TU Delft

Delft University of Technology

Document Version
Final published version

Licence
CC BY

Citation (APA)
de Wolf, R. J. A., Nijhuis, S., Boelhouwer, P. J., & Tillie, N. (2026). Developing a Design Framework for Workscapes through Field Experiments on TU Delft Campus, the Netherlands. *Urban Forestry and Urban Greening*, *126*(1), Article 129688. https://doi.org/10.1016/j.ufug.2026.129688

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
In case the licence states “Dutch Copyright Act (Article 25fa)”, this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.

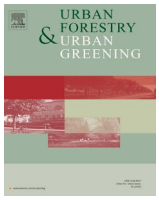
Urban Forestry & Urban Greening 126 (2026) 129688



Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug



Original article

Developing a design framework for workscapes through field experiments on TU Delft Campus, the Netherlands

Rosa de Wolf [a,*], Steffen Nijhuis [a], Peter Boelhouwer [b], Nico Tillie [a]

[a] Department of Urbanism, Delft University of Technology, Julianalaan 134, Delft, 2628BL, the Netherlands
[b] Department of Management in the Built Environment, Delft University of Technology, Julianalaan 134, Delft, 2628BL, the Netherlands

ARTICLE INFO

Keywords:
Workscapes
Landscape architecture
Field experiments
Business districts
Transformative design
Pattern language

ABSTRACT

Pedestrianisation is increasingly prominent in Dutch urban environments, as municipalities seek more sustainable mobility and improved spatial quality. Yet 20% of the Dutch built-up surface, its business districts, lags behind. These urban landscapes remain dominated by fast-moving traffic and include insufficient high-quality public space, despite being places where many people spend substantial time. These environments are not future-proof, whilst they have great potential to become more multifunctional and socio-ecologically inclusive landscapes: workscapes. Theoretical knowledge on designing workscapes is lacking. The TU Delft Campus is one of the business districts that exemplifies the transformative development from a car-oriented, sealed-surface work environment to a more socio-ecologically inclusive, sustainable one. This paper describes spatial strategies of the TU Delft Campus and presents field experiments within the scope of designing workscapes to assess how local interventions can contribute to the spatial quality of business districts. The research identifies a set of design patterns that support workscape development by transforming recurring elements of business districts into socio-ecologically inclusive spaces. Examples include diversifying monotonous green strips in street profiles and introducing human-scale interventions in oversized, underused paved spaces. Early observations indicate promising ecological and social effects. Beyond the resulting patterns, the study contributes a methodology for translating site-specific landscape experiments into transferable design knowledge through the pattern language approach. By integrating field experimentation, research through design, and pattern language theory, the paper offers a framework for generating and communicating design knowledge. Although applied here to the transformation of business districts into workscapes, the methodology is transferable to other landscape and urban transformation challenges.

1. Introduction

Whilst the rise of the car, and its accompanying sealed surface, used to be a symbol of modernisation (Feriel, 2023), the opposite development, pedestrianisation, is becoming a trend. Dutch municipalities often opt for more slow-traffic-friendly environments and public spaces (Gemeente Rotterdam, n.d; Gemeente Amsterdam, 2013). However, with current population growth and urbanisation, cities are becoming denser, thereby putting pressure on the availability of urban green space (de Vries et al., 2020). This is particularly concerning as this space plays a crucial role in creating healthy living environments (Konijnendijk, 2023). In the Dutch urban concept of business districts, which accounts for 20% of the total built environment, green space is lacking in both quantity and quality. These urban landscapes are characterised by fast-moving traffic and a lack of sufficient, high-quality public space (de Wolf et al., 2025). One third of the Dutch working population works on these landscapes, affecting many people's lives (Werklandschappen van de Toekomst, 2022). Considering climate change, these environments are not future-proof. However, the districts have great potential to become more multifunctional and socio-ecologically inclusive landscapes: workscapes. Theoretical knowledge on designing these workscapes is lacking.

The Delft University of Technology (TU Delft) Campus is one of the Dutch business districts that exemplifies the transformative development from a car-oriented, sealed-surface environment to a more socio-ecologically inclusive and sustainable one. This paper describes the applied transformative design principles of the TU Delft Campus and presents four field experiments within the scope of designing

* Corresponding author.
E-mail address: R.deWolf@tudelft.nl (R. de Wolf).

https://doi.org/10.1016/j.ufug.2026.129688
Received 26 February 2026; Received in revised form 19 August 2026; Accepted 13 September 2026
Available online 15 September 2026
1618-8667/© 2026 The Author(s). Published by Elsevier GmbH. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

workscapes. These experiments specifically focus on elements common to Dutch business districts, including large, paved, underused spaces, slim linear elements in street design, and paved parking lots (de Wolf et al., 2025; Weppelman et al., 2025, pp. 50–75), recurring problems. By analysing the spatial transformations on the TU Delft Campus, this paper identifies design patterns for converting car-oriented business districts into socio-ecologically inclusive workscapes. Beyond the resulting patterns themselves, the paper contributes a methodology for translating site-specific landscape experiments into transferable design knowledge through pattern language. By integrating research through design, field experimentation, and pattern language theory, the study offers a framework for generating and communicating design knowledge. Although applied in this research to the transformation of business districts into workscapes, the methodology is transferable to other landscape and urban transformation challenges.

2. Background

This research spatially considers the transformed TU Delft Campus North as a business district. With a total surface area of over one square kilometre, eight faculties, and multiple research institutes, the campus educates over 26000 students and 3000 doctoral candidates, and employs around 7300 FTE (TU Delft, n.d.-a; TU Delft, n.d.-b; TU Delft, 2023). The TU Delft Campus is an urban environment where many people come during regular working hours, like in business districts. TU Delft, established in 1842, is the oldest and largest public university of technology in the Netherlands. As it has undergone several spatial transformations in the past and as it aims to become a Sustainable Campus, it can set a spatial example for Dutch business districts seeking to transition into workscapes. The TU Delft can especially set an example, as highlighted by van den Dobbelsteen et al., 2023, p.85; 'As organisations that develop knowledge, conduct research, and valorise their experience, universities are capable of testing and investigating new approaches, models, strategies, and technology. The process can be monitored, evaluated, and corrected or enhanced as needed. Therefore, universities can be safe places for the roll-out of climate action and sustainability measures, paving the way for other organisations and cities to reach their climate goals.'. Fig. 1 depicts the map of the TU Delft Campus North.

2.1. Research objective

This paper aims to answer the following research question:

What design patterns facilitate the transformative design of business districts into workscapes?

To address this question, the research:

1. Tests several spatial interventions via field experiments on the TU Delft Campus.
2. Generates external validity by generalising the findings beyond the TU Delft Campus, formulating design patterns for future workscape development.
3. Develops and demonstrates a transferable methodology that integrates research through design, field experimentation and pattern language theory to generate and communicate design knowledge for urban landscape transformation.

3. Methods and materials

According to Deming and Swaffield (2011), research strategies in landscape architecture can be classified along two dimensions:

Table 1
Strategies of Inquiry, adapted from Deming and Swaffield, 2011 (p. 9).

	Inductive (theory building)	Reflexive (theory/practice interactions)	Deductive (theory testing)
Objectivist strategies	Description	Modelling and correlation	Experimentation
Constructionist	Classification	Interpretation	Evaluation and diagnosis
Subjectivist strategies	Engaged action	Projective design	Logical systems

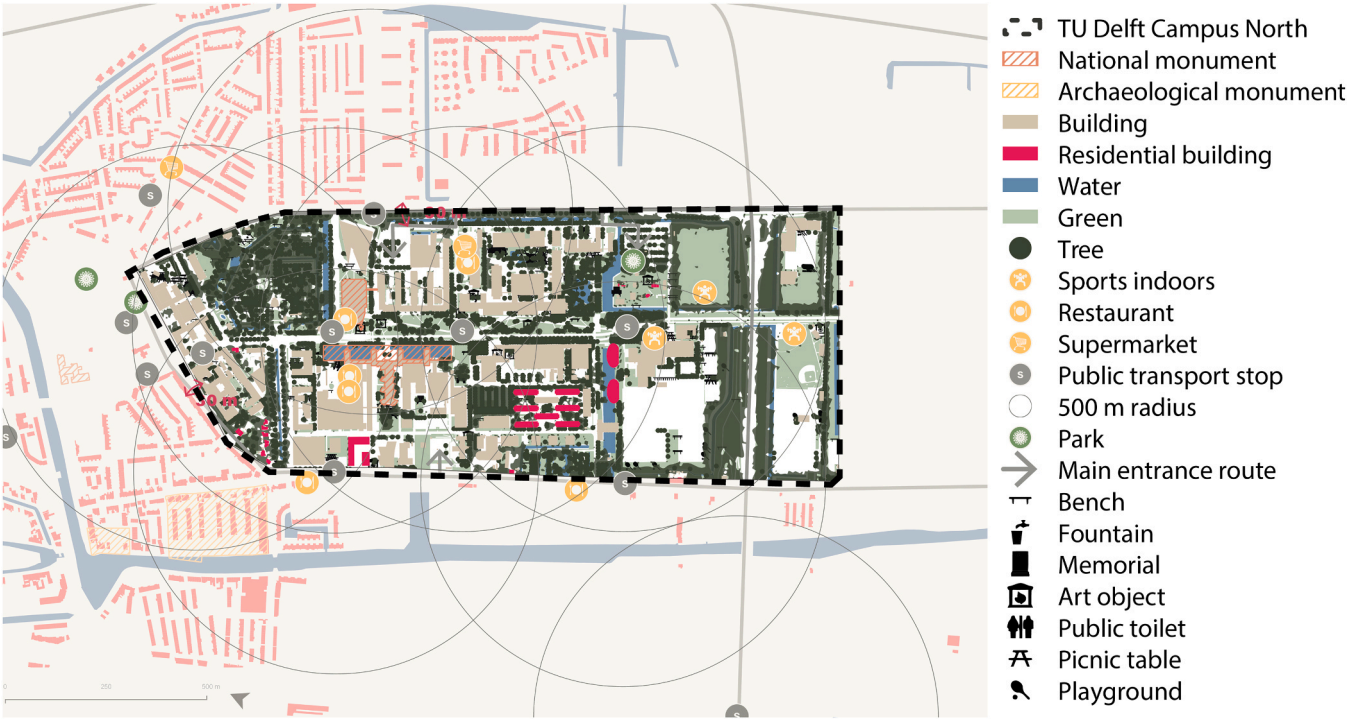


Fig. 1. Analytic map TU Delft Campus North. By the authors.

epistemological position (objective, constructive, subjective) and reasoning mode (inductive, reflexive, deductive), see Table 1.

This research employs an objective-deductive, experimental strategy, building upon the established body of knowledge by de Wolf et al., 2025 on the spatial quality of business districts. They present a comprehensive framework, Fig. 2, for evaluating spatial quality in business districts, particularly in the context of transforming them into workscapes. The study highlights that spatial quality in business districts is not a singular metric but a multi-dimensional concept. The proposed framework facilitates a nuanced evaluation that supports design-led transformation towards more liveable, sustainable, and inclusive urban environments.

The landscape is an integrative framework that combines diverse aspects, ranging from nature and climate adaptiveness to social dimensions and economics, into the physical environment (Nijhuis, 2024). As landscape architecture can facilitate the search for integrated solutions (Nijhuis & de Vries, 2020), this research investigates how the indicators of the framework for spatial quality of business districts, as shown in Fig. 2, can be improved through landscape architectural design experiments. The experiments are executed by the Landscape Architecture Section at TU Delft, including staff members and/or students. As van Dooren., 2020 describes, the design process begins with ideas and sketches, exploring possible solutions to a spatial problem. Several landscape architectural field experiments are conducted in the 'real-world' setting of the TU Delft Campus. In this setup, there is no full control over the experiments or randomisation. The field experiments conducted within a research-through-design framework draw on quasi-experimental evaluation principles through before-and-after assessment. The aim was not causal attribution in the strict experimental sense, but the systematic evaluation of design interventions under real-world conditions. To enhance the accuracy and reliability of interpreting design outcomes, triangulation was applied at two levels. Quantitative triangulation for issues such as water nuisance, heat stress, and ecological value, supported by measurable increases in the number of trees, the shrub layer, green space, and water buffering capacity, and methodological triangulation, which combines these site measurements with qualitative user observations to verify spatial relationships. This is evident, for example, in assessing whether tree planting strengthens visual connections or transforms underutilised paved areas into more inviting public spaces. This dual approach strengthens the robustness of the design patterns.

This research aims to identify and generate spatial design patterns to improve spatial quality in business districts through field experiments. This study assesses how the local interventions influence experienced spatial quality at the district level.

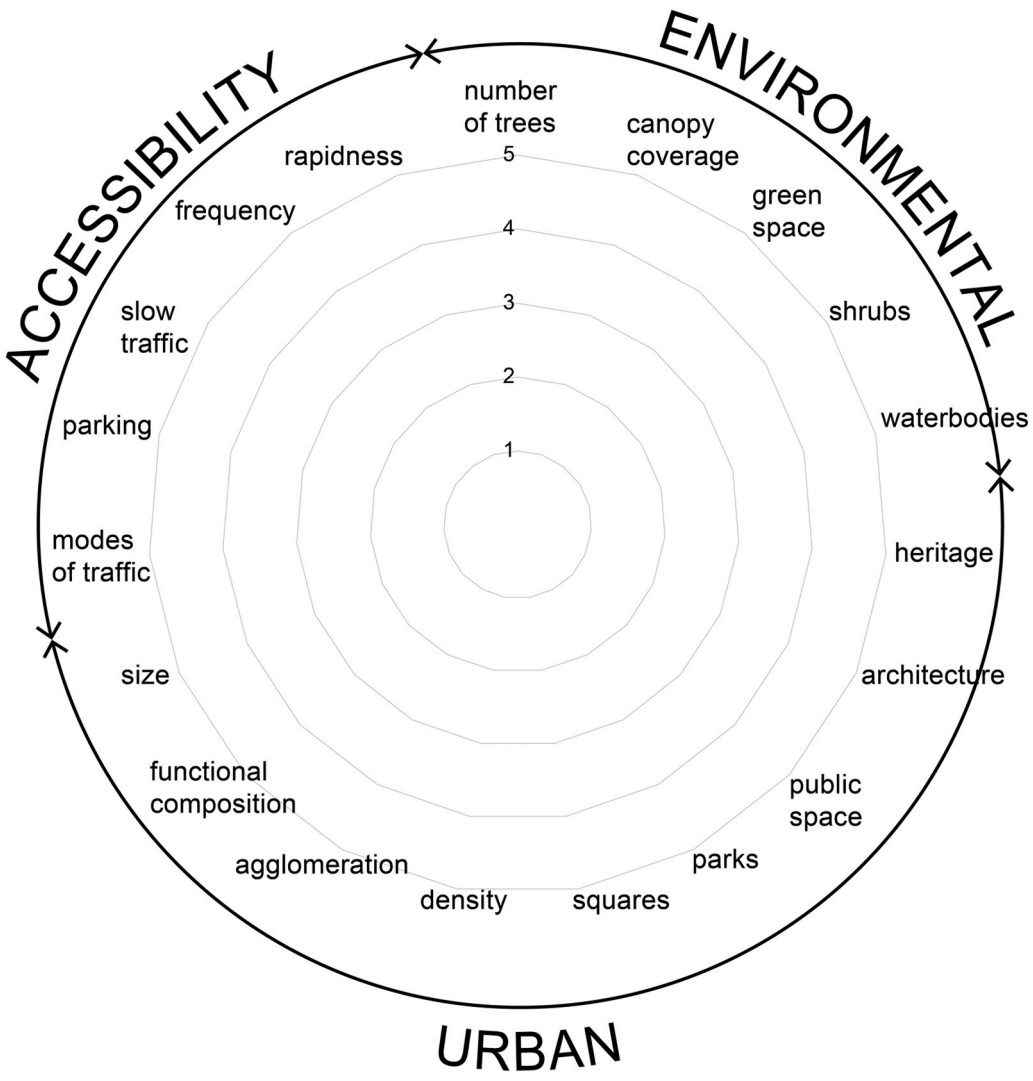


Fig. 2. Framework for spatial quality in workscape development, adapted from (de Wolf et al., 2025).

3.1. Experiencing spatial quality

To determine and quantify changes in users' perceived spatial quality, an anonymous Microsoft Forms survey was administered from April 16, 2026, to April 24, 2026. To assess perceived spatial quality, respondents were shown photographs of both pre- and post-intervention situations for each site in the questionnaire. Consequently, the assessment of the 'before' and 'after' conditions was based on visual comparison and respondents' recollections of past experiences. Prior familiarity with the sites was therefore not required. The Likert scale, formulated by Likert (1932), is commonly used to evaluate participants' preferences or degree of agreement with statements (e.g. Alabi & Jelili, 2023). The survey includes six Likert-type items representing dimensions of perceived spatial quality: overall spatial quality, safety, accessibility, visual attractiveness, visual connection to greenery, and comfort. Following the conditions for its use in urban and related studies formulated by Alabi and Jelili (2023), each item was measured on a five-point Likert-type scale (very poor, poor, neutral, good, very good). This provided a symmetric bipolar response format with a clearly defined midpoint. The scores were aggregated by taking their mean, yielding a composite perceived spatial quality score for each respondent. T-tests are commonly used to analyse respondents' perceptions in urban landscape design studies (e.g. Kazemi et al., 2023; Sadeghpoor et al., 2024). Accordingly, this research conducted paired-samples *t*-tests to compare composite perceived spatial quality scores before and after the intervention at each location. These tests assess whether respondents' mean composite scores differ significantly between the two measurements. By comparing repeated measurements from the respondents, the analysis controls for inter-individual differences. The survey and *t*-test results are presented in detail in Appendix A. Survey data were analysed systematically in RStudio (Version 2026.05.1 +225). Graphical modifications were made in Adobe Illustrator (Version 30.6) to enhance readability and generate the final plots.

3.2. Pattern Language

These field experiments utilise the campus terrain as a testing ground for innovations that can be scaled up and translated to business districts. In landscape architecture research, generalisation is often challenging. Design outcomes are highly context-dependent; therefore, this research aims to formulate design patterns that are not rigid rules but adaptable templates to be interpreted and modified to local contexts. Generic design principles are abstracted from the field experiments to spatially set an example for other business districts with similar spatial characteristics, following Alexander et al., 1977 foundational Pattern Language approach. In this language, patterns function as recurring solutions to common spatial problems. The spatial analysis by de Wolf et al., 2025 presents several commonalities, or recurring spatial problems, amongst Dutch business districts. The study shows that they are characterised by monotonous rows of large, rectangular buildings arranged in rigid grid patterns, with public space dominated by car-oriented infrastructure such as roads and parking lots. Green and blue elements are scarce, fragmented, and low in diversity, resulting in underused spaces that lack comfort, activity, and social interaction. Each pattern describes a problem in the physical environment and offers a solution that can be applied repeatedly. Patterns can range in spatial scale, from regional planning to building design, and are interconnected, forming a language that designers can use to formulate site-specific design outcomes. In this way, the research contributes to theoretical knowledge on designing workscapes.

The research methodology is schematically visualised in Fig. 3.

3.3. Context

The TU Delft Campus has already undergone several spatial transformations over time (see Fig. 4). The university was initially located in the inner-city of Delft. In the early 1900s, the university relocated to its current site, where early plans already included a linear forest, sports fields, and a vegetative buffer to separate the campus from the neighbouring residential area. The campus took over the former polder landscape. A grid of lanes between major green anchors, with the Mekelweg as the central axis, was established. Faculty buildings were framed by perpendicular tree lanes and intersecting paths. The landscape complemented the architecture, with vegetation being mere ornamental elements rather than forming green spaces for social interaction. This contrasts with Mien Ruys's landscape design for one of the faculty's, which prioritised human use. Throughout time, the campus landscape developed to accommodate the university's growth and educational demands. Already in the 1970s, a new urban plan proposed to remove traffic from the Mekelweg and increase greenery. The plan introduced new facilities, such as a library and student housing (SteenhuisMeurs, 2018 pp. 31–49). Both the publicly accessible roof of the new library and the Mekelpark later became green spaces where students, staff, and visitors could gather and recreate. Although intended as temporary, the housing remains in use.

Regarding mobility, the campus's main axis, the Mekelweg, was redeveloped into the green Mekelpark. Especially the variation in heights and vegetation, as well as the diagonal pedestrian pathways within the rigid polder system, create an outdoor space that invites campus users to meet. The adjacent faculties' orientations are now centred towards this slow-traffic green core. More recent developments include other transformations of former parking areas into green public

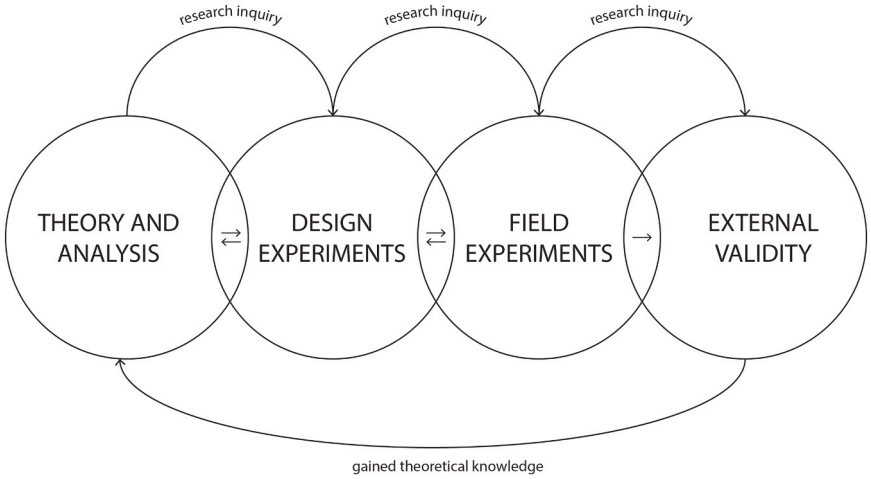


Fig. 3. Research methodology. By the authors.

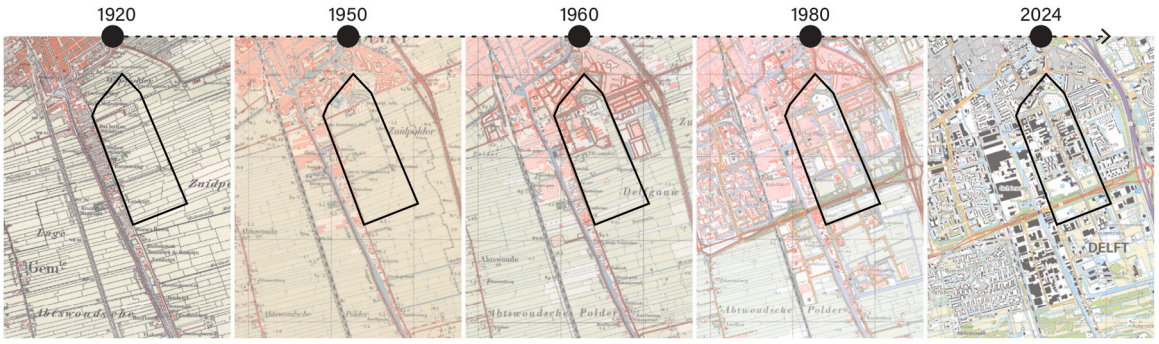


Fig. 4. Transformative development of the TU Delft Campus, from 1920 to 2024. Images from (Topotijdreis, n.d), edited by authors.

spaces, such as the Clusterplein, enabled by centralised multi-storey parking. This mobility strategy prioritises sustainability and multi-modal transport, integrating public transit and slow-traffic infrastructure. By opening public spaces and implementing greening projects, these strategies not only enhance accessibility but also improve urban character and environmental quality. In addition to changes to open spaces and parking facilities, several new buildings were added to the TU Delft Campus landscape. For example, multifunctional and residential buildings were added with active public plinths that incorporate amenities such as supermarkets, restaurants, and other publicly accessible functions that contribute to campus vitality. Qualitative, or smart, densification integrates qualitative dimensions alongside quantitative ones (Ahmad et al., 2022, pp. 1520–1528). Added buildings, such as Echo, offer more multifunctional, multi-user functions, and their architecture focuses on bio-based materials, green building envelopes, and energy neutrality. Well-designed environments can reduce the negative perceptions of density. However, for this, innovative design solutions that integrate urban greenery and high-quality public space are needed (Lehmann, 2016).

4. Results

van den Dobbelsteen and van Gameren., 2022 present TU Delft's Campus Vision 2040, aiming to establish a CO_2-neutral, climate-adaptive, and circular campus. Within this vision, the ECO-Campus ambition promotes a healthy environment for both humans and non-humans. In line with this vision, the campus transitioned to more ecological maintenance and implemented multiple greening and de-paving projects. However, the ecological network (Bennett, 2004) requires new green typologies for this urban green space (de Wolf & Tillie, 2024). These new typologies are being tested on campus through the field experiments presented in the following subsections. In the design, the landscape serves as the integrative framework for indicators of spatial quality in business districts. The experiments exemplify how current spatial characteristics of business districts can be understood as stepping stones and linear corridors within the ecological network.

4.1. Experiment descriptions, empirical research

In this section, the field experiments aimed at enhancing the spatial quality of business districts, the Urban Climate Grove, BK Park, Urban Bocage, and Bee Ridge, are presented. These interventions address spatial characteristics common to business districts, including large and paved spaces, paved lots, monocultural tree lanes, and small, single-layered green strips. The survey results show that the median perceived spatial quality of these spaces before transformation was poor to neutral, and increased after transformation. The survey questions and results are provided in Appendix A, where Figure A1 presents the corresponding pre- and post-intervention assessments for each site.

4.1.1. Stepping stones in business districts

The Urban Climate Grove is a transformative project and addresses three critical issues on the Faculty of Architecture and the Built Environment's forecourt: extreme heat stress, low socio-ecological value, and water nuisance caused by extensive paving. See Fig. 5. These challenges mirror conditions in many business districts with large, sealed surfaces, as documented in the Klimaateffectenatlas (Deltares & Richtlijn Overstromingsrisico's, n.d; Nelen & Schuurmans, 2024). The intervention, a tree-rich wadi, integrates 25 tree species arranged by hydrological tolerance, creating a gradient from wet-adapted vegetation in the basin to more drought-tolerant species on raised mounds. Secondly, surface-temperature simulations were conducted using ENVI-met (V5.5.1), a commonly used simulation software in microclimate research (e.g. Wang et al., 2019; Aleksandrowicz et al., 2023; Chen et al., 2025), which identified the areas on the forecourt with the highest surface temperatures. Surface temperature was selected to simulate, as it provides insight into the thermal behaviour of different landscape materials and vegetation structures. Faragallah & Ragheb (2022) describe surface temperature as the most crucial factor in individuals' lifestyles. Via this simulation, the relative cooling potential of the described design interventions could be assessed. The indicator, however, was not intended as a direct measure of pedestrian thermal comfort or heat stress. The computational domain covered 100 × 55 m and encompassed only the area of interest, its enclosing façade and part of the building. Setting this boundary reduced computational demands whilst capturing the relevant microclimatic effects. The building enclosing the forecourt was modelled as a 21 m-high volume. Materials were assigned to each surface.

The simulation was run for 21 June, 2020, 15:00, a hot moment in the year and day. The trees with the most cooling capacity (van der Velde et al., 2023) were strategically positioned at locations where human activity was centred in the design, which were also identified as hot areas on the court by the simulation. The design was remodelled in ENVI-met to validate this design strategy.

The study's outcomes, along with the tree species' positions, are presented in Appendix B. This design aligns the faculty's entrance with its sustainability-focused research and education agenda. An example of spatial design as a tool for expressing institutional values (Chaban,



Fig. 5. Left: paved forecourt before transformation. Photography by BK Communication. Right: Urban Climate Grove, after transformation. Photography by the authors.

2025). Beyond aesthetics, the forecourt improves microclimatic performance, biodiversity, and social usability, transforming a monofunctional paved space into a smaller, interactive green space (Blauwe Kamer, 2025, pp. 154–157).

Community engagement through an exhibition informed the final design, ensuring responsiveness to user needs. The survey results show a positive assessment of the redevelopment: a very strong majority agrees that their experience has improved, with no negative responses. Aesthetic quality is the most important contributor to these experiences. EIS, the Dutch knowledge centre for insects, conducted a baseline survey prior to the project's implementation and a follow-up assessment after the first growing season to evaluate the impact of the transformation on bee biodiversity. Initially, the forecourt was the least bee-friendly location on campus; however, within a single growing season, the transformation led to a remarkable increase in bee species richness, rising from three observed species in 2024 to nineteen in 2025, which is also high compared to the other monitored locations on the same campus. This demonstrates the effectiveness of the measures taken to enhance non-human usage as well (Dijkshoorn, 2025; Dijkshoorn, 2026). Designing with diverse plant and tree species provides biodiversity with a range of flowering periods, food, shelter, and nesting places, while also creating a more spatially complex atmosphere for people. Forecourts in business districts can function as ecological stepping stones, mitigating fragmentation in urban green networks.

The Faculty of Architecture and the Built Environment's outdoor parking lot exemplifies typical conditions in business districts: extensive paving, high parking pressure, and minimal vegetation. This vegetation was previously limited to nine cherry trees, located far from the building and stressed by vehicular use. Replanting obligations required planting nine new trees, prompting a strategic redesign. Diverse tree species tolerant of the heat and drought of the parking lot were selected and redistributed across the site to optimise visual connectivity with public spaces and interior views, aligning with Konijnendijk's (2023) 3–30–300 rule. This rule explains that to shape healthy neighbourhoods, one should be able to see at least three trees from every home, place of work, or school, live in a neighbourhood with at least 30% tree canopy, and be no more than 300 m from a public green space from their residence. Each tree now benefits from an underground volume equivalent to three parking spaces, improving root development and long-term viability. The tree bed design originated from the ECOCampus ON-SITE elective, an elective master's course first taught in 2020 (TU Delft, n.d.-c), which frames the campus as a living laboratory for eco-innovation and incremental ecological integration (Roggema & Tillie, 2022). While each bed design aligns with the specific tree species, cohesion is achieved through shared vegetative elements. The less rigid design allows for future expansion if mobility shifts permit converting parking into green space. This intervention transforms a monofunctional paved lot into a more climate-adaptive landscape with visual connectivity to greenery, as shown in Fig. 6. The survey results are more mixed than those for the forecourt, but overall, still show a positive evaluation of the redevelopment: most respondents perceive the space as improved. Unlike the forecourt, the current experience is less dominated by aesthetic quality alone; functionality and social atmosphere emerge as important contributing factors, showing a more heterogeneous perception of the intervention.



Fig. 6. Left: paved parking lot before transformation. Middle: BK Park, after the first nine trees were replanted. Right: Visual connection to greenery from the interior after planting. Photography by the authors.

4.1.2. *Linear corridors in business districts*

The Urban Bocage concept adapts historical bocage structures, multilayered, linear vegetation systems that separate plots, into the urban context. Unlike hedges, bocages incorporate a mix of trees, shrubs, and ground cover. This layered vegetation enhances soil health, reduces noise pollution, improves air quality, and provides a more spatially complex promenade. When bocages are integrated into the street profile, these infrastructural elements shift from obstructive boundaries to connective green corridors in the ecological network. They function as linear forests, see Fig. 7. This multifunctionality positions bocages as a sustainable strategy for resilient urban infrastructure (Gauthier et al., 2025), enhancing biodiversity and climate adaptability. The survey results indicate a strongly positive overall evaluation of the redevelopment: the large majority of respondents perceive the space as improved (60 out of 67), and most agree that the redevelopment has enhanced their personal experience (49 agree or strongly agree, none disagree). Aesthetic quality clearly dominates as the main contributor to this improved experience. Far outweighing the feeling of safety, social atmosphere, functionality, comfort and other suggestions.

The Bee Ridge (see Fig. 8) applies similar principles; however, it is designed specifically to support pollinator habitats. Despite their ability to fly, bees depend on proximate ecological networks for nesting and foraging. Effective habitats require sandy substrates, woody elements and diverse flowering vegetation (van Rooij et al., 2020). The Bee Ridge introduces a loam-based linear feature enriched with species tailored to bee ecology. This addresses critical declines in bee populations (Biesmeijer et al., 2006). This Bee Ridge is shaped by digging a linear wadi, using the dug-away soil as the core of the element. This intervention enhances pollinator corridors and promotes urban ecological connectivity, enriching bee species diversity on this location from 16 in 2024 to 25 in 2025 (Dijkshoorn, 2025; Dijkshoorn, 2026). The survey results show a clear positive impact of the redevelopment: nearly all respondents perceive the space as improved, and a strong majority agree that their experience has improved, with very little disagreement. As in the other cases, aesthetic quality is by far the dominant contributor to the current experience.

Both interventions easily fit the street profiles present in business districts, which commonly include small strips of monocultural, monolayered vegetation.

4.2. *Derived patterns and analysis, theoretical synthesis*

Through spatial analysis, de Wolf et al., 2025 show that Dutch business districts are predominantly composed of large, uniform buildings laid out in rigid grids. Public space is shaped by car-oriented infrastructure, and green and blue space are limited, fragmented and lacking diversity. Leading to spaces that are poorly used and offer limited comfort, activity and opportunity for social interaction. Based on the field experiments and spatial transformations on the TU Delft Campus, spatial solutions have been formulated for these recurring spatial problems. These patterns were derived through an iterative process of abstraction. First, the design interventions and spatial



Fig. 7. Left: Urban Bocage before transformation, image captured from Google Street View (Google, 2026). Right: Urban Bocage after transformation, photography by the authors. Transforming the common linear strips of grass and trees into a more diverse strip.



Fig. 8. Left: Bee Ridge before transformation, photography by Julius Knoester. Right: Bee Ridge after transformation, photography by the authors. Transforming the common linear strips of grass and trees into a more diverse strip.

outcomes were documented for each field experiment and the spatial transformations. Second, a design exercise sought to generalise the specific spatial principles. Third, principles were clustered into candidate patterns. Fourth, the candidate patterns were compared with other locations to assess their applicability to recurring spatial aspects of business districts beyond their specific contexts. This process resulted in six design patterns, categorised according to the spatial scale at which they operate. In line with Alexander et al., 1977 pattern language, each pattern addresses a recurring issue and offers a transferable solution applicable to other business districts with similar characteristics. At the spatial scale, the patterns focus on the district (D), the street (S), or the private plot (P). See Table 2.

4.3. Discussion of generalisability and external validity

In this research, design itself is a research method, making it part of the iterative research inquiry. This reflexive methodology extends beyond the application of retrospective analysis, enabling learning, real-time reasoning, and adaptation within the design process (Schön, 2017). As described by Lawson (2006), design is not only an outcome but also a process of negotiation between problems and solutions through iterative activities. Lawson also identifies several design traps designers might fall into. In this research, two of the authors were both designers and researchers, which introduces a risk of bias. Though it enriches contextual understanding, design intentions can influence how the results are interpreted. To counteract this bias, data triangulation is applied, combining multiple methods (Simmons, 1927), to validate the findings. Moreover, at each field experiment, at least one additional designer and researcher were involved.

The TU Delft Campus offers a distinct institutional, economic, social, and spatial context. Although other institutions are present, the campus largely functions as a single property. Also, the user population is dominated by students and academic staff. Unlike business districts driven by profit and managed by multiple stakeholders, TU Delft's Campus prioritises research and education, with the public domain centrally managed by Campus Real Estate and Facility Management. This limits the implementation and transferability of the patterns. Nevertheless, the spatial challenges addressed, extensive hard surfaces, low ecological connectivity, and a lack of human-scale public space, are typical in commercial business districts. Survey results, specified by user group, indicate that the proposed design interventions remain relevant for professional, non-academic users (Appendix A, Figure A2). The university campus, therefore, provides a relatively safe environment for experimenting with innovative green typologies to be mainstreamed in practice. Another limitation of this study, however, concerns respondents' familiarity with the intervention sites. To enable evaluation of both the pre- and post-intervention conditions, images of each condition were included in the questionnaire. As assessments were based on the presented visual material rather than solely on personal experience, all responses were included regardless of prior site familiarity. Nevertheless, the findings could be strengthened by restricting the analysis to respondents who were highly familiar with both the original and transformed situations. Such an approach, however, would substantially reduce the sample given the dynamic nature of the university campus user group. Regarding the questionnaire, it should be noted that the field experiments took place between 2023 and 2025, allowing the design patterns to evolve throughout the research process, whereas the questionnaire was conducted in 2026 and primarily served as a retrospective assessment confirming enhanced perceptions of spatial quality. Furthermore, the ENVI-met analysis assessed surface temperature as an indicator of heat storage and microclimatic performance, but human thermal comfort would be more comprehensively evaluated using Mean Radiant Temperature, Physiological Equivalent Temperature or Universal Thermal Climate Index. The questionnaire-based perceived comfort captures broader experiential qualities beyond thermal conditions alone.

The strategy employed in this research enables the identification of relational patterns between intervention types and improvements in spatial quality, rather than prescribing fixed design solutions. This relational focus allows the derived design patterns to operate as transferable design knowledge, context-sensitive frameworks that can be adapted to local socio-ecological, climatic, and governance conditions. In this sense, the research contributes to middle-range theory in design studies, bridging situated experimentation and generalisable design principles for transforming car-oriented business districts into socio-ecologically inclusive workscapes.

The research identifies which spatial-quality indicators improve through the design patterns, but it does not assess the extent of improvement, as visualised in Table 3. As this overview shows, the formulated design patterns do not improve the spatial quality indicators heritage, agglomeration, and frequency. Additional design patterns should be developed to improve business districts in these areas. In Appendix C, the indicators for the spatial quality of business districts are linked to workscape values, design patterns, and monitoring aspects.

5. Conclusion

This research explored how landscape-based design experimentation contributes to transforming car-oriented business districts into socio-ecologically inclusive workscapes. By situating field experiments within the TU Delft Campus, a living laboratory for sustainable urban design, the study demonstrated how site-specific interventions can generate middle-range design knowledge. The experiments revealed that small-scale spatial transformations, such as the introduction of stepping stones and multi-layered green corridors, can collectively enhance spatial quality across environmental, urban, and accessibility domains. The research identifies which spatial-quality indicators may improve through the design patterns, but it does not assess the extent of improvement.

Early observations suggest promising ecological and social effects. Using a strategy that integrates quantitative and qualitative assessments, the study demonstrates how field experiments can generate transferable design patterns from site-specific landscape interventions. By linking experimentation, research through design, and pattern language theory, the research contributes a methodology for generating design knowledge from real-world spatial transformations. The resulting design patterns, Centre Orientation, Add Human Dimension, Densifying Strategically, Cluster Parking, Diversifying Strips, and Diversify Sightlines, provide a framework for designers and planners navigating the transformation of business districts into workscapes.

The TU Delft Campus offers a distinct institutional setting, limiting the generalisability of the design patterns. However, the issues the patterns address are spatially emblematic of commercial business districts. By articulating the design patterns as adaptable, evidence-informed frameworks, this research advances a transferable methodology for converting site-specific experimental findings into generalisable design knowledge. While demonstrated through the transformation of business districts into workscapes, the methodology can be applied to other landscape and urban design challenges where locally tested interventions need to be translated into transferable spatial strategies. It

Table 2
Spatial design patterns to design for workscapes, based on field experiments and ongoing spatial transformation.

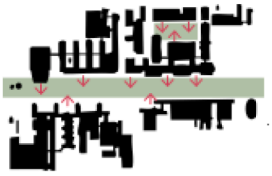
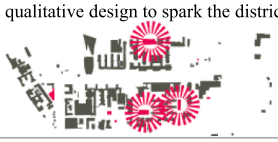
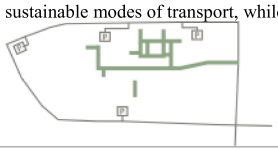
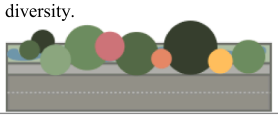
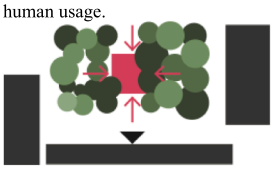
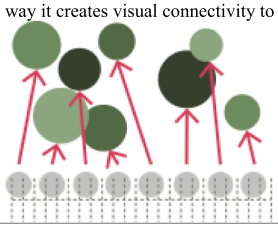
Design pattern	Description	Empirical reference / experiment source
Scale: district **D.1 Centre Orientation**	Problem: Public space on business districts is inactive. Solution: Enhance the density of public space usage by centring orientation of buildings towards a green, slow-traffic friendly, public core. 	Spatial transformation TU Delft Campus North
Scale: District **D.2 Densify Strategically**	Problem: Business districts do not include services, functions, and amenities that stimulate exploration outdoors. The architecture on business districts is often outdated and contributes to the monotony of the district. Solution: Strategically densify the business district by adding facilities and services that can be of use to multiple types of users. Also, ensure qualitative design to spark the district's urban character. 	Spatial transformation TU Delft Campus North
Scale: District **D.3 Cluster Parking**	Problem: Business districts must be accessible by motorised traffic. However, it generates a car-dominated environment with too much sealed surface. Solution: By clustering parking on the outer ring of the business districts, the street image becomes less cluttered and allows to create green slow-traffic zones in the core of the districts. It stimulates more sustainable modes of transport, while remaining accessible. 	Spatial transformation TU Delft Campus North
Scale: Street **S.1 Diversify Strips**	Problem: The street design on business district is monotonous. It includes much space for the car and monocultural and monolayered vegetation. Solution: Diversify the many linear green elements by adding multiple layers of vegetation, elevation differences, and introducing species diversity. 	Urban Bocage and Bee Ridge
Scale: Plot **P.1 Add Human Dimension**	Problem: On business districts, many large, open, paved areas can be found, lacking space for humans and non-humans. This results in heat stress, water nuisance, and underutilised space. Solution: Create human dimension by adding elements, such as greenery. Also add street furniture to activate the space, allowing human usage. 	Urban Climate Grove
Scale: Plot **P.2 Diversify Sightlines**	Problem: Views from the workplace and outdoors are monotonous and do not meet the 3-30-300 rule by Konijnendijk (2023). Solution: Diversify sightlines by positioning diverse tree species in a way it creates visual connectivity to greenery. 	BK Park

Table 3
Impact of the spatial design patterns on the indicators from the framework for spatial quality in workscape development.

Indicators → / Patterns ↓	Number of trees	Canopy coverage	Green space	Shrubs	Waterbodies	Heritage	Architecture	Public Space	Parks	Squares	Density	Agglomeration	Functional composition	Size	Modes of traffic	Parking	Slow traffic	Frequency	Rapidness
Centre orientation			■				■										■		
Add human dimension	■	■	■	■				■	■	■			■	■					
Densify strategically							■				■		■						
Cluster parking	■	■	■	■	■		■	■	■	■					■	■	■		■
Diversify strips	■	■	■	■	■			■									■		
Diversify sightlines	■	■	■	■	■			■	■	■					■	■	■		

Pattern does not affect indicator	Pattern affects indicator

offers a model for reimagining business districts as socio-ecologically inclusive workscapes across diverse urban settings.

CRediT authorship contribution statement

Rosa de Wolf: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Steffen Nijhuis:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Peter Boelhouwer:** Writing – review & editing, Supervision. **Nico Tillie:** Writing – review & editing, Supervision, Project administration.

Funding

This study was supported by the research project Designing Workscapes of the Future: An Approach to Understand and Design for Liveable Business Districts, and is part of the Workscapes of the Future Dutch national programme, funded by the Dutch National Growth Fund, grant number 4.01.047 1e. Wonen & recreatie.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

In all four field experiments, R. de Wolf, N. Tillie, and R. Hoonhout were involved in the design process. The Urban Climate Grove design team further included R. van der Velde. The design team of the Urban Bocage also included J-F. Gauthier, M. Roos, R. Lelieveld, and M. Mol. With the design of the Bee Ridge, J. Schmeitz, J. Knoester, and T. Tabak were included. The design of BK Park included input from R. van der Velde and the ON-SITE ECOCampus student group '23-'24, being: J. Schmeitz, J. Knoester, H. Sivakumar, F. Schwegman, J. Spaaij, S. Lei, M. Lugtenburg, C. Delobbe, Y. Ji, P. Bosveld, E. Holtes, S. de Horde, P. te Braake, W. de Joode, and I. Trim.

Appendix A. Survey perceived spatial quality field experiments

The survey was conducted from April 16, 2026, to April 24, 2026. In this period, 67 respondents answered the survey. The results of each question are presented in the tables and figures below.

Table A1
What is your role on the TU Delft Campus (select all that apply)?

Role	Number
Student	17
Teacher / Researcher	25
Non academic staff	20
Visitor	7
Other	3

The total number is 72, which exceeds the number of respondents. This is because multiple answers were allowed in this question. For example, students can also work on campus.

Table A2
How often are you at the TU Delft Campus?

Presence on campus	Number
Daily	24
Several times per week	29
Occasionally	14

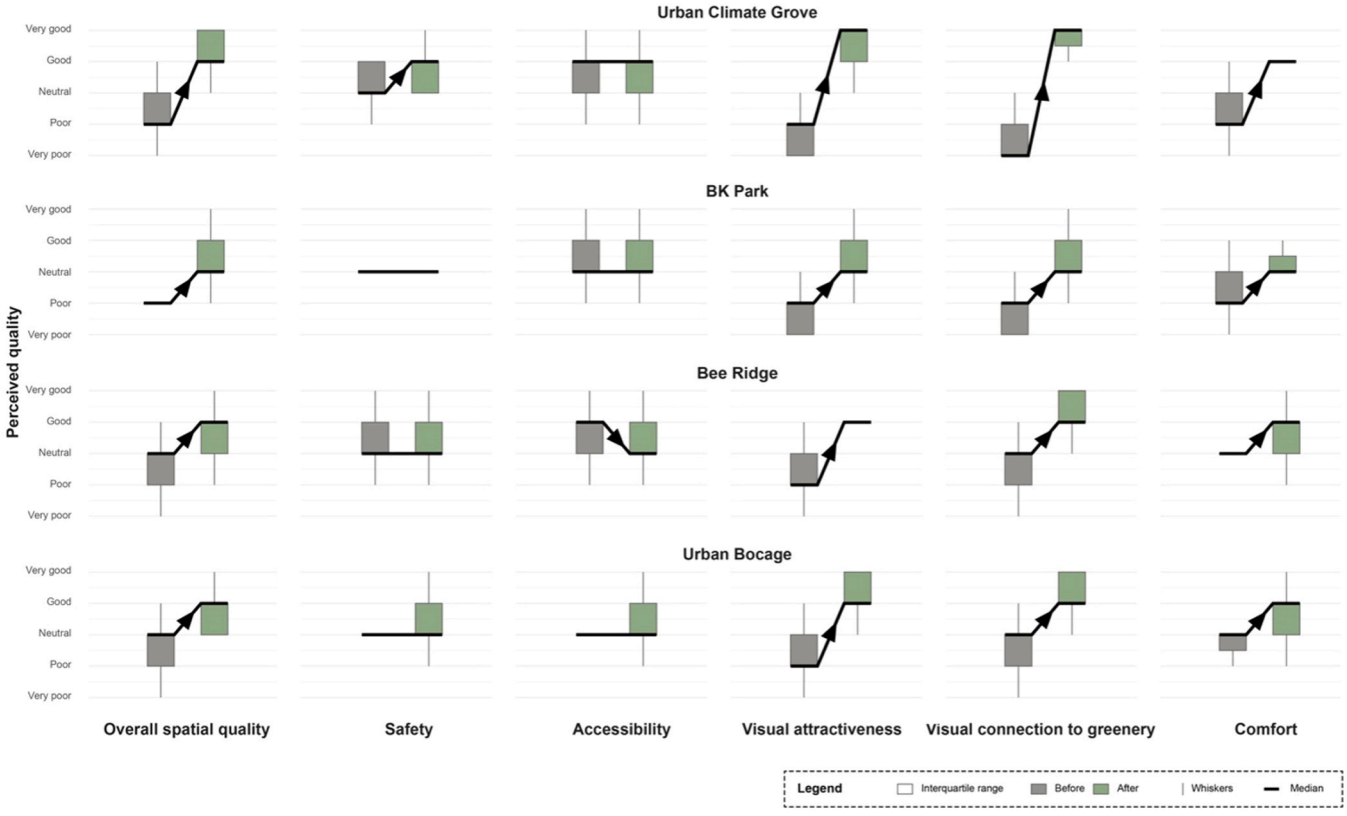


Figure A1. The box chart shows the perceived quality of the previous and current situation of the four field experiments per aspect. The boxes represent the interquartile range of the Likert-scale responses, with the horizontal line indicating the median. Boxes collapsing to a line indicate strong agreement among respondents

Table A3
How familiar are you with the space?

Location	Very familiar (I use it regularly)	Somewhat familiar	Not familiar at all
Urban Climate Grove	46	19	2
BK Park	29	28	10
Urban Bocage	9	22	36
Bee Ridge	12	40	15

Table A4
Compared to the previous situation, how has this space changed overall?

Location	Much improved	Slightly improved	No change	Slightly worse	Much worse
Urban Climate Grove	61	6	0	0	0
BK Park	3	49	15	0	0
Urban Bocage	32	28	7	0	0
Bee Ridge	25	37	3	2	0

Table A5
To what extent do you agree with the following statement?: "The redevelopment has improved my experience of this space."

Location	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Urban Climate Grove	38	23	6	0	0
BK Park	4	25	28	10	0
Urban Bocage	15	34	18	0	0
Bee Ridge	16	33	15	3	0

Table A6
What contributes most to your current experience of this space?

Location	Aesthetic quality	Feeling of safety	Social atmosphere	Functionality	Comfort	Other
Urban Climate Grove	43	2	7	1	2	12
BK Park	23	5	13	15	3	8
Urban Bocage	48	2	4	3	2	8
Bee Ridge	39	3	3	7	1	14

Table A7
Paired *t*-tests

Location	T value	df	P value	Mean before	Mean after
Urban Climate Grove	18.75	66	3.87E-28***	2.48	4.17
BK Park	10.84	66	2.66E-16***	2.34	3.22
Urban Bocage	9.41	66	8.13E-14***	2.79	3.74
Bee Ridge	9.52	66	5.25E-14***	2.96	3.73

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

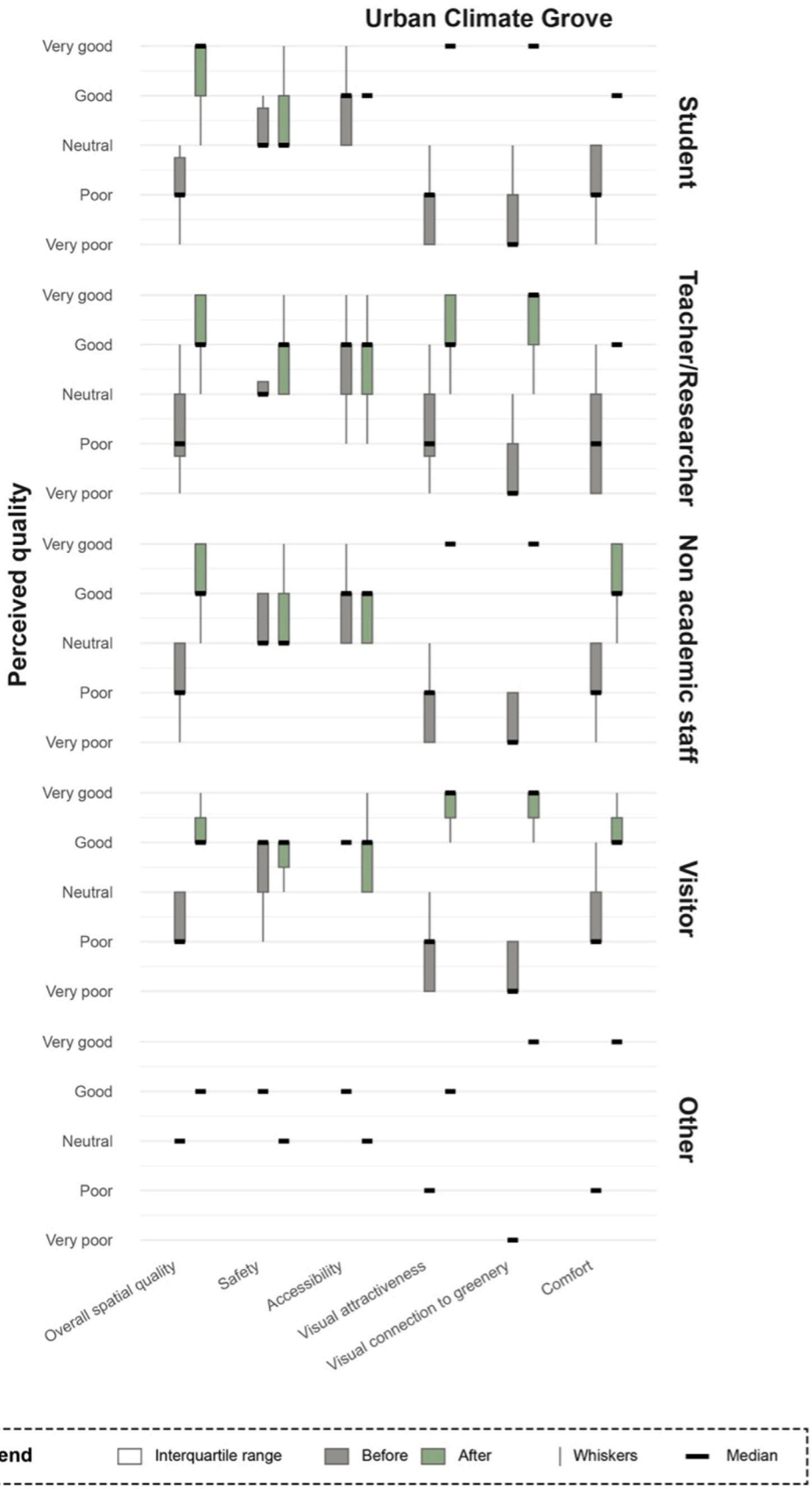


Figure A2.1. The box chart shows the perceived quality of the previous and current situation of the Urban Climate Grove per aspect, divided by role. The boxes represent the interquartile range of the Likert-scale responses, with the horizontal line indicating the median. Boxes collapsing to a line indicate strong agreement among respondents

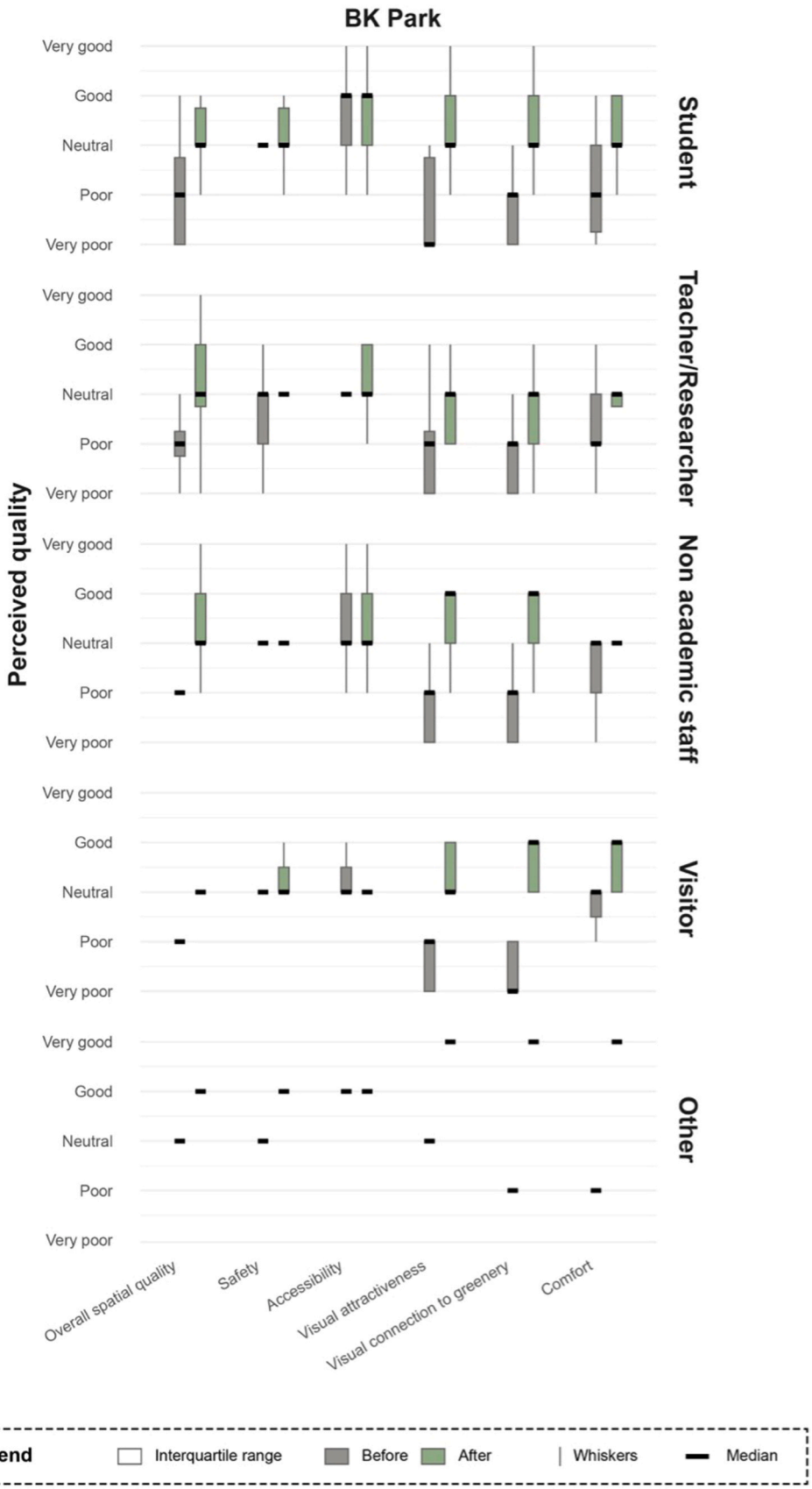


Figure A2.2. The box chart shows the perceived quality of the previous and current situation of the BK Park per aspect, divided by role. The boxes represent the interquartile range of the Likert-scale responses, with the horizontal line indicating the median. Boxes collapsing to a line indicate strong agreement among respondents

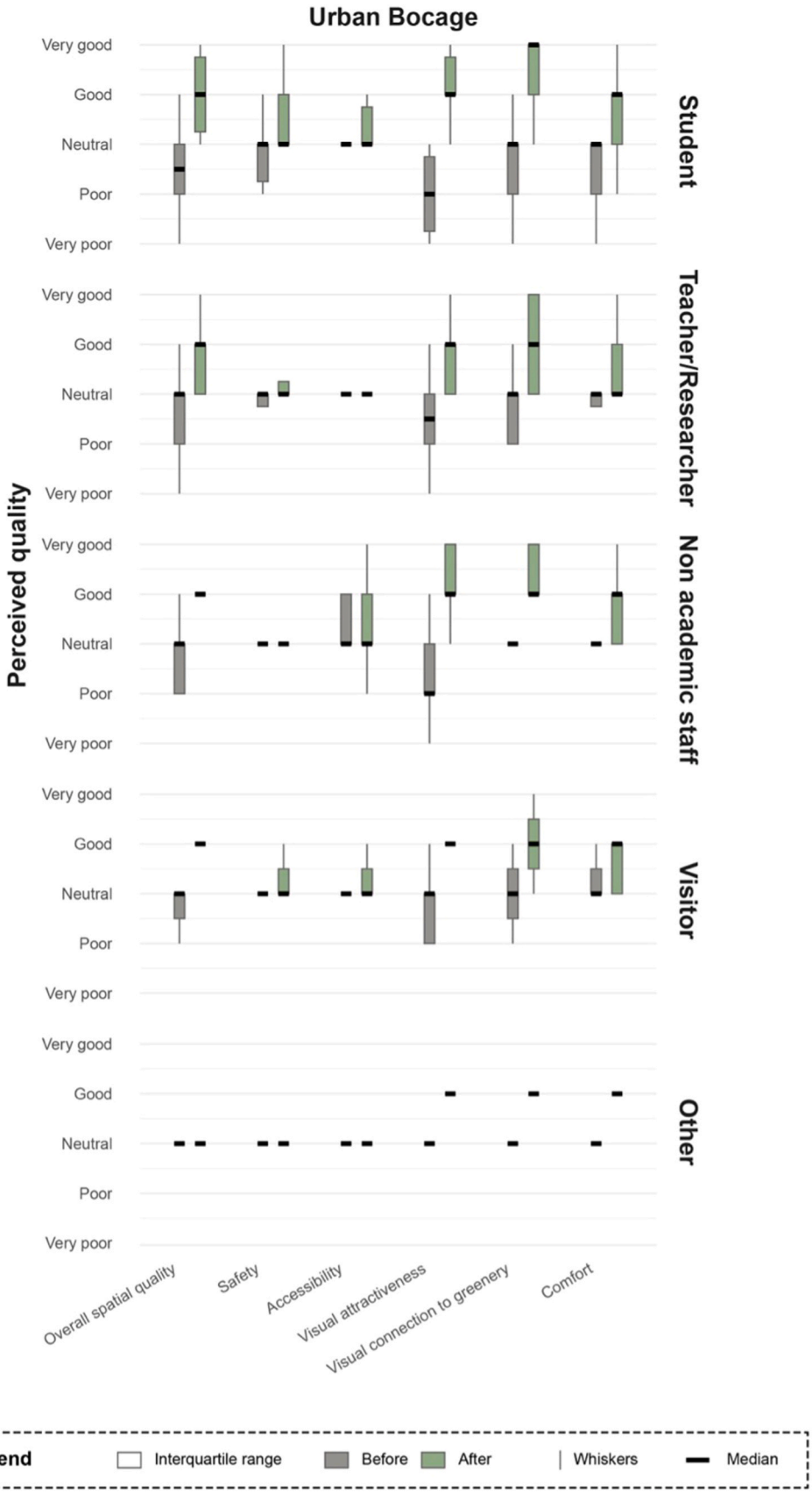


Figure A2.3. The box chart shows the perceived quality of the previous and current situation of the Urban Bocage per aspect, divided by role. The boxes represent the interquartile range of the Likert-scale responses, with the horizontal line indicating the median. Boxes collapsing to a line indicate strong agreement among respondents

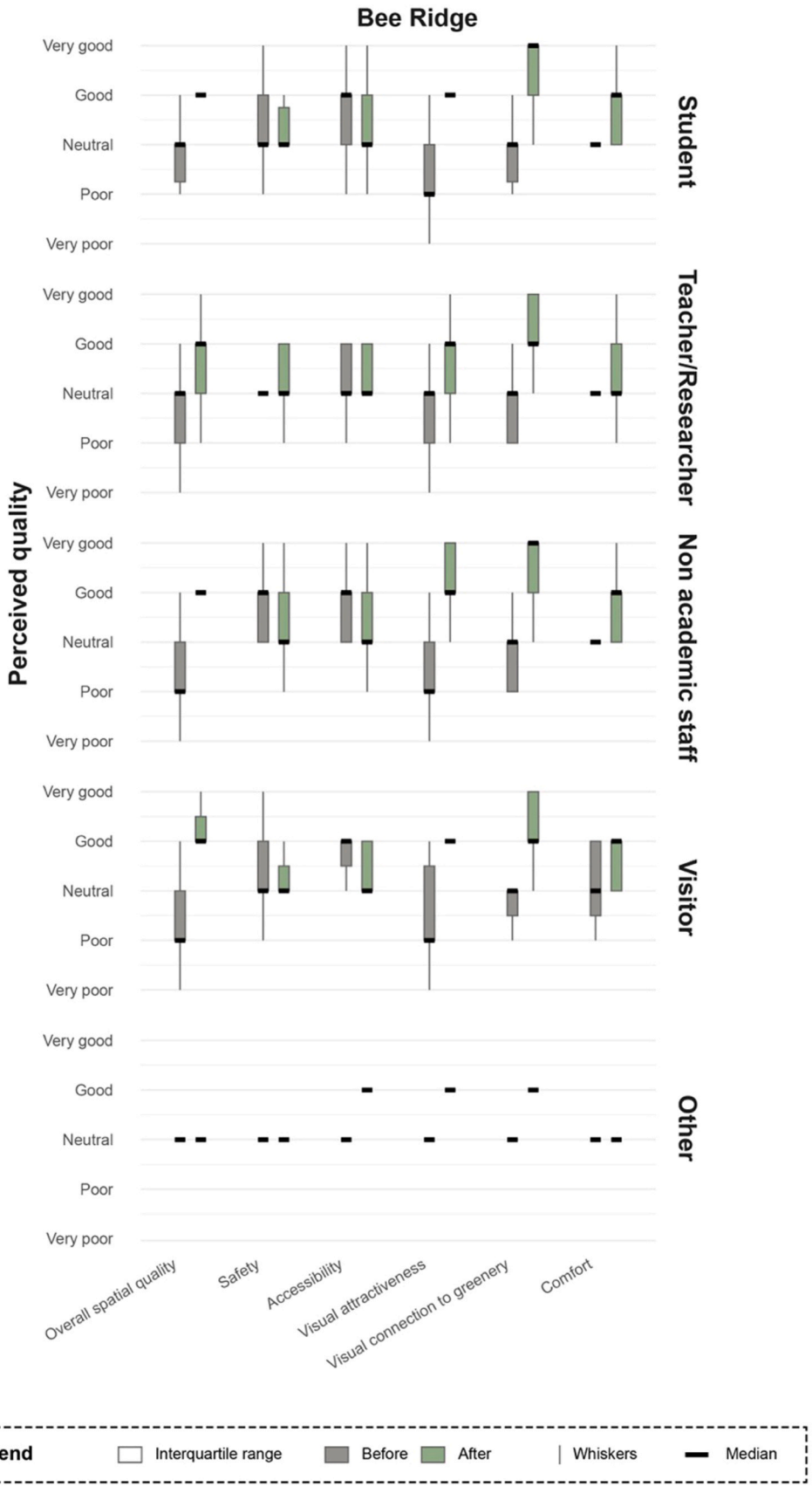
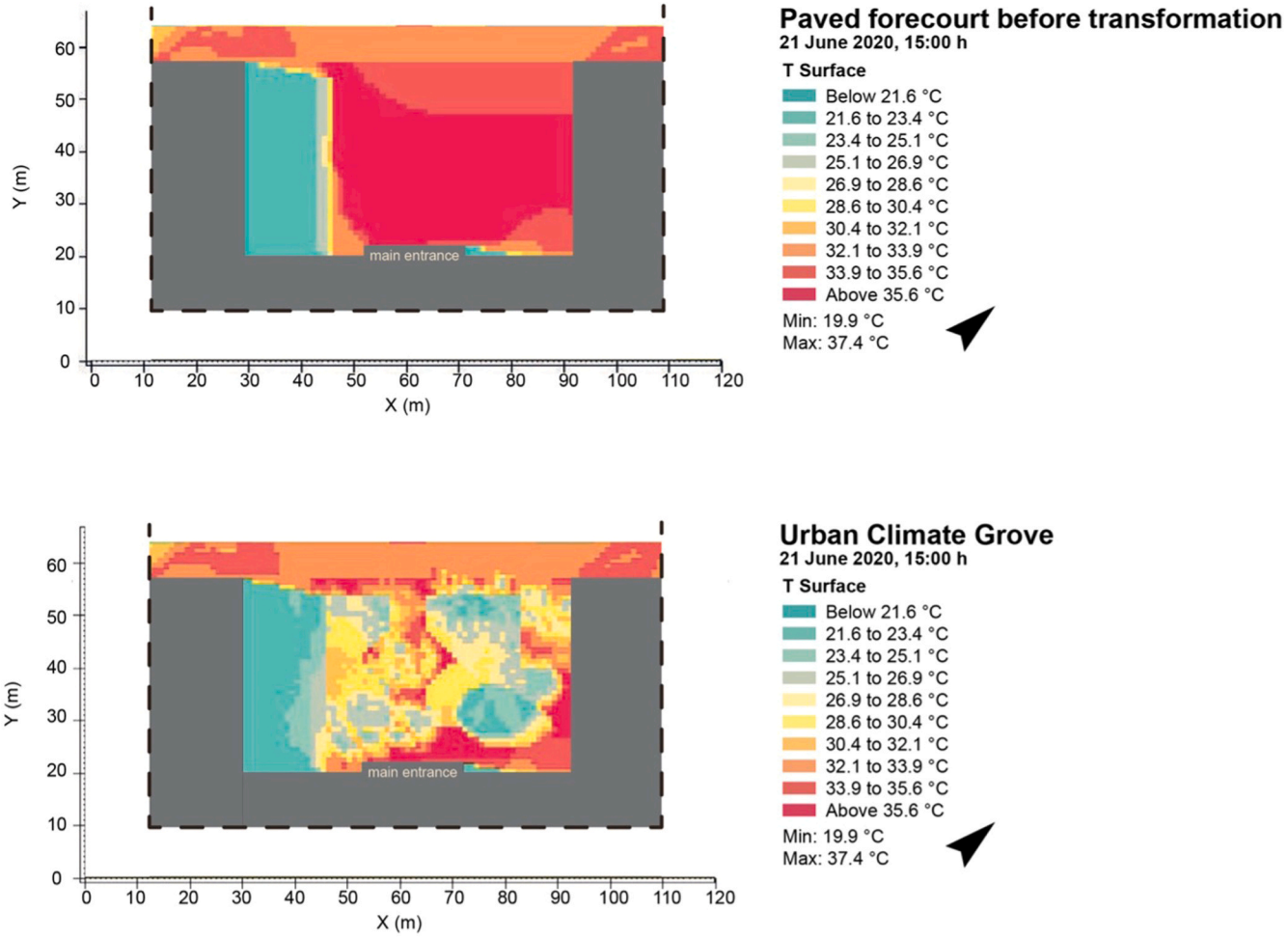


Figure A2.4. The box chart shows the perceived quality of the previous and current situation of the Bee Ridge per aspect, divided by role. The boxes represent the interquartile range of the Likert-scale responses, with the horizontal line indicating the median. Boxes collapsing to a line indicate strong agreement among respondents

Appendix B. ENVI-met analysis Urban Climate Grove



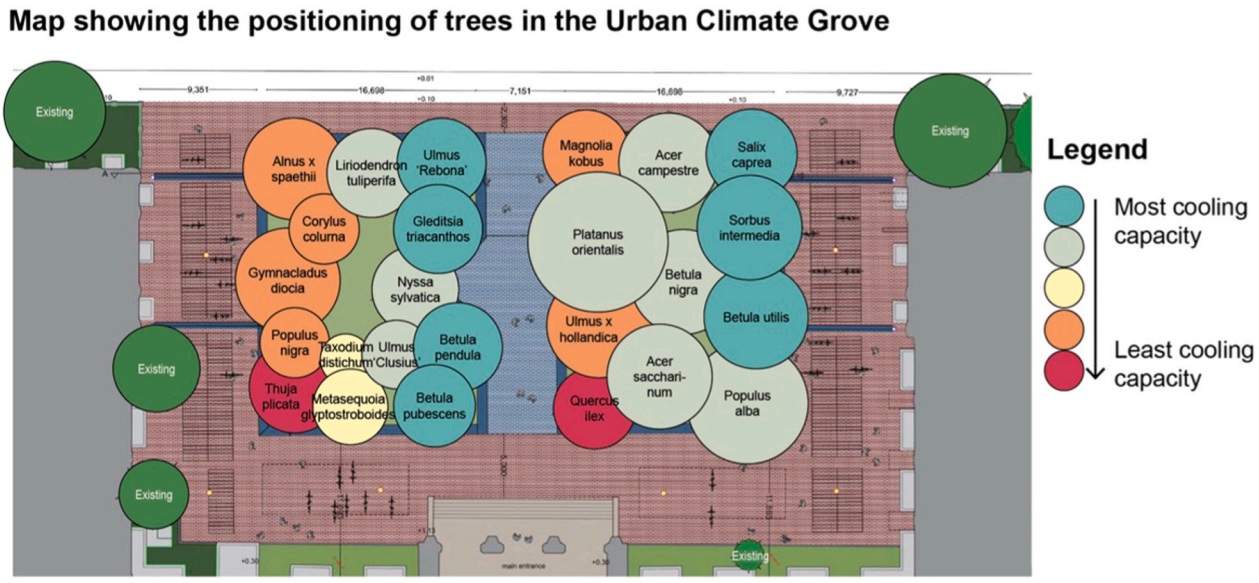


Figure B1. Results ENVI-met analysis of the forecourt of the Faculty of Architecture and Built Environment before transformation and the designed situation. Map showing the position of trees in the Urban Climate Grove based on their cooling capacity

Appendix C. Impact on the indicators per intervention

Table C1
Description of indicators for the spatial quality of business districts, linked to their workscape value (de Wolf et al., 2025), design pattern, and aspects to monitor the impact of the pattern

Indicator	Workscape value	Design pattern	Monitoring impact
Number of Trees	Sightlines to trees from every building's façade.	Add Human Dimension, Cluster Parking, Diversify Strips, Diversify Sightlines	Number [#] and qualitative observation
Canopy Coverage	30% canopy coverage.	Add Human Dimension, Cluster Parking, Diversify Strips, Diversify Sightlines	Surface [m^2]
Green Space	Private green space and maximum public green space.	Centre Orientation, Add Human Dimension, Cluster Parking, Diversify Strips, Diversify Sightlines	Surface [m^2]
Shrub Layer	Many multi-layered green spaces enhance the ecological network.	Add Human Dimension, Cluster Parking, Diversify Strips, Diversify Sightlines	Surface [m^2] and number [#]
Water Bodies	Different types of water bodies present in the district, creating a pleasant public space.	Add Human Dimension, Diversify Strips	Volume [m^3] and qualitative observation
Heritage	Several heritage elements and atmospheres.	N/A	N/A
Architecture	Attractive and diverse architecture generates a pleasant atmosphere in the public space.	Densify Strategically, Centre Orientation	Qualitative observation
Parks	Several public green spaces in strategic locations with street furniture and activities.	Add Human Dimension, Cluster Parking, Diversify Sightlines	Public green surface [m^2] and qualitative observation
Squares	Several public squares in strategic locations with furniture, activities, and shelter from diverse weather conditions.	Add Human Dimension, Cluster Parking, Diversify Sightlines	Surface to publicly accessible use [m^2] and qualitative observation
Public space	> 40%.	Add Human Dimension, Cluster Parking, Diversify Strips, Diversify Sightlines	Surface [m^2] and qualitative observation
Agglomeration	In population centres and in agglomeration cores.	N/A	N/A
Density	Residential area continues in the district.	Densify Strategically	Qualitative observation
Functional Composition	A business district with many urban amenities and facilities.	Add Human Dimension, Densify Strategically	Ratio
Size	> 140 ha	Add Human Dimension	Qualitative observation and surface [m^2]
Modes of Traffic	Multimodal connections in safe and comfortable use.	Cluster parking	Qualitative observation
Parking	Mobility hubs.	Cluster Parking, Diversify sightlines	Qualitative observation and number of mobility hubs [#].
Slow Traffic	Safe, prioritised, wide, and comfortable slow traffic infrastructure in the whole district.	Centre Orientation, Cluster Parking, Diversify Strips	Qualitative observation
Frequency	Public transport lines are always frequent.	N/A	N/A
Rapidness	Highway exit near the district; public transport stops in districts that are frequent and comfortably and safely accessible.	Cluster Parking	Qualitative observation

References

Ahmad, M., Darchen, S., Alidoust, S., Sipe, N., 2022. Smart Densification. In: Brears, R.C. (Ed.), The Palgrave Encyclopedia of Urban and Regional Futures. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-87745-3_278.

Alabi, A.T., Jelili, M.O., 2023. Clarifying likert scale misconceptions for improved application in urban studies. Qual. & Quant. 57 (2), 1337–1350. https://doi.org/10.1007/s11135-022-01415-8.

Aleksandrowicz, O., Saroglou, T., Pearlmutter, D., 2023. Evaluation of summer mean radiant temperature simulation in ENVI-met in a hot Mediterranean climate. Build. Environ. 245, 110881.

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., 1977. A pattern language: towns, buildings. construction. Oxford University Press, *New York*.

Bennett, G., 2004. Integrating biodiversity conservation and sustainable use: lessons learned from ecological networks. IUCN, Gland, Switzerland, and Cambridge, UK.

Biesmeijer, J.C., Roberts, S.P., Reemer, M., Ohlemuller, R., Edwards, M., Peeters, T., Schaffers, A.P., Potts, S.G., Kleukers, R., Thomas, C.D., Settle, J., Kunin, W.E., 2006. Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science 313 (5785), 351–354.

Blauwe Kamer. (2025). *Jaarboek Landschapsarchitectuur en stedenbouw in Nederland 2025*. 154-157.

Chaban, Y. (2025). Brand Architecture: A Design Methodology That Shapes Commercial Identity. IJSAT-International Journal on Science and Technology, 16(3).

Chen, Y., Deng, S., Hou, Y., Yan, Q., 2025. Impact of environmental elements in classical Chinese gardens on microclimate and their optimization using ENVI-MET simulations. Energy Build. 329, 115238. https://doi.org/10.1016/j.enbuild.2024.115238.

de Vries, S., Buijs, A.E., Snep, R.P., 2020. Environmental justice in The Netherlands: Presence and quality of greenspace differ by socioeconomic status of neighbourhoods. Sustainability 12 (15), 5889.

de Wolf, R., Roggema, R., Nijhuis, S., Tillie, N., 2025. The design of workscapes: A scoping study. Land 14 (5), 1072. https://doi.org/10.3390/land14051072.

de Wolf, R., Tillie, N., 2024. Ecologisch netwerk vraagt nieuwe groentypologieën. Tuin & Landsch. 9, 20–23.

Deltares & Richtlijn Overstromingsrisico's (n.d.). Waterdiepte bij hevige neerslag. Available at: https://www.klimaateffectatlas.nl/nl/waterdiepte-bij-kortdurende-hevige-neerslag. (Accessed 13 October 2025).

Deming, M.E., Swaffield, S., 2011. Landscape architectural research: Inquiry, strategy, design. John Wiley & Sons.

Dijkshoorn, D. (2025). Bijen op de TU Delft campus: Nulmeting 2024. EIS Kenniscentrum Insecten.

Dijkshoorn, D. (2026). Bijen op de TU Delft campus: Herhaling 2025. EIS Kenniscentrum Insecten.

Faragallah, R.N., Ragheb, R.A., 2022. Evaluation of thermal comfort and urban heat island through cool paving materials using ENVI-Met. Ain Shams Eng. J. 13 (3), 101609. https://doi.org/10.1016/j.asej.2021.10.004.

Feriel, C., 2023. Rethinking the dominant modernist planning narrative: Investigating pedestrianisation in Europe, 1960s–1970s. J. Transp. Hist. 44 (2), 233–253.

Gauthier, J.-F., Klemm, W., Konijnendijk, C.C., Mol, M., Roos, M., Tillie, N., de Wolf, R., Lelieveld, R., 2025. Urban Forest Living Lab - 'Urban Symbiosis': Vital Soil as Foundation for Future Proof Urban Forestscapes - Experimenting in Real Time Locations with Different Actors in The Hague. SPOOL 12 (1), 143–160. https://doi.org/10.47982/spool.2025.1.08.

Gemeente Amsterdam. (2013). *Amsterdam Aantrekkelijk Bereikbaar*. Available at: https://openresearch.amsterdam/nl/page/99028/amsterdam-aantrekkelijk-bereikbaar. (accessed 13 October 2025).

Gemeente Rotterdam. (n.d.). Klimaatdoelen duurzame mobiliteit. Available at: https://www.rotterdam.nl/klimaatdoelen-duurzame-mobiliteit. (Accessed 19 August 2026).

Google. (2026). Google Street View image of Urban Bocage, Delft, the Netherlands. Available at: https://maps.app.goo.gl/BNsvrgAuLyVUKah56. (accessed 9 April 2026).

Kazemi, F., Hosseinpour, N., Ebrahimian, M., 2023. People's preferences and perceptions toward low-input versus conventional park design approaches using 3D images and interview-based surveys. Urban. For. & Urban. Green. 86, 128040. https://doi.org/10.1016/j.ufug.2023.128040.

Konijnendijk, C.C., 2023. Evidence-based guidelines for greener, healthier, more resilient neighbourhoods: Introducing the 3–30–300 rule. J. For. Res. 34 (3), 821–830.
Lawson, B. (2006). *How designers think*. Routledge.
Lehmann, S., 2016. Sustainable urbanism: towards a framework for quality and optimal density? Fut. Cit. & Env 2, 8. https://doi.org/10.1186/s40984-016-0021-3.
Likert, R., 1932. A technique for the measurement of attitudes. Arch. Psychol.
Nelen & Schuurmans. (2024). Klimaateffectenatlas: Kaartviewer Gevoelstemperatuur 2022. Available at: https://www.klimaateffectatlas.nl/nl/kaartviewer. (Accessed 13 October 2025).
Nijhuis, S. (2024). Landscape Logic. Jap Sam Books.
Nijhuis, S., de Vries, J., 2020. Design as Research in Landscape Architecture. Landsc. J. 38 (1-2), 87–103. https://doi.org/10.3368/lj.38.1-2.87.
Roggema, R., Tillie, N., 2022. Realizing Emergent Ecologies: Nature-Based Solutions from Design to Implementation. Land 2022 11, 1972. https://doi.org/10.3390/land11111972.
Sadeghpoor, F., Ranjbar, E., Esmaeilinasab, M., Valiloo, M.H.S., Nieuwenhuijsen, M.J., 2024. Streets and stress: a pilot study on how quality and design of streets impacts on urban stress. HERD Health Environ. Res. & Des. J. 17 (1), 224–248. https://doi.org/10.1177/19375867231200584.
Schön, D.A. (2017). The Reflective Practitioner: How Professionals Think in Action. Routledge. https://doi.org/10.4324/9781315237473.
Simmons, K.B. (1927). The triangulation method of stadia transit topographic surveying adapted to landscape architecture. Available at: https://scholarworks.umass.edu/theses/1965. (accessed 17 October 2025).
Steenhuis Meurs. 2018. Cultuurhistorisch onderzoek TU Delft. Available at https://backend.tudelftcampus.nl/app/uploads/2026/04/Cultuurhistorisch-onderzoek-TU-Delft_def.pdf. (Accessed on 6 November 2025).
Topotijdreis. (n.d.). Topotijdreis. Available online via: https://www.topotijdreis.nl/. (accessed 11 January 2024).
TU Delft. (2023). Facts and figures. Available at: https://www.tudelft.nl/en/about-tu-delft/organisation/facts-and-figures. (accessed 11 January 2025).
TU Delft. (n.d.-a). Over TU Delft. Available at: https://www.tudelft.nl/over-tu-delft. (accessed 11 January 2025).
TU Delft. (n.d.-b). Geschiedenis TU Delft. Available at: https://tresor.tudelft.nl/about/geschiedenis-tudelft/. (accessed 11 January 2025).
TU Delft. (n.d.-c). Urban Ecology the Increasing importance of Nature in the City. Available at: https://www.tudelft.nl/en/stories/articles/urban-ecology-the-increasing-importance-of-nature-in-the-city. (accessed 22 November 2025).
van den Dobbelsteen, A.A.J.F., van Gameren, D., Roeling, M., Van Mourik, T., 2023. Practising What You Teach and Preach: Working for a Sustainable University Is a Verb. 18th Conf. Sustain. Dev. Energy Water Environ. Syst. 85 (University of Zagreb).
van den Dobbelsteen, A.A.J.F., van Gameren, D. (2022). *Vision, Ambition and Action Plan for a Climate University*.
van der Velde, R., de Wit, S., Pouderoijen, M., 2023. Cool Tree Architecture: A descriptive framework for a tree architecture typology to temper urban microclimates. Landsc. Archit. Front. 11 (5), 30–42.
van Dooren, E., 2020. Anchoring the design process: A framework to make the designerly way of thinking explicit in architectural design education. A+BE | Archit. Built Environ. 10 (17), 176. https://doi.org/10.7480/abe.2020.17.5351.
van Rooij, S., van Eupen, M., Larosch, C., Braat, C., van Empel, R., 2020. Ruggengraat van het Bijenlandschap in West-Brabant: Een analyse van de huidige situatie en aanbevelingen voor versterking. Wagening. Environ. Res. https://doi.org/10.18174/555631.
Wang, Y., Zhou, D., Wang, Y., Fang, Y., Yuan, Y., Lv, L., 2019. Comparative study of urban residential design and microclimate characteristics based on ENVI-met simulation. Indoor Built Environ. 28 (9), 1200–1216. https://doi.org/10.1177/1420326X19860884.
Weppelman, I., Dill, S., Snep, R., Langers, F., de Kort, E.-J., Meijerink, R., Stopel, P., Bloem, J. (2025). *Kenschets bedrijventerreinen: systeemanalyse met de karakteristieken en potenties van bedrijventerreinen voor klimaatadaptatie en biodiversiteit*. https://doi.org/10.18174/692370.
Werklandschappen van de Toekomst. (2022). Groene, Gezonde en Toekomstbestendige Bedrijventerreinen: Aanvraag Nationaal Groeifonds 2021. Available at: https://www.scribd.com/document/643564547/Werklandschappen-van-de-Toekomst-Voorstel-geactualiseerd-1-pdf. (accessed 1 November 2023).