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The Design of Workscapes: A Scoping Study

Rosa de Wolf [1,*], Rob Roggema [2], Steffen Nijhuis [1] and Nico Tillie [1]

[1] Department of Urbanism, Delft University of Technology, Julianalaan 134, 2628BL Delft, The Netherlands; s.nijhuis@tudelft.nl (S.N.); n.m.j.d.tillie@tudelft.nl (N.T.)
[2] Tecnológico de Monterrey, School of Architecture, Art and Design, Campus Monterrey, Monterrey 64700, Mexico; rob.roggema@tec.mx
* Correspondence: r.dewolf@tudelft.nl

Abstract: Population growth and urbanization are straining the limited space in the built environment. The business districts take up a great portion of this built space. These districts face climate change hazards and spatial emptiness due to their profit-driven foundation. Sustainable ambitions and strategic locations offer the potential to rethink business districts and integrate them into the living environment. Understanding business districts as potential workscapes, more socio-ecological inclusive business districts, is a new perspective. This research formulates a method to define the spatial quality of business districts through literature review and spatial analysis. A spatial analysis of forty cases in the Netherlands presents a higher spatial quality on more diverse landscapes. This indicates that diversification of the business districts' landscape from monotone to multitone is needed to enable workscape development. Landscape-driven urbanism is needed to generate this desired level of quality. The research highlights the strategic location of edge-city business districts, situated between urban and rural areas, showing the potential to strengthen the urban-rural relationship. Further research on and by design is needed to enable workscape development.

Keywords: business districts; spatial quality; workscapes; landscape-driven urbanism; multitone; edge-city districts

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1. Introduction

Rapid population growth and urbanization are intensifying spatial pressures in cities worldwide, demanding innovative approaches to land use and urban development. Also in the Netherlands, this space is already limited. The Dutch population is prognosed to grow from 18.0 million today [1] to 18.9 million in 2035, with the growth mainly occurring in medium to large municipalities [2]. With this population growth, the Netherlands is not only in need of more housing but also in need of more space to live, while the total area of the country does not increase. This asks for an integrated use of space in its built environment. The Dutch business districts cover approx. 20% of the Dutch built environment. These business districts have always been developed from a sole economic perspective. Understanding these business districts as potential workscapes, e.g., socio-ecological inclusive business districts, is a unique perspective that adds to the existing knowledge on these specific urban landscapes.

1.1. Introduction Dutch Urban Concept of Business Districts

The Dutch business districts show serious vulnerability due to the economic-driven development process. With their focus on minimizing land preparation costs, municipalities play a crucial yet often commercially driven role in the development of business

districts. Rather than prioritizing the quality of their built environment, local governments primarily act as economic stakeholders [3] (p. 36). These efforts by the municipalities result in monofunctional business districts. Dutch governmental subsidies, such as the Topperregeling from the Ministry of Economic Affairs, reinforced the monofunctionality of business districts. This funding is exclusively allocated to improving existing business districts under the condition that they retain their designated function. Therefore, these subsidies limit opportunities for mixed-use development [4]. Municipalities offered low land prices while continuously developing new business districts. As a result, businesses operating in physically outdated districts often found relocating to be a more efficient option than upgrading their existing properties [3,5].

It is already widely acknowledged that Dutch business districts are perceived as unattractive and space-consuming [3,4,6]. However, the business districts play a crucial role in the national economy and people's lives, as they contribute up to 40% of the Dutch national income, and one in three people work there [7]. Mixed districts often receive more positive evaluations of quality of life compared to monofunctional districts [4,8]. Policymakers and developers, however, often avoid mixing due to the perceived lower market value for housing next to businesses, whilst proper design can mitigate these issues [4]. The VROMraad [9] and Taskforce (her)ontwikkeling bedrijventerreinen [10] played a pioneering role in advocating for transformative spatial strategies regarding business districts. They recognized the urgency of integrating business districts into the living environment. Mixing economic functions with housing in current business districts is becoming more feasible due to the changing economy, shifting from industry to services. However, such a mix puts pressure on the traditional industrial business districts [3,4]. Even with the current circularity and sustainability ambitions and trends, society continues to need the nuisance businesses that are located in these districts. Though such businesses do bring along externalities, for instance, making activities may bring noise, dust, vibrations, and smells [11].

Also, investing in spatial quality can have an adverse effect and negatively impact potential transformations due to increased (land) value [3]. Mixed residential areas often have higher land prices than business districts. Some segments of businesses prefer cheap land and less limiting legislation, resulting in the ability to easily expand their business. However, not every business segment has similar demands; labor-intensive and representative-oriented businesses prefer proximity to amenities and a good atmosphere, which is crucial to the work environment and company image [4].

1.2. Potential of Dutch Business Districts

Working conditions and terms become increasingly important in the current battle for talent [12,13]. This change in the economic structure gives rise to new concepts and types of work locations. Van Dinteren [14] presents the trend of increasing importance of the quality of the working environment, next to salary and career opportunities. This 'Enjoy Work' approach, corresponding with Chiswick Park business district's slogan, aims to enhance sustainability, provide inspiration, and offer recreational opportunities for employees. This attractive working environment attracts and retains employees. It features a mix of green spaces, areas for social interaction, sports, recreation, and various amenities and requires an integral approach for rethinking business districts with landscaping, architecture, and functional aspects.

Googleplex is another early example of this, based in California. The architect stressed that variety creates places to congregate, and casual interaction fosters teamwork and creativity. The company is spread over several smaller building blocks and 'lives seemingly in symbiosis with its environment' [15] (p. 120). This environment includes various urban

amenities one could also find in one's own living environment, such as sports facilities, the hospitality industry, leisure, and personal care. Boelhouwer and Remøy [16] endorse the importance of the work environment in the current tight labor market. Employers must attract employees not only by offering them a good salary but also with good secondary employment conditions. The work environment plays an increasingly important role in this. 'Employees prefer to work in an urban area with many facilities over a monotonous business district. There must be something to experience in the working environment. Soft factors such as representativeness, appearance, and atmosphere have become just as important as the hard factors of accessibility and working environment'. [16] (p. 15) [translated]. However, van 't Hoff and Wall [17] (pp. 286–287) argue in their spatial-economic analysis that esthetic elements like green areas, water bodies, public spaces, and waterfronts do not significantly impact the investment in business districts. They suggest that international firms tend to prefer locations with a more urban presence.

Repurposing the vacant buildings that lost their function, buildings left by relocated companies, into housing with other functions might be a solution. With the current housing demand, this also meets a major societal need [18,19]. The location of the real estate, however, is crucial in this; properties in city centers, residential areas, or their peripheries are typically suitable for conversion into housing. However, many vacant buildings, particularly offices, logistics, and industrial properties, are situated in business districts that are not located near urban centers or desirable residential locations. Nevertheless, with an integrated urban development plan, a viable alternative to further urban expansion could be created by transforming existing real estate in these business districts [16]. The maps in Appendix A show the Dutch business districts' proximity to population centers and a high percentage of obsolescence. However, these districts do not meet the conditions to create an attractive living environment yet: their spatial conditions are far from future-proof.

The efforts to improve the business districts are increasing, including the restructuring of older districts. The Dutch National Growth Fund, a fund that invests in projects with the highest potential for structural and durable economic growth, funded the Workscapes of the Future [translated, Werklandschappen van de Toekomst] program [7]. Business districts contribute a lot to the country's GDP and the quality, or lack thereof, of people's lives. This national program aims to transform the country's approximately 3800 business districts into future-proof urban environments that are multifunctional, healthy, climate-adaptive, nature-inclusive, and energy-efficient. The program seeks to shift from mere business districts to vibrant "work landscapes", or workscapes, landscapes wherein living, working, recreation, and nature are combined. These transformed areas will be more resilient to water-related challenges, such as flooding and drought, bend the current trend of degradation of biodiversity, and enhance employee happiness, productivity, and health. Hence, it aims to create a vivid contrast to the once-gray and paved business district environments [7].

1.3. Workscape as a Challenge

The historical analysis by Louw, Needham, Holden and Pen [20] shows that throughout time, businesses have been pushed out of Dutch cities. Furthermore, the shift in the Dutch economy, from manufacturing to service-oriented, changed their functional composition. According to Ecorys [21], five transitions will affect the future of our business districts: biodiversity, energy transition, climate adaptivity, spatial quality and the circular economy. Stec Groep [22] defined several megatrends that affect the business districts as they play a role in the choice of location and development of business districts: circular economy, smart industry, robotization, open innovation and smart logistics.

Business districts can be found at the edge of the city. They form the gray, underused barrier between the urban and the rural. Especially these districts have a great potential to become part of a regenerated living environment so as to strengthen the urban–rural connections. When the climate adaptiveness of the business landscape is enhanced by (re-)generating green–blue public spaces, humans and non-humans can co-exist, meet, and recreate in more attractive business districts.

1.4. Categorization of Business Districts

There are different types of business districts, ranging from traditional industrial districts to more service-oriented ones. The existing categorizations and typologies of business districts [7,23–26] are explored to understand the diversity amongst them.

The Dutch IBIS data [23] for instance, describes four types: seaport districts, business districts, economic zones focusing on retail, education, health, agribusiness and aviation, and office locations. The latter not being considered as business districts. This classification by IBIS [23] is very much oriented towards uses and economics. Hall's [24] categorization is more focused on the context of business districts, such as traditional downtown centers or outermost edge cities at major train stations. This focus on the context of the districts aligns with several other arising types of districts. Katz and Wagner [25] describe the re-imagining of former underutilized, car-oriented, isolated (industrial) districts with a lack of integrated housing, recreation, and quality of life. This transformation can lead to innovation districts: amenity-rich enclaves that are more vibrant living and work environments and are explicitly located in proximity to the city centers. Important factors are the presence of innovative firms with talented employees that co-locate in compact, mixed-use business districts that are walkable, bikeable and transit accessible. Pratt [26] emphasizes that even in this digital age, geographical location and physical proximity remain crucial and that social interaction and co-location are important to industries that rely heavily on creativity, innovation and problem-solving. The ability to interact face-to-face is a significant factor in the success of these industries. With the concept of untraded dependencies, the informal non-contractual relationships and interactions are highlighted as vital for the economy. Within the Dutch national Workscapes of the Future program [7] (pp. 125–129), Stec Groep described five segments of business districts. These being campus/innovation, mixed urban, regular, large-scale urban and large-scale functional districts. The categorization as described by Stec Groep is focused on the business activities, environmental zone, and context. When business activities change, the environmental zone can change along with them. The context is the most long-term factor.

1.5. Research Significance and Objective

Business districts are often regarded as unattractive and inefficient in their use of space, whilst current major challenges demand a more sustainable approach. Their spatial quality significantly influences a diverse range of users, encompassing both humans and non-humans, as well as residents and businesses. The urban and environmental context of these districts plays a pivotal role in determining their usability. However, contemporary socio-economic transformations have introduced new demands for working environments, with economics continuing to dominate developmental priorities. Addressing these challenges requires a shift towards a more spatially integral perspective.

Adopting a spatial perspective enables the landscape to serve as an integrative framework, fostering sustainable and inspiring environments. Rethinking the design of business districts offers an opportunity to harmonize their integration within living environments, which could benefit all users. These reimagined workscapes would fulfill broader societal

functions, including functional diversity and vibrant public spaces, while maintaining economic viability.

Achieving this requires a foundational understanding of the landscape and its inherent spatial quality. Currently, there is a lack of comprehensive and universal methodologies to evaluate the spatial characteristics of business districts and understand these districts as potential workscapes.

The objective of this research is threefold as follows:

1. Establishing a framework for defining the spatial quality of business districts. By creating this framework, outcomes can be consistently compared across various future studies and projects.
2. Understanding business districts as potential workscapes by defining the current spatial quality, common challenges, and potential.
3. Supporting workscape development with a first set of action perspectives based on the common spatial quality.

2. Materials and Methods

2.1. The Need for a Spatial Perspective

The transition of business districts into workscapes is predominantly driven by economic considerations, reflecting the motivations behind their initial development and design. Qualitatively, this does little to facilitate their transformation. This is supported by a program focused on fostering economic growth. Nijhuis [27] (p. 18) underscores the importance of the landscape as a pivotal element in addressing multifaceted challenges. According to Nijhuis, the landscape serves as an integrative framework, combining diverse aspects such as energy, nature, climate adaptiveness, social dimensions, and economics into the physical environment. Consequently, there is a need for a spatial perspective that transcends mere esthetics and architecture to comprehensively approach the evolution of business districts. This landscape serves as an integrative foundation, effectively addressing multisectoral challenges by uniting them.

The transition to workscapes necessitates reimagining business districts through a spatial lens. This involves evaluating dimensions of spatial quality and quality of the living environment, ultimately employing a set of indicators to operationalize spatial quality within these districts. A categorization of business districts from this perspective is formulated. This allows an analysis of the spatial quality of a diverse set of Dutch business districts to validate the proposed universal analytic framework.

2.1.1. Quality of the Living Environmental and Spatial Quality

Integrating business districts into the living environment implies more than adding residential functions to these districts. It requires a livable landscape to work, live, and recreate in that meets certain environmental and spatial qualities. It suggests enhancing these qualities, as the districts do not meet the desired quality of a living environment yet. As presented in the literature [3,4,6], the spatial quality of Dutch business districts is generally perceived as low. However, measuring spatial quality is challenging. It involves subjective assessments besides objective ones. Especially in business districts, the perception of quality varies among stakeholders such as business owners, municipalities, and neighboring residents. Moreover, the dynamic nature of spatial environments as well as these different perceptions influences the quality of data to define the spatial quality [28]. Defining the spatial quality of business districts is needed to understand them as potential workscapes. However, this is complex, as it is difficult to capture in one single measure. Hooimeijer, Kroon and Luttik [29] highlight in their analytical framework (Table 1) that spatial quality encompasses economic, social, ecological and cultural dimensions. Per

dimension in their analytic framework, indicators of spatial quality are presented that correspond to three main values: utility value, experience value, and future value.

Table 1. Analytic framework to measure spatial quality by Hooimeijer, Kroon and Luttik [29] (p. 82, translated).

	Economic	**Social**	**Ecologic**	**Cultural**
Utility value	Allocation efficiency Accessibility External effects Multipurpose	Access Distribution Participation Choice	Safety, nuisance Pollution Desiccation Fragmentation	Freedom of choice Diversity Encounter
Experience value	Image Attractiveness	Inequality Connectedness Safety	Space, Peace Beauty Health	Uniqueness Beauty Contrast
Future value	Stability/Flexibility Agglomeration Cumulative attraction	Inclusion Cultures of poverty	Resources Ecosystems	Heritage Integration Renewal

Besides the required spatial quality, integrating business districts into the living environment also requires a certain quality of the specific living environment. Jacobs' [30] analytical framework (Table 2) distinguishes the quality of the living environment into four levels: biological, social, phycological and metaphysical, that correspond to human needs. The levels interact; change on one level always generates change on another level. Ecology and environmental aspects are more objective and measurable, whilst the social level is more intersubjective, and the psychological level is more subjective. The environment is divided into three aspects: coherence, variation, and sustainability.

Table 2. Quality of the living environment by Jacobs [30] (p. 41, translated).

	Biological	**Social**	**Psychological**	**Metaphysical**
Coherence	Coherence as a condition for stability of spatial components, coherence that makes a collection of elements into an entity = coherence of ecotope, hydrological unity, habitat, geological unity, metapopulation, soil unity.	Coherence as the whole of functional relationships between spatial units, coherence as spatial organization (ordering patterns structure) of the landscape = coherence of logistical functioning and parcelization occupation patterns, etc.	Coherence as comprehensibility and information value related: clarity [31] coherence [32] = coherence of origin, functioning, structure, construction [33].	Coherence as harmony, coherence between previous coherences, that makes the area into a unity, into a 'world of its own' = coherence as integration of spatial units, functional relationships and ordering, comprehensibility and information value into a harmonious whole.
Variation	Diversity of species, variation in environments = variation as biodiversity, variation in environmental types, geomorphological variation.	Variation in land use and variation in approaches to landscape management and functioning = variation in functionality, spatial patterns, rules for different areas.	Variation as a spectrum of choices for individuals, variation in shapes, textures, colors, smells, etc.; variation in behavioral possibilities for meaning-making (degree of unprogrammedness, absence of socially constructed experiences), shapes, processes, colors, etc.	Variation in 'worlds' (with their own forms, processes and laws; thus, variation in value systems), variation in unusual characteristics, variation in symbiological references variation as representation of different eras, presence of different worlds, presence of multiple unknowable values.

Table 2. *Cont.*

	Biological	Social	Psychological	Metaphysical
Sustainability	Sustainability as the continued existence of the carrying capacity of the environment and the continued existence of biological life = maintenance of (dynamic) input/output balance [34], nutrient balances [35], stable biosphere, parameters of undisturbed areas, clean environment [36], healthy nutrition [36].	Sustainability as the continuation of habits and the continuation of functioning = maintenance of (rational) efficiency, profitability, social support and acceptance, employment.	Sustainability as the continued existence of opportunities for personality development and personal associations = maintenance of emotional ties with landscape and species, recreational opportunities, places with personal associations.	Sustainability as the continued existence of characteristics that transcend the current (daily) = maintenance of cultural-historical values (past), symbols that refer to (cultural) worldview (transcending), symbols that refer to other regions (elsewhere), other worlds (for example, autonomous nature).

These frameworks are not yet operationalized for business districts. For this, specific indicators must emerge from research on the enhancement of the quality of business districts. This research is a move away from the sectorial approach that sees business districts as places detached from the living environment, built solely for economic purposes. It starts a transition from economy-focused business districts to landscape-based designing of workscapes. Within landscape-driven urbanism [37], the urban field should fit within the natural systems. This relates to the different levels within the quality of the living environment as described by Jacobs [30], wherein biological processes such as elevation, water and soil systems, and ecology precede the social, psychological, and metaphysical ones.

This landscape-driven design of workscapes corresponds to the layers approach by Sijmons [38]. In this approach, the subsurface precedes the network and occupation layer. It also relates to the SDGs wedding cake by the Stockholm Resilience Centre [39], which depicts the sustainable biosphere as the base for global sustainability. Following this chain of thought, the urban landscape design of the districts must be rethought to build sustainable, more productive, and socially and ecologically inclusive workscapes. For this, first, a method to understand business districts as potential workscapes is needed.

2.1.2. The Potential Spatial Indicators to Improve Spatial Quality on Business Districts

This research defines the indicators for spatial quality of business districts based on the literature [14,15,40–47].

Regarding the ecological dimension, several studies show that vegetation improves thermal comfort in business districts. Research by Balany, Muttil, Muthukumaran, Wong and Ng [40] presents the effect of blue–green infrastructure on microclimate and human comfort in Melbourne's central business district. Their research also shows that greening the public space in business districts can improve the thermal comfort of its users. This improvement is mostly ensured by trees and deep ponds. Their research showed little effect of the green building envelope on thermal comfort on the district level, whilst they do mention the importance of other ecosystem services. Wang and Zacharias [41] examined landscape modification for ambient environmental improvement in central business districts via a case in Beijing. They conclude that redesigning the ground-level space and allocating space for urban greening, trees and shrubs on underused road infrastructure provides a comfortable walking and living environment in the whole area.

The significance of integrating green and water aspects in the public space of business districts will become more important due to the rising temperatures and/or potential flood risk due to changing precipitation patterns and sea level rise, all resulting from climate change. When businesses prefer safer, more future-proof and comfortable locations over

others, municipalities that want to attract firms must reconsider green–blue space and the urban quality of the land that they are offering.

Konijnendijk [42] provides guidelines for creating greener, healthier, and more resilient neighborhoods with his 3-30-300 rule. When developing the business districts as an integral part of the living environment, this rule should also be applied to the business districts. Especially as the Workscapes of the Future program envisions workscapes as more resilient and vibrant spaces that integrate nature and human well-being in the work environment. Konijnendijk's rule includes three key elements. Firstly, there should be a visual connection with at least three trees from every home, school, or workplace. This promotes well-being and enhances the urban environment. Secondly, at least 30% of the neighborhood should be covered by tree canopy, as trees provide shade, improve air quality, and support biodiversity. Lastly, public green spaces should always be accessible within a 300 m radius that users can enjoy. These criteria aim to create equitable access to nature and enhance urban living.

The indicators for spatial quality depend on stakeholders' perspectives. For instance, for birds, the ecologic dimensions are important, whilst for businesses, the economic dimensions of spatial quality seem crucial. As mentioned in the analytic framework for spatial quality [29], spatial quality also covers economic dimensions. 'Firms look for the most convenient location for production and markets but also for business environments that enhance their global connectivity, company image, and interaction with other firms, van 't Hoff and Wall' [17] (p. 273). According to the research by van 't Hoff and Wall, spatial structure is essential to economic competitiveness. Important indicators they highlight in their spatial-economic research are parking, accessibility and proximity, functional composition, amenities, and urban and architectural character. These were also presented in the examples of Chiswick Park [14] and Googleplex [15].

Ram and Gerretsen [43] argue that the Netherlands has sufficient spatial resources; however, they can be utilized more to improve the country's economic competitiveness. They argue that this competitiveness can be improved via a spatial approach, the urban, mobility, and environmental characteristics, meanwhile also enhancing each other. These characteristics include improving the agglomeration position via aspects such as density, size, composition, and accessibility with excellent multimodal connections. Moreover, by improving the social dimension of quality of life by establishing a sustainable and attractive living environment by including recreation, culture, nature, the hospitality industry, and education in the environment. This opposes the strategy of municipalities to attract firms by offering low land prices, and thus low spatial quality, but it coincides with integrating business districts into the living environment.

Specifically for the older, post-industrial business districts that include industrial heritage, besides the economic, social, and ecological aspects, the cultural dimension should also be considered in any transformative process [44–46]. Gospodini [47] signifies important spatial aspects to enhance the identity of place and interaction amongst users, such as mixed-use, density, heritage, public space, and architecture.

Based on the literature [14,15,20,29,30,40–47], the analytical framework for the spatial quality of business districts (Table 3) is constructed.

Sustainable integral urban development of the business districts necessitates a multi-dimensional approach integrating environmental, urban, and accessibility pathways. From an environmental perspective, the emphasis lies on fostering a healthy landscape characterized by prioritizing values such as the caring capacity of the landscape and co-existence between species: humans and non-humans. Urban considerations prioritize creating an inspiring sociosphere through values like multipurpose, safety, and esthetically appealing spaces that encourage encounters and flexibility while maintaining architectural harmony

and heritage. The accessibility pathway focuses on the economic viability of the business districts. These values emphasize efficiency, inclusivity, and the coherent structuring of transport systems.

Collectively, these values can be operationalized by indicators such as the number of trees, functional composition, and modes of traffic. Improving on these indicators can form the foundation for sustainable urban landscapes.

2.1.3. Spatial Typology

When designing for the future of business districts, the upcoming trends and transitions must be considered. As the functional composition of business districts changes along with the economy and trends, an approach to rethinking business districts must not be solely linked to the functional composition and economic focus within that type as presented in the IBIS data [23]. To formulate action perspectives, the districts must be categorized based on long-term structures, as the literature [14,21,22] presented many upcoming trends and transitions. The spatial design must be flexible enough to adhere to these, to become resilient, and to prevent spatial emptiness. Important aspects of the categorizations in the literature [7,24–26] are the proximity of vibrant urban environments and accessibility. Looking at the Dutch business districts in the urban region and networks, a geographical categorization emerges. The inner city and edge-city districts benefit from the proximity of a vibrant urban environment and thus often have more multimodal accessibility and lower environmental classes. Locations along the water or the highway relate to dependencies of distinct modes of accessibility and the original functional composition, often allowing higher environmental classes. Following the layers approach by Sijmons [38], changes in the subsurface and network layers are more long-term than those in the occupation layer. Four types of business districts, linked to the long-term characteristics of the existing urban landscape, can be derived: inner-city, edge-city, waterway, and highway districts (Table 4).

2.2. Methods

The 3800 business districts in the Netherlands vary considerably. Therefore, a representative selection of 40 cases is made for the in-depth spatial analysis of the current status of Dutch business districts to validate the proposed analytic framework. For each of the types of business districts presented in Section 2.1.3, several cases are selected for the spatial analysis. Furthermore, the selection varies in environmental, urban, and accessibility characteristics such as elevation, landscape and soil types, environmental class, urban context, and public/private ratio. The selected business districts are spread over the full width of the Netherlands, from the North Sea to the German border. The districts differ regarding their position towards agglomerations and their relationship with nearby population centers, infrastructure, waterways and functions. The geographical scope is visualized in Figure 1 (enlarged in Appendix B, Figure A5), wherein the selected cases are highlighted. The overview of these forty cases can be found in Appendix C.

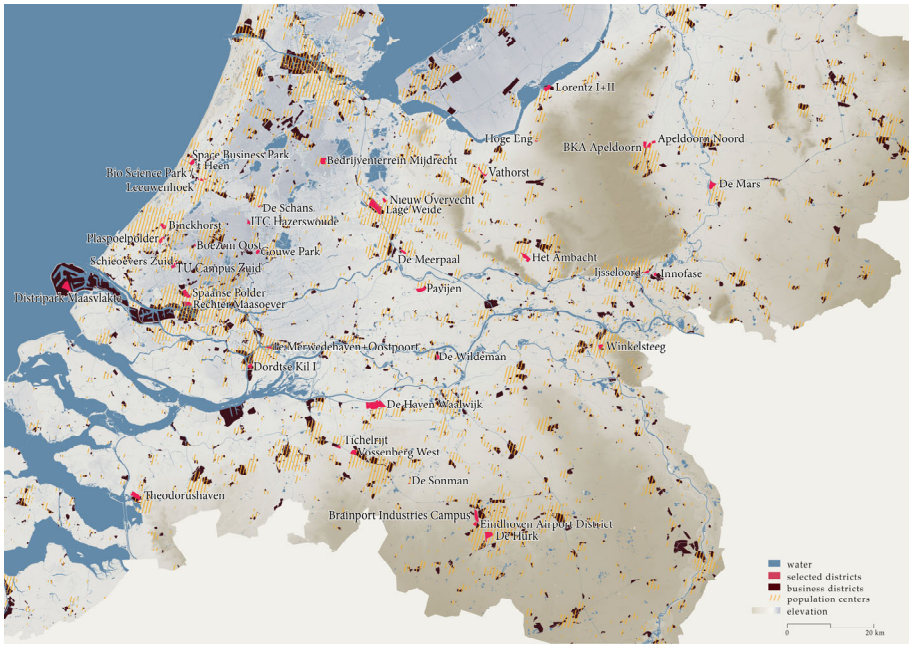


Figure 1. Geographical scope of the spatial analysis visualized in a map. Digital Terrain Model of the Netherlands with business districts and their urban context. The forty selected Dutch business districts are highlighted [48–51]. By the author, 2025. See enlarged in Appendix B, Figure A5. Software: QGIS (version 3.34.1).

The indicators on which these cases are assessed are presented in Section 2.1.2. After the selection of the cases, a spatial analysis in QGIS (version 3.34.1) is conducted to examine geographic data and uncover spatial patterns, relationships, and trends. After importing and cleaning the datasets, which are described in Section 2.3 and listed in the Reference List [48–66], the analysis is conducted. This results in visualizations in maps, charts, and sections as presented in Appendix D. For each indicator, measuring criteria are formulated (Appendix E). Radar charts are used to provide a holistic view of the spatial quality of each district by integrating the various indicators into a single visual representation. This helps in understanding the overall spatial performance of a district. Each axis represents a different spatial indicator, and the shape of the chart provides a visual summary of the data. This allows for easy comparisons between different districts by overlapping their charts. The shape and size of the radar chart highlight areas of strength and weakness; this can inform landscape-driven urban design and policy decisions. For example, a district with a more irregular shape has specific areas needing improvement. Each indicator has been assigned the same scoring span, 0–5. The maps, diagrams, sections, scoring, weighing, and explanatory texts can be found in Appendices B–E.

2.3. Data Sourcess and Processing Methods

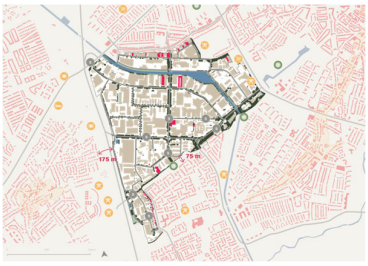
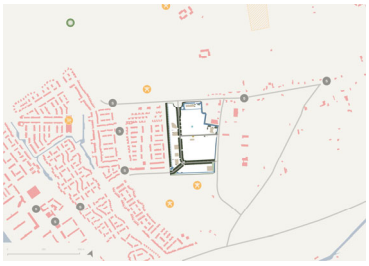
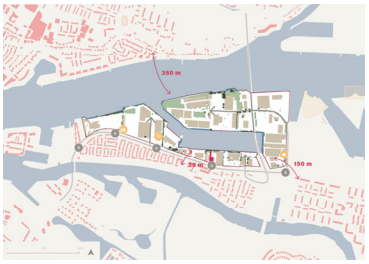
The analytical framework spatial quality of business districts, Table 3, is operationalized by gathering open access data for each indicator on all 40 different business districts. The overview of the data used can be found in the Reference list [48–66]. The IBIS data [48] is used to mark the selected districts in QGIS (version 3.34.1). In this dataset, districts that are built in several phases are provided with a different district code and contour. This spatial analysis merged these districts into one, such as Lorentz I and Lorentz II being merged into Lorentz I + II. This results in an overview of the size of the districts. The maps are standardized to a common scale to ensure comparability. In the landscape-driven transition aimed for, understanding the natural systems precedes urban developments. Therefore, the natural systems, such as elevation [49], water systems [50], soil types [52],

and landscape typology [53], are understood before assessing the spatial quality of the business districts. The elevation data are used, for each district, to define its position towards the NAP, general sea level in the North Sea. The open datasets of the Dutch government with actual geo-information are gathered on PDOK. Via the Dutch Registration of Addresses and Buildings [54], the business districts are analyzed on the construction year of their buildings, functional composition, and surface. Together with the total district's surface, this results in a GSI value per district. In Excel (version 16.96.1), treemap charts are made to depict the land use composition, functional composition, and composition of the construction years of their buildings in one clear visual overview. For the land use charts, surfaces classified as 'in transition, construction land, agricultural grassland' are removed from the charts as their surface is either already outdated or soon to be outdated. PDOK also provides information on the position of the districts towards large-scale agglomerations [55], population centers [51] and the presence of train tracks and train stops [56]. For public transport methods other than the train, there are many different providers differing per site. To gather information on the frequency and rapidness of public transport in the districts, Moovit [57] is consulted for all districts. Moovit combines crowdsourced and official public transit data. Information regarding the accessibility of the districts by car is gathered via Data Rijkswaterstaat [58]. The connection with larger green structures [50], wetlands [59], and Natura 2000 areas [60] are also analyzed using PDOK. Via the BGT download [61], the water bodies, shrub layer, green space, number of trees, presence of fast and slow traffic infrastructure as well as parking, street furniture, and type of public space are identified. The RIVM dataset [62] is used to generate an overview of the presence and heights of the trees, which includes all trees, not just the registered ones found in the BGT data. RCE data are used to analyze the presence of national [63] and archeological [64] monuments on and near the districts. To validate findings with the latest transformations and atmosphere on-site, Google Street View images [65] and aerial photos [66] are consulted. The original data are presented in diagrams, maps, and sections, using Excel (version 16.96.1) and QGIS (version 3.34.1). All figures resulting from this are edited or made in Adobe Illustrator (version 29.3.1). All data used in this spatial analysis is publicly accessible via the Reference List [48–66].

Table 3. Analytical framework spatial quality of business districts.

	Environmental	**Urban**	**Accessibility**
Pathways	A healthy landscape, first	An inspiring sociosphere, second	A viable economy, third
Values	Ecosystems, resources, diversity, integration, renewal, carrying capacity, nutrients, coexistence, undisturbed, calm, healthy, stability, species, environmental types, geomorphology, ecotype, hydrology, habitat, soil	Multipurpose, space, peace, image, attractiveness, quality, safety, beauty, health, uniqueness, contrast, connectedness, encounter, flexibility, agglomeration, symbology, unprogrammedness, senses	Efficiency, externalities, distribution, participation, choice, access, inclusion, ordering, clarity, coherence, structure, construction, occupation
Indicators	Number of trees, canopy coverage, green space, shrubs, water bodies	Heritage, architecture, public space, parks, squares, density, agglomeration, functional mix/composition, size of the districts and buildings	Modes of traffic, slow traffic, rapidness, frequency, parking

Table 4. Spatial categorization of Dutch business districts based on long-term structures.

District	Characteristics	Exemplary Case
Inner-city	Surrounded by a residential neighborhood nearby on at least 3 sides of the district. Potential to benefit from proximity to a vibrant urban environment and amenities. Environmental class relates to this position.	
Edge-city	Located on the edge of the city, forming a barrier between the residential district and the rural landscape. Potential to benefit from proximity to a more vibrant urban environment and amenities. Environmental class relates to this position.	
Waterway districts	Positioned along a waterway. Often, a barrier between the district and residential neighborhood separates the district from the vibrant urban environment on at least one side of the district; however, it might benefit from the proximity of its amenities. Environmental class can relate to this position.	
Highway districts	Positioned along the highway and oriented on this. No vibrant urban environment to benefit from in proximity. Environmental class can relate to this position.	

3. Results

The following findings of this research are threefold:

1. Defining a framework to identify the spatial quality of business districts. The framework is validated by a spatial analysis and identifies the quality of 40 business districts.
2. Understanding business districts as potential workscapes by identifying the spatial quality.
3. Formulating a first set of action perspectives for workscape development.

The overarching perspective to enhance the spatial quality of business districts is formulated.

3.1. The Framework to Identify Spatial Quality of Business Districts

The analyses are used to construct the framework to identify the spatial quality of business districts. The values in the analytical framework (Table 3) precede the indicators. The indicators are measurable aspects of business districts.

To measure the spatial quality of business districts, the analytical framework is translated into a radar chart and is presented in Figure 2.

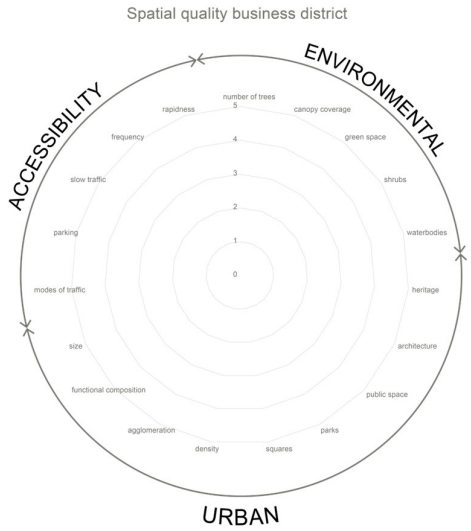


Figure 2. Framework to identify the spatial quality of business districts, including a weighing to quantify the spatial quality of business districts via a 0-5 score in a radar chart format on the indicators presented in Table 3.

As the aim of the research is to understand the spatial quality of business districts, each indicator includes a scoring system.

3.2. Understanding Business Districts as Potential Workscapes

The framework presented in Section 3.1 is used to analyze the selected 40 Dutch business districts, hence defining their spatial quality. The districts are presented in ascending total spatial quality score (Figure 3). This corresponds to an ascending diversity in function, construction year buildings, street profiles, and land use (Appendix D).

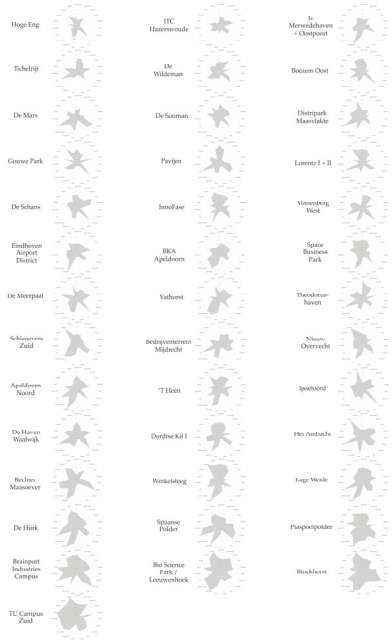


Figure 3. Spatial quality score of the selected 40 Dutch business districts, presented in ascending order. See enlarged in Appendix D, Figure A6.

The spatial quality of business districts and the monotonous appearance of these environments are strongly connected. The spatial quality and monotonous appearance are caused by the following:

- Their repetitive geometries.
- Rows of large and rectangular buildings, often with little variation in height or architectural style.
- The streets in the districts align in grid patterns, emphasizing efficiency and predictability.
- The public space in the business districts is predominantly infrastructural, including roads and parking places, with extremely limited public squares and parks.
- The infrastructure is merely car-oriented, lacking comfortable and safe slow-traffic-friendly space. With little space for slow traffic use of the infrastructure and a lack of objects that stimulate this use, such as street furniture, the little public space does not promote activity or interaction.
- The business districts include vegetation mostly on main axes of infrastructure and along its borders. The vegetation is often single-layered and includes little species diversity.
- Though many districts are located along waterways, within the districts themselves little waterbodies are present.
- The little green spaces present often comprise vacant lots. Therefore, the districts do not meet the 3-30-300 rule.

The concluding radar chart of 40 overlapped charts highlights these common challenges faced by business districts (Figure 4). Although scarce, potential can be found in more multitone business districts, for instance with diverse functional composition, land use, construction years of buildings, or modes of mobility. This stresses the importance of variation in Jacobs's framework [30].

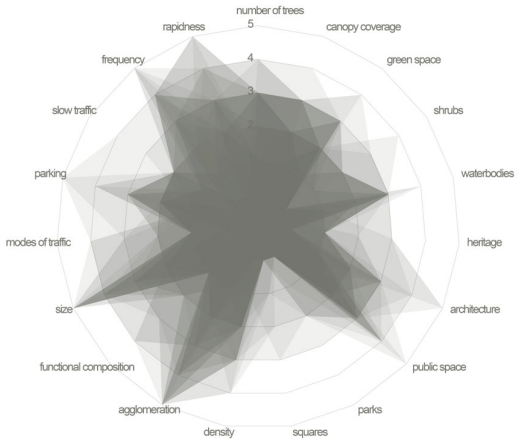


Figure 4. Radar chart presenting the spatial quality of 40 cases. 40 individual charts of business districts overlapped.

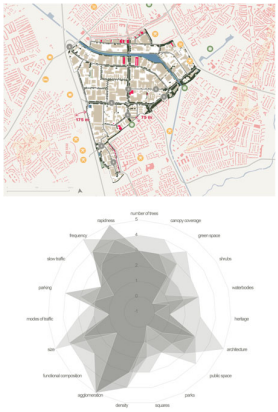
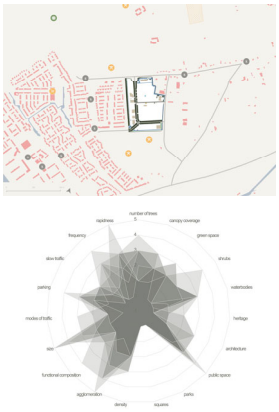
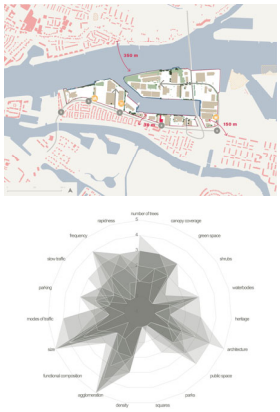
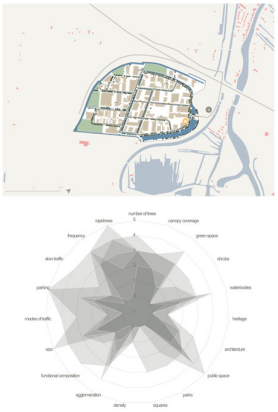
3.3. Action Perspectives

The four different types of business districts have different transformation strategies regarding workscape development. In Table 5 below, the overlapping radar chart of the forty cases is divided into one overlapping chart per type. The main criteria on which the business districts are lacking is there is a serious deficiency of qualitative public spaces, such as parks and squares; however, the severity of these deficiencies ranges per type.

As presented in the analysis, certain businesses, such as heavy industries, may not be suitable for integration with residential functions due to noise, pollution, or safety concerns. In most cases, this already results in more distance to the residential areas. Related to the four types of districts, this research identifies three types of transformative development of business districts into workscapes: preserving industrial characteristics while improving work and environmental qualities; urban redevelopment requiring, e.g., revised zoning plans; and immediate implementable integral transformation. Although not all these future workscapes include housing, being the physical shelter of people, they do provide humans

and non-humans with a place to live, work, and recreate in. It integrates business districts in the living environment. For this, the districts need to be drastically transformed, as the overall attractiveness of business districts should be significantly enhanced.

Table 5. The overlapping radar chart is broken down into the four different types of business districts.

Inner-City	Edge-City	Waterway	Highway
			

Particularly the districts near residential areas can provide essential services to the nearby neighborhoods without necessarily adding housing. To realize this potential, both physical and non-physical connectivity with surrounding neighborhoods must be enhanced. Specifically, the edge-city business districts have great potential to be integrated into the living environment and strengthen the urban-rural connection.

The overarching perspective to enhance the spatial quality of business districts is that the districts must diversify and transition from monotonous to multitonous. The first key action perspectives to achieve this are the following:

- From an environmental perspective, business districts require substantial redesign to include additional qualitative and diverse vegetation and water bodies to generate climate-adaptive, healthy, comfortable, and nature-inclusive environments. Many districts already feature green main axes with space for safe, slow traffic, which should be extended throughout the inner district.
- Both the quantity and quality of public spaces must be enhanced. Often, the scarcity of the quantity of public space requires involving private stakeholders in urban re-development to significantly improve spatial quality. Repurposing the many unused, vacant plots for public use is a potential strategy when there is a deficiency of public space.
- The functional composition of each site indicates potential site-specific diversification opportunities. The implementation of mixed-use developments that integrate the often dominant industrial and office spaces with amenities that focus on leisure and, if possible, with residential functions stimulates activity. For this, re-evaluation and modernization of environmental zones may permit a more diverse range of functions.
- Regarding infrastructure, the creation of pedestrian- and cyclist-friendly routes is imperative. Transforming existing street and lot parking into shared-built parking facilities can enhance spatial esthetics. Together with promoting transit accessibility, this makes business districts more attractive workplaces that facilitate interaction among workers, visitors, and potential residents.

4. Discussion

The criteria and analyses are used to construct the analytical framework to measure the spatial quality of business districts, as presented in Section 3.1. However, some indicators presented in the literature on spatial quality and successful transformation of business districts still need some further exploration. For instance, it is not yet clear how beauty, attractiveness, uniqueness, emotional ties with the landscape, and places with personal associations are achieved through improving on the presented indicators via the urban-landscape design of workscapes, specifically. Research on the design of best practices can pose a perspective on this and can support the research-based design of workscapes. Regarding the spatial quality of the forty selected sites, the highest-scoring site is not necessarily the best practice in designing workscapes. It is only the best-scoring site amongst the selected set. The set of sites was selected based on its diversity in urbanity, environmental zone, typology, etc. To work on a thorough best practice analysis, a set of good examples should first be selected, and a systemic comparative design analysis should be conducted. That study is outside the scope of this research.

Now business districts can be understood as workscapes; research on and by design is needed to further develop a method to enable this workscape development. This can be achieved via the formulation of a pattern language. This is a method that includes recurring design solutions, patterns that represent a proven-to-be-effective guideline, to solve problems that arise in the urban environment [67]. This research presented a range of contexts and stakeholders along the 3800 different business districts. This variety makes one integral pattern language a reasonable option for workscape development, as it may enrich the knowledge field and still requires translation into site-specific design [67–69]. The analytical framework presented in this research can be the basis for such a pattern language.

This research moves away from the profit-oriented development of the business districts. However, the literature on the development of business districts, their spatial quality, and sustainable development goals suggests that when aiming for a landscape-driven approach, the business districts might be even more profitable. Research on the added value of this landscape-driven approach in business districts is needed.

The method to measure spatial quality can be used to understand business districts as potential workscapes and to develop workscapes. However, some indicators presented in this research are not all directly implementable because they somehow require a prerequisite. These are, for instance, the heritage and architecture indicators. There are many great examples of business districts, such as the German IBA Emscherpark, where industrial heritage creates an identity for the environment. Business districts that already score on these two indicators have a high potential to utilize these characteristics to catalyze their development, improving identity. However, when there are no rudiments present in the district, also in the subsoil, these districts can hardly improve on those. To improve the spatial quality of these specific indicators, only new buildings, renovation, restoration, and transformation can take place. This is different from, for instance, the indicator ‘amount of trees’, where trees can be added to improve the score. The size of the district is important to the potential spatial impact workscape development can make and its contribution to the agglomeration. However, the weighing of the size simply follows an ascending scale. This is important to the spatial quality, but only in relation to the other indicators; with a large district that scores low on the other spatial indicators, a higher score is not necessarily positive. Furthermore, the spatial analysis of the forty cases is limited to the data that can be found for each district at the time of data retrieval. Moreover, for each district, the borders of the districts as presented in the IBIS data [48] are used. This means that it is possible that waterway districts do not score on the water-related indicator, as there is not

any water within the border. Or districts linked to a nature area can lack scoring on green space whilst this is located within 300 m, which is a key element in the 3-30-300 rule [42].

5. Conclusions

In the context of ongoing socio-economic and environmental challenges, rethinking the concept of business districts is crucial. Potential lies in integrating the business districts into the living environment. However, Dutch business districts exhibit distinct spatial characteristics compared to other urban environments. These districts often prioritize economic efficiency, functionality, and business activities at the expense of ecology, livability, and sustainability, resulting in a monotonous and deficient spatial quality that hinders their integration into the living environment.

The landscape provides an integrative framework to address these multifaceted challenges. Transitioning business districts into socio-ecologically inclusive workscapes requires reimagining these spaces through a spatial lens.

Through this spatial perspective, business districts can be classified into four typologies: inner-city districts, edge-city districts, waterway districts, and highway districts. These typologies are linked to different transformation strategies. Preserving industrial characteristics while enhancing work and environmental qualities, urban redevelopment necessitating revised zoning plans, and immediate, integrative transformations are identified as key strategies.

This research proposes a multidimensional framework for assessing the spatial quality of business districts by integrating environmental, urban, and accessibility pathways. The framework incorporates values and measurable indicators to evaluate these dimensions comprehensively.

The spatial analysis of 40 cases reveals that Dutch business districts often lack sufficient green-blue spaces, diverse functional compositions, and vibrant pedestrian zones, such as public squares or parks. Diversifying environmental, urban, and accessibility characteristics can address this monotony and transform business districts into multitone workscapes. Edge-city districts, in particular, hold significant potential for integration into the living environment and strengthening the urban-rural connection due to their proximity to both.

The key action perspectives to support workscape development are as follows:

- Including additional qualitative and diverse vegetation and water bodies and extending the green axis throughout the inner district.
- Enhancing the quality and quantity of public spaces. With a lack of public space, involve private stakeholders in urban redevelopment and repurpose unused, vacant plots for public use.
- Implementing mixed-use development. Re-evaluate and modernize the environmental classes to optimize the development potential.
- Creating pedestrian- and cyclist-friendly routes, shared-built parking facilities and transit accessibility.

The analytical framework for spatial quality of business districts and first key action perspectives contribute to the development of workscapes. To further enable this, design patterns are essential. This requires further research on-and-by design.

Author Contributions: Conceptualization, R.d.W., S.N. and R.R.; methodology, R.d.W., S.N. and R.R.; validation, R.d.W.; formal analysis, R.d.W.; writing—original draft preparation, R.d.W.; writing—review and editing, R.R., S.N. and R.d.W.; visualization, R.d.W.; supervision, S.N., R.R. and N.T.; project administration, R.d.W.; funding acquisition, R.d.W. and N.T. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: All data used in the spatial analysis are publicly accessible via the Reference List [48–66].

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Appendix A. National Maps Context 3800 Dutch Business Districts

Figure A1. Digital Terrain Model of the Netherlands with current business districts and their urban-landscape and infrastructural context [48–51,56,58]. By author, 2025. Software: QGIS (version 3.34.1).

Figure A2. Digital Terrain Model of the Netherlands with current business districts categorized by public/private space ratio [48–50]. By author, 2025. Software: QGIS (version 3.34.1).

Figure A3. Digital Terrain Model of the Netherlands with state of obsolescence of its business districts [48–50]. By author, 2025. Software: QGIS (version 3.34.1).

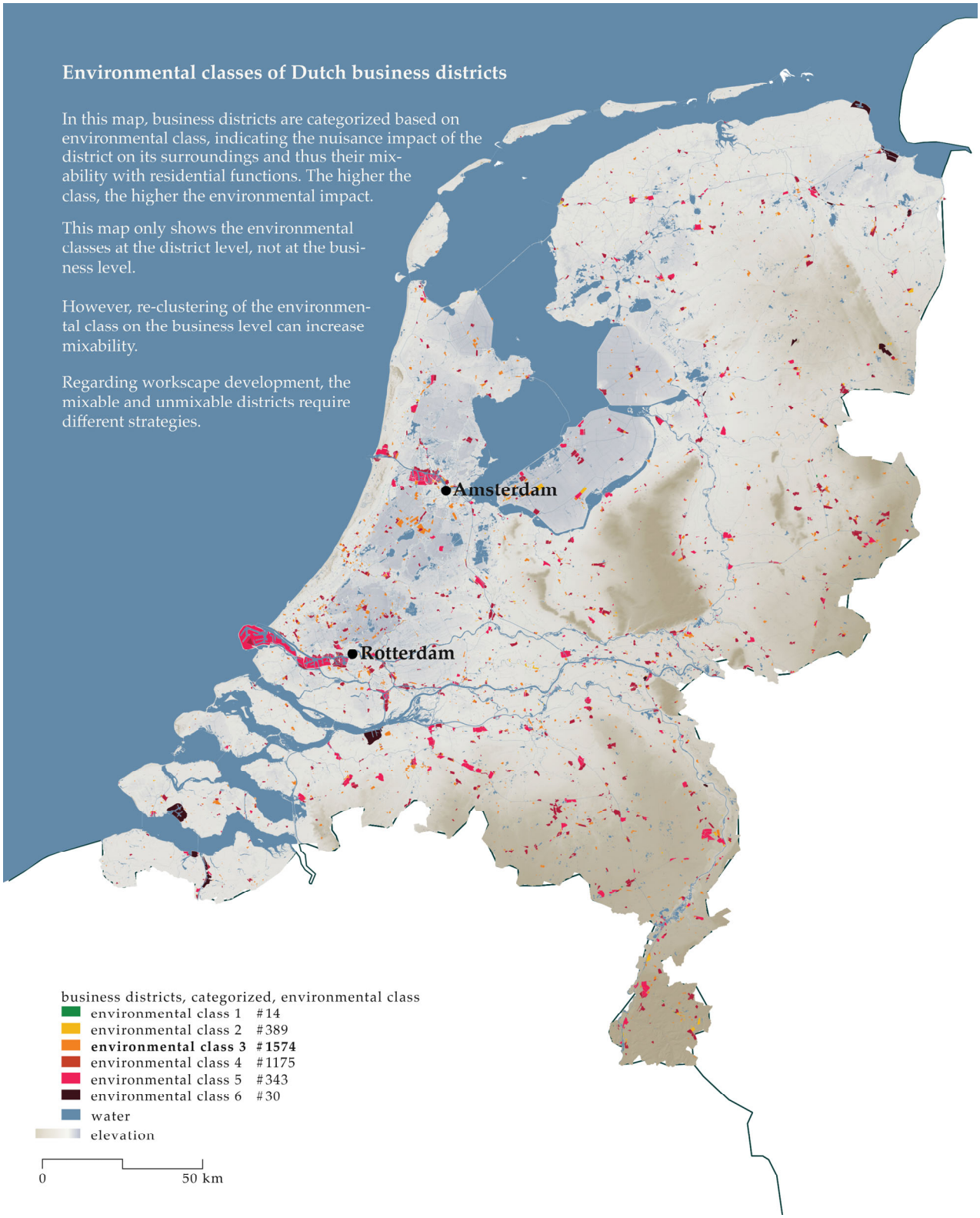

Figure A4. Digital Terrain Model of the Netherlands with current business districts categorized by environmental class [48–50]. By author, 2025. Software: QGIS (version 3.34.1).

Appendix B. Geographical Scope of the Spatial Analysis

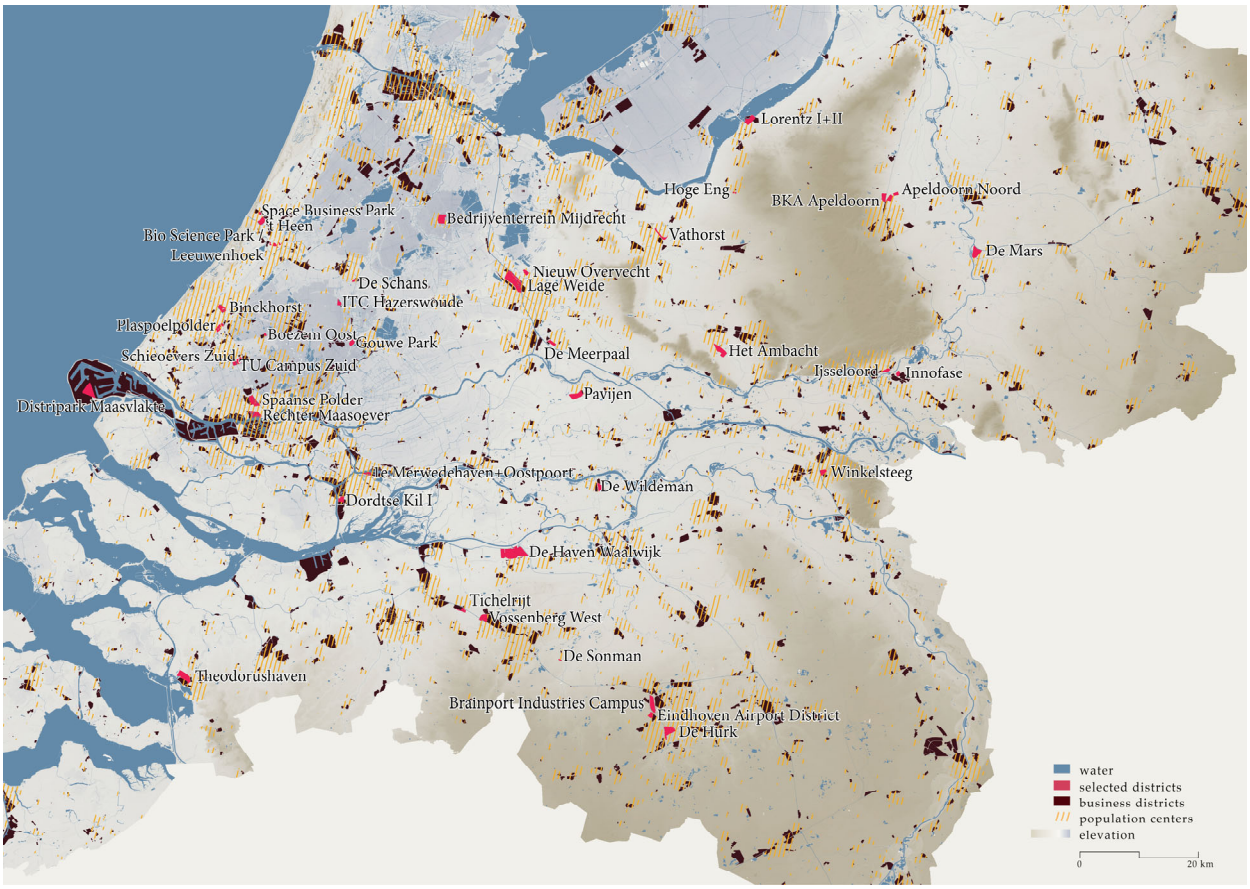

Figure A5. Geographical scope of the spatial analysis visualized in the map. Forty selected Dutch business districts highlighted. Digital Terrain Model of the Netherlands with current business districts and their urban context [48–51]. By the author, 2025. Software: QGIS (version 3.34.1).

Appendix C. Table Overview Districts

Table A1. Overview of districts. Made by author, information business districts from IBIS [48], information soil from Wageningen Environmental Research [52] and information landscape typology by Rensink, Weerts, Kosian, Feiken, Jansen and Smit [53].

Business District	Surface (HA)	Public Space (%)	GSI	Maximum Environmental Zone	Start (Year)	Province	Outdated	Soil	Landscape Typology	District Type	Transformation Type	Average Elevation (−/+ NAP)
Space Business Park	15	20	0.07	3	2005	Zuid-Holland	No	Sand	Estuarium, strandvlakten	Edge-city	Integral	+1.5 m
Brainport Industries Campus	179	63	0.11	4	2018	Noord-Brabant	No	Loam	Dekzandvlakten, dekzandruggen, droogdalbodems	Highway	Cherish	+18 m
TU Campus Zuid	105	24	0.17	3	1985	Zuid-Holland	No	Clay	Kwelders	Highway	Integral	+1.5 m

Table A1. *Cont.*

Business District	Surface (HA)	Public Space (%)	GSI	Maximum Environmental Zone	Start (Year)	Province	Outdated	Soil	Landscape Typology	District Type	Transformation Type	Average Elevation (−/+ NAP)
Bio Science Park/Leeuwenhoek	101	11	0.25	3	1967	Zuid-Holland	No	Built	Stroomcrevcasseruggen, overstromingsvlakte	Inner-city	Integral	+0.5 m
Binckhorst	100	20	0.38	4	1939	Zuid-Holland	No	Built	Strandvlakten, strandwallen, lage duinen, kwelders	Inner-city	Zoning	+1 m
Plaspoelpolder	95	34	0.42	3	1954	Zuid-Holland	No	Built	Kwelders/kreekruggen	Inner-city	Integral	+0.5 m
Rechter Maasoever	116	14	0.36	4	2022	Zuid-Holland	No	Built	Kwelders	Waterway	Zoning	+3 m
Winkelsteeg NXP	64	8	0.29	4	N/A	Gelderland	N/A	Built	Sandrs	Inner-city	Zoning	+12 m
Vathorst	45	28	0.44	3	1999	Utrecht	No	Sand	Dekzandvlakten, dekzandruggen, rivierduinen	Edge-city	Integral	+2 m
Ijseloord	60	46	0.36	4	N/A	Gelderland	N/A	Silt	Stroom- en crevasseruggen, overstromingsvlakte	Edge-city	Zoning	+10 m
De Mars	189	22	0.37	5	N/A	Gelderland	N/A	Built	Beekdalbodems, uiterwaarden	Waterway	Zoning	+8 m
Boezem Oost	21	36	0.41	4	2014	Zuid-Hollans	No	Clay	Wadden	Highway	Cherish	−4 m
Gouwe Park	65	30	0.46	4	2005	Zuid-Holland	No	Peat	Wadden, overstromingsvlakte	Highway	Cherish	−5 m
De Schans II	20	35	0.33	4	2001	Zuid-Holland	No	Clay	Overstromingsvlakte, stroom-crevasseruggen, veenvlakten	Edge-city	Zoning	−1 m
'T Heen	78	13	0.49	3	1967	Zuid-Holland	Yes	Built	Estuarium	Waterway	Integral	+1 m
Hoge Eng	11	20	0.41	3	N/A	Gelderland	N/A	Sand	Hellingen	Edge-city	Integral	+15 m
De Meerpaal	50	30	0.58	4	1999	Utrecht	No	Clay	Overstromingsvlakte	Edge-city	Zoning	+1 m
Bedrijventerrein Mijdrecht	175	18	0.38	5	1960	Utrecht	No	Clay	Wadden, kreekruggen	Edge-city	Zoning	−5.5 m
Apeldoorn Noord	107	23	0.43	3&4	N/A	Gelderland	N/A	Sand	Plateaus, hellingen, droogdalbodems, dekzandvlakten	Edge-city	Zoning	+8 m
Lorentz I + II	152	16	0.44	5	N/A	Gelderland	N/A	Built	Dekzandvlakten	Waterway	Zoning	+1.5 m
De Sonman	10	25	0.56	3	1985	Noord-Brabant	No	Sand	Dekzandvlakten, droogdalbodems, dekzandruggen	Edge-city	Integral	+12 m
Tichtelrijt	134	22	0.06	3&4	1983	Noord-Brabant	Partly	Sand	Droogdalbodems, dekzandvalkten, beekdalbodems	Waterway	Cherish	+4.5 m
Pavijen	167	21	0.50	4	N/A	Gelderland	N/A	Clay	Overstromingsvlakte, stroom- en crevasseruggen	Edge-city	Zoning	+1 m
Lage Weide	408	24	0.41	5	1945	Utrecht	No	Clay	Overstromingsvlakte, stroom- en crevasseruggen	Waterway	Zoning	+1.5 m
De Hurk	212	22	0.52	5	1955	Noord-Brabant	No	Built	Dekzandvlakten, dekzandruggen, droogdalbodems	Inner-city	Zoning	+18 m
Distripark Maasvlakte	165	11	0.37	4	N/A	Zuid-Holland	No	Built	Kwelders	Waterway	Cherish	+5 m
Vossenberg West	122	35	0.55	5	2012	Noord-Brabant	No	Sand	Dekzandvlakten, droogdalbodems	Waterway	Zoning	+6 m
InnoFase	46	22	0.15	5	N/A	Gelderland	N/A	Silt	Overstromingsvlakte	Highway	Cherish	+9 m
Theodorushaven	237	14	0.17	5	1960	Noord-Brabant	Yes	Built	Kwelders, kreekruggen	Waterway	Cherish	+1.5 m
1e Merwedehaven + Oostpoort	43	4	0.30	4	1938	Zuid-Holland	No	Built	Kwelders	Waterway	zoning	+3 m
Dordtse Kil I	62	23	0.43	4	1965	Zuid-Holland	No	Built	Kwelders	Edge-city	Zoning	0 m
Spaanse Polder	171	32	0.51	5	1946	Zuid-Holland	No	Built	Kwelders	Waterway	Zoning	+0.5 m
De Wildeman	98	23	0.34	4	N/A	Gelderland	N/A	Silt	Overstromingsvlakte	Highway	Cherish	+3 m
Eindhoven Airport District	57	11	0.41	4	1950	Noord-Brabant	No	Sand	Dekzandvlakten, dekzandruggen	Highway	Cherish	+6 m
Schieoevers Zuid	48.3	28	0.37	4	1969	Zuid-Holland	No	Built	Kwelders	Edge-city	Zoning	0 m
BKA Apeldoorn	87	15	0.04	5	N/A	Gelderland	N/A	Built	Hellingen	Edge-city	Cherish	+11 m
De Haven Waalwijk	630	34	0.28	5	1960	Noord-Brabant	Partly	Clay	Kwelders, kreekruggen, open water, dekzandvlakten	Edge-city	Cherish	+1 m
Het Ambacht	183	25	0.44	5	1960	Utrecht	No	Sand	Dekzandvlakten	Edge-city	Cherish	+7 m
Nieuw Overvecht	51	29	0.50	3	1970	Utrecht	Yes	Built	Overstromingsvlakte	Edge-city	Integral	+1.5 m
Sierteeltcentrum ITC Hazerswoude	42	20	0.36	3	1990	Zuid-Holland	No	Clay	Wadden, veenvlakten	Highway	Cherish	−5 m

Appendix D. Spatial Analysis 40 Business Districts

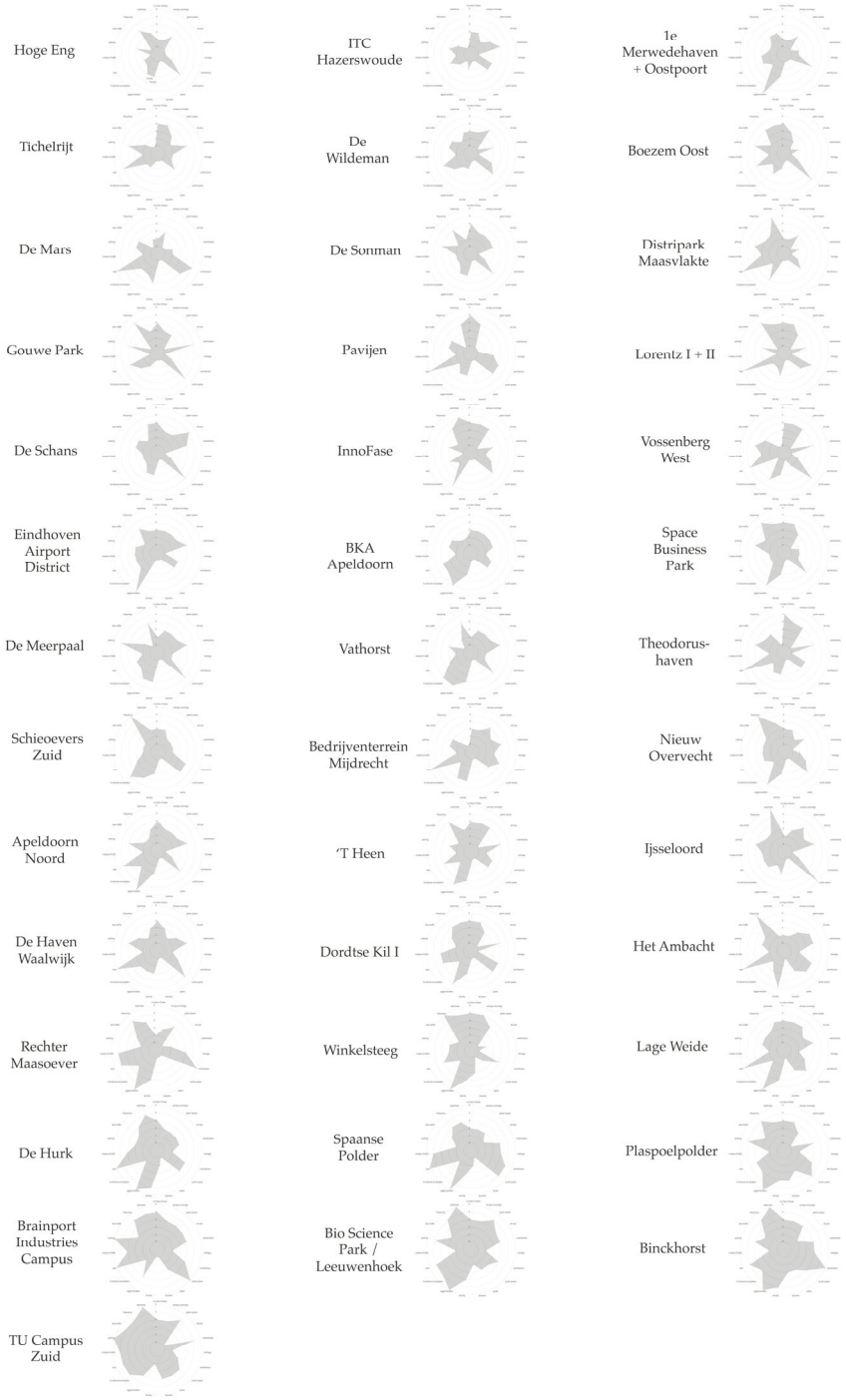

Figure A6. Radar charts of 40 cases. The radar charts are presented in an ascending order in total quality score.

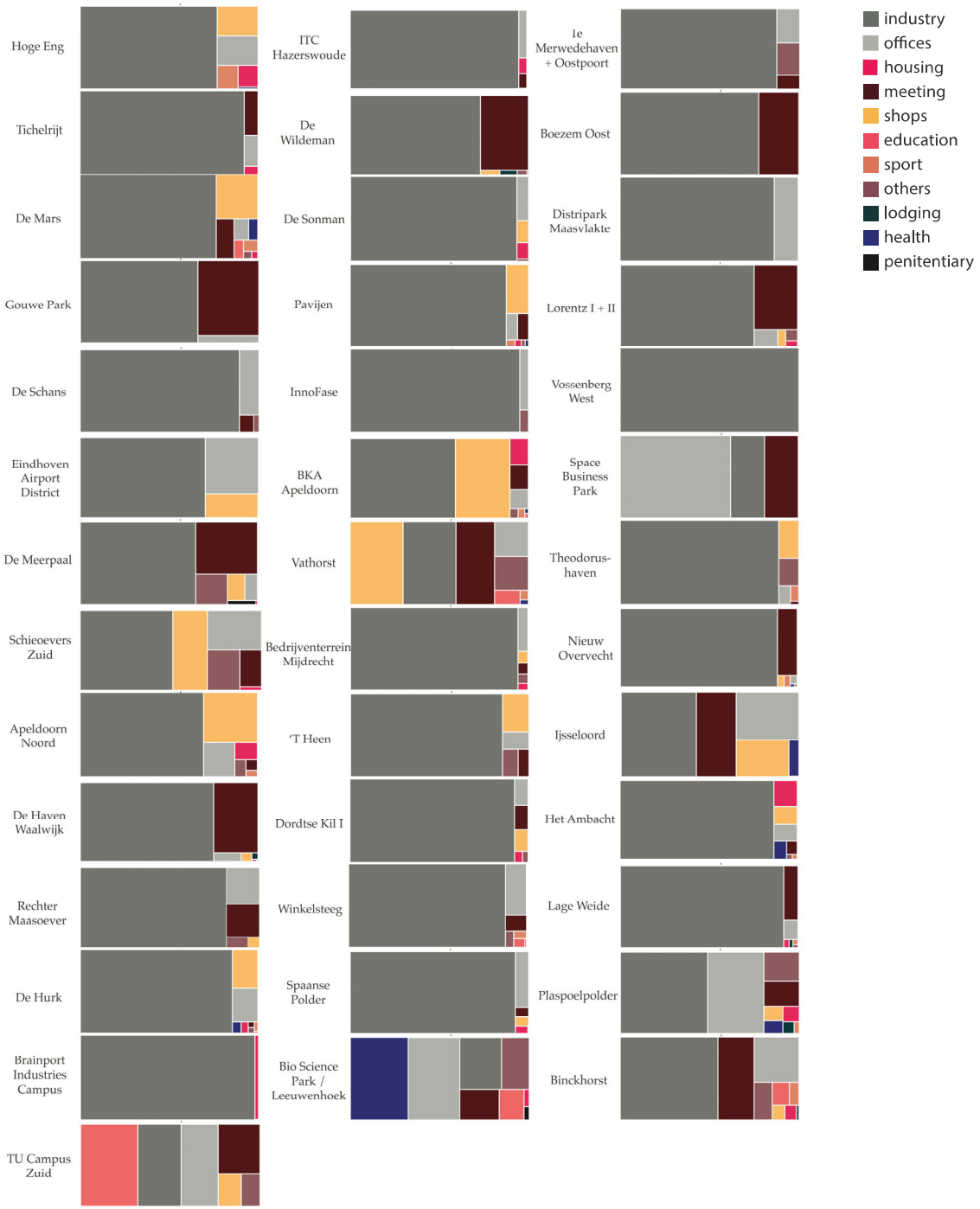

Figure A7. Functional composition in 40 cases. The radar charts are presented in an ascending order in total quality score. The analysis of the functional composition of the 40 cases shows that most districts include over 50% of industrial functions, together with offices and meeting functions. Rarer is the composition of multiple dominant functions. There is a correlation between this diversity and quality score.

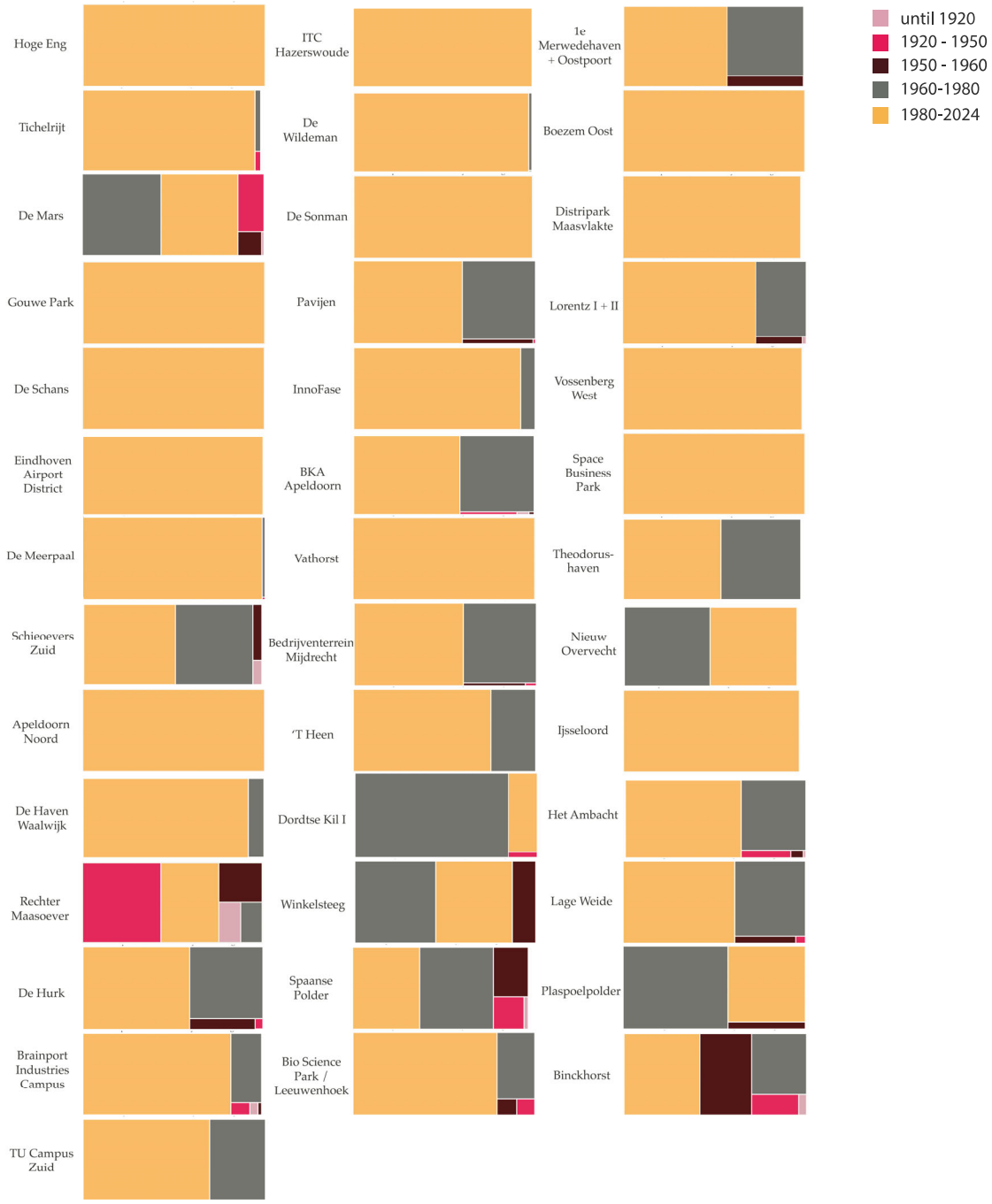

Figure A8. Composition of construction years buildings in 40 cases. The charts are presented in an ascending order in total quality score. The temporal categorization is based on key historical events, as presented by Louw et al. [20] (pp 16–19), that affected the Dutch business districts' development, including the Industrial Revolution (late 19th century), Functionalism (1920s), the rise in the car (1950s), land scarcity on city edges (1960s), and highway-oriented development (1980s). The analysis of the composition of construction years of the buildings in 40 cases shows a dominance of building years 1980–2024, not the most inspiring architectural period in business districts. There is a correlation between diversity in composition and quality score.

Figure A9. Typical street profile in 'inner' paths of 40 cases. The profiles are presented in an ascending order in total quality score. The sections are made on typical 'inner' paths of the districts; the streets where employees enter or leave their workspace. The sections present a very sealed surface and car-dominated image. In most cases, there is little space for safe, slow traffic. The street image is dominated by parked vehicles. When green is present, this is often single-layered: only strips of grass, monocultural tree lanes, or shrubs. There is a correlation between the diversity (more green surface, trees and space for pedestrians) and the quality score.

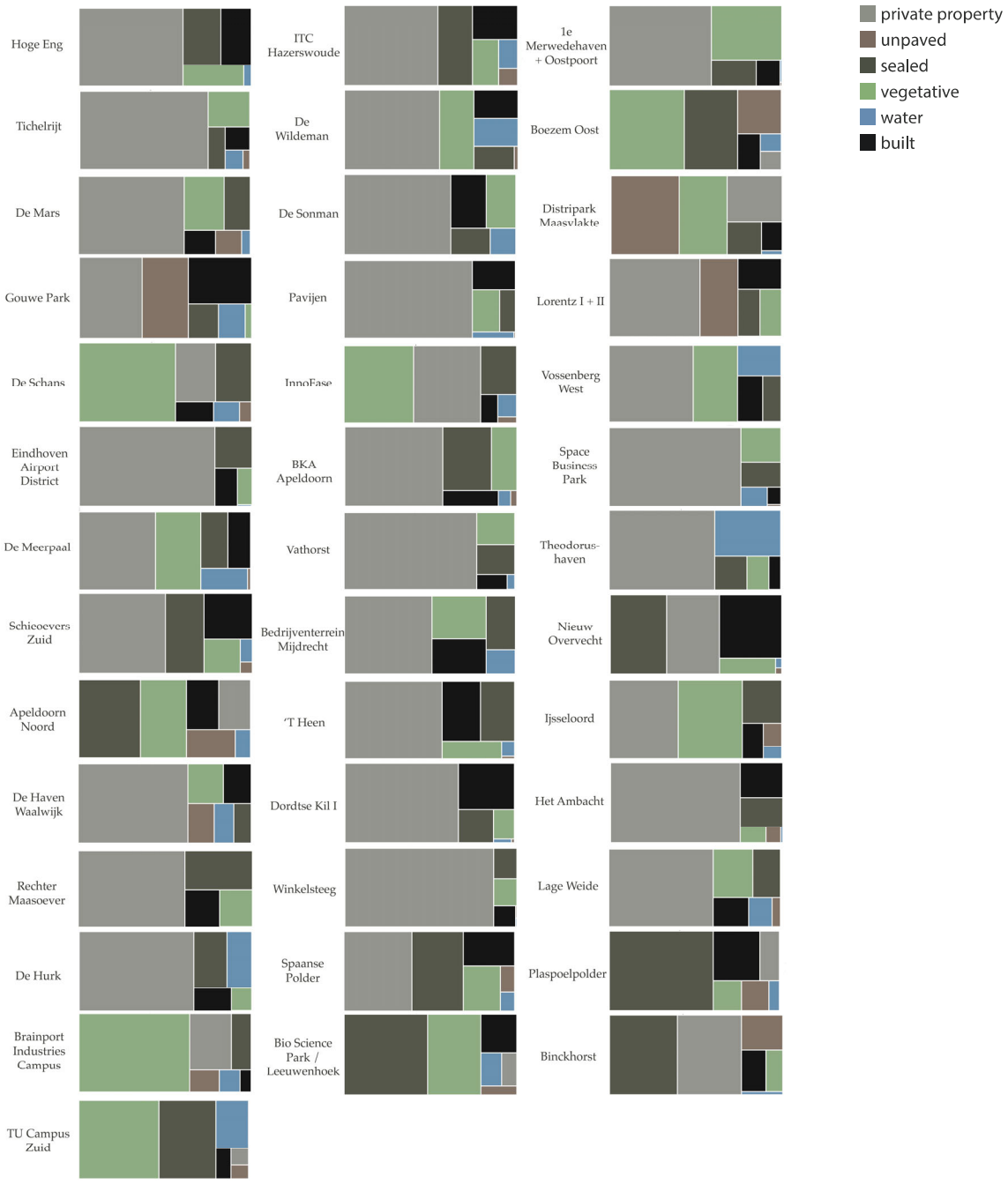

Figure A10. Composition of land use in 40 cases. The charts are presented in an ascending order in total quality score. The analysis of the composition of land use in 40 cases shows a dominance of private property and sealed surfaces.

Figure A11. Environmental performance, urban characteristics, and infrastructural accessibility in 40 cases. The maps are presented in ascending order of the total quality score. The analysis shows that in many locations, the landscape is elevated and flattened by a layer of up to 3 m of sandy soil. Many of the districts are located along (human-made) waterways. The urban context differs. Many districts are closely located to population centers, though separated by a barrier in the form of a waterway or infrastructure. Amenities are often mostly located in the surrounding urban landscape. Building size stands out. Often, only the main axes or borders include trees or other vegetation types and water bodies. Green spaces are frequently no more than vacant lots to be built on. The infrastructure is car-oriented; it does not provide a safe and comfortable space for slow traffic. In some districts there is quite a lot of public space (in quantity); however, almost no squares or parks can be found (quality). There is a correlation between the presence of residential functions and amenities nearby and the quality score.

Appendix E. Weighing

Table A2. Weighing to quantify the spatial quality of business districts, on the indicators presented in the analytical framework (Table 3). The indicators regarding urban characteristic are heritage, architecture, parks, squares, public space, agglomeration, density, functional composition, size. The indicators regarding accessibility are modes of traffic, parking, slow traffic, frequency, rapidness. The environmental indicators are number of trees, canopy coverage, green space, shrub layer, water bodies.

	0	1	2	3	4	5
			Urban Characteristics			
Heritage	No heritage elements nearby.	A heritage element close to the district.	A heritage element within the district.	A heritage element and landmark within the district.	Some heritage elements within the district.	Several heritage elements and atmospheres.
Architecture	Fully uninspiring.	One dominant construction period, including monotonous architecture.	Two dominant construction periods.	A dominant construction period with several less dominant ones.	Interesting mix in construction years.	Attractive and diverse architecture generates a pleasant atmosphere in the public space.
Parks	No public parks present in the district.	One public green space without any furniture.	One public green space with some street furniture.	One public green space with furniture and activities surrounding it.	Several public green spaces with some furniture.	Several public green spaces in strategic locations with street furniture and activities.
Squares	No public squares in the district.	One public square without any furniture.	One public square with some street furniture.	One public square with furniture and activities surrounding it.	Several public squares with some furniture.	Several public squares in strategic locations with furniture, activities, and shelter from diverse weather conditions.
Public space	0–5%.	5–10%.	10–20%.	20–30%.	30–40%.	>40%.
Agglomeration	Not close to agglomeration nor population center.	Close to population center.	In a population center, far from agglomeration.	In population centers near agglomeration, out-population centers on the edge of agglomeration.	In population centers partly on the edge of agglomeration.	In population centers and in agglomeration cores.
Density	No housing around the district.	Housing present close to the district.	Housing close to one side of the district.	Housing on two sides of the district and some housing within.	Housing on three sides of the district and some housing in.	Residential area continues in the district.
Functional Composition	One single function.	One extremely dominant industrial function.	Industry and offices being extremely dominant functions.	Industry and offices being dominant, several less dominant functions included.	Substantial part of functional composition other than industry and offices.	A business district with many urban amenities and facilities.
Size	<5 ha.	5–20 ha.	20–60 ha.	60–100 ha.	100–140 ha.	>140 ha
			Accessibility			
Modes of Traffic	Car-oriented infrastructure only.	Car-oriented infrastructure with unsafe and insufficient slow traffic.	Fast and slow traffic, together with sufficient infrastructure for motorized infrastructure.	Fast and safe slow traffic, public transport, and infrastructure for motorized infrastructure.	Excellent multimodal connections.	Multimodal connections in safe and comfortable use.
Parking	No parking available while needed.	Street parking only.	Street parking combined with parking lots.	Parking lots, clustered parking only.	Parking lots combined with built parking.	Mobility hubs.
Slow Traffic	No infrastructure for slow traffic.	Unsafe slow traffic infrastructure: dead-ends and shared lanes only.	Separated slow traffic lanes on main routes.	Separated slow traffic lanes in the whole district.	Safe, prioritized and wide slow traffic infrastructure in the whole district.	Safe, prioritized, wide, and comfortable slow traffic infrastructure in the whole district.
Frequency	No public transport in the district.	Public transport lines are hourly during working hours (09:00–17:00 on weekdays).	Public transport lines are frequent during working hours (09:00–17:00 on weekdays).	Public transport lines are frequent during working hours (09:00–17:00 on weekdays) and hourly on weekend days.	Public transport lines are frequently busy during the daytime on all days.	Public transport lines are always frequent.
Rapidness	No highway exits or public transport stops nearby.	Highway exit near district; no public transport stops near.	Highway exit near district; no public transport stops in the district or multiple not accessible by slow traffic or infrequent.	Highway exit near district; public transport stops in districts that are frequent.	Highway exit near district; public transport stops in districts that are frequent and easily accessible by slow traffic.	Highway exit near the district; public transport stops in districts that are frequent and comfortably and safely accessible.
			Environmental			

Table A2. *Cont.*

	0	1	2	3	4	5
			Urban Characteristics			
Number of Trees	No trees present in the district.	Trees along the border of the district.	Trees along the border of the district and some along main routes.	Trees along the border of the district and along main routes, some on side streets.	Trees along the border of the district and along main routes, on side streets and on private plots.	Sightlines to trees from every building's façade.
Canopy Coverage	Individual trees only.	Some clusters of canopy coverage.	Clusters of canopy coverage along main infrastructure.	Clusters of canopy coverage along all infrastructure.	Full canopy coverage along all slow traffic infrastructure.	30% canopy coverage.
Green Space	No green space present in district.	Green space on vacant lots only.	Green space on vacant lots and minimal green space along infrastructure.	Green space on vacant lots and minimal green space along infrastructure and strategic locations.	Green space on vacant lots and minimal green space along infrastructure and strategic locations, including the building envelope.	Private green space and maximum public green space.
Shrub Layer	No significant shrub layer present in district.	Very few shrubs on private plots.	Shrubs strategically positioned along infrastructure.	Some shrub layers linked to ground cover or trees.	Many multilayered systems along infrastructure.	Many multilayered green spaces enhance the ecological network.
Water Bodies	No water bodies present in the districts.	Some standalone ponds in the districts.	Some water bodies present form corridors and connect the district with its surrounding landscape.	Different types of water bodies present in the district.	Different types of water bodies present in the district, a large surface.	Different types of water bodies present in the district, creating a pleasant public space.

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