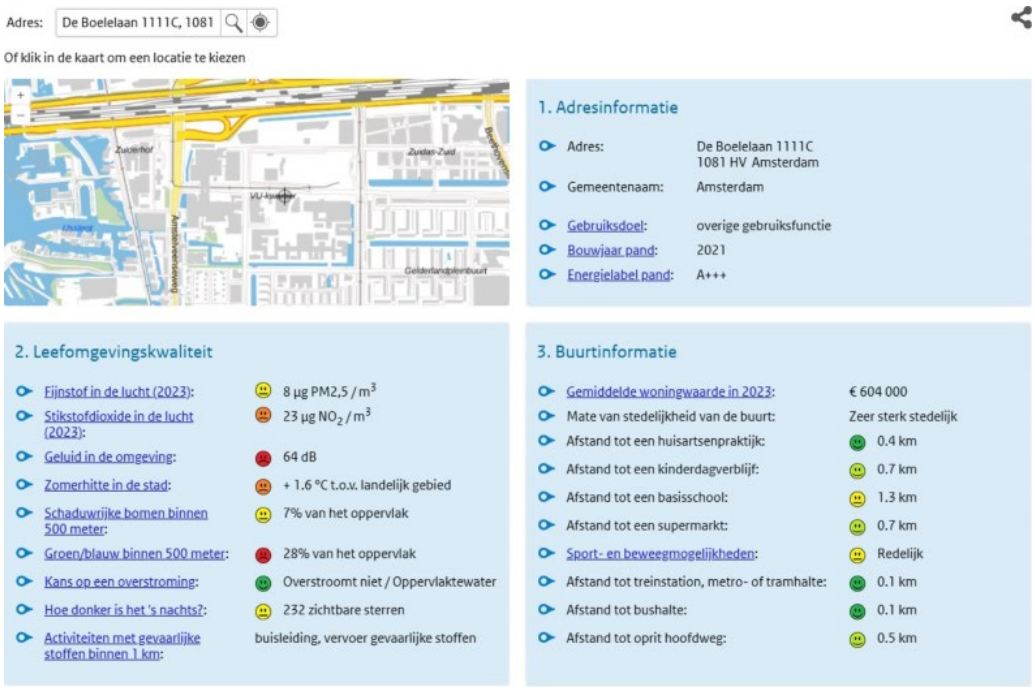
Fijnstof in de lucht (2023):	9 µg PM2,5 / m^3
Stikstofdioxide in de lucht (2023):	14 µg NO_2 / m^3
Geluid in de omgeving:	54 dB
Zomerhitte in de stad:	+ 2.0 °C t.o.v. landelijk gebied
Schaduwrijke bomen binnen 500 meter:	6% van het oppervlak
Groen/blauw binnen 500 meter:	28% van het oppervlak
Kans op een overstroming:	Overstroomt niet / Oppervlaktewater
Hoe donker is het 's nachts?:	215 zichtbare sterren
Activiteiten met gevaarlijke stoffen binnen 1 km:	aardgasstation, buisleiding, vervoer gevaarlijke stoffen

3. Buurtinformatie

Gemiddelde woningwaarde in 2023:	€ 320 000
Mate van stedelijkheid van de buurt:	Zeer sterk stedelijk
Afstand tot een huisartsenpraktijk:	0.3 km
Afstand tot een kinderdagverblijf:	1.0 km
Afstand tot een basisschool:	1.0 km
Afstand tot een supermarkt:	0.2 km
Sport- en beweegmogelijkheden:	Goed
Afstand tot treinstation, metro- of tramhalte:	0.3 km
Afstand tot bushalte:	0.1 km
Afstand tot oprit hoofdweg:	1.7 km

Strijp-S (Ministerie van Infrastructuur en Waterstaat, n.d.)

Indicator	Eenheid	Zeer goed (groene smiley)	Goed (lichtgroene smiley)	Redelijk (gele smiley)	Matig (oranje smiley)	Slecht (rode smiley)
Afstand tot een huisartspraktijk (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een kinderdagverblijf (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een basisschool (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een supermarkt (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Sport- en beweegmogelijkheden	indicator - getal tussen 0 en 100	≥ 80	≥ 60 en < 80	≥ 40 en < 60	≥ 20 en < 40	< 20
Afstand tot treinstation, metro- of tramhalte	km	< 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4 en < 8	≥ 8
Afstand tot bushalte	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4
Afstand tot oprit hoofdweg	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4



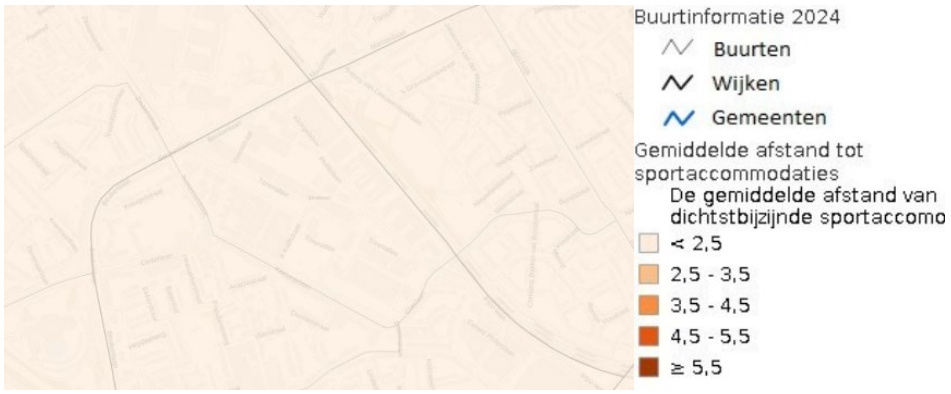
VU – kwartier (Ministerie van Infrastructuur en Waterstaat, n.d.)

Indicator	Eenheid	Zeer goed (groene smiley)	Goed (lichtgroene smiley)	Redelijk (gele smiley)	Matig (oranje smiley)	Slecht (rode smiley)
Afstand tot een huisartspraktijk (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een kinderdagverblijf (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een basisschool (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Afstand tot een supermarkt (over de weg)	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2,5	≥ 2,5 en < 5	≥ 5
Sport- en beweegmogelijkheden	indicator - getal tussen 0 en 100	≥ 80	≥ 60 en < 80	≥ 40 en < 60	≥ 20 en < 40	< 20
Afstand tot treinstation, metro- of tramhalte	km	< 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4 en < 8	≥ 8
Afstand tot bushalte	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4
Afstand tot oprit hoofdweg	km	< 0,5	≥ 0,5 en < 1	≥ 1 en < 2	≥ 2 en < 4	≥ 4

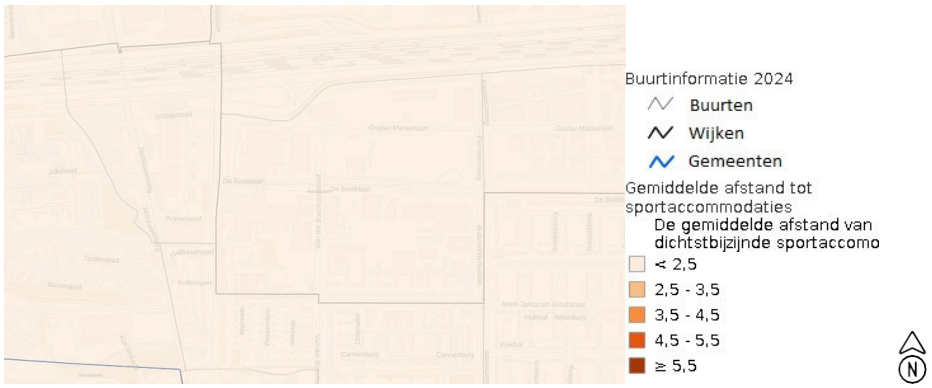
Spoorzone (Ministerie van Infrastructuur en Waterstaat, n.d.)

Advanced amenities

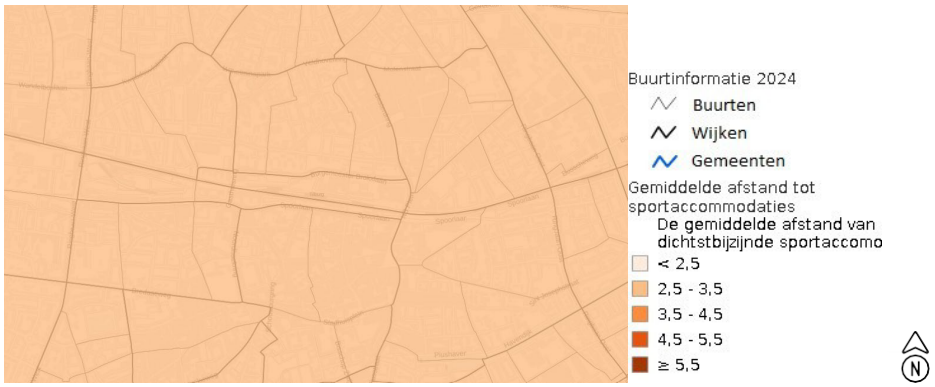
Average distance to sport facilities



Strijp-S (Rijksinstituut voor Volksgezondheid en Milieu, 2023)

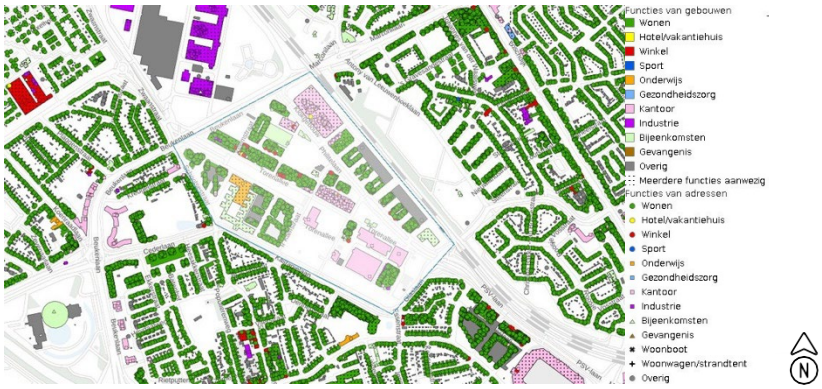


VU-Kwartier (Rijksinstituut voor Volksgezondheid en Milieu, 2023)



Spoorzone (Rijksinstituut voor Volksgezondheid en Milieu, 2023)

Functions of buildings



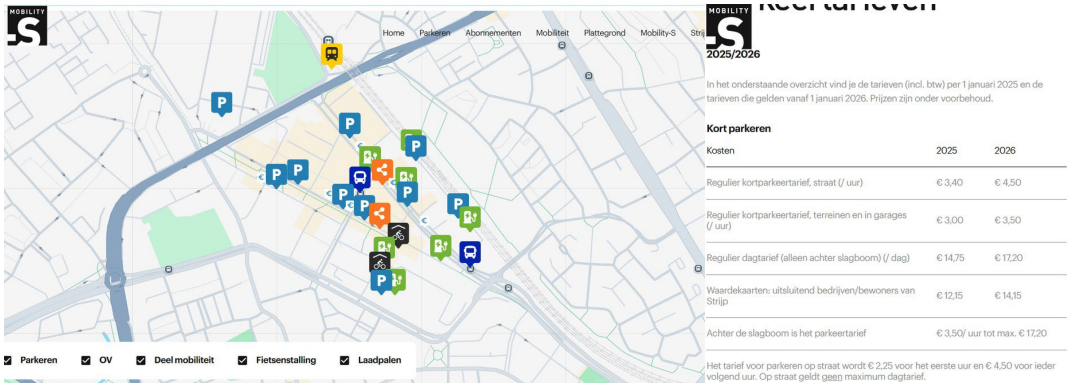
Strijp-S (Rijksinstituut voor Volksgezondheid en Milieu, 2026)

VU-kwartier (Rijksinstituut voor Volksgezondheid en Milieu, 2026)

Spoorzone (Rijksinstituut voor Volksgezondheid en Milieu, 2026)

Urban mobility

Public transport, parking and speed-limits



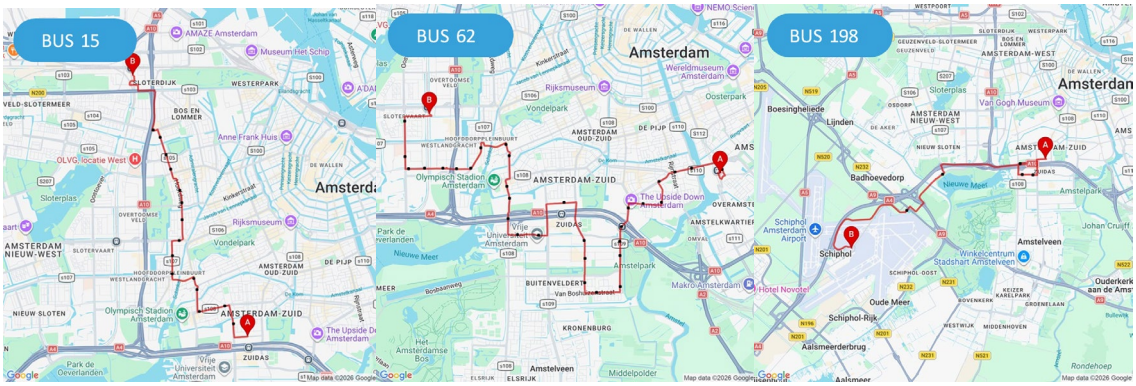
Strijp-S (Mobility-S, n.d.)

Strijp-S bus 401: (Hermes, n.d.-a)

Strijp-S bus 402 + 403: (Hermes, n.d.-b)

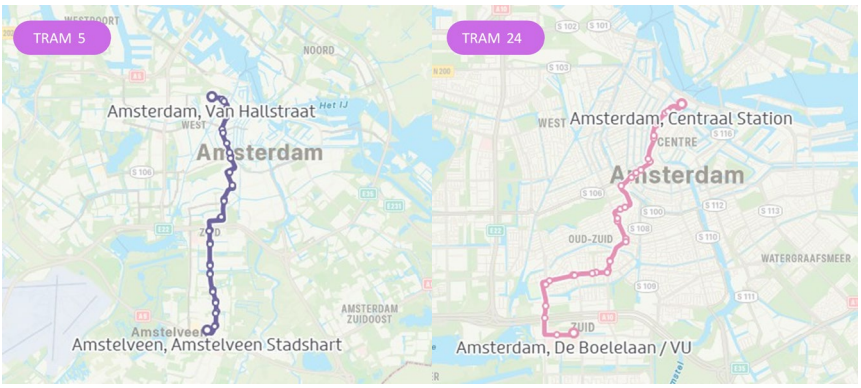
Strijp-S (Nationaal Wegenbestand, n.d.)

VU-kwartier (Prettig Parkeren, n.d.)

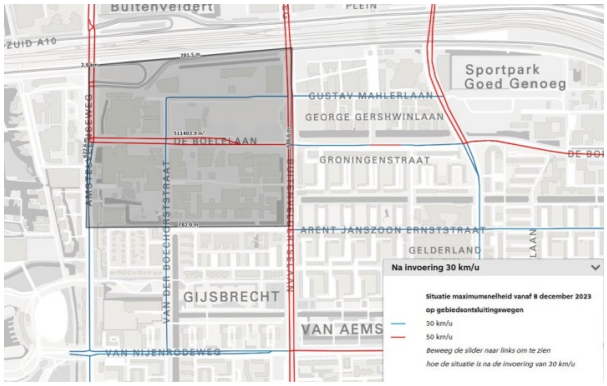


VU-kwartier (Hermes, n.d.-b)

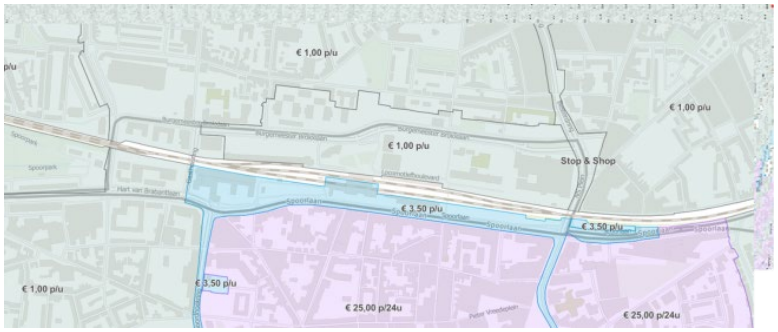
VU-kwartier (GVB, n.d.)



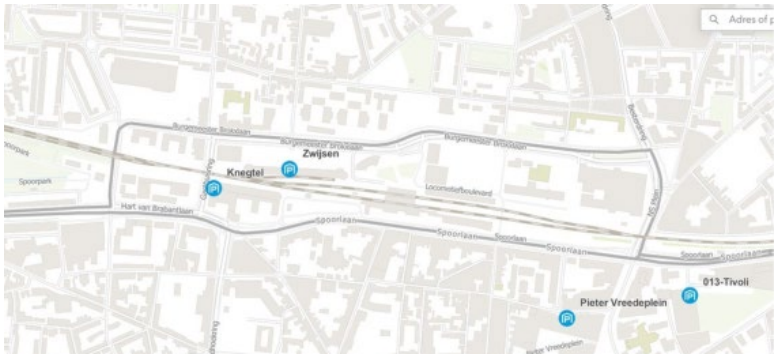
VU-kwartier (Transit, n.d.)



VU-kwartier (Gemeente Amsterdam, n.d.)



Spoorzone (Gemeente Tilburg., n.d.-a)



Spoorzone (Gemeente Tilburg., n.d.-b)

Spoorzone (Centrale Informatievoorziening van Rijkswaterstaat, n.d.)

(Rail) roads

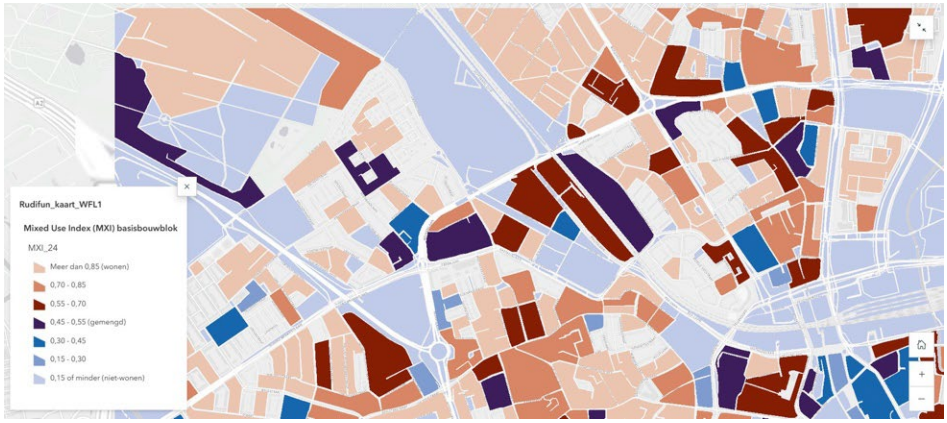
Strijp-S (Kadaster, n.d.)

VU-kwartier (Kadaster, n.d.)

Spoorzone (Kadaster, n.d.)

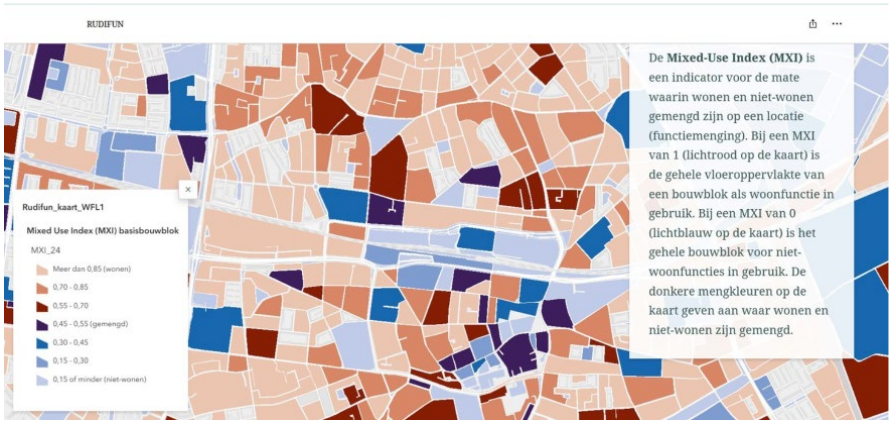
Mixed-use development

MXI & SDI



Strijp-S (Harbers et al., 2025)

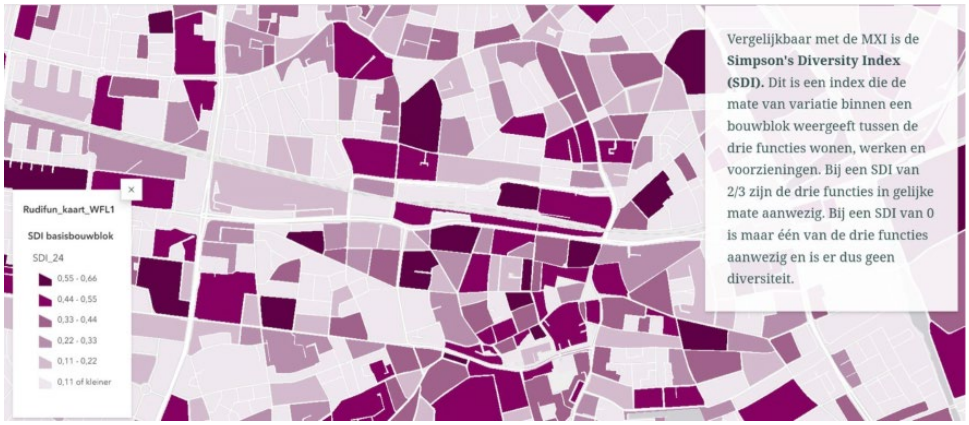
VU-kwartier (Harbers et al., 2025)



Spoorzone (Harbers et al., 2025)

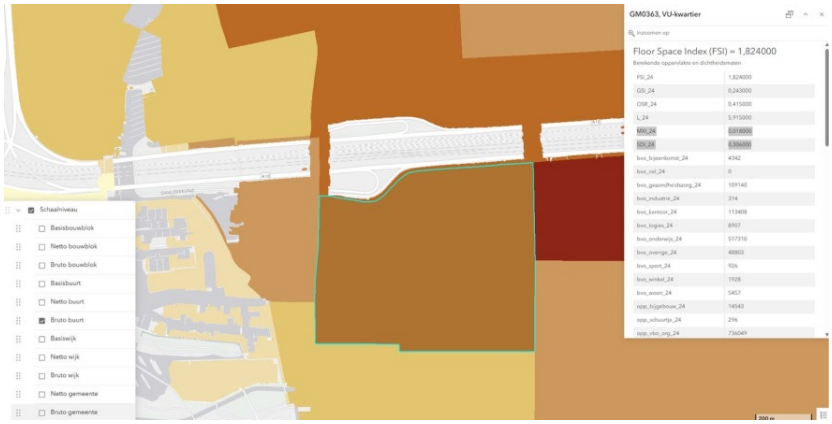
Strijp-S (Harbers et al., 2025)

VU-kwartier (Harbers et al., 2025)

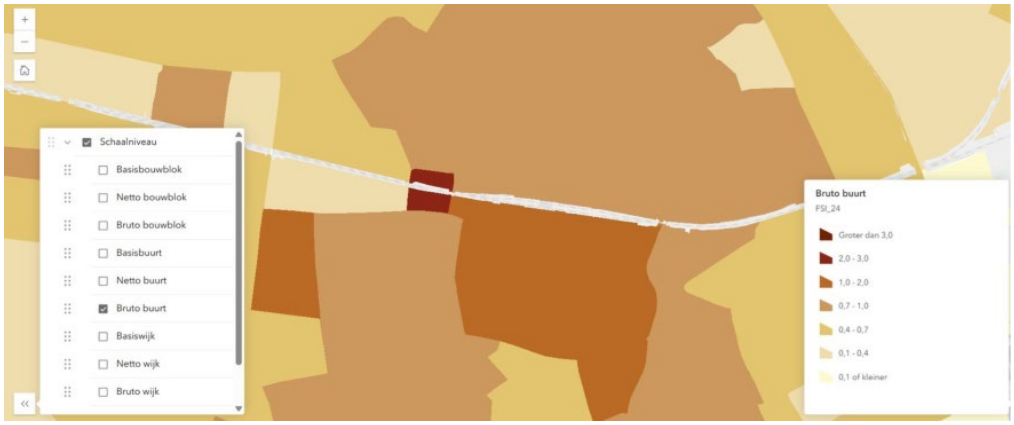


Spoorzone (Harbers et al., 2025)

Strijp-S (Harbers et al., 2025)



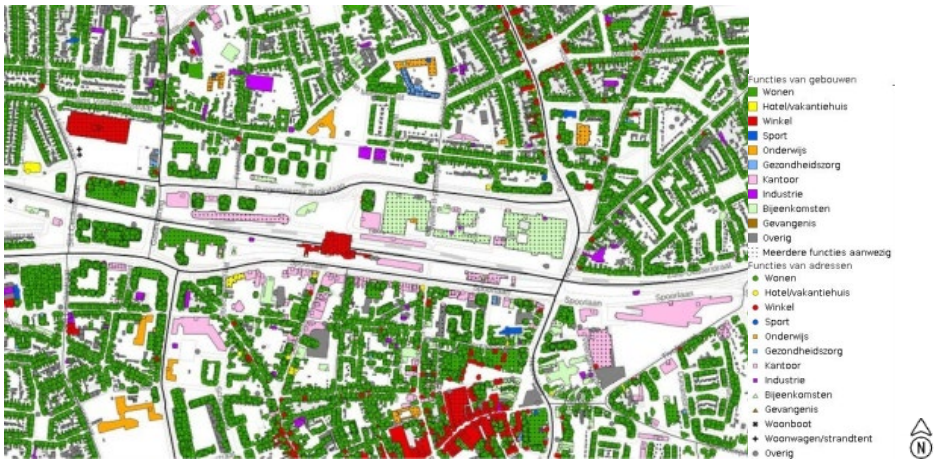
VU-kwartier (Harbers et al., 2025)



Spoorzone (Harbers et al., 2025)

Strijp-S (Rijksinstituut voor Volksgezondheid en Milieu, 2026)

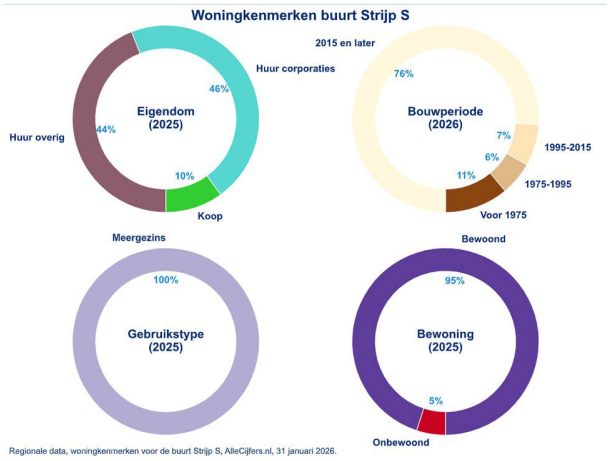
VU-kwartier (Rijksinstituut voor Volksgezondheid en Milieu, 2026)



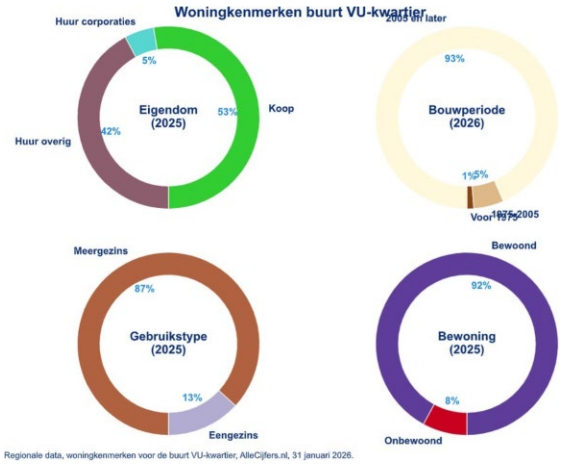
Spoorzone (Rijksinstituut voor Volksgezondheid en Milieu, 2026)

Property availability and value

Housing information and average WOZ-value



Strijp-S (AlleCijfers.nl, 2026b)

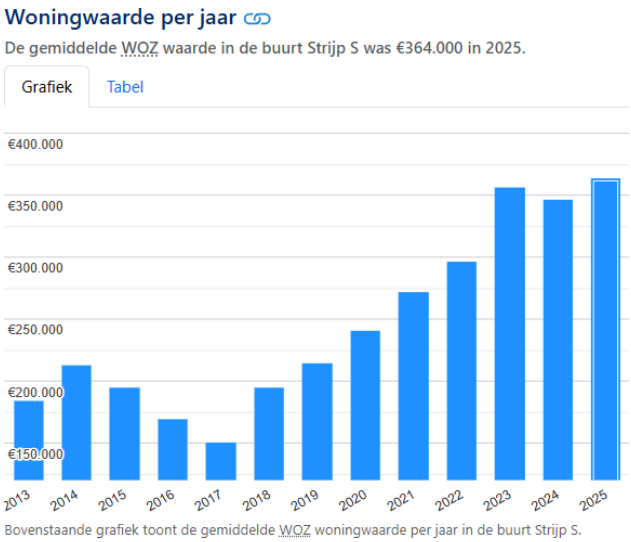


VU-kwartier (AlleCijfers.nl, 2026c)

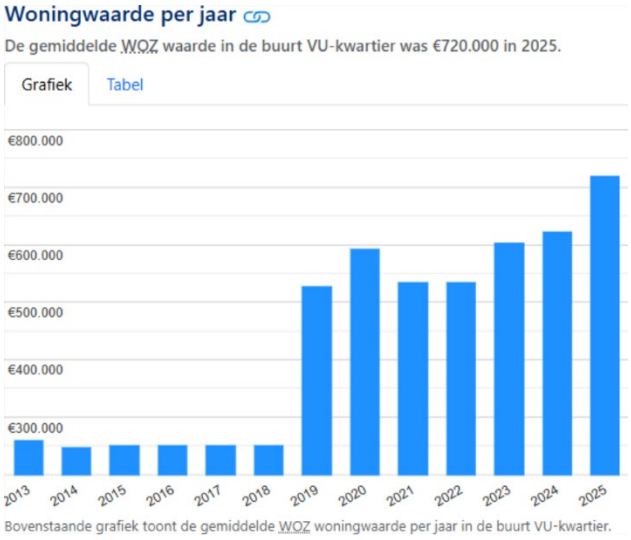
Spoorzone (AlleCijfers.nl, 2026a)

Segment	Nieuw (prijspeil 2025)	Oud (prijspeil 2025; Deltaplan)
Sociale huur	Laag: 683 euro/ maand Hoog: 900 euro/ maand	Laag: 683 euro/ maand Hoog: 900 euro/ maand
Middenhuur	1.185 euro/maand (Nieuwbouw: +10% tot 2028)	Laag: 1.070 euro/ maand Hoog: 1.259 euro/ maand
Betaalbare koop	Laag: 328.000 euro Hoog: 405.000 euro	Laag: 283.000 euro Hoog: 328.000 euro

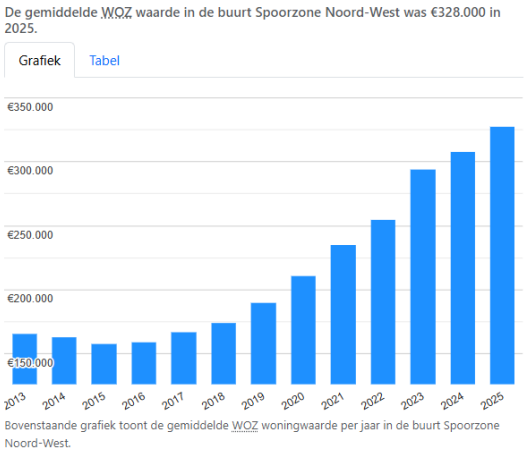
(Gemeente Amersfoort, 2026)

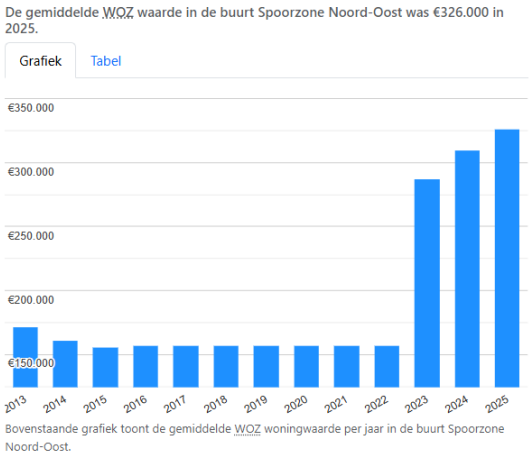


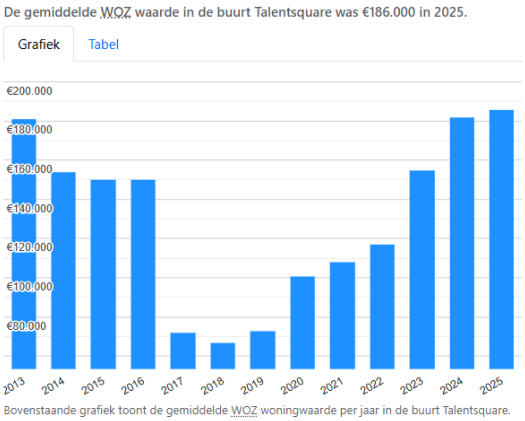
Strijp-S (AlleCijfers.nl, 2026b)

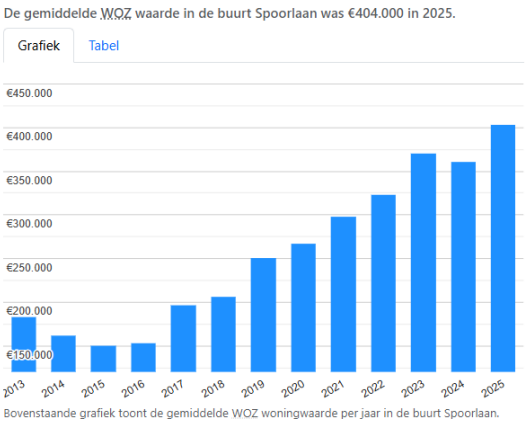


VU-kwartier (AlleCijfers.nl, 2026c)

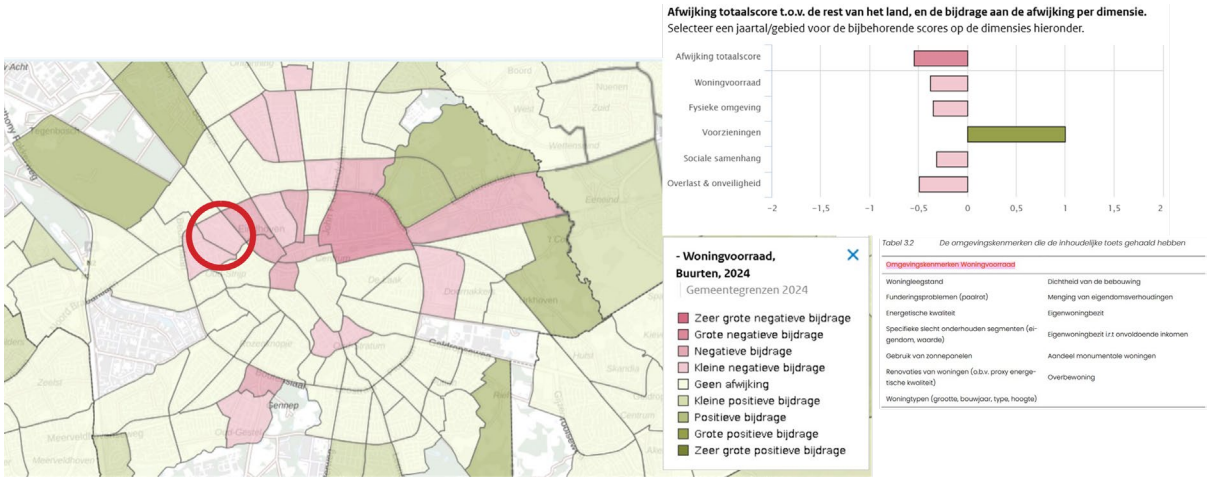




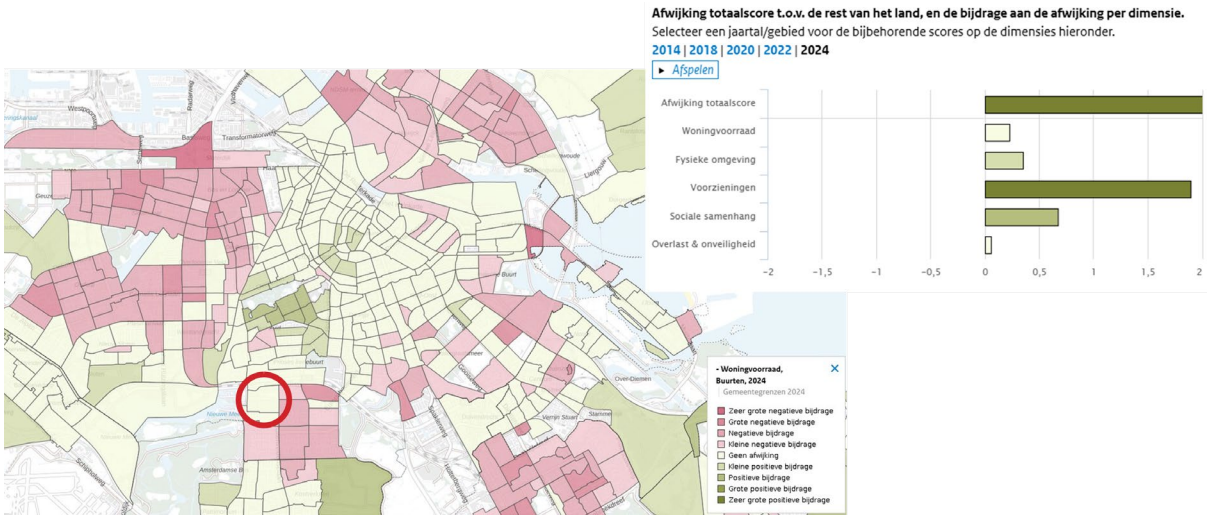




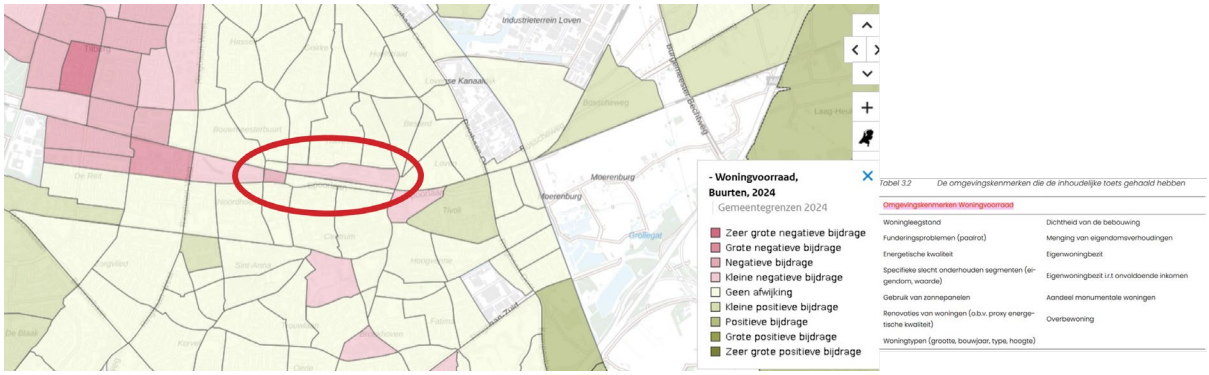
Spoorzone (AlleCijfers.nl, 2026a)



Strijp-S - (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2024)

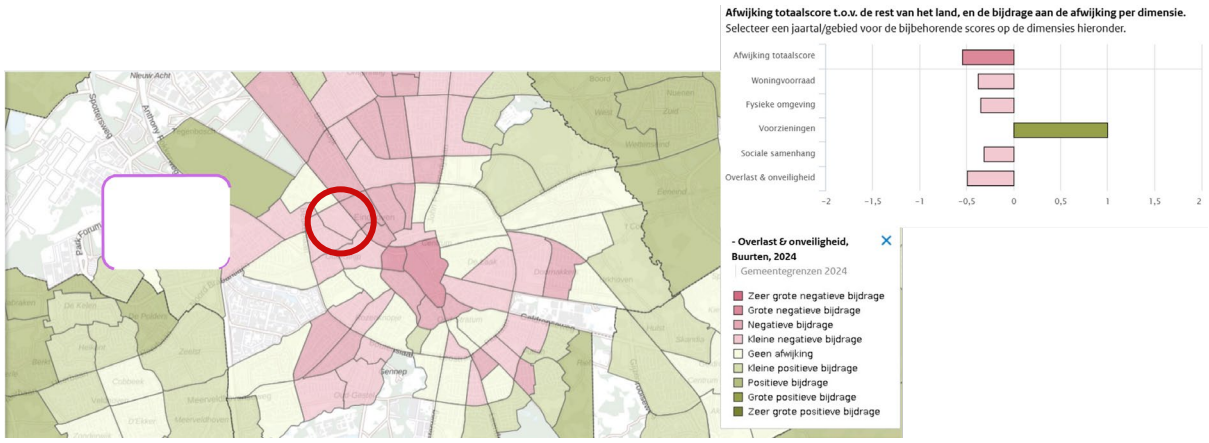


VU-kwartier (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2024)

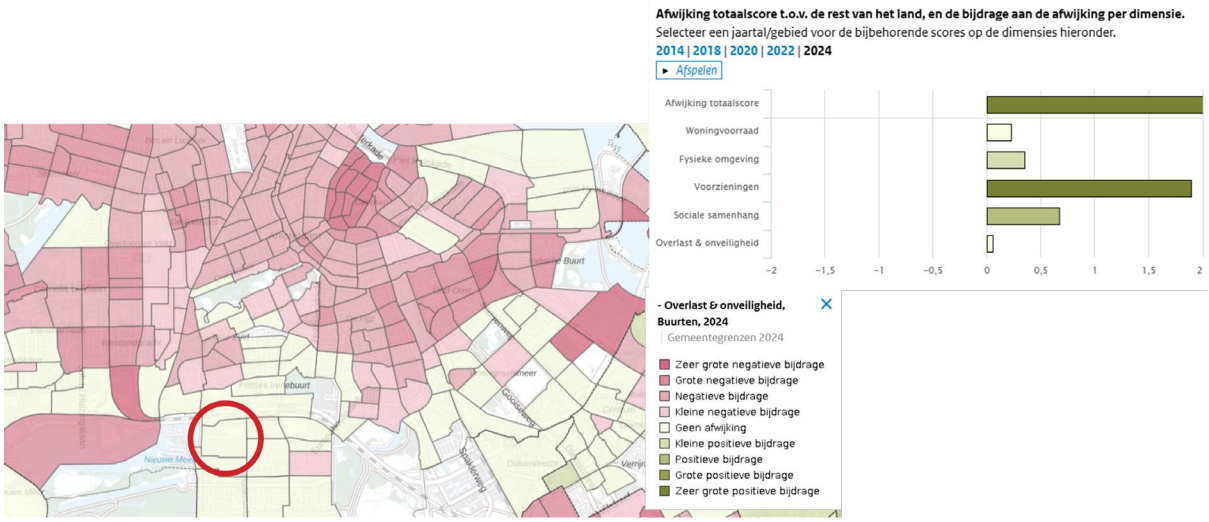


Spoorzone (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2024)

Objective safety and security



Strijp-S (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2024a)



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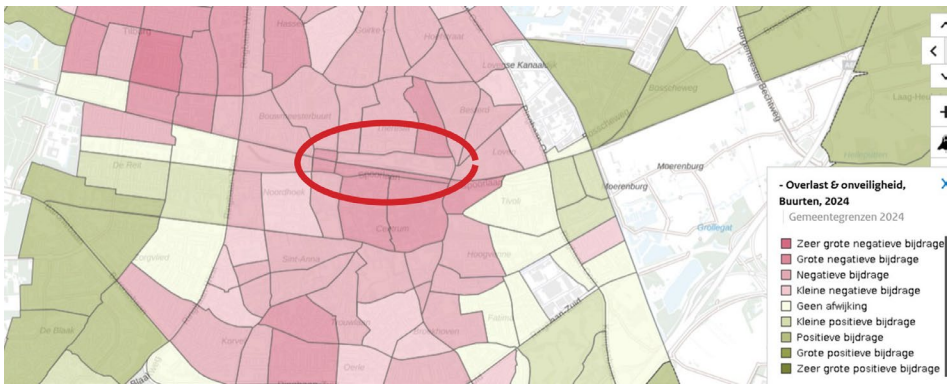

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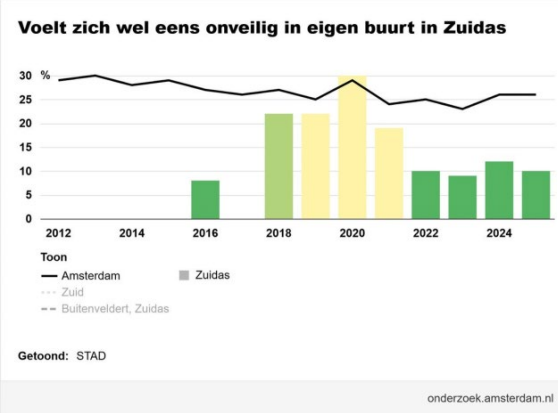

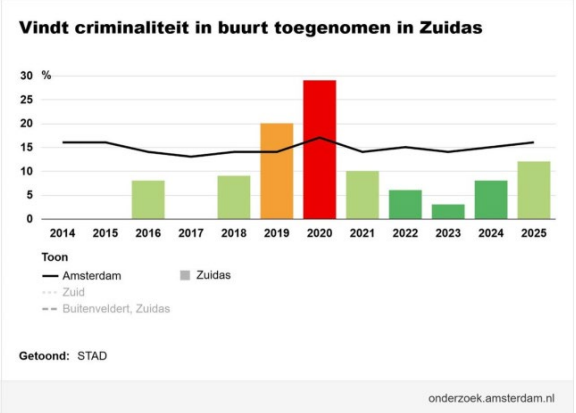

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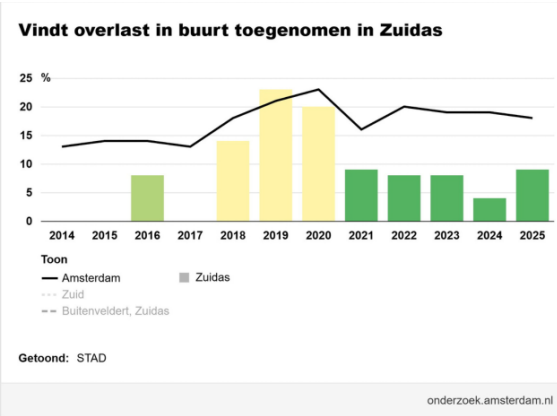

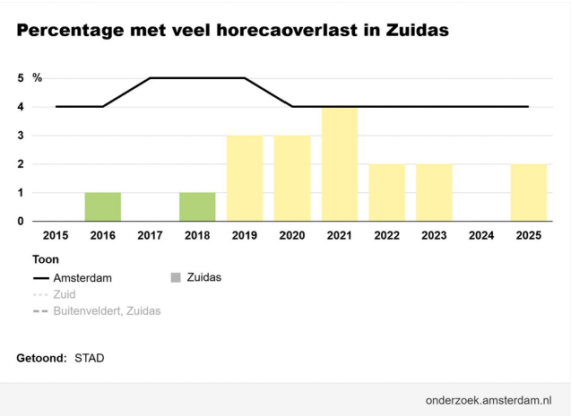

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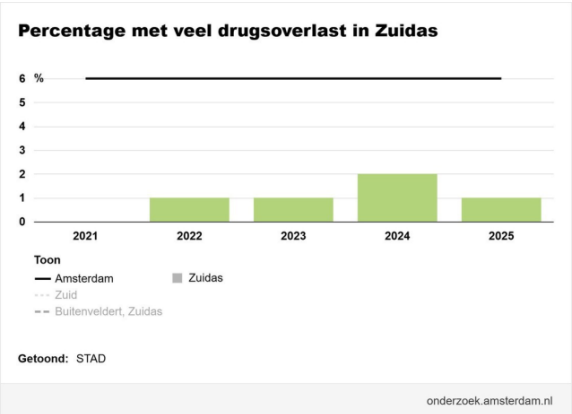

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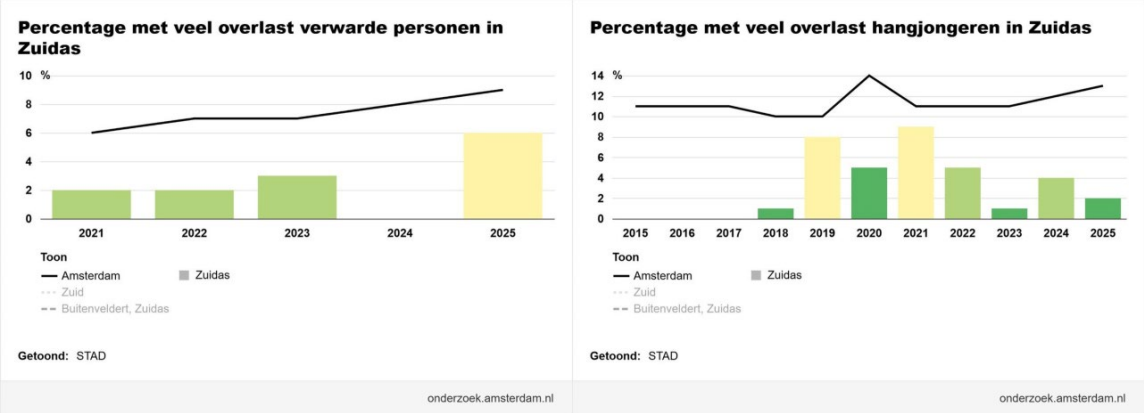

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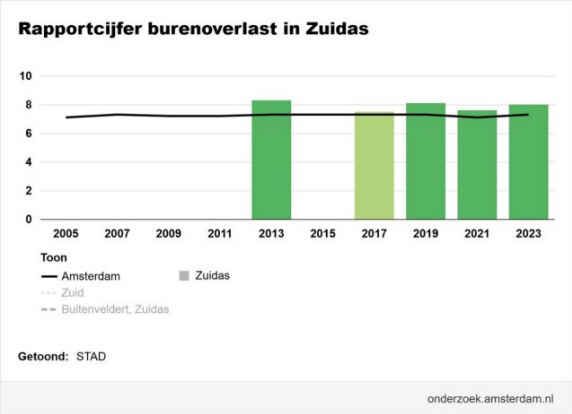

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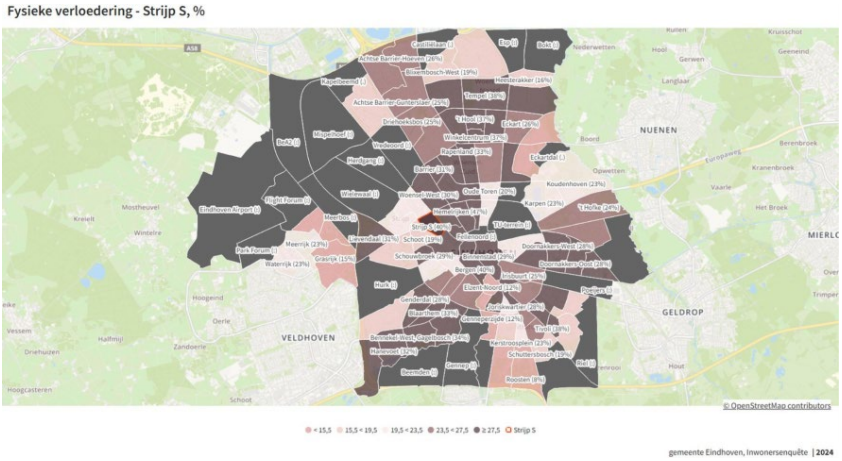

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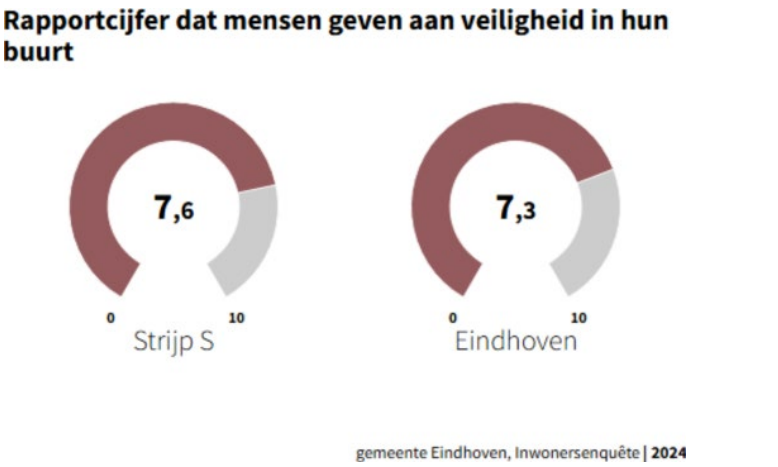

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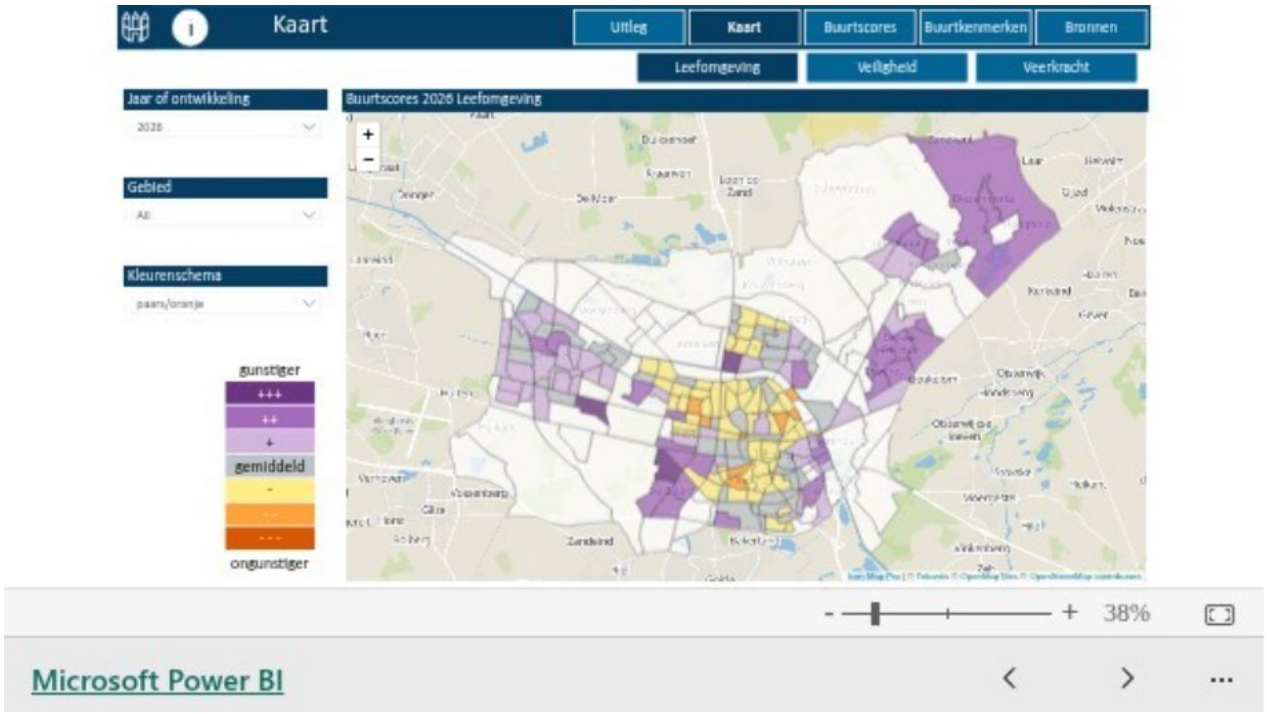
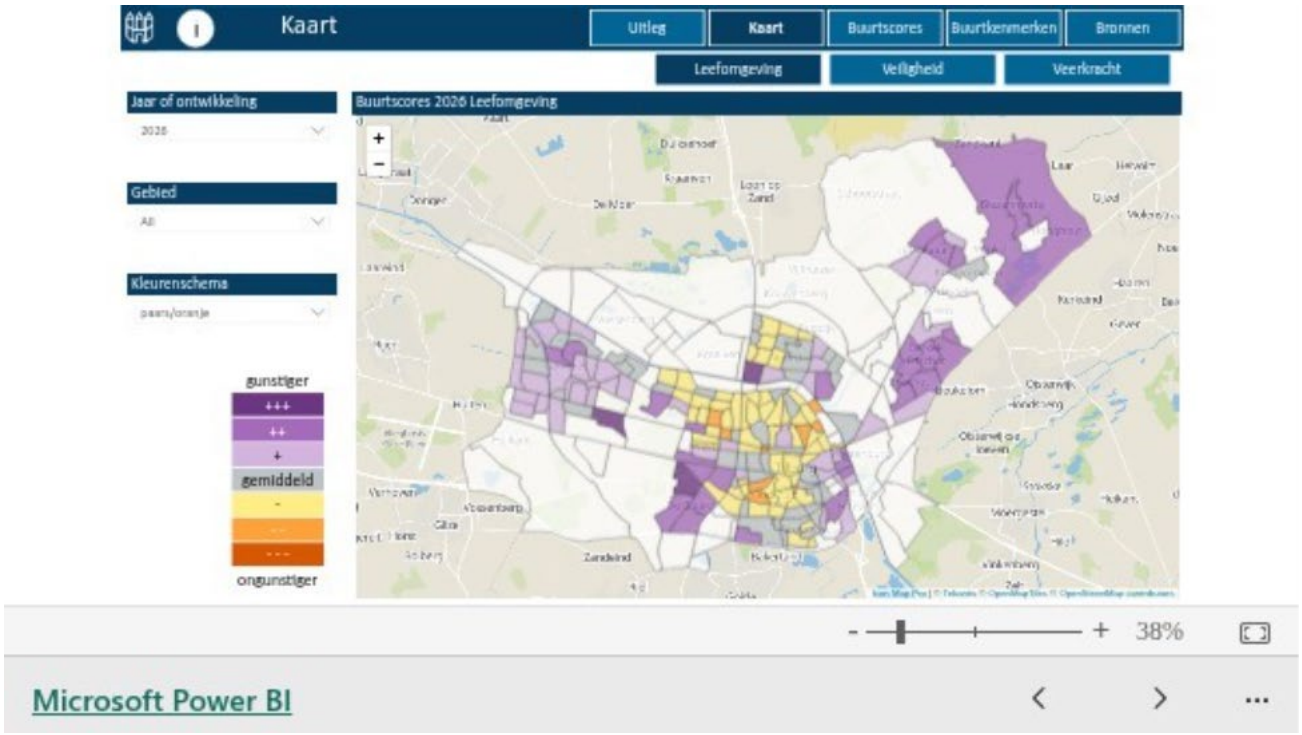


Spoorzone (additional maps and data from: Gemeente Tilburg (2026))

Place attachment



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Appendix 2 – Data management

Plan Overview

A Data Management Plan created using DMPonline

Title: MSc Graduation

Creator: Lotte van der Horst

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

Project abstract:

This research evaluates the role of spatial quality in the development of Dutch urban areas into successful mixed-use innovation districts. While innovation districts represent a promising urban development model combining research, business, housing, and services, their implementation faces significant challenges including governance fragmentation, displacement risks, and the prioritization of economic over spatial integration. Drawing on literature analysis, a Dutch case selection, site visits, spatial analysis, innovation capacity analysis and comparative case studies, this research identifies the spatial quality of three Dutch innovation districts and evaluates the influence on the level of success. The study addresses a critical knowledge gap regarding how spatial quality influences innovation districts success, moving beyond conventional approaches that overlook the essential interplay between form and function. By synthesizing theoretical frameworks and empirical observations, this research develops recommendation grounded in management and planning perspectives, offering municipalities and developers evidence-based essential and identity-specific spatial elements for guiding the future development of innovation districts. Ultimately, the research aims to support more successful innovation district development practices.

ID: 205711

Start date: 09-02-2026

End date: 25-06-2026

Last modified: 03-06-2026

MSc Graduation report– Lotte van der Horst

0. Administrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

The data management plan has been shared with my thesis supervisors Karel Van den Berghe and Agnes van der Meij, and reviewed by them on 04-06-2026

2. Is TU Delft the lead institution for this project?

Yes, the only institution involved

I. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

Type of data/code	**File format(s)**	**How will data/code be collected/generated?** *For re-used data/code: what are the sources and terms of use?*	**Purpose of processing**	**Storage location**	**Who will have access to the data/code?**
Firm-level employment data	.csv, .xlsx	Re-used data from the LISA database (1996–2024), received by submitting an application via DANS	To identify innovative companies, jobs, start-ups, and scale-ups to determine innovation capacity	TU Delft OneDrive	Lotte van der Horst
Geospatial data	public	Public and open data from among others Atlas Leefomgeving, PDOK, PBL Kaarten, Buurtatlas and Open Street Map	To analyze quantitative spatial quality of three selected cases	x	Public
Other open data	.csv, .xlsx (Public)	Public and open data from municipality websites, CBS, BBGA	To analyze quantitative spatial quality of three selected cases	TU Delft OneDrive	Public

Photographs	.jpeg	Spatial photographs were made during site visits of the cases, no human-participants were included	To analyze qualitative spatial quality of three cases	TU Delft OneDrive	Lotte van der Horst
Research Report	.docx / .pdf	The research report is an academical representation of the research including problem statement, theoretical framework, methodological framework, results, discussion, conclusion, recommendations and limitations	To answer the main research question, and to provide proper research documentation	TU Delft OneDrive, TU Delft Data Repository	Public

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- < 250 GB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- Another storage system – please explain below, including provided security measures
- TU Delft OneDrive

Non-personal and non-confidential data was stored on personal OneDrive

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Procedure – A description of data processing procedure(s) (such as laboratory setup, simulation workflows).
- Data – Methodology of data collection

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

- No

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

Yes, confidential data received from commercial, or other external partners

Stichting LISA. (2024). *LISA Dutch Company Data* [Data set]. DANS Data Station Social Sciences and Humanities. https://doi.org/10.17026/SS/AQNXQ9

10. How will ownership of the data and intellectual property rights to the data be managed?

Data will be stored on TU Delft OneDrive of Lotte van der Horst (researcher). Only the researcher has access to this OneDrive, and thus the data.

V. Data sharing and long term preservation

26. What data/code will be publicly shared?

- Not all data/code can be publicly shared – please explain below which data/code and the reason why public sharing is not possible

The raw LISA data is not publicly available and needs to be requested separately, and therefore cannot be published publicly. All other data is shared through the research report and can be accessed publicly online.

28. How will you share your research data/code?

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the TU Delft Repository

30. How much of your data/code will be shared in a research data repository?

- < 100 GB

31. When will the data/code be shared?

- At the end of the research project

32. Under what licence(s) will the data/code be released?

- Other – please explain below

Not applicable

VI. Data management responsibilities and resources

33. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?

Supervisor Karel Van den Berghe, Assistant Professor of Spatial Planning and Urban Development,

34. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

No dedicated resources needed. The research report will be uploaded in the TU Delft repository.

35. Which faculty do you belong to?

- Faculty of Architecture and the Built Environment (ABE)

Appendix 3 – AI statement

This thesis was supported by the use of AI tools for tasks such as improving grammar and wording, clarifying academic phrasing, and brainstorming. AI was also used to for troubleshooting small analytical steps (e.g., Excel formulas). All AI-generated suggestions were carefully read, evaluated, and adapted by the author. The final interpretations, arguments, and conclusions presented in this thesis are entirely the responsibility of the researcher.