Enhancing Campus Walkability to Stimulate Creativity and Innovation for Students and Employees

A Research-Based Recommendation Report for the Future of TU Delft's Mekelpark

CTB3000-16: Bachelor's thesis

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TU Delft

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by

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Style: TU Delft Report Style, with modifications by Daan Zwaneveld

Preface

This thesis was written as part of the Bachelor Final Project for the Civil Engineering bachelor at Delft University of Technology. It is a Transport and Planning Bachelor Thesis of the course CTB3000-16. The research explores how the design of walking environments can stimulate creativity and innovation, with a particular focus on Mekelpark, a central green space on the TU Delft campus.

This research idea was inspired by Maria Salomons, the Transport and Planning Bachelor Thesis coordinator, who inspired me to consider this thesis topic. A growing body of research highlighting the cognitive benefits of walking and the importance of the walking environment, particularly in high-pressure academic environments, made me even more eager to explore this topic.

The inspiration for this research originated from Maria Salomons, coordinator of the Transport and Planning Bachelor Thesis. This encouraged me to explore the cognitive benefits of walking. Which is a topic that increasingly gains attention, especially in high-pressure academic environments. The idea that a simple activity like walking can contribute to improved idea generation sparked my motivation to translate this concept into a practical, research-based design approach.

I would like to thank my supervisors, Yufei Yuan and Srinath Mahesh, for supporting me with their excellent guidance,insightful feedback, and critical perspective throughout the process. Their support helped me stay focused and continuously improve the quality of my work.

The insights of Ingeborg Oostlander, my external expert, were of great importance in this research. They helped ensure that the proposed recommendations align with the broader vision of the TU Delft and therefore increased the feasibility.

I am also grateful to my group members Emma van Wely, Xander Mourik, Isabella Teeuwen, Lars Kreser, and Derk Verhees, for the weekly feedback and collaborative spirit. Their imput made the whole process more productive and enjoyable.

Finally, I would like to thank all survey respondents and the individuals who helped distribute the survey. Without your participation, this research would not have been possible.

Femke Rutgers
Delft, June 2025

Summary

This thesis investigates how campus walkability can be enhanced to stimulate creativity and innovation among students and employees, using TU Delft's Mekelpark as a case study for a design-based recommendation report. The research is grounded in scientific findings, linking walking to cognitive enhancement.

The study defines 'walkability' as a measure of friendliness of a built environment associated with walking behaviour, either for physical activity, active mobility, recreation or access to services. A literature review identified key walkability elements from prior research, particularly Ramakreshans et al. (2020), and adapted these elements to the unique context of green, car-free campus environments.

A stakeholder analysis identified Campus Real Estate and Facility Management (CREFM) as the most powerful and involved stakeholder, and their input was integrated in the final recommendations to ensure feasibility and alignment with institutional goals.

A survey with as target group, students and employees of the TU Delft, was conducted. It aims to investigate walking behaviour and interaction preferences, rank the importance of walkability elements, and assess current satisfaction levels within Mekelpark.
The 59 participants closely mirror the general population of TU Delft in terms of gender and university status, indicating a representative sample for this study.

The analysis showed key findings:

- The average respondent is on campus 3,53 times per week, spends 25% of the breaks walking, and walk for 15,05 minutes per break.
- Greenery and separation from cyclists were ranked as the most important walkability elements in the tier ranking. The elements signage, and water dispensers were rated last.
- An importance–satisfaction framework showed that elements such as greenery, number of different routes and the comfort of those routes were identified as important but currently unsatisfactory, and therefore prioritized for future improvement.
- 66,1% of the participants choose the rotating installation as interaction preference. This makes it by far the most preferred interactive option.
- There was no statistically significant differences in walking behaviour and preference for interaction across gender or university status groups found. Supporting the general applicability of the findings.

In collaboration with CREFM, key contextual considerations such as financial constraints and the preservation of the original design vision were taken into account. This resulted in a set of evidence-based, cost-conscious, and spatially feasible design recommendations.

High Priority Interventions:

- Enhance biodiversity by adding flowering plants and low shrubs; place new trees closer to walking paths.
- Relocate space-consuming activities that hinder the enhancement of greenery and are not uniquely tied to Mekelpark.
- Create informal pedestrian paths between existing linear roads using semi-paving.
- Apply semi-paving around the intersection of linear roads.
- Install temporary wayfinding signage to assist users during construction phases.

Low Priority:

- When pavement needs replacement, consider more comfortable surface materials for walking.
- Add more lampposts and, next to the informal roads, introduce small-scale solar-powered lighting.
- Make use of low-cost visual opportunities, such as collaborations with TU Delft students.

Finally, the element ‘maintenance’, though important, received relatively high satisfaction scores and may allow for modest budget reallocation to more critical improvements.

This thesis contributes to the growing interest in how the design of public space can support well-being, creativity, and cognitive performance. It can be used for all green areas on campus seeking to improve environments in a user-centered and evidence-based manner.

Contents

1 Introduction

In recent years, walking has emerged as more than just a form of physical activity. A study by Stanford University found that walking can significantly boost creative output. Researchers measured participants perform tasks that demonstrate “divergent thinking” while sitting or walking. They found that walking boosts creative output by 60%. Not only that, participants exhibited a residual creative boost after walking [27].

These findings highlight the importance of encouraging walking, especially in environments focused on learning and innovation. Research indicates that students on campuses with improved walkability are 9.75% more likely to report positive walking experiences compared to those at institutions lacking such enhancements [32]. Optimizing the walkability of a campus by prioritize pedestrian access, comfort and safety can therefore contribute to improved cognitive functioning.

Both these findings align with a growing interest in integrating movement into learning environments, particularly if they’re mostly innovation-driven.
At Delft University of Technology the aim is to develop technology-based innovations for major societal problems by training high-quality engineers who are creative, innovative and responsible. To achieve this, they want to encourage the development of innovative applications [10]. A way to encourage this is by developing a campus that stimulates students and employees to take a walk and that sparks their creativity and innovation.

1.1. Research Objective

In this thesis, the most important campus walkability elements for green areas without car traffic will be identified. Campus walkability elements are factors that influence the stimulation to walk, like road type, maintenance and amount of shaded areas. Among these elements, a ranking will be established based on their importance for stimulating walking, as well as the satisfaction level with these elements in Mekelpark, located on the TU Delft campus. Mekelpark is a central green strip surrounded by university buildings and is frequently used by students and employees during breaks. It is shown as the horizontal green area with diagonal pathways in Figure 1.1.

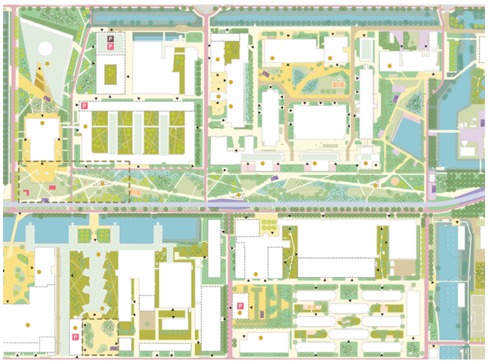

Figure 1.1: TU Delft Campus Midden, De Zwarte Hond, 2022

The data and analysis will be translated into a recommendation report for Mekelpark. The primary focus will be on improving walkability elements that have a relative high importance and low satisfaction. Since Mekelpark is already a well-used area, it provides an ideal testing ground to apply the research findings.

1.2. Research Question and Sub-Questions

The research question of this thesis is:

What is the relationship between campus walkability elements and the stimulation of creativity and innovation among students and employees at TU Delft and how can these insights be applied to create recommendations for Mekelpark?

To answer this research question, two main phases are distinguished.

- The first two sub-questions aim to answer the first part of the research question. This is be done by exploring the general relationship between walking, environmental elements, and the stimulation of creativity and innovation. These insights are broadly applicable to green, car-free campus areas.
- The last four sub-questions answer the later part of the research question. They help move from research to real-world impact, while ensuring that the recommendations are user-informed and stakeholder-validated.

The 6 sub-questions, their contribution to the main question, and the connection between each other are given below:

1. **What role does walking play in supporting cognitive processes related to creativity and innovation?**

   This question lays the foundation for the research by establishing the importance of walking in enhancing cognitive processes. It demonstrates why encouraging walking is valuable in educational and innovation-driven environments like TU Delft.

2. **What environmental factors in walking routes on campus contribute to enhanced creativity and innovative thinking in students and employees?**

   Now that the importance of walking is clear, this sub-question clarifies what "walkability" entails and selects the relevant environmental walkability elements that influence walking behavior for green car-free campus areas.

3. **Who are the stakeholders in the redesign of Mekelpark and who has the most power and interest?**

   This question shifts the research from theory to practice by identifying key players in the changes to Mekelpark and visualizing them using a power-interest matrix. It helps determine with whom to collaborate in the redesign process to ensure that the design suggestions align wit the intrest of powerful or invested parties.

4. **What is the order of importance of the environmental factors, as identified through a survey?**

   This gathers input from the students and employees to prioritize which walkability element matter most to users and therefore most important to be sufficient within Mekelpark. This ensures that the proposed recommendations are user-informed.

5. **How can the survey results be translated into targeted design recommendations for Mekelpark?**

   The survey will also give insight into the current satisfaction of walkability elements within Mekelpark. Together with the importance prioritization, this question helps to formulate concrete, actionable recommendations that address user needs.

6. **How does the most important stakeholder respond to the proposed recommendations, and how can this feedback refine the final suggestions for Mekelpark?**

This final question closes the loop by validating the created recommendations with the key stakeholder, incorporating their feedback, and refining the recommendations to ensure they are feasible and aligned with stakeholder goals.

Together, these sub-questions guide the research process in a logical sequence. They ensure that the project is grounded in science, relevant to campus users, and capable of guiding a meaningful redesign of Mekelpark that supports creative and innovative thinking.

1.3. Hypotheses

To support the research questions and guide the statistical analysis, a set of hypotheses has been formulated. These hypotheses are not used to determine the importance ranking of walkability elements or to identify which elements participants are satisfied with, those insights are derived directly from survey results. Instead, they serve to explore underlying patterns and provide a more nuanced understanding of the data. Specifically, the hypotheses aim to clarify how factors such as gender and university role may relate to differences in behavior and preferences. This helps to enrich the interpretation of the results and better understand the diversity in behavior and opinions of campus users.
The following null hypotheses are tested in this study:

- $H_0 1$: There is no significant difference in walking behaviour between male and female participants at TU Delft.
- $H_0 2$: There is no significant difference in walking behaviour between the different university statuses.
- $H_0 3$: There is no significant difference in interaction preferences between male and female participants at TU Delft.
- $H_0 4$: There is no significant difference in interaction preferences between the different university statuses.

1.4. Scientific & Societal Relevance

From a scientific perspective, this research gives useful insights into how walking can support creative thinking, and how certain physical elements in the environment can encourage walking. These findings are relevant for fields like urban planning, and campus development.
On a societal level, the results can help improve cognitive processes, because of how university campuses and other innovation-focused areas are designed. The findings are not only useful for TU Delft, but also for other green, car-free university campuses. In addition, the insights may be especially helpful for future projects at TU Delft, where creativity, innovation, sustainability, and well-being are important goals in the design of campus spaces.

1.5. External Experts

To strengthen the practical relevance of the research, the help of an external expert is used: Ingeborg Oostlander, who works in the field of policy for mobility and accessibility within CREFM at TU Delft.
As a policy advisor, she provided valuable context on the campus' infrastructure, goals and ongoing projects related to walking and mobility. Her insights helped ensure that the proposed adjustments align with the broader vision of the TU Delft, which formed a vital part of the development of this thesis.

1.6. Reading map

After reading this introduction chapter, the objective of this project has become clear. The following chapters will help reach this objective. Chapter 2, will answer the first and second sub-questions through literature research. In chapter 3 the power and interest of different stakeholders will be analyzed and sub-question 3 will be answered. Chapter 4 describes the methodology used to approach this project. The results of the survey and consult with the most important stakeholder will be analyzed in Chapter 5. Chapter 6 interprets these results and preforms a critical reflection on the used methods and limitations. Lastly, the answer to the main question and final recommendations will be provided in Chapter 7. The appendix shows the distributed flayers, survey questions, survey results, additional calculations for the TU Delft status distribution, the SPSS analysis results, additional tables with exact values and descripes the use of AI within the writing process.

2 Theoretical Framework

In recent years, the importance of walkable environments in urban and institutional settings has received growing attention. University campuses, as daily environments for students and staff, offer a unique opportunity to promote walking through thoughtful spatial design. This section outlines the cognitive benefits of walking, as well as the key elements that define a walkable campus environment. The relationship between the physical campus structure, walking and cognitive processes forms the theoretical foundation of creating recommendations that improve walkability in the context of TU Delft's Mekelpark. Finally, this section also includes insights into the demographic distribution of the TU Delft community, which is essential to ensuring that the upcoming survey reaches a diverse and representative group of participants.

2.1. Benefits of walking

Research has shown that students at TU Delft experience higher levels of stress compared to students at other institutions. According to the independent journalism platform of TU Delft, a survey conducted among 450 students revealed that 52.9% of TU Delft students experience "very high" levels of study-related stress, defined as stress that interferes with their personal lives. This figure is significantly higher than that of other technical universities, such as TU Eindhoven (37.6%), and the national average of 40% [5].

In contrast to this high-stress environment, walking has been proven to have a positive impact on mental well-being and cognitive performance. As already mentioned in the introduction, walking leads to a boost in creative output by 60%. And even after the walk, people still showed signs of a residual creative boost [27].

Erik Scherder, professor of clinical neuropsychology at VU Amsterdam, emphasizes that regular walking not only reduces feelings of gloom but also boosts creativity and concentration. A daily walk of just half an hour can already make a meaningful difference. The physiological explanation lies in the increased heart rate during walking, which pumps more blood, and thus more oxygen and glucose, to the brain. These nutrients are essential for optimal brain function, facilitating efficient communication between brain cells. This is beneficial for cognitive processes like planning, information filtering, and stress regulation [29]. Next to fact that walking improves the cognitive processes, it may also inhibit the development of sedentary lifestyle habits [32]. Sedentary behavior is defined any behavior such as sitting or leaning with an energy expenditure of 1.5 metabolic equivalent task (MET) or less [25].

Moreover, walking leads to mind wandering and occupies up to half of our waking thoughts. 'Mind wandering' or 'stimulus-independent thought' refers to thinking about things that are not happening in one's immediate environment and appears to be the brain's default mode of operation [23]. These spontaneous, unguided thoughts [21] often lead to a more relaxed state of mind, encouraging self-reflection and openness [29]. This mental refreshment can be valuable during solitary walks or walks shared with peers or colleagues.

2.2. Walkability Factors

The university environment plays a significant role in encouraging active behavior among both students and staff [**Active**]. Research indicates that students on campuses with enhanced walkability are 9.75% more likely to report positive walking experiences compared to those at institutions without such improvements [32]. Improving walkability on campus can therefore serve as an effective strategy to promote walking behavior, which in turn supports both well-being and cognitive functioning. These two causal relationships, between walkability and walking behavior and between walking and cognitive enhancement, form the foundation of this research. This is visualized in Figure 2.1

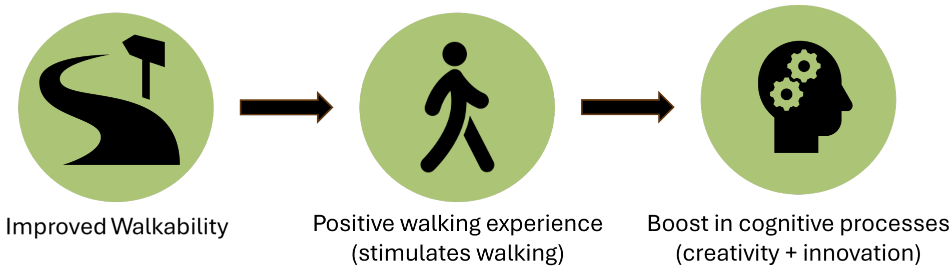

Figure 2.1: Key causal relationships, own figure

Although there is no universally accepted definition of walkability, the term is commonly used by researchers, the public, and in various measurement tools. It generally refers to characteristics of the built and social environment that influence physical activity, energy balance, and overall health at the population level [22]. In order to keep consistent throughout a research it is beneficial to stick to one definition. In this research the definition for walkability from Battista and Manaugh (2019) will be used:

'Walkability is a measure of friendliness of a built environment associated with walking behaviour, either for physical activity, active mobility, recreation or access to services.' [13]

The walkability of a campus can be analysed using two different kinds of data [2]:

- Perceived walkability data
  These are subjective, thus based on how people feel or interpret their walking environment. This kind of data is typically gathered through observations, surveys or interviews [30]. Examples of subjective walkability data are: perceived safety. Aesthetic appeal, perceived connectivity, social atmosphere and shade and weather protection.

- Physical walkability data
  These are features of the built environment that is indexed to some objective measure [11]. Observation or geographic information systems (GIS) mapping are often used to collect these kinds of data. Examples are land use, sidewalk presence and width and lightning infrastructure

Even though, a person's attitude towards walking has a big effect on their walking experience, subjective and objective factors also play an important role. There is a causal link between improved geographical features on campus, including perceived walkability improvements, and enhanced affective walking experiences among students [2].

Ramakreshans et al. (2020) identified key element associated with campus walkability, using the same definition of walkability as proposed by Battista and Manaugh (2019). These elements were derived from an online survey conducted between May and September 2019, which collected a total of 504 responses. In the present research, the same factors will be taken into account [**Environment_factors**]. An overview of these elements, bundled in categories, is presented in Figure 2.2.

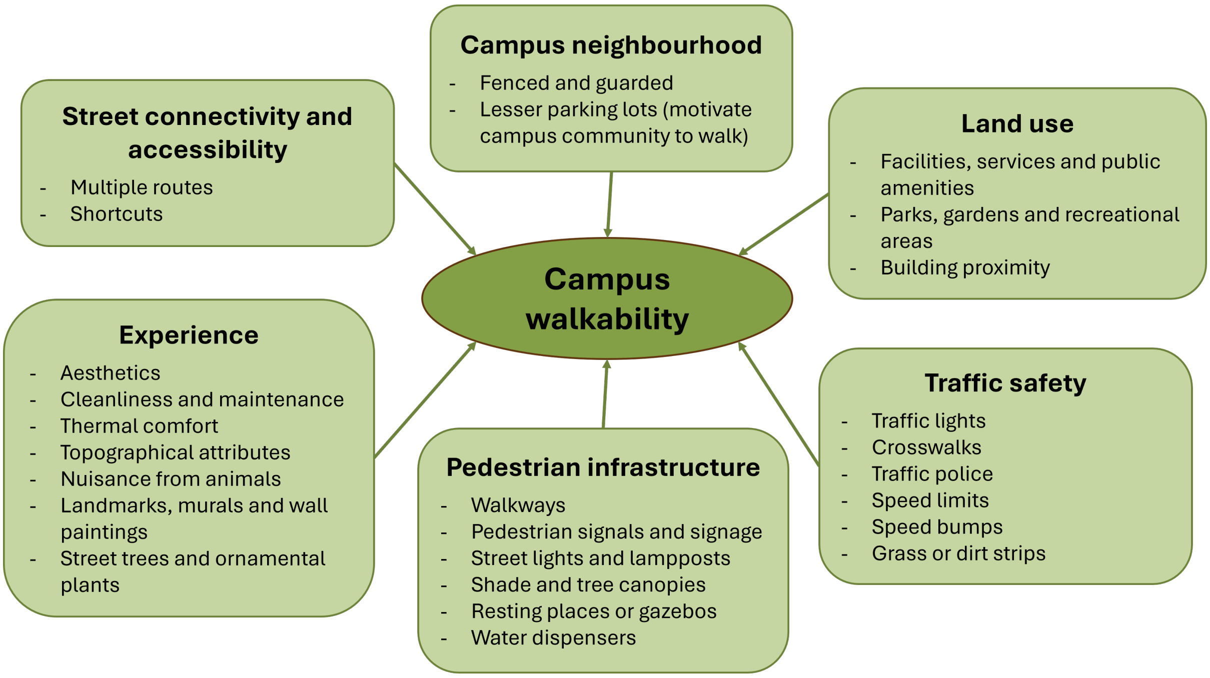

Figure 2.2: Campus walkability elements, adapted from Ramakreshans et al., 2020

In the study by Ramakreshans et al.'s (2020), these categories were ranked based on the survey and expressed using adjusted scores (AS). The ranking showed that the categories 'street connectivity and accessibility' (AS: 97,62%), 'land use' (AS: 96,76%) and 'pedestrian infrastructure' (AS: 94,25%) are considered most important by participants. After that, 'walking experience' (AS: 87.07%) and 'traffic safety' (AS: 85.28%). Ranked lastly was the category 'campus neighbourhood' (AS: 59.62%). This ranking was done from the viewpoint of a campus in Kuala Lumpur, Malaysia.

The campus walkability elements within these categories will be considered in this thesis. However, because Malaysia has a different culture and a tropical climate, the ranking could differ from the ranking of TU Delft students and employees. This is the reason why the ranking of the different walkability elements will be researched again, but this time targeted at students and employees at the TU Delft.
Another notable difference is that the walkability elements found in the literature are based on the entire campus and their surrounding neighborhoods. Given the limited time frame of this research, such a broad scope within Delft is not feasible. Therefore, this study is deliberately narrowed down to focus solely on green areas on campus without cars. As a result, the walkability elements shown in Figure 2.2 represent a wider range of walkability elements than is useful for the scope of this project.

The category **'Campus Neighbourhood'** will not be considered in this research, as the study is limited to green areas within the campus and does not include the broader surrounding area. Similarly, **'Land Use'** is not applicable to the proposed modifications. The existing land use will remain unchanged; the size of the green areas will neither be expanded nor reduced, and the nearby buildings will retain their current functions.
One category that will be included is **'Street Connectivity and Accessibility'**. New walking routes might be introduced within the park if it is found to promote walking. These new routes will be intended exclusively for pedestrians. Roads for vehicular traffic will not be considered. As a result, the category **'Traffic Safety'** has been adapted. Elements such as traffic lights, crosswalks, traffic police, speed limits, and speed bumps will not be modified and are therefore excluded. Existing bike paths will remain unchanged. However, measures will be explored to prevent cyclists from using pedestrian trails in order to maintain a clear separation between modes of transportation.
'Pedestrian Infrastructure' is highly relevant and applicable to this study. The only subelement that will be excluded is 'Resting places or gazebos', as the focus is specifically on the walking aspect rather than pausing or sitting.
Additionally, the category **'Experience'** will be included; however, sub-elements that are very expensive or too difficult to influence within the scope of this project have been omitted. These include 'Topographical attributes', 'Thermal comfort' and 'Nuisance from animals', because changing the climate or fauna

is not realistic. In addition, 'Aesthetics' will also not be considered. Aesthetics is the philosophical study of beauty and taste and therefore very subjective [28]. This causes that there are a lot of approaches to aesthetics and it is hard to measure. An overview of the selected elements can be found in Figure 2.3.

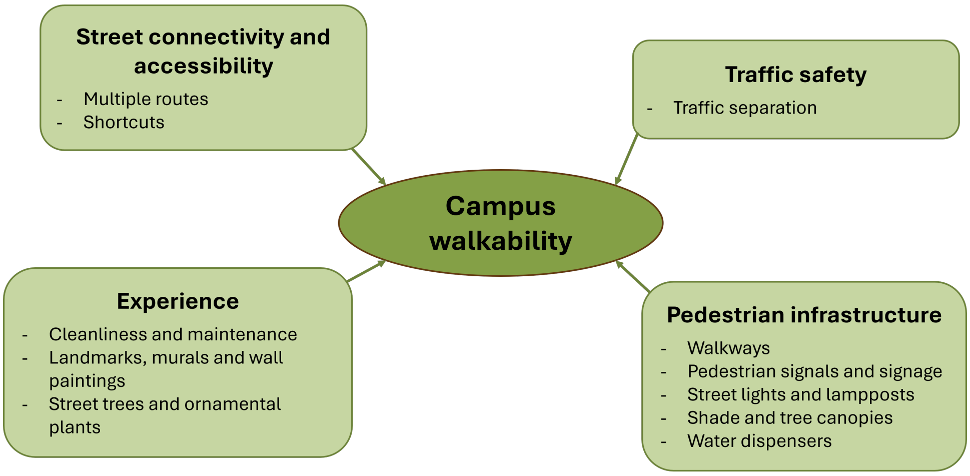

Figure 2.3: Necessary campus walkability elements, adapted from Ramakreshans et al., 2020

In addition to the elements from Ramakreshans et al.'s research, two additional elements have been identified that are relevant to the Mekelpark context: 'wheelchair accessibility' and 'ongoing construction'.

The presence of several stairs in Mekelpark, shown in Figure 2.4, and the element 'traffic separation' could raise concerns about wheelchair accessibility. This is a critical aspect of inclusive design and should be considered when evaluating the park's walkability.
Furthermore, at the time of writing, significant construction work is going on for a tramline that will run next to Mekelpark. This construction currently affects both the accessibility and the overall atmosphere of the park. The tram is expected to become operational in Q3 of 2025, making this a highly topical and time-sensitive issue for park users [4].
The impact of these two elements will be assessed through a Mekelpark targeted question in the survey, to ensure the analysis is more topical and Mekelpark centered.

Figure 2.4: Small stair in Mekelpark, Landezin, 2009

2.3. Delft Facts and Figures

Demographic information from the TU Delft is essential for this study, because by comparing the official population data to the distribution of future survey respondents, it becomes possible to assess whether the survey sample is a good representation of the broader TU Delft population. The facts and figures on the TU Delft website show the demographics of students and employees at TU Delft in December 2024 [8]. TU Delft uses the categories student, PhD, and personnel. For each of these, both the total number of individuals and the male-female ratio are available. The student and personnel population consists of different categories, with known shares. Table 2.1 and 2.2 show the demographic data of TU Delft that will be used for comparison.

Table 2.1: Demographic Data of different university statuses at TU Delft (December 2024)

Status at university	**Category**	**Population**	**Share [%]**
Student	Bachelor	–	51
	Bridging program	–	2
	Master	–	47
	Total students	26,196	
PhD	–	3,538	–
Personnel	Faculty	–	18
	Other scientific staff	–	15
	PhD candidates (salaried)	–	29
	Support staff	–	38
	Total personnel	7,592	
TOTAL	**(excluding salaried PhDs)**	**35,122**	

Table 2.2: Gender distribution across university statuses at TU Delft (December 2024)

Status at university	**Male [%]**	**Female [%]**
Student	68.8	31.2
PhD	68.8	31.2
Personnel	61.3	38.7

2.4. Summary

This chapter outlined the positive effects of walking on cognitive functioning, like creativity and innovation. It also introduced the concept of walkability, distinguishing between perceived and physical walkability data. Given the scope and context of this research, the campus walkability elements of the study of Ramakreshans et al. (2020) were narrowed down to car-free green spaces. Elements such as 'Campus Neighbourhood' and 'Land Use' were excluded, while 'Street Connectivity and Accessibility' and selected aspects of 'Traffic Safety', 'Pedestrian Infrastructure' and 'Experience' were retained. These refined elements are shown in Figure 2.3 and together with 'wheelchair accessibility' and 'ongoing construction', they will serve as the analytical framework for evaluating and enhancing walkability in Mekelpark. In addition, the demographic distribution of the TU Delft shown in Figure 2.1 2.2. This will help determine to what extent the survey participants represent the broader population of the TU Delft.

3

Stakeholder Analysis

In this chapter, the parties involved will be discussed. In the first subsection 3.1 the role, power, and interest of these stakeholders will be mentioned. subsequently, in subsection 3.2 the power-interest matrix has been created. This is an intuitive analytical tool for analyzing the power of influence and the level of interest of stakeholders in relation to the problem [26].

3.1. Stakeholders

1. **TU Delft Students**
   They use the park during study breaks or free time to relax, commute or have meetings. Their primary interests are the accessibility of the park and its aesthetics. They benefit if it stimulates mental clarity, creativity and innovation. However, their influence on the project is limited, because they can only express their preferences through the survey data.
2. **TU Delft Employees**
   Just like the TU Delft students, employees use the park during breaks or walk meetings, therefore the intrest is the same. They also profit if it is accessible and aesthetic and they can express their opinion in survey ass well. Because they are more likely to have useful connections, their power is slightly larger that that of students.
3. **CREFM (Campus Real Estate & Facility Management)**
   CREFM is responsible for the design, development and maintenance of Delft's campus. They play a crucial role in translating Delft's physical environment visions into tangible improvements. Their interests lie in creating a coherent, sustainable campus aligned with TU Delft's long-term goals. Given that they are directly involved in the planning and implementation of spatial changes, their influence on this project is very high. Any recommendation for redesigning the park must align with CREFM's frameworks and gain their approval to move forward.
4. **TU Delft Executive Board** As the highest governing body at TU Delft, the Executive board holds final authority over all major campus developments. They are responsible for approving changes or funding. Their priorities include a campus that supports innovation, sustainability and student/employee satisfaction. Since no significant physical change can occur on campus without their endorsement, their influence is also high.
5. **Green TU Delft**
   Within TU Delft, Green TU advocates for ecological and sustainable campus solutions. Therefore, their primary interest is that green, low-impact design choices are made. They are able to let their voice be heard, but their influence on the project is relatively low.
6. **Municipality of Delft**
   Urban planning, transport, education and welfare are examples of responsibilities of the municipality of Delft. They do not decide which changes are implemented, but TU Delft has to comply with certain municipal regulations. Their interest in the project is relatively low, and their main concerns

are how the adjustments to Mekelpark integrate with public space and safety. They will only be consulted if plans affect public access routes, like the tram at Mekelpark, or require permits.

7. **External parties Renting Space on Campus**
   A variety of external parties, mostly companies, rent buildings or rooms on the TU Delft campus for various purposes [3]. As frequent users of the campus, their employees or members are often present during the day and are likely to use shared outdoor areas, such as the park, during breaks. While they are regular users of the campus environment, they are neither students nor employees of TU Delft and are not directly involved in university decision-making. As a result, their influence on development projects is very low.
8. **Local Residents**
   Local residents are people living on campus or within a relatively small radius of it, including both non-affiliated individuals and students who live in university housing or nearby neighborhoods. As residents, they regularly interact with the campus environment and are likely to use public outdoor spaces such as the park for leisure, exercise, or socializing. While some of them are TU Delft students and therefore already represented in internal decision-making processes, many others are not formally connected to the university. As a group, their influence on campus development is relatively low, but their experiences and needs are still important to consider especially when aiming to create a park that is inclusive, accessible, and enhances the broader campus atmosphere.
9. **Tourists and Passers-by**
   Their use of the park is usually incidental and without a regular pattern. As a result, both their interest and influence on the project are low.

It is important to recognize that some individuals may belong to more than one stakeholder group. For example, a student might also be an employee, a local resident, or a member of Green TU. Similarly, university staff could live near campus or participate in municipal initiatives. These overlaps mean that people can have multiple perspectives, interests, and levels of influence in the project. This can enrich the design process by highlighting diverse needs, but also requires careful consideration to ensure that conflicting interests are balanced and that no single perspective is overrepresented or overlooked.

3.2. Power-Intrest Matrix

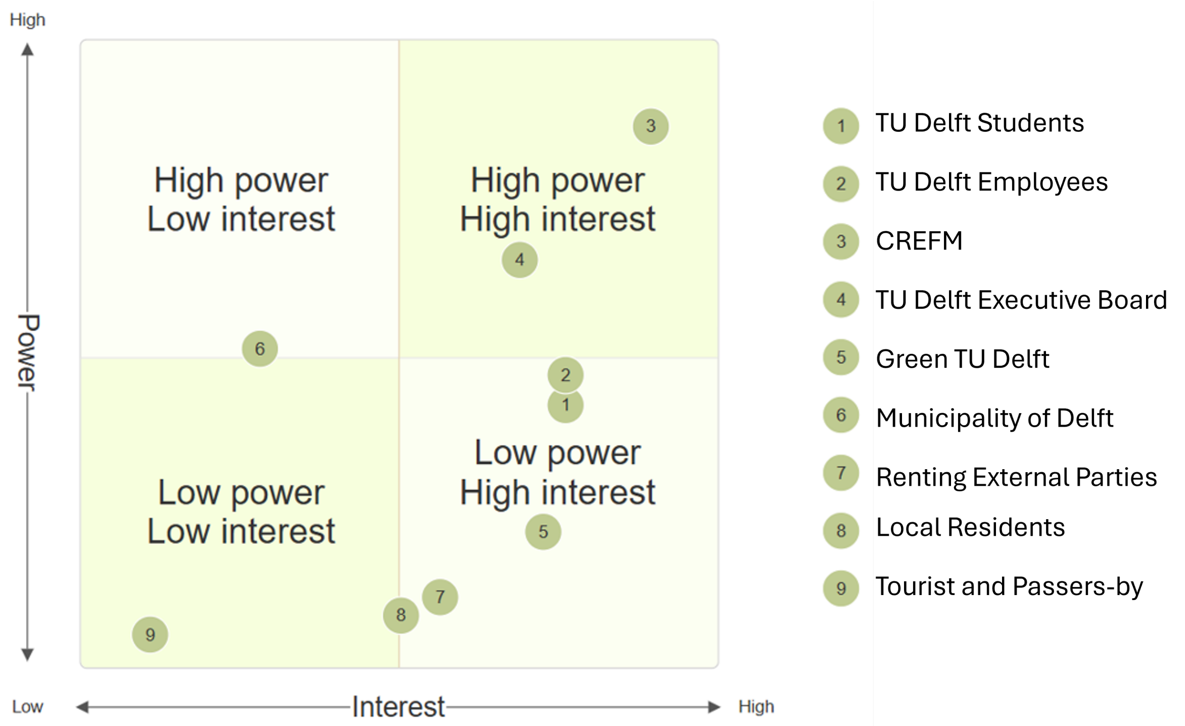

Figure 3.1: Power-Interest Matrix of the stakeholders

The power-intrest matrix is shown in Figure 3.1. The stakeholders in the top-right quadrant have high power and high interest. These should be closely managed and actively involved in the decision-making process. Those in the bottom-right quadrant with low power and high interest, like Green TU Delft, should be kept informed and consulted regularly to ensure their needs and concerns are addressed. Stakeholders with high power but low interest, the municipality of Delft, should be kept satisfied without overwhelming them with details. Lastly, those with low power and interest require only minimal communication.
This categorization ensures efficient communication tailored to the specific role and impact of each stakeholder in the development of the Mekelpark [20].

The stakeholder with the most power and intrest is CREFM, number 3. Therefore, they are kept up-to-date with research progress and will be involved in the decision-making process off the final recommendations. Their participation is essential to ensure that the recommended report not only aligns with university policies and technical feasibility, but also has a realistic chance of being implemented.

The power-interest matrix shows that many stakeholders fall into the high-interest category. This highlights that the park redesign is relevant to a wide and diverse range of campus users. The involvement of so many different groups not only emphasizes the spatial and social value of the project, but also strengthens the overall relevance of this research.

4 Methodology

This chapter outlines the methodological approach adopted for this project. The last step of this research is to create recommendations for the most important stakeholder to improve the walkability of Mekelpark. In order to develop user-oriented design recommendations, a combination of methods has been used, including a literature review, institutional data analysis, and a user survey. A general explanation of the method used is given in 4.1. Followed by a detailed explanation of the survey method (4.2), terms (4.3) and analysis (4.4). Lastly, section 4.5 helps identify recommendation priorities.

4.1. Used Method

This project will follow a step-by-step approach.
First, a literature review is conducted to answer the first two sub-questions. Its primary purpose is to explore relevant theories and findings about walking as a stimulus for creativity and to identify stimulating environmental elements. These are adjusted to the scope of this thesis. In addition, the demographic data of the TU Delft is given. This information is essential to judge whether the future survey population represents the status distribution of the TU Delft.
The research papers are found in Scopus and Google Scholar and the keywords used for the first sub-question are: Walking, Benefit, Cognitive. For the second sub-question the key words used are: Walkability, cognitive, metal health, campus, and factors.
The stakeholder analysis gives insight into the role of the different stakeholders and which stakeholder has the highest power and interest. Thereby, answering sub-question 3 and increasing the legitimacy of the project.

Next to the literature, existing institutional research provided by CREFM, the highest stakeholder, is analyzed. The reports contain a brief description of the campus environment of Delft and current ambitions related to walking around and on campus. Frabrique is a digital Design Agency and together with CREFM they have made an overview of areas on campus that can be used for:

- Sole Use
  Where there is little opportunity to pause or observe the surroundings, such as walking or cycling routes.
- Consumption
  Where is more time and freedom to absorb visual or informational elements in the environment.
- Interaction
  Where people are encouraged to slow down or stop entirely to engage with their surroundings.

This overview is shown in Figure 4.1.

Figure 4.1: Overview of campus area use, adapted from CREFM & Fabrique, 2025

Mekelpark is the red diagonal strip indicated by the green arrow, which means that it is a location where interactive features might be considered.

In the following phase, a user survey is created to collect primary data on TU Delft students and employees. Its primary function is to discover the order of importance in the selected campus walkability elements in Figure 2.3 and to get insights into the current walking behavior and satisfaction of elements in Mekelpark. More about this survey can be found in the section 4.2.

As the survey collects primary data from students and employees of TU Delft and provides insight regarding various walkability elements, it serves as a valuable resource. The results of the survey will show general behavior and preferences, which elements are most important and if they are sufficient in Mekelpark. The survey, mainly the importance and satisfaction scores of the elements, together with findings from the literature and institutional research, will be used to create recommendations for adjustments within Mekelpark. With a privatization of elements that currently negatively affect creativity and innovative thinking. The primary aim is to ensure that all proposed changes are user-centred and aligned with the actual needs of campus users.

These potential changes will be presented to Ingeborg Oostlander, policy advisor of CREFM, which is the most important stakeholder as can be seen in chapter 3. Her feedback on the recommendations, about if it matches the vision of TU Delft and is realistic, will be implemented in the final recommendation report.

Throughout the project, regular reviews, feedback sessions, and milestone deadlines will help guide progress and ensure timely delivery. The use of Open AI has helped in different ways, which are indicated in Appendix H.

4.2. Survey method

The survey is be created using Qualtrics and to reach both students and employees, flayers with QR codes will be distributed around campus. Distributing them in different buildings of the TU Delft campus including: the auditorium, pulse and faculties like Civil Engineering, Industrial Design Engineering, 3ME and EEMCS will help the survey reach a wider audience. The TU Delft has flayer guidelines that will be followed [9]. The flayer format is shown in Figure 4.2. A large version and a large dutch version are shown in Appendix A.

When distributing the survey, efforts will be made to take into account the gender and university status distributions shown in Table 2.1 and Table 2.2, in order to increase the likelihood that the survey sample reflects the actual distribution at TU Delft.

To reach students of the TU Delft, group chats and connections will be used. To target employees, the survey will be sent to Ingeborg Oostlander and Maria Salomons, the Transport and Planning thesis coordinator. They have indicated that they will fill it and send it around.

Figure 4.2: Distributed survey flyer, own design

As can be seen in Table 2.1, the total population is 35122, excluding the double PhD students in both the PhD and Personnel group. It is usual for a research to work with 5 to 10% margin of error and a 95% confidence level (z-score of 1,96). The sample size can be calculated using formula 4.1 and 4.2, also called Cochran's formulas [24].

$$n_0 = \frac{z^2 \cdot p \cdot (1-p)}{e^2} \tag{4.1}$$

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \tag{4.2}$$

Where:

- e: margin of error
- p: estimated proportion of the population (0.5 if unknown)
- z: z-score corresponding to the desired confidence level
- n_0: Cochran's initial sample size estimate (assuming infinite population)
- N: total population size
- n: final required sample size (adjusted for finite population)

A 10% margin needs 96 participants and a 15% error margin only 43. Given the limited time frame of this research a minimum of 43, thus a error margin of 15%, is maintained.

While the broader scientific relevance of this research lies in ranking campus walkability elements for green, car-free environments, additional questions were included to gain deeper insights and better inform recommendation priorities specific to Mekelpark. An overview of the survey questions is provided, along with the reasoning for their inclusion.

- **Demographic data**
  Demographic questions about gender and university status are useful in evaluating whether the survey participants are representative of the broader TU Delft population. They also allowed for meaningful comparisons in walking behavior and perceptions between different groups. Additionally, the question about age provided insight into the age distribution of respondents, helping to determine whether the findings reflect a narrow or broad age range. Together, they enriched the interpretation of the results.
- **Current walking behavior**
  Questions such as *'How often do you go for a walk during your break on campus?'* or *'How long are your walks on average?'*, provide an insight into the potential progress that can be made. Together with the demographic data, it provides a better understanding of the current state of walking as a break.
- **Importance ranking for encouraging walking**
  The goal of this section is to gather insights into how participants rank importance of the various walkability elements with respect to encouraging walking. The insights from this part of the survey can help shape the design of all car-free green areas across university campuses. This means the results are not limited to Mekelpark alone.
  Participants are asked to assess the importance of each sub-element shown in Figure 2.3, using a five-point Likert scale: 'Very important', 'Important', 'Neutral', 'Unimportant', and 'Very unimportant'. An example question is: *'To encourage walking: How important do you consider the separation of pedestrians and cyclists?'*
- **Satisfaction Mekelpark**
  Aiming to identify where the need for improvement is greatest, questions about the satisfaction regarding current walkability elements in Mekelpark will be asked. In this part, accessibility and ongoing construction are also taken into account, as mentioned at the end of section 2.2. Starting with the question: *"How familiar are you with Mekelpark on campus?"*, accompanied by a brief description and an image of the park. Respondents indicate which walkability elements of Mekelpark they are satisfied with, selecting multiple options if applicable. Respondents who are not familiar with the park are not required to answer this question. The results from this section will provide valuable insights into which aspects of Mekelpark require improvement and will help guide targeted suggestions.
- **Determine preferences**
  Given that the Mekelpark presents opportunities for interaction, the final category of survey questions is designed to gain insight into preferences regarding interaction. This will be done with the questions: *'To encourage walking: What would be your preferred kind of interaction on campus?'*, with multiple answer options and the choice to select more than one response.
  The goal is to walk; thus the kinds of interactions should make this possible or only require a short stop. The options will be QR codes (with for example, informative podcasts), prompt boards (with questions or quotes to spark reflection), rotating installations (which display student or employee works), scavenger hunts or other ideas. This helps determine which changes are most appreciated.

The forwarded survey can be found in Appendix B

4.3. Harmonizing TU Delft and Survey Terms

Before starting the survey data analysis, it is essential to study the demographic data of the TU Delft. This overview, given in Table 2.1, provides a clear picture of the composition of the TU Delft community. To judge if the survey is representative, it is of importance that the demographic terms of both the TU Delft and the survey are harmonized. Therefore, some changes need to be made:

- Within the student population at the TU Delft campus, a distinction is made between "BSC, "MSc", and "bridging program" students. The latter group represents only 2% of the total student population. Given that the survey includes 43 participants, this subgroup is either too small for reliable analysis or may not be represented at all. Therefore, it is included in the BSc category, as the Bridging Program is designed to prepare students for bachelor-level education [7]

- The "personnel" category includes "faculty", "other scientific staff", "PhD candidates (salaried)", and "support staff". Since "PhD candidates (salaried)" are also part of the "PhD population", they will be excluded from the "personnel" group to avoid double counting.
- In the survey, the following categories are used: "academic staff/professor", "non-academic staff", "bachelor student", "master student", and "PhD candidate". To enable a fair comparison between the survey results and the TU Delft population, the categories are aligned accordingly: "faculty" and "other scientific staff" are grouped under "academic staff/professor", while "support staff" corresponds to "non-academic staff".

How these terms are compared is clearly indicated in the Figure 4.3.

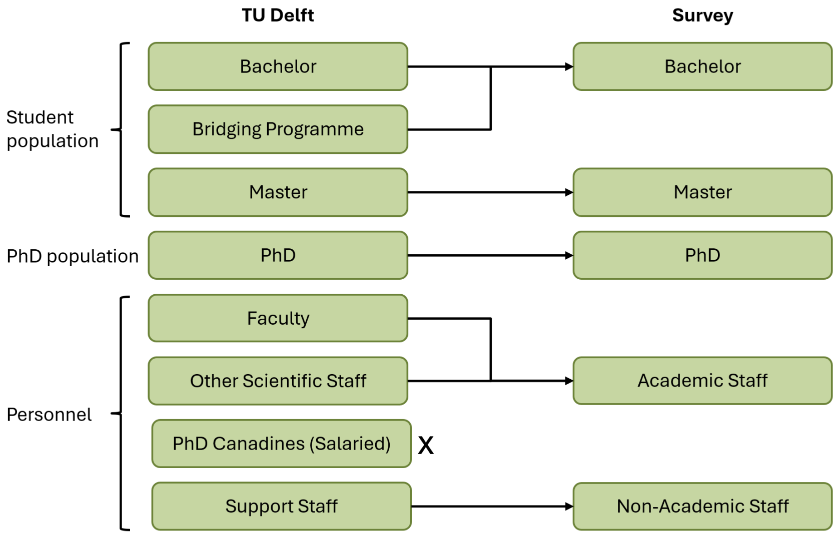

Figure 4.3: Harmonization of Demographic Terminology TU Delft and survey, own figure

4.4. Survey Analysis

To analyze the data gathered from the survey, the statistical software IBM SPSS (Statistical Package for the Social Sciences) will be used. SPSS is a powerful tool for handling complex data structures and performing a wide range of statistical analyses [15]. In this analysis, five different types of tests will be used. For descriptive statistics, *Frequencies* and *Descriptives*, and for comparative tests with non-parametric data, the *Mann-Whitney U test*, *Wilcoxon signed-rank test* and *Kruskal-Wallis H test*. A non-parametric test is one that does not assume a specific distribution, like the normal distribution, for the data [15].

Firstly, some general observations will be made. This includes the total number of participants, the corresponding error margin, and how respondents found the survey. The following data analysis is structured into seven main components, each outlined below. The objective is not only to describe the data but also to compare patterns in order to draw meaningful and well-founded conclusions.

1. **Demographic Analysis**
   First, the demographic data of the the TU Delft is transformed into the terms of the survey. Second, to understand the demographics of the respondents, the gender and university status distribution of the participants is analyzed. The standard analysis of Qualtrics and the function "Frequencies" in SPSS for descriptive statistics will be used to get insight into these data [14] [31].

   For the average age, 'Frequencies' is also used. In the survey, the ages are given in ranges instead of exact numbers, therefore an estimation the average age of each age group needs to be used. In age groups like '30-39', the estimated average age is 35, because this is the average of people that just turned 30 or will almost turn 40. It becomes more complex for the age groups: '19 or younger' and '60 or older'. For the first group, the average age of 19 was taken, because 18 is the most probable minimum age of the participants and almost 20 is the maximum age in this group. For ’60 or older’ the maximum age is the retirement age of 67 years. This gives a estimated average age of 63,5 years.

2. **Current Walking Behavior Analysis** The walking behavior analysis helps to establish a baseline understanding of current walking habits on campus [18]. This mainly includes the average of the answers of the questions of this part of the survey.For example, the average duration of these walks. The ”descriptives” function in SPSS will be used here.

3. **Comparing Demographics and Walking Behavior** This combines the first and second part of the data analysis by investigating whether walking behavior differs between demographic groups. This analysis consists of two parts.

   The first part looks at the median difference for two groups, such as males and females. Step one of this part is to split the data into two separate files: man and woman. Then ’frequencies’ determines the mean of three different questions: ’How often are you at Delft campus per week?’, ’How often do you go for a walk as a break when you are on campus?’ and ’How long are your walks on average?’ for both male and female. Step two is to determine the p-value by using the Mann-Whitney U test. This is a non-parametric test that compares the median values of two independent samples. Because the data does not need to follow a normal distribution, it makes the test well suited for survey data presented on ordinal scales [17]. A p-value of less than 0.05 is considered statistically significant, indicating that the observed difference is unlikely to be due to chance and therefore most likely reliable.

   Part two will look at wether there is a difference between walking behavior and the 5 different university statuses. This will be done by splitting the file into the 5 different groups and again using ’frequencies’ to calculate the mean. The Kruskal-Wallis H test is used when comparing walking behavior between more than two demographic groups [16]. This test extends the logic of the Mann-Whitney U to more than two groups, again comparing medians. If the p-value is below 0.05, it can be concluded that at least one group significantly differs from the others. By testing the different status combinations using Mann-Whitney tests it can be determined where the significant difference or differences lie.

4. **Ranking the Importance of Walkability Elements** The fourth element focuses on identifying which elements of walkability are most important for encouraging walking.
   Participants are asked to rate each element on a five-point Likert scale, ranging from ‘very unimportant’ (1) to ‘very important’ (5). To analyze this, a Weighted Sum Model (WSM) is used. For each element, the importance score is calculated by multiplying the number of respondents selecting each Likert option by the corresponding numerical value and summing the results, as shown in equation 4.3.

$$\text{Element Importance Score} = \sum_{n=1}^{5} (n \times \text{number of respondents choosing value } n) \tag{4.3}$$

   The average score is then obtained, by deviding the Element Importance Score (EIS) with the total number of respondents. A higher average score indicates greater perceived importance among participants. Based on these average scores, a ranking of the walkability elements can be created. This analysis can also be done in SPSS by using the mean for the average EIS.

   An overview of the abbreviations used for each walkability element is provided to enhance clarity and efficiency in the discussion of results. Table 4.1 lists the notations corresponding to each walkability question, all of which follow the same structure: *’To encourage walking: How important do you consider ...’*

Table 4.1: abbreviations for the different survey walkability questions

Question	Notation
Having enough different routes to choose from?	Different
Having organically shaped, curved pathways instead of straight roads?	Shape
The separation of pedestrians and bikers?	Separation
The comfortability of walkways?	Comfortability
Having clear road signs?	Signs
Sufficient street lightning?	Lightning
Shaded areas?	Shade
Water dispensers?	Water dispensers
Cleanliness and maintenance?	Maintenance
Street trees and ornamental plants?	Greenery
Landmarks, murals and wall paintings?	Visuals

However, some elements may have very similar average scores. To determine if these small differences are statistically significant, the Wilcoxon Signed-Rank Test is used. This test compares the distribution of paired responses, meaning each respondent's ratings for two different elements [19]. Because the same person rates multiple elements, the samples are related. If the p-value is less than or equal to 0.05, the difference is considered statistically significant, and the element with the higher score ranks higher. If not, the two elements are considered equally important.

It can be that three or more elements are considered equally important. For example, picture element A, B and C, of which A has the highest average element importance and C the lowest. Element A might not differ significantly from B and neither might B from C. However, this does not conclude that A is not significantly different from C and needs to be tested using the Wilcoxon Signed-Rank Test.
If the p-value of A and C turns out to be lower than 0,05, this causes a ranking paradox and complicates a strict linear ranking. The term 'tier' is used for a broader categorization than 'rank', because it is the relative position of a tier [1]. The difference in importance within the tier is not statistically significant, but between tiers they are. This way of ranking causes some overlap of different walkability elements, but avoids over-interpreting non-significant score differences.

5. **Satisfaction Mekelpark** The fifth element examines satisfaction with specific elements of Mekelpark. Two survey questions are considered here: the degree of familiarity with Mekelpark and which elements are considered satisfactory by the participants. Familiarity responses are on a Likert scale and can be converted into numerical values: 0 = not familiar at all, 1 = not really familiar, 2 = somewhat familiar, 3 = very familiar. For each element, a satisfaction score of 1 is assigned if the respondent selected that element as satisfactory, and 0 otherwise. To weigh satisfaction by familiarity, equation 4.4 will be used.

$$\text{Element Satisfaction Score} = \sum_{n=1}^{N} (\text{familiarity score}_n \times \text{element satisfaction score}_n) \tag{4.4}$$

where N is the total number of respondents and n is an individual participant. This score ensures that opinions from more familiar participants carry more weight in the analysis, and opinions from participants that are 'not familiar at all' will not be considered. This is done because the opinion of participants who are more familiar is more reliable, which makes the conclusions more robust.

6. **Interaction Preferences** Preferences for different types of interactions on campus were collected using a multiple-choice question. The analysis here uses SPSS *Frequencies* to determine how often each interaction type was selected, thus identifying which types of interaction spaces are the most desirable.

7. **Comparing Demographics and Interaction Preferences** This part is similar to the third part of the analysis. The difference in gender and status at the university will be examined, but instead of looking at walking behavior, there will be looked at interaction preferences. Because this is about frequencies instead of median, the Mann-Whitney U and Kruskal-Wallis H test will not be used. Instead, the Chi-square test is more fit [**Chi-square**]. It can conclude if the different demographic groups have different preferences regarding interaction types.

   However, this test becomes less reliable when only a few respondents select a particular type of interaction preference. In such cases, SPSS issues a warning. One way to address this issue is by merging demographic groups to increase sample sizes. For gender, merging is not feasible; therefore, interaction types chosen by too few respondents will be excluded from gender-based comparisons. For university status, merging is possible: ”bachelor”, ”master” students, and ”PhD candidates” will be grouped as ”students”, while ”academic” and ”non-academic” staff will be grouped as ”employees”. Although PhD candidates occupy a position between students and employees, they are classified as students in this context due to their required university contribution, either a tuition or bench fee [6]. This approach increases the likelihood that the minimum threshold for analysis is met. If a merged group still lacks sufficient responses for a particular interaction type, no conclusions will be drawn for that case, thereby preserving the reliability of the findings.

Together, these seven elements of analysis provide a well-rounded understanding of how TU Delft community members use and perceive walkability on campus, particularly within and around Mekelpark. This structured analysis will support data-driven recommendations for design improvements at Mekelpark.

4.5. Importance-Satisfaction Framework

The calculated importance scores and the Mekelpark satisfaction scores will be combined using an importance-satisfaction framework. The output is a grid, which is especially useful in assessing customer satisfaction [12]. It helps identify elements, that are highly important and under performing in satisfaction, as top priorities for improvement recommendations. Conversely, elements rated as less important but with high satisfaction can be de-prioritized. The four different quadrants are shown in Figure 4.4.

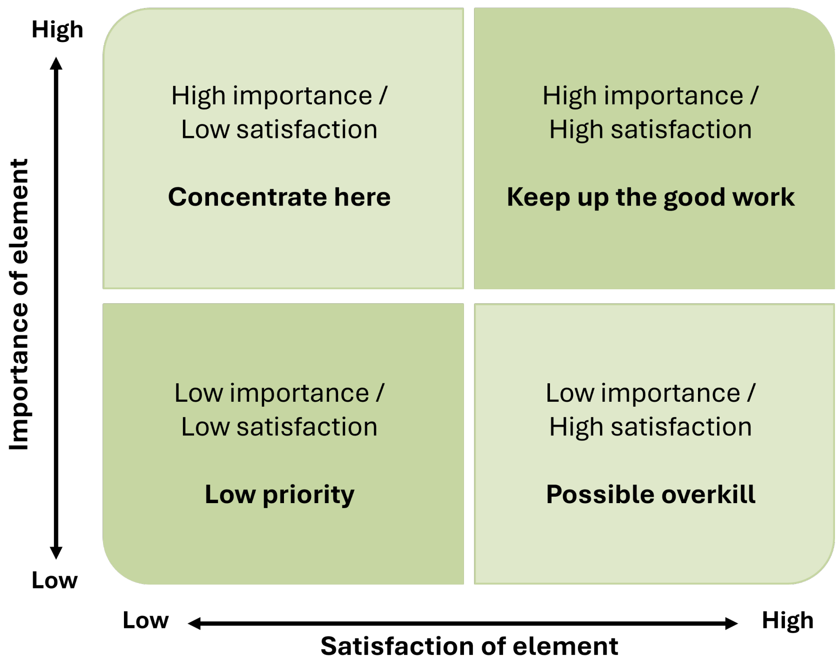

Figure 4.4: Quadrant information of the important-satisfaction framework, adapted from B2BFrameworks, n.b.

The importance of the elements will be relative to each other. The mean importance values will be normalized from 0 (lowest score given) to 1 (highest score given) using formula 4.5. This gives a clear overview of which elements are relatively of high importance.

$$X_{\text{norm}} = \frac{X - X_{\text{min}}}{X_{\text{max}} - X_{\text{min}}} \tag{4.5}$$

Where:

- X_{norm}: Normalized value
- X: Original value
- X_{min}: Minimum value
- X_{max}: Maximum value

The satisfaction of the elements will also lie between 0 and 1 and will be calculated using formula 4.5. However, to show the improvement potential of the element, the element satisfaction scores will be normalized using the maximum possible satisfaction level as 1 and a satisfaction score of 0 will be the lowest. The maximum possible satisfaction level is the sum of the familiarity column and can be easily obtained using ’frequencies’ in SPSS. When everybody is satisfied the sum of familiarity is equal to the maximum satisfaction score, because if everybody is satisfied the familiarity needs to be multiplied with 1.

5
Results

This chapter presents the results of the survey analysis, as described in Section 4.4. It begins by visualizing the demographics of the TU Delft population and the survey respondents. Notable findings from the survey are acknowledged, together with additional comments and feedback provided by participants. The chapter also introduces the importance-satisfaction framework developed to guide interpretation. Finally, insights and recommendations collected during the consultation with CREFM are presented.

5.1. General Observations

In total, 59 participants answered the survey. 51 of them are obtained using an analogous link sent in group chats and emailed to Maria Salomons and Ingeborg Oostlander. The remaining 8 have scanned the QR-code on the flayers around campus. The minimum amount of collected responses was 43, which means that the maximum error margin of 15% is not crossed. Using formula 4.1 and 4.2, the error margin of a sample with 59 participants is calculated and equal to 12,7%. In Appendix C the detailed results of the survey can be found. In addition, all the relevant analysis results of the SPSS can be found in Appendix E.

5.1.1. Demographic Analysis TU Delft

As stated in the theoretical framework, demographic information of the TU Delft is essential to judge whether the survey sample is a good representation of the broader TU Delft population.
In Figure 4.3 the harmonization of survey and TU Delft university status terms is shown. Together with the information given in Figure 2.1, this is used to calculate the distribution of each status at the university, using the survey terminology. The calculations for the distribution, including the adjusted "personnel" group, can be found in Appendix D. The university status distribution of the TU Delft, after harmonization, is shown on the left side of Figure 5.1.

To assess whether the overall male-female ratio in the survey matches that of the TU Delft population, the total ratio must be calculated. Figure 2.2 shows necessary data of the TU Delft to calculate the ratio. Since the "personnel" data include "PhD candidates (salaried)", these individuals must be removed, and the ratio must be corrected. The detailed calculations for the average male-female ratio are provided in Appendix D. The final calculated average man-woman ratio for students and employees is:

- Average male ratio: **67.2%**
- Average female ratio: **32.8%**

5.1.2. Demographic Analysis Survey

The status distribution of the survey, both number and percentage of the 59 participants is shown in the right pie chard in Figure 5.1.

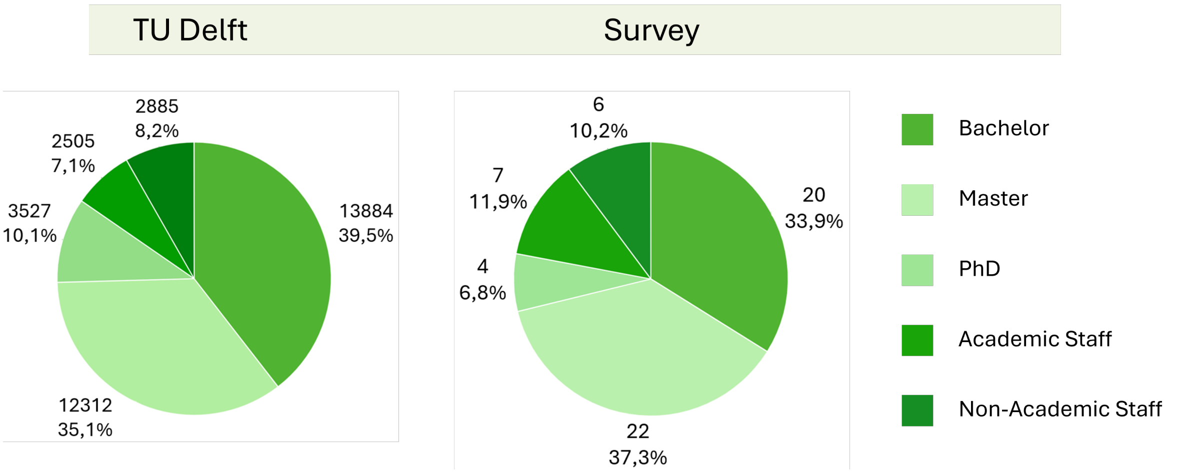

Figure 5.1: TU Delft and survey status distribution, own figure

37 men and 22 women have completed the survey. This provides the following man-woman ratio

- Average male ratio: **62.7%**
- Average female ratio: **37.3%**

The distribution of both gender and academic status in the sample is very similar. Male respondents are slightly underrepresented, as are Bachelor students and PhD candidates, though only to a small extent. This similarity between demographic groups strengthens the reliability of the conclusions that will be drawn.

The SPSS 'Frequencies' analysis shows a mean age of 29,24 years, with a standard deviation of 11,70. The relatively large standard deviation indicates a wide spread in age.

5.2. Walking Behaviour in Relation to Demographics

The SPSS descriptive test resulted in three useful analysis outcomes:

- The amount of times that the participants are on campus **3,53 times a week**
- How many of the breaks on campus are used to go on a walk on average **25%**
- The length of the average walk **15,05 minutes**

5.2.1. Male vs Female

First we will look at if there is a difference in man and woman, when it comes to walking behaviour, by splitting the file and using the Mann-Whitney U test as mentioned in sub-chapter 4.4. Table 5.1 shows collected analysis output together with the p-values.

Table 5.1: Mean values of walking behaviour and p-values: male and female

Gender	At university a week [times/week]	Go for a walk as a break when on campus [%]	Duration of walks [minutes]
Male	3,69	27,4	16,38
Female	3,27	21,0	12,88
p-value	0,244	0,466	0,110

None of the 3 p-values is lower than 0,05, which means that the first null hypothesis, $H_0 1$, is proven to be true. Thus, based on this sample, it can not be concluded that the walking behaviour of male and females differ significantly.

5.2.2. The Different University Statuses

Is there a difference in walking behaviour for the different university statuses? The data is split and Kruskal-Wallis Test is run to determine the p-value. The outcome is shown in Table 5.2.

Table 5.2: Mean values of walking behaviour and p-values: different university statuses

Status	At university a week [times/week]	Go for a walk as a break when on campus [%]	Duration of walks [minutes]
Bachelor Student	3,50	21,1	12,11
Master Student	3,59	24,7	15,36
PhD candidate	2,50	22,9	25,25
Academic staff/professor	4,36	12,5	12,50
Non-academic staff	3,17	55,2	18,00
p-value	0,225	0,112	0,059

Again, none of the three p-values is lower than 0.05. Therefore, the second null hypothesis, $H_0 2$, is also supported. For this sample size, we cannot conclude that the walking behaviour of the different academic statuses at TU Delft differs significantly. As a result, there is no need to perform Mann-Whitney U tests to determine between which groups any significant differences might occur.

However, it is worth noting that the difference in the duration of walks comes close to reaching statistical significance.

5.3. Importance Ranking of Walkability Elements

The results of of the average element importance scores are obtained using equations 4.3 and deviding them by 59, as mentioned in the Methodology Chapter. The exact EIS values can be seen in appendix F. Table 5.3 shows the ranking of the walkability elements based on their average element importance score. The difference between the element and the one ranked above is given in the 'Difference' column. To check if these differences are significant, multiple Wilcoxon Signed-Rank Tests are used. The p-values are also given in Table 5.3 and bold if they are significant.

Table 5.3: Initial ranking including mean and difference with the one above

Rank	Walkability Element	Average EIS	Difference	P-value
1	Greenery	4,4237	-	-
2	Separation	4,2034	0,2203	0,073
3	Maintenance	4,1525	0,0509	0,491
4	Different	3,6780	0,4745	**<0,001**
4	Comfortability	3,6780	0,0000	1,000
6	Lightning	3,3898	0,2882	**0,046**
7	Shape	3,3390	0,0508	0,684
8	Shade	3,2712	0,0678	0,665
9	Visuals	2,9322	0,3390	**0,033**
10	Water dispensers	2,8136	0,1186	0,422
11	Signs	2,5254	0,2882	0,132

The p-values in Table 5.3 show that the following differences are significant.

- Maintenance - Different
- Comfortability - Lightning
- Shade - Visuals

This would seem as if the final ranking could be concluded. However, as mentioned in 4.4, every possible combination must be analyzed. The combinations are shown in Table 5.4 and the right column shows the p-value obtained using the Wilcoxon Signed-Rank test.

Table 5.4: Significance for combinations within ranking

Combination	P-value
Greenery - Maintenance	**0,009**
Lightning - Shade	0,437
Visuals - Signs	**0,013**

Table 5.4 shows that the p-value of 'Greenery - Maintenance' and 'Visuals - Signs' is lower than 0,05. This creates the ranking paradox. In Table 5.5 the final ranking is shown using tiers.

Table 5.5: Final ranking walkability elements

Tier	Walkability Element(s)
1	Greenery, Separation
2	Maintenance, Separation
3	Different
4	Comfortability
5	Lightning, Shape, Shade
6	Visuals, Water dispensers
7	Signs, Water dispensers

5.4. Element Satisfaction Scores of Mekelpark

In the SPSS database, the familiarity and satisfaction of an element were assigned numbers. These numbers and equation 4.4 gave the Element Satisfaction Scores (ESS), shown in Table 5.6. In this table, the different elements are already ranked on the basis of satisfaction.

Table 5.6: Total element satisfaction score per walkability element

Rank	Walkability Element	ESS
1	Maintenance	105
2	Separation	79
3	Comfortability	74
4	Greenery	66
5	Shade	61
6	Different	53
6	Accessibility	53
8	Signs	43
9	Shape	41
10	Visuals	40
11	Lightning	37
12	Water dispensers	30
13	Construction	15

5.5. Interaction Preferences in Relation to Demographics

With descriptive statistics ’Frequencies’, there was looked at the amount of participants that have answered each option of the question about the preferred interaction type. The results are shown in Table 5.7.

Table 5.7: Participant selection frequency for each interaction preference type

QR-Codes	Prompt Boards	Rotating Installations	Scavenger Hunts	Other
5	17	39	9	8

As can be seen in 5.7, 8 participants that have chosen the option ’other’. 5 of them noted they did not want interaction at all, 1 mentioned study areas in the park, 1 mentioned they wanted sitting areas and one said: ’Bring back the frisbee’. This is interpreted as a preference for informal, playful interaction opportunities over structured or digital installations.

Striking is the fact that 66,1% of the participants choose the rotating installation as interaction preference, and is by far the most popular interaction preference. In the additional comments or feedback a participant stated that this was because they did not require stopping and provide a conversation topic.

5.5.1. Male vs Female

First we will look at if there is a difference in man and woman considering preference for iteration types. The Chi-square Test is repeated 5 times, once for every interaction type and once for ’other’. The SPSS warning popped up for the chi-square analysis of ’QR-codes’, ’scavenger hunts’ and ’other’, because at least one of the different gender groups did not reach the minimum of 5 people that have chosen the interaction type. Therefore, only the bold p-values for ’prompt boards’ and ’rotating installations’ in Table 5.8 will be considered. As mentioned in the methodology, this ensures a higher analysis reliability.

Table 5.8: Interaction preference of survey participants

Gender	QR-Codes	Prompt Boards	Rotating Installations	Scavenger Hunts	Other
Male	3	9	24	5	7
Female	2	8	15	4	1
p-value	0,896	**0,323**	**0,795**	0,630	0,119

None of the bold p-values are lower than 0,05, which means that the third null hypothesis, H_03, is partly proven to be true. Because the answers of the other 3 options can not be taken into account, the hypothesis is only proven to be true for the interaction types, ’prompt boards’ and ’rotating installations’. Thus, based on this sample, it can not be concluded that the preferences for interaction types ’prompt boards’ and ’rotating installations’ of males and females differ significantly.

5.5.2. The Different University Statuses

The data is split into 5 different statuses and the distribution of the preferred interaction types is shown in Table 5.9.

Table 5.9: Interaction preference of the 5 different university statuses

Status	QR-Codes	Prompt Boards	Rotating Installations	Scavenger Hunts	Other
Bachelor Student	4	8	13	2	2
Master student	1	5	15	6	2
PhD candidate	0	1	4	0	0
Academic staff/professor	0	1	2	0	4
Non-academic staff	0	2	5	1	0

At least five people are needed who have chosen every kind of interaction of each group. This is not the case, and therefore the Kruskal-Wallis Tests will not be reliable. As mentioned in the methodology, the status groups are merged into 'students' and 'employees'. The result of the analysis is shown in Table 5.10.

Table 5.10: Interaction preference of the merged university statuses

Merged Group	QR-Codes	Prompt Boards	Rotating Installations	Scavenger Hunts	Other
Students	5	14	32	8	4
Employees	0	3	7	1	4
p-value	0,214	0,605	**0,290**	0,390	0,040

Only the analysis of 'rotating installations' is reliable, therefore the fourth null hypothesis, $H_0 4$ is also partly proven to be true. Based on this sample, it can not be concluded that the preference for 'rotating installations', as a kind of interaction, differ significantly between students and employees.

5.6. Additional comments

In the survey, there was room to leave additional comments or feedback. Almost all of these have been processed in the results, but two remained.
One participant noted that some people in the target group do not speak English. Due to the language barrier, they cannot fill in the survey.
The other comment is that Mekelpark is simply too small for a long walk. Therefore, it might be beneficial to connect Mekelpark, Jaffa, the botanical garden and other parks. This last part was also a suggestion of a different survey participant.

5.7. Importance-Satisfaction Framework

As mentioned in the methodology, the first step is to normalize the importance ranking using formula 4.5. These are plotted on the vertical axis of figure 5.2 and the exact values are given in appendix F. These values give a clear overview of the relative importance of the walkability element.

Next, the element satisfaction scores are normalized using the maximum and minimum ESS. In this sample, the sum of the familiarity of the participants is 151. These normalized values are plotted on the horizontal axis of figure 5.2 and the exact values are also given in appendix F.

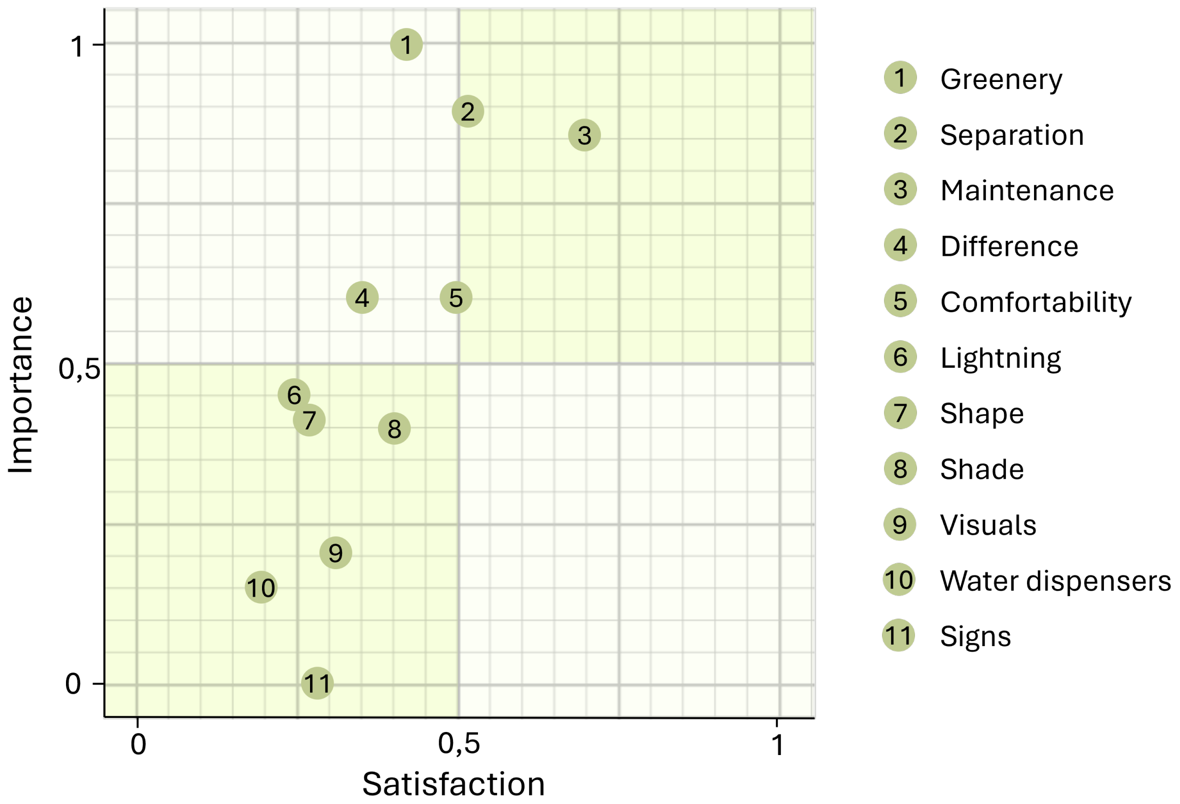

Figure 5.2: Importance-satisfaction framework of survey results, own figure

Even though there is no importance ranking of the elements 'construction' and 'accessibility' the normalized satisfaction scores are known:

- Construction: **0,099**
- Acessability: **0,351**

5.8. Consult with CREFM

The results of the importance–satisfaction framework (Figure 5.2), supported by the quadrant definitions in Section 4.5 and visualized in Figure 4.4, have been instrumental in identifying which walkability elements should be prioritized in the future redesign of Mekelpark. The quadrant-based structure distinguishes between four categories: "concentrate here", "keep up the good work", "low priority", and "possible overkill".
To ensure that the recommendations are not only evidence-based, but also feasible within the institutional context, the outcomes were discussed in detail with Ingeborg Oostlander from CREFM. This dialogue provided critical insight into practical constraints and can be found in Appendix G.

First, it was acknowledged that improvements for one walkability element could potentially have unintended trade-offs for others. Therefore, the recommendations aim for a thoughtful balance between competing elements.
Second, CREFM indicated that financial support from the national government has recently declined due to budget cuts. This financial limitation has been taken into account by prioritizing low-cost, high-impact interventions. In some cases, walkability elements with relatively high satisfaction scores have even been considered for budget reallocation.
Lastly, CREFM emphasized the importance of preserving the park's characteristic landscape design, in particular, the combination of a slightly hilly topography with straight pathways composed of alternating walking surfaces. This design is seen as a core part of the original landscape architect's vision and preserving this is therefore considered an important condition.

These considerations are essential to ensuring the reliability of the recommendations. The following section presents these recommendations, incorporating key insights from CREFM, which play a crucial role in shaping the final design suggestions.

5.8.1. Concentrate Here

1. Greenery

Greenery emerged as the most important walkability element in the survey, yet satisfaction with it in Mekelpark was relatively low. This highlights the importance for improvement. Encouragingly, this recommendation aligns directly with CREFM's own current ambitions to enhance campus biodiversity. Ingeborg Oostlander has indicated that asphalting is not an option. Increasing seasonal planting and introducing more diverse vegetation, including low shrubs and flowering plants, would support both biodiversity and the user experience.

Currently, large open spaces in Mekelpark are reserved for events. However, CREFM indicated that some of these events could be relocated to a nearby field along the Berlageweg, which features a pond and shelter. By relocating event spaces, more surface area within Mekelpark could be used for planting, without disrupting core campus functions. An exception is the area around the aula, which CREFM stressed must remain available for larger events due to its central role on campus.

4. Number of Route Options

This element was rated moderately important, but satisfaction with this aspect of Mekelpark was relatively low. Expanding route diversity within the limited area of the park is challenging therefore a better connection with green areas might be beneficial, but this falls outside of my scope, so no recommendations will be made for this.

By putting gravel or fine grid around the sharp intersections, taking a turn while walking will feel more intuitive, because there is no need to walk on grass or make a very sudden turn. This all while the original pavement and linear roads can be kept the same. Even though the original pavement stays the same, CREFM did expressed some hesitation about deviating from the formal design concept, but they acknowledged that such soft interventions could modestly improve walkability. For a gravel, yellow semi-paving was suggested by Ingeborg. This is a by product derived from limestone quarries. it contains no artificial additives, making it 100% natural. And thanks to its high hardness, it is highly resistant to damage.

Another way of creating more route options is by introducing informal walking paths. These are paths with organic shapes in between the linear roads made of the same yellow semi-paving as last recommendation. Ingeborg Oostlander saw this as a good alternative, because the organic-shaped pathways could increase perceived route variety without interfering with the primary structure and sharp intersections. This also creates a more inviting environment for short exploratory walks, especially once tram line 11 construction is completed and access routes are restored.

5. Comfort of Walking Paths

CREFM noted that, pathway materials have been selected primarily for visual appeal, rather than comfort. This element is very close to the 'keep up the good work' quadrant and replacing all the pavement is an expensive project. Therefore a different recommendation is created in consultation with Ingeborg. The current linear pavement does not require urgent intervention, but future replacements could incorporate more comfortable surface materials, such as rubberized or smoother tiles while still sticking to the caracteristic tiles. This does not require urgent intervention and, because it is paired replacement, it is cost efficient. In addition, the comfort of the walking paths will be increased if the informal walking paths are created, because they offer more surface softness.

5.8.2. Keep Up the Good Work

2. Separation Between Pedestrians and Cyclists

This is an elements, with high importance and moderately high satisfaction scores. Interestingly, CREFM was surprised by the high satisfaction level, as they often receive complaints about poor cross-park accessibility due to surrounding bike traffic. This suggests that while the internal separation works well due to the surface discomfort of the roads, approaching the park from certain directions may still pose challenges. Nonetheless, because this was not explicitly reflected in the survey, and the bike traffic around mekelpark is not part of the scope of this research, no recommendation was made to address this directly.

3. Maintenance and Cleanliness
This element received the highest satisfaction rating, while also ranking very high in importance. It represents a current strength of Mekelpark. However, in light of ongoing budget cuts, this area may be considered for minor budget reduction. Redirecting part of the maintenance budget to higher-priority elements like greenery could increase overall user value without significantly compromising perceived quality.

5.8.3. Low Priority

6. Street Lighting
Although this element is located in the lower left quadrant, it is close to the 'concentrate here' quadrant. Lighting may play a more critical role during winter months. More lampposts next to the linear roads or small-scale solar-powered lights next to the informal roads, could improve user experience with minimal cost and maintenance. CREFM had no additional notes on this suggestion.

7. Organically Shaped Pathways
Although the current straight-line structure holds architectural significance and organically shaped paths may contrast with this, minor adjustments could still improve walkability. In line with the recommendations from the section on 'number of route options', this could involve softening intersections with gravel or introducing informal gravel paths with subtle curves between existing main routes. Such interventions would have little to no impact on the formal design, offering a balanced compromise between aesthetic consistency and walkability.

8. Shaded Areas
The medium importance and satisfaction do not require additional interventions. However, it can be combined with the recommendations for biodiversity, by taking the proximity to walking pathways into account for future planting efforts. CREFM confirmed an increase in the demand for shade on campus, particularly during the warmer months. Current trees are often placed too far from the main paths to provide effective shade.

9. Visual Elements (e.g., Monuments, Murals)
Both importance and satisfaction were low, suggesting no urgent action is needed. However, CREFM noted that if a low-cost opportunity arises, such as an art student collaboration, it could be a worthwhile enhancement. Rotating installations could also serve as visual stimuli, though these were categorized separately in the interaction survey questions.

10. Water Dispensers
Given the short average walk duration (15 minutes) and the mild Dutch climate, participants saw little need for water stations. Additionally, indoor water taps in adjacent buildings are safe and accessible. In contrast to warmer climates this element is not essential in the TU Delft context.

11. Signage for Walking Routes
The survey participants consisted of students and employees, who are generally familiar with the campus layout. This likely explains the low perceived importance of signage in the results. CREFM further clarified that signage is primarily intended to support visitors, rather than daily campus users. Since this research focuses on the needs and preferences of students and employees and signage was rated as low in importance by them, no recommendation will be made in this area.

5.8.4. Contextual Elements: Construction and Accessibility

Although not included in the original 2020 walkability framework, two additional elements were included for their relevance to Mekelpark. Ingeborg agreed had no additional feedback on the following reasoning.

Construction
Although the construction is temporary and contributes to long-term public transport improvements, it currently has a negative impact on the amount of different routes, accessibility and visual quality of the

park. Since satisfaction with this element was the lowest among all walkability factors, minor interventions, such as temporary clear signage for way-finding, could help improve the user experience during the transition period by reducing confusion and frustration.

Accessibility
The TU Delft places strong emphasis on inclusiveness and the satisfaction with accessibility is relatively low (0,351). It lies on the same vertical line as the element 'difference'. The informal gravel paths offer more hard and even surfaces and therefore support accessibility without large-scale restructuring.
In addition, the stairs currently separating the "free zone" and walking paths may be of negative influence of the comfort of the walking paths, especially to those with reduced mobility, but flattening or ramping might complicate the separation between cyclists and pedestrians. The risk of compromising cyclist-pedestrian separation, which has a high importance ranking and is close to falling in the upper left quadrant, removing the stairs is not recommended.

6 Discussion

This chapter discusses the key findings, reliability, and limitations of the research. It begins with an interpretation of the survey results and assesses how representative the sample is. The strengths and limitations of the methods are critically reflected upon. Insights from the CREFM consultation are included to evaluate the feasibility of the recommendations. Finally, the broader implications for campus walkability are discussed, along with suggestions for follow-up research.

6.1. Interpretation Survey results

A clear and critical interpretation of the results is essential to ensure that the conclusions are both grounded and representative. The survey data show that the distribution of gender and university status in the sample aligns closely with the actual demographic distribution of TU Delft. This was the goal during the survey distribution phase, thus appeared to be successful. Male respondents, Bachelor students and PhD candidates are slightly underrepresented, but only slightly. This alignment enhances the robustness of the conclusions and increases the reliability of the resulting recommendations.

The age distribution of the respondents supports this reliability even further. With a mean age of 29.24 years and a relatively large standard deviation of 11.70, the sample represents a wide range of age groups. This is to be expected, as it concerns young adults up to retirement age. Therefore, the created recommendations include opinions from a broad range.

The Mann-Whitney U test and the Kruskal-Wallis H test were used to evaluate differences in walking behavior between gender and university status. The first two hypotheses ($H_0 1$ and $H_0 2$), which assumed no significant difference in walking behavior between different genders and university statuses, were supported by these tests and data. However, the difference in duration of walks between academic statuses approached significance ($p = 0.059$). Although it does not meet the 0.05 criterion, this may indicate that with a larger sample size a meaningful difference in walking duration between university statuses could emerge.

The ranking of campus walkability elements showed that 'Greenery' received the highest importance score (4.42), followed closely by 'Separation' between cyclists and pedestrians (4.20), and 'Maintenance' (4.15). These results align partially with the framework from Ramakreshans et al. (2020), but there are notable contextual differences between the theoretical framework and the survey results. Some were expected, like the fact that the importance of shade or water dispensers decreases in a less tropical climate.
Compared to the 2020 study, where street connectivity and pedestrian infrastructure are most valued, TU Delft respondents placed higher priority on natural and experiential qualities such as greenery and comfort. This likely reflects the high baseline of Dutch pedestrian infrastructure and a cultural emphasis on integrating nature into urban spaces.

Normalizing the element satisfaction with the maximum (ESS: 151) and minimum score (ESS: 0) shows that many of the walkability elements are on the left side of the satisfaction scale. This indicates that a lot of satisfaction improvement can be made.

This in relation with the element importance scores formed the importance-satisfaction framework. The elements in the 'concentrate here' quadrant were 'Greenery', 'Difference' and 'Comfortability'. These three elements all contribute greatly to the characteristic appearance of Mekelpark, what was originally a fairly bare, hilly area with a few straight paths with alternating walking surfaces. CREFM is very keen on preserving this characteristic look and this might be part of the reason that they have not yet been changed. Through the conversation with CREFM intrest like these have discovered which is necessary to make the recommendations more feasible.

What is striking is the clear preference of 'Rotating Installations' in comparison to all the other interaction options. This could be because it provides a low-effort engagement and is a conversation starter, however this does not explain why options as 'Prompt Boards' were not as high.

There was also no proven significant difference between interaction preferences of the demographic groups, gender and status. Therefore, as far as the number of participants allowed reliable conclusions, the other two hypotheses are also proven. The fact that all 4 hypotheses are proven for as far as possible, shows that the recommendations are more likely to be equally beneficial and less specific group-centered.

6.2. Critical reflection methods and limitations

Overall, the method of this research is reliable, considering the approach and used test. Below some strengths of the research are given:

- The final tiered ranking of the element importance score provides more nuance than a linear list and avoids over-interpreting small, non-significant differences in EIS's.
- The iterative validation of recommendations with CREFM increased the feasibility.
- The element satisfaction scores were calculated by weighting each response with the familiarity of the park, to ensure that the familiar participants carry greater analytical weight.

However, the scope of the research imposed some limitations.
First, certain elements from the Ramakreshans et al. (2020) framework had to be scraped, resulting in a less comprehensive view of walkability across the entire campus.
Second, the satisfaction analysis focused solely on Mekelpark, which is relatively small. For walks longer than 15 minutes, other green, car-free areas on campus are likely used. Assessing the walkability of these connecting areas could provide a more complete picture and may indirectly encourage greater use of Mekelpark as part of longer walking routes.

Within the scope some assumptions were made that limit the reliability of the research:

- There is primarily focused on what is beneficial to the walkability of the park to encourage cognitive processes, instead of considering all the functions the park has. For example, sitting areas or playful recreation.
- It is not taken into account that, some of these other activities can also boost cognitive processes, like football.
- Seasonal variations in walkability, and how they might influence the prioritization of certain elements, such as lighting—were not examined in this study.

The survey also included some element that need to be acknowledged:

- A Dutch version of the survey would have made it more accessible to everyone. Now, the chances are that some, especially non-academic staff could not fill it in due to the language barrier. The assumption that all students and academic staff are proficient in English, may have led to a more biased result.
- Not including 'None' as an explicit option for preferred type of interaction may have led to an underrepresentation of respondents who did not want any interaction. Requiring participants to think of this themselves and type it under 'Other' created a barrier that may have prevented some from fully expressing their true opinion.

- No specific answer options were provided for questions about age and walking behavior. This was a deliberate choice to make the survey easier to complete, especially since participants may not know some of these values precisely. However, this approach reduces the reliability of the analysis, as it relies on rough estimations rather than exact data.
- The sample size of 59 participants results in a margin of error of 12.7%, which is higher than the commonly accepted range of 5–10% in research. Although efforts were made to distribute the survey widely through links and flyers across campus, the limited timeframe restricted the response rate. This higher margin of error should be acknowledged, as it reduces the overall reliability of the findings.

6.3. Implications

This research provides valuable insights into the walking behavior, perceived importance and satisfaction of walkability elements, and interaction preferences of students and employees at TU Delft. Elements with high importance but relatively low satisfaction contribute most to the reduced walkability of Mekelpark and may therefore hinder the cognitive benefits associated with walking. The study offers concrete, user-centered recommendations to improve these elements, directly enhancing the walkability of Mekelpark. Moreover, the importance ranking developed in this study is broadly applicable to other green, car-free campus areas. Since the survey reflects the needs and preferences of actual campus users, implementing the recommendations is likely to have a positive impact, encouraging more people to take walking breaks. Additionally, the consultation with CREFM has increased the feasibility and practical relevance of the proposed measures.

6.4. Suggestions follow-up research

As mentioned above, the difference in the duration of walks of different university statuses is almost significance and might suggests a possible trend. It could be considered an interesting point for future research or further exploration. With a larger sample size the statistical power increases and a meaningful difference in walking duration between academic status groups could emerge. This can be especially useful in subgroup analyses especially. In this study, PhD candidates reported the longest average walk duration (25.25 minutes), while Bachelor students had the shortest (12.11 minutes). A targeted follow-up study focusing solely on walk duration and break behavior across university roles could possibly prove a correlation.

Another potential direction for follow-up research is to explore the demand and feasibility of improving connections between Mekelpark, Jaffa, the Botanical Garden, and other nearby parks. Strengthening these connections could enhance the overall walkability of the campus by creating a more continuous and attractive walking network. Several survey responses mentioned that Mekelpark is perceived as too small, and that improved connectivity would be beneficial—indicating a possible need. As these areas are currently separated by roads for cars and bicycles, future research should also expand the walkability framework to include elements relevant to these connecting zones.

7 Conclusion

This chapter presents the final conclusion of the research by answering the main research question through insights drawn from the theoretical framework, stakeholder analysis, survey results, and discussion chapters.

The main research question was:
'What is the relationship between campus walkability elements and the stimulation of creativity and innovation among students and employees at TU Delft and how can these insights be applied to create recommendations for Mekelpark?'

This first part of the question: *'What is the relationship between campus walkability elements and the stimulation of creativity and innovation among students and employees at TU Delft?'*, was addressed through the first two sub-questions. It identified two key causal relationships:

1. A positive relationship between walkability and walking behavior
2. A positive relationship between walking behavior and cognitive enhancement, particularly in the form of increased creativity and innovation.

Based on the literature, especially the work by Ramakreshans et al. (2020), a set of relevant walkability elements was selected and adapted to the context of green, car-free areas such as Mekelpark.
These selected elements, as shown in Figure 2.3, together with the key causal relationships, provided the basis for the empirical phase of the research.

The second part of the research question: *'How can these insights be applied to create recommendations for Mekelpark?'*, was addressed through the remaining sub-questions.

The stakeholder analysis revealed that CREFM (Campus Real Estate & Facility Management) holds both the highest power and interest in the redesign of Mekelpark. Furthermore, a broad range of other stakeholders showed a high level of interest, underlining the social relevance of the park's redesign.

The recommendations have been made based on a survey and a consult with CREFM. The survey provided a final tiered ranking of walkability element importance (Table 5.5), that showed that the presence of greenery (trees and ornamental plants) and separation of pedestrian and bike travel were considered the most important elements. By combining this ranking with the element satisfaction scores (Table 5.6), the importance–satisfaction framework (Figure 5.2) was constructed. This helped identify 'greenery', 'number of different routes' and 'comfortability of walkways' as elements to focus most on.
The survey analysis did not show a significant difference between gender and university status in walking behaviour and preference for interaction. Therefore, the recommendations are likely to be beneficial for all tested demographic groups. Among the interactive elements, rotating installations emerged as the most preferred option.

In the conversation with Ingeborg Oostlander, several practical constrains have been discussed. These include, the need to preserve Mekelpark characteristic design, national budget cuts and the possibility of trade-offs between elements.
Based on the combined analysis, the following design recommendations have been formulated:

High Priority Interventions:

- Enhance biodiversity by adding flowering plants and low shrubs; place new trees closer to walking paths.
- Relocate activities that hinder the enhancement of greenery and are not uniquely tied to Mekelpark.
- Introduce informal pedestrian paths between existing linear roads using semi-paving.
- Apply semi-paving around the intersection of linear roads.
- Install temporary way-finding signage to assist users during construction phases.

Low Priority:

- When pavement needs replacement, consider more comfortable surface materials for walking.
- Apply more lampposts and, next to the informal roads, introduce small-scale solar-powered lighting.
- Make use of low-cost visual opportunities, such as collaborations with TU Delft students.

In addition, the walkability element ‘Maintenance’, although ranked relatively high in importance, shows a higher satisfaction score and may be considered for minor budget reallocation if needed.

This conclusion brings together the theoretical and empirical insights of the study to offer practical, grounded, and feasible recommendations for enhancing the walkability of Mekelpark in a way that supports the creative and innovative potential of TU Delft’s students and employees.

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A
Survey Flyers

Figure A.1: Distributed English Flyer Format, own design

Figure A.2: Distributed Dutch Flyer Format, own design

B

Survey Questions

Enhancing Campus Walkability to Stimulate Creativity and Innovation for Students and Employees

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Start of Block: Introduction

Enhancing Campus Walkability to Stimulate Creativity and Innovation for Students and Employees, TU Delft Thank you for taking the time to participate in this survey! This survey is part of my bachelor’s thesis in the field of Transport and Planning at TU Delft. It is intended for **students and employees of TU Delft** and investigates how campus design elements, such as road types and maintenance, influence the motivation to walk. There will be a special focus on Mekelpark on the TU Delft campus. The answers will be used to create a design for Mekelpark with higher walkability, which means it will encourage more walking. The survey consists of **5 sections** with **a total of 20 questions**, and takes approximately 3 minutes to complete. All responses are completely anonymous and cannot be traced back to individual participants. Participation is entirely voluntary, and you may stop at any time. The results will be handled in accordance with TU Delft's research ethics.

End of Block: Introduction

Start of Block: Demographic data

I. Demographic data

Q1 What is your age?

- ○ 19 or younger
- ○ 20 - 24
- ○ 25 - 29
- ○ 30 - 39
- ○ 40 - 49
- ○ 50 - 59
- ○ 60 or older

Q2 What is your gender?

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other ____

Q3 What is your status at TU Delft?

- ○ Bachelor student
- ○ Master student
- ○ PhD candidate
- ○ Academic staff / professor
- ○ Non-academic staff
- ○ Other ____

End of Block: Demographic data

Start of Block: Block 2

II. Current walking behavior

Q4 How often are you at Delft campus per week?

- ○ Less than once
- ○ 1 - 2 times
- ○ 3 - 4 times
- ○ 5 times or more

Q5 How often do you go for a walk as a break when you are on campus?

- ○ Never
- ○ Hardly ever (1 - 10% of the times)
- ○ Sometimes (11 - 30% of the times)
- ○ Regularly (31 - 60% of the times)
- ○ Often (61 - 99% of the times)
- ○ Always

Q6 How long are your walks on average? (skip if you answered 'Never' in the previous question)

- ○ Less than 10 minutes
- ○ 10 - 25 minutes
- ○ 26 - 40 minutes
- ○ More than 41 minutes

End of Block: Block 2

Start of Block: Block 3

III. Importance of different campus factors that encourage walking (like road signs and maintanance)

Q7 To encourage walking: How important do you consider having enough different routes to choose from?

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q8 To encourage walking: How important do you consider having organically shaped, curved pathways instead of straight roads?

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q9 To encourage walking: How important do you consider the separation of pedestrians and bikers?

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q10 To encourage walking: How important do you consider the comfortability of walkways?

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q11 To encourage walking: How important do you consider having clear road signs?

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q12 To encouraging walking: How important do you consider sufficient street lightning

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q13 To encourage walking: How important do you consider shaded areas

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q14 To encouragewalking: How important do you consider water dispensers

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q15 To encourage walking: How important do you consider cleanliness and maintenance

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q16 To encourage walking: How important do you consider street trees and ornamental plants

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

Q17 To encourage walking: How important do you consider landmarks, murals and wall paintings

- Very important
- Important
- Neutral
- Unimportant
- Very unimportant

End of Block: Block 3

Start of Block: Block 4

VI. Satisfaction Mekelpark (The green strip shown in the figure)

Q18 How familiar are you with Mekelpark on campus?

- Very familiar
- Somewhat familiar
- not really familiar
- Not familiar at all

Q19 To encourage walking: Which of Mekelparks elements you satisfied with and do not need change? (Multiple answers are possible, no need to answer if you are not familiar with the park)

- ☐ Amount of different routes
- ☐ Curvage of the routes
- ☐ Pedestrian and bike separation
- ☐ Comfortability of walkways
- ☐ Clarity of road signs
- ☐ Amount of street lightning
- ☐ Amount of shaded areas
- ☐ Presence of water dispensers
- ☐ Cleanliness and maintenance
- ☐ Amount of street trees and ornamental plants
- ☐ Amount of landmarks, murals and wall paintings
- ☐ Access for people with physical limitations
- ☐ Amount of construction work

End of Block: Block 4

Start of Block: Block 5

V. Determine preferences

Q20 To encourage walking: What would be your preferred kind of interaction on campus? (Multiple answers are possible)

- ▢ QR codes with sound fragments (e.g., campus facts)
- ▢ Prompt boards (with questions / quotes to spark reflection)
- ▢ Rotating installations (e.g., to feature student work)
- ▢ Scavenger hunts (with elements along routes)
- ▢ Other: ____

Do you have any additional comments or feedback?

____

____

____

____

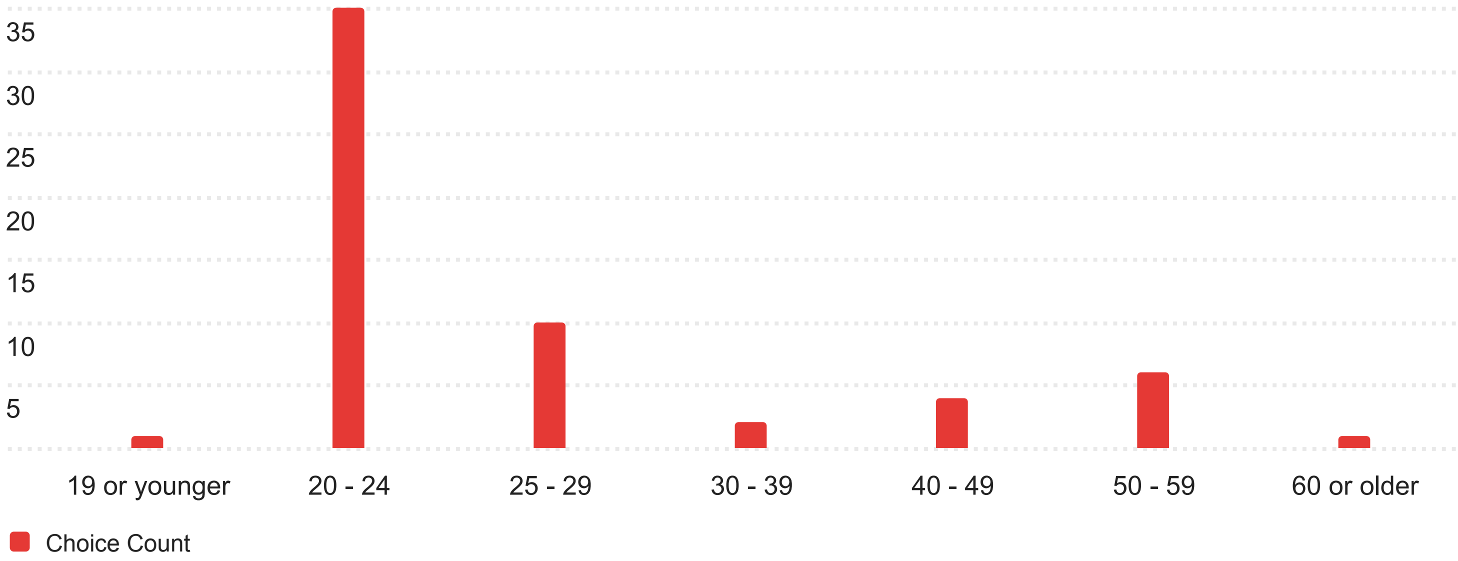
____

End of Block: Block 5

C

Survey Results

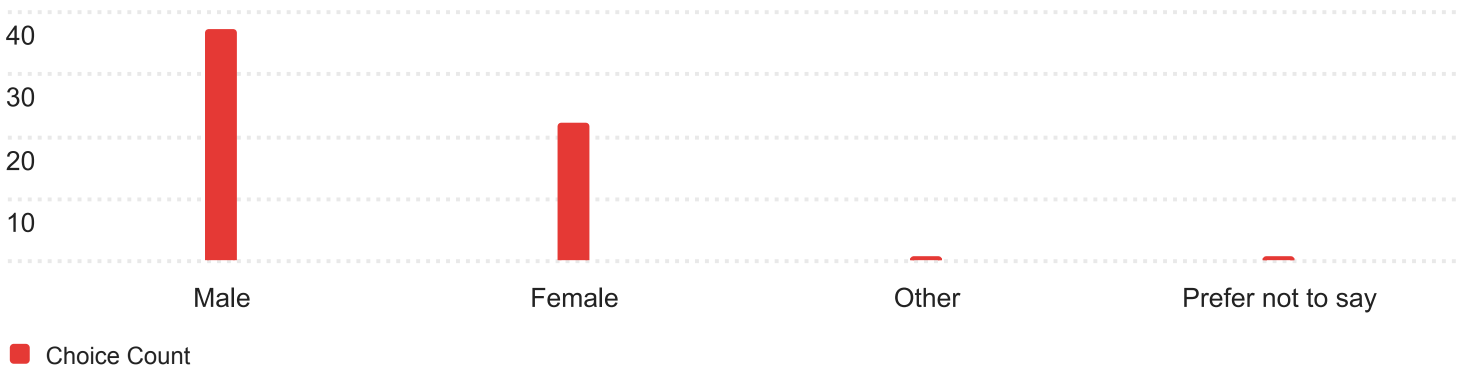
Q1 - What is your age?



Q1 - What is your age?

Field	Choice Count
19 or younger	1
20 - 24	35
25 - 29	10
30 - 39	2
40 - 49	4
50 - 59	6
60 or older	1

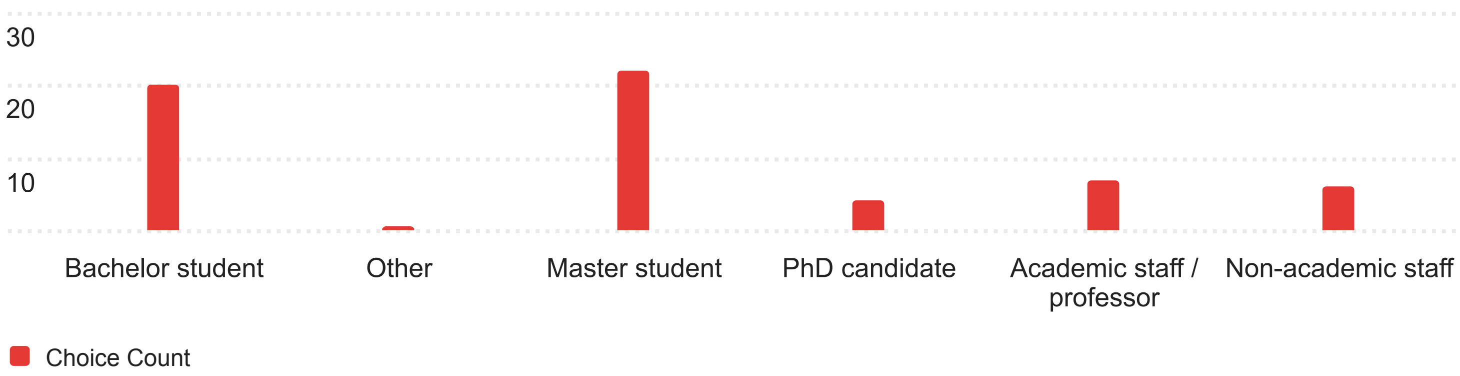
Q2 - What is your gender? - Selected Choice



Q2 - What is your gender? - Selected Choice

Field	Choice Count
Male	37
Female	22
Other	0
Prefer not to say	0

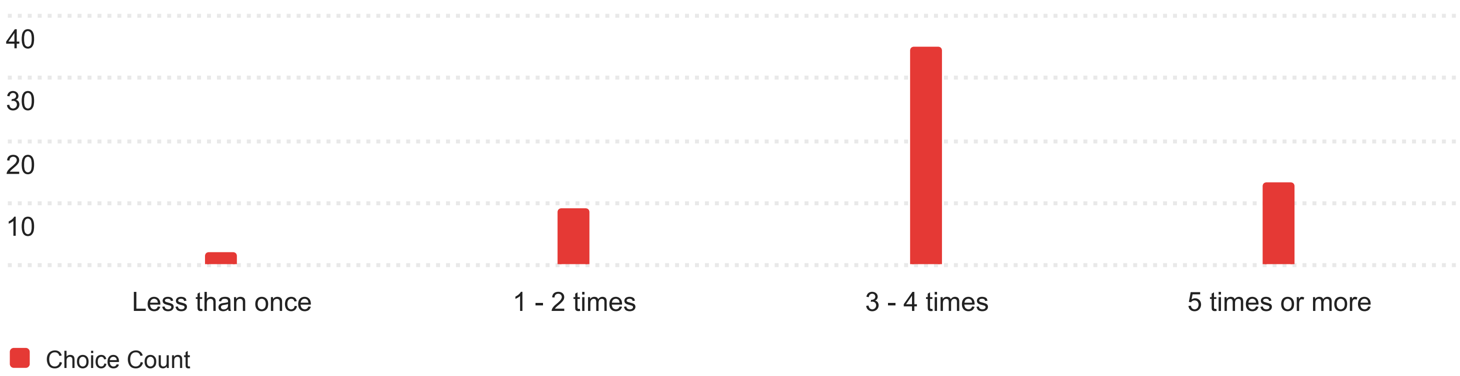
Q3 - What is your status at TU Delft? - Selected Choice



Q3 - What is your status at TU Delft? - Selected Choice

Field	Choice Count
Bachelor student	20
Other	0
Master student	22
PhD candidate	4
Academic staff / professor	7
Non-academic staff	6

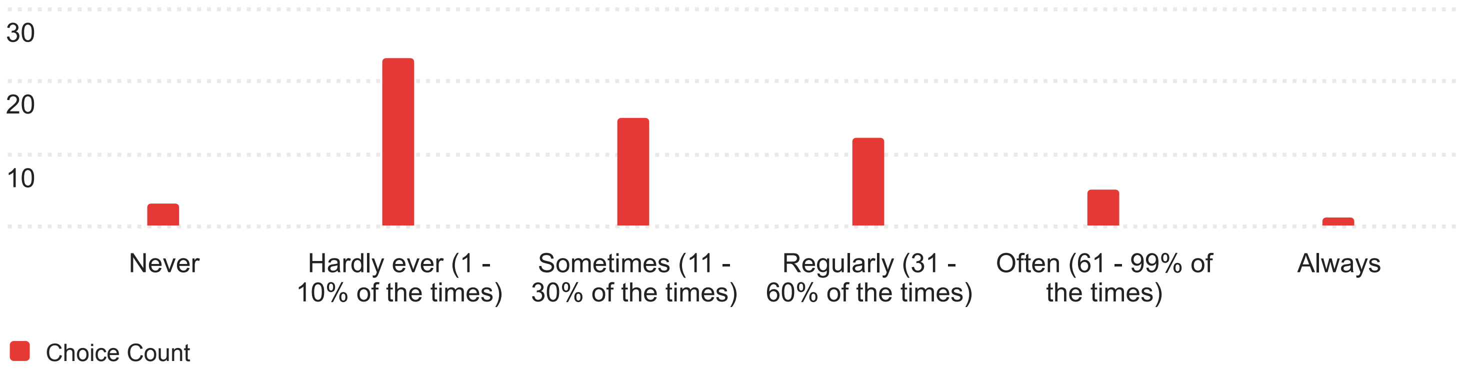
Q4 - How often are you at Delft campus per week?



Q4 - How often are you at Delft campus per week?

Field	Choice Count
Less than once	2
1 - 2 times	9
3 - 4 times	35
5 times or more	13

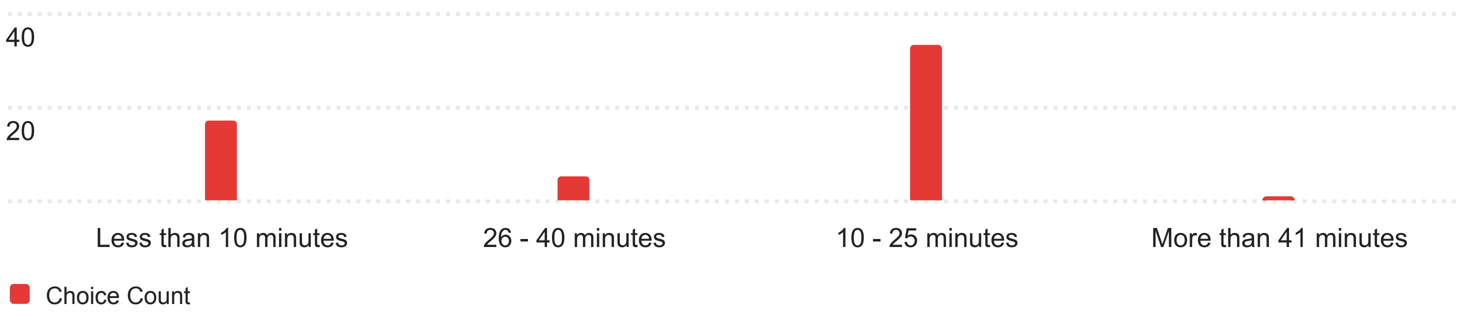
Q5 - How often do you go for a walk as a break when you are on campus?



Q5 - How often do you go for a walk as a break when you are on campus?

Field	Choice Count
Never	3
Hardly ever (1 - 10% of the times)	23
Sometimes (11 - 30% of the times)	15
Regularly (31 - 60% of the times)	12
Often (61 - 99% of the times)	5
Always	1

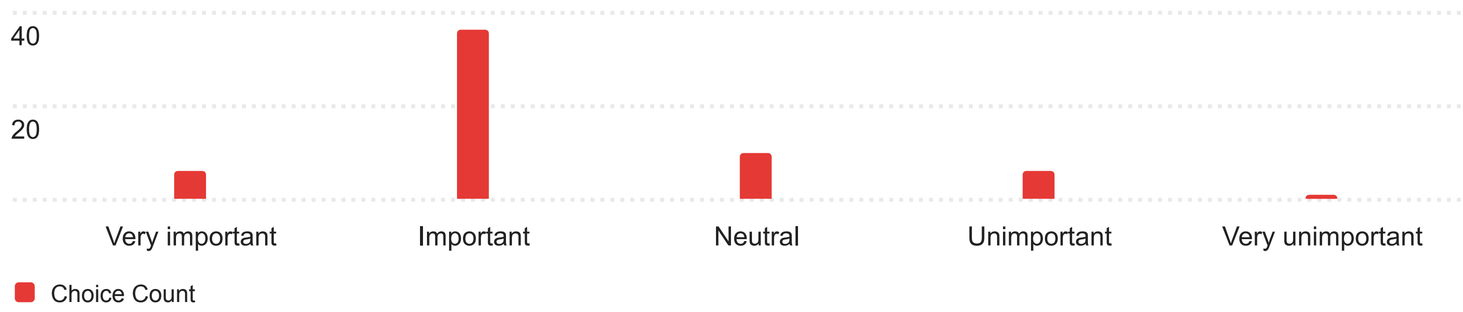
Q6 - How long are your walks on average? (skip if you answered 'Never' in the previous question)



Q6 - How long are your walks on average? (skip if you answered 'Never' in the previous question)

Field	Choice Count
Less than 10 minutes	17
26 - 40 minutes	5
10 - 25 minutes	33
More than 41 minutes	0

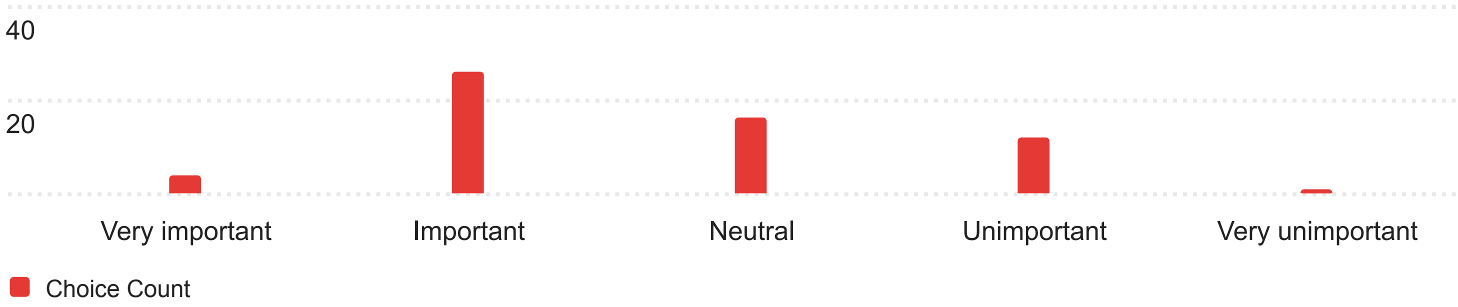
Q7 - To encourage walking: How important do you consider having enough different routes to choose from?



Q7 - To encourage walking: How important do you consider having enough different routes to choose from?

Field	Choice Count
Very important	6
Important	36
Neutral	10
Unimportant	6
Very unimportant	1

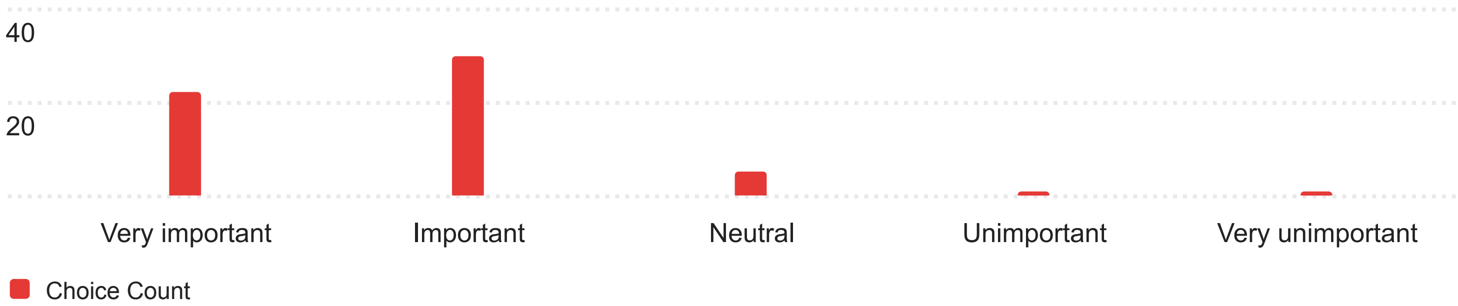
Q8 - To encourage walking: How important do you consider having organically shaped, curved pathways instead of straight roads?



Q8 - To encourage walking: How important do you consider having organically shaped, curved pathways instead of straight roads?

Field	Choice Count
Very important	4
Important	26
Neutral	16
Unimportant	12
Very unimportant	1

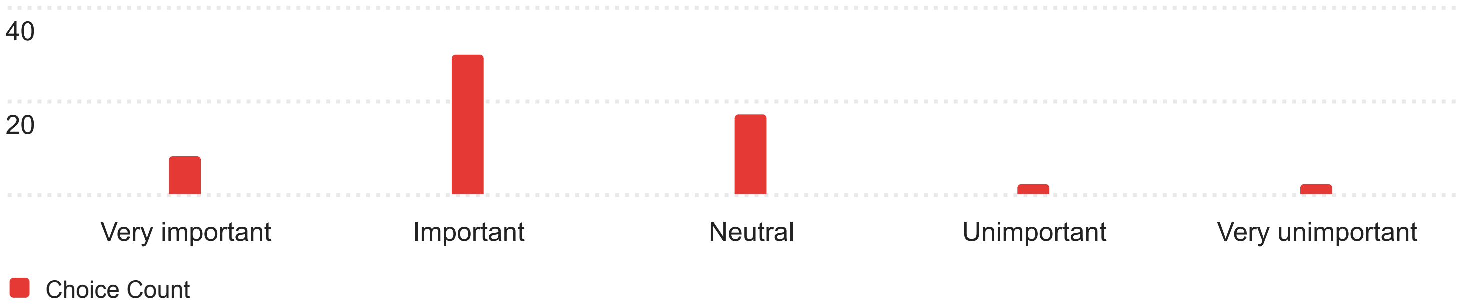
Q9 - To encourage walking: How important do you consider the separation of pedestrians and bikers?



Q9 - To encourage walking: How important do you consider the separation of pedestrians and bikers?

Field	Choice Count
Very important	22
Important	30
Neutral	5
Unimportant	1
Very unimportant	1

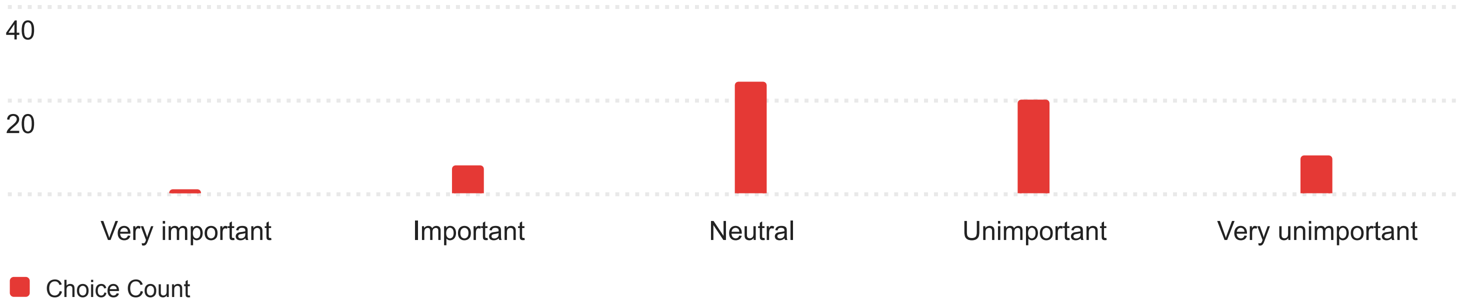
Q10 - To encourage walking: How important do you consider the comfortability of walkways?



Q10 - To encourage walking: How important do you consider the comfortability of walkways?

Field	Choice Count
Very important	8
Important	30
Neutral	17
Unimportant	2
Very unimportant	2

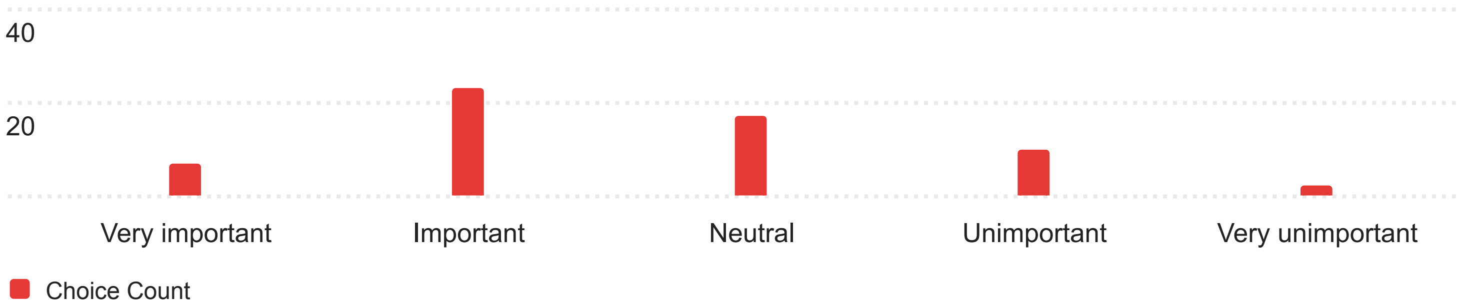
Q11 - To encourage walking: How important do you consider having clear road signs?



Q11 - To encourage walking: How important do you consider having clear road signs?

Field	Choice Count
Very important	1
Important	6
Neutral	24
Unimportant	20
Very unimportant	8

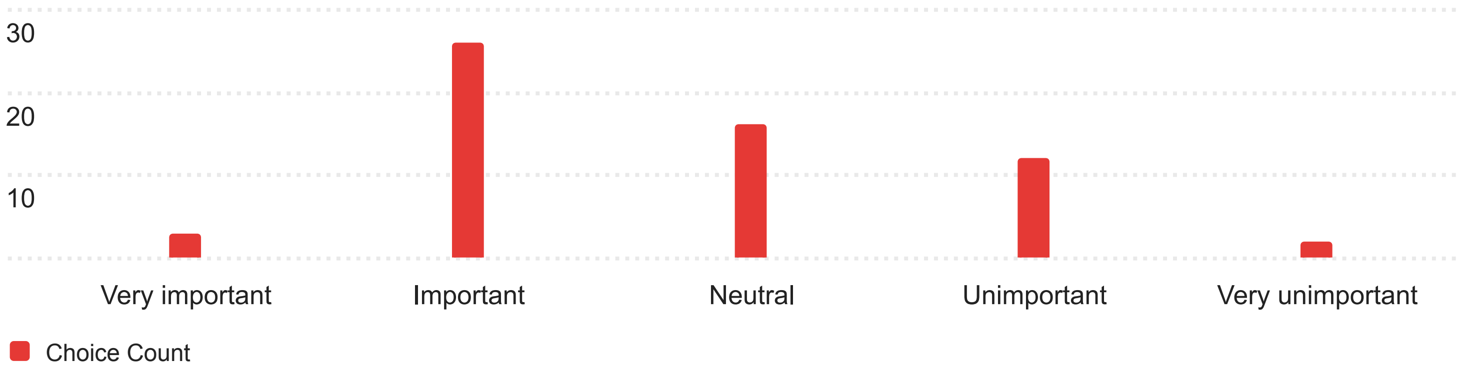
Q12 - To encourage walking: How important do you consider sufficient street lightning



Q12 - To encourage walking: How important do you consider sufficient street lightning

Field	Choice Count
Very important	7
Important	23
Neutral	17
Unimportant	10
Very unimportant	2

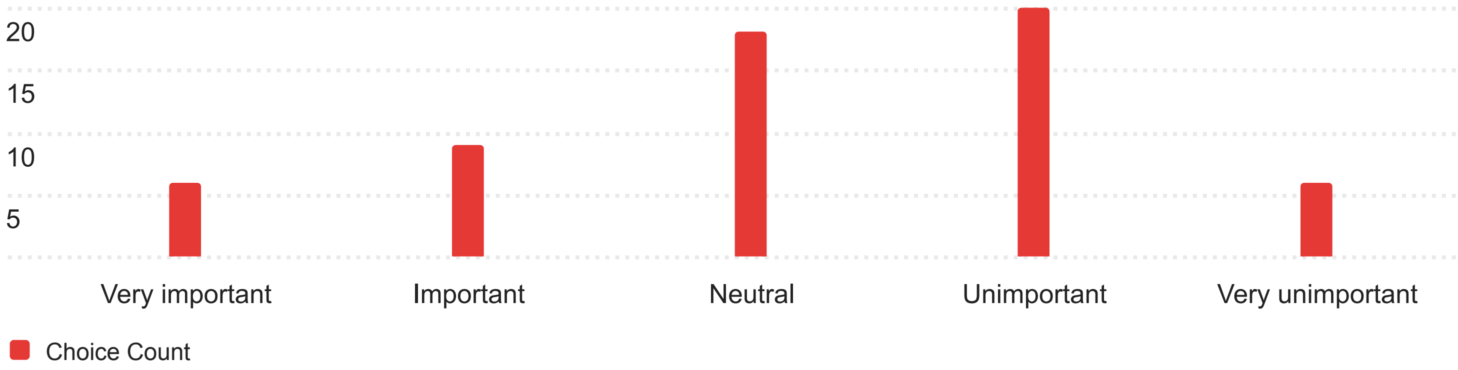
Q13 - To encourage walking: How important do you consider shaded areas



Q13 - To encourage walking: How important do you consider shaded areas

Field	Choice Count
Very important	3
Important	26
Neutral	16
Unimportant	12
Very unimportant	2

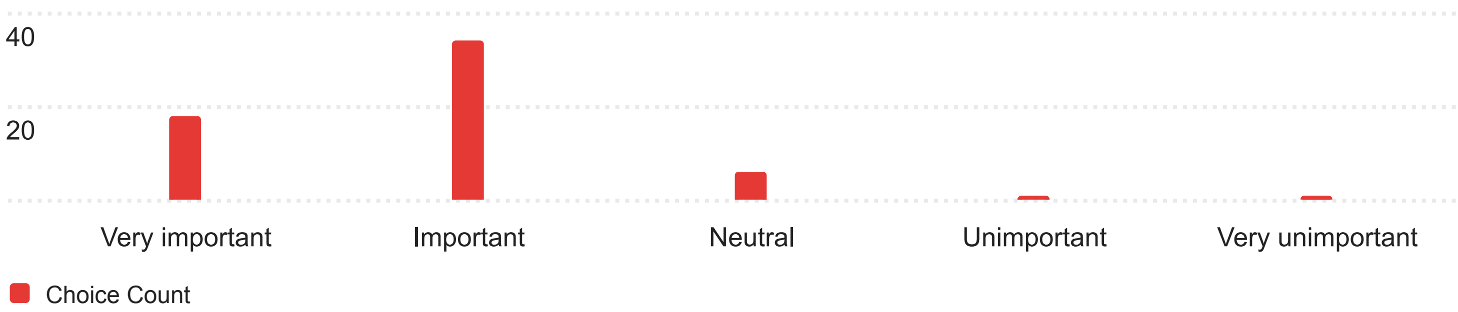
Q14 - To encourage walking: How important do you consider water dispensers



Q14 - To encourage walking: How important do you consider water dispensers

Field	Choice Count
Very important	6
Important	9
Neutral	18
Unimportant	20
Very unimportant	6

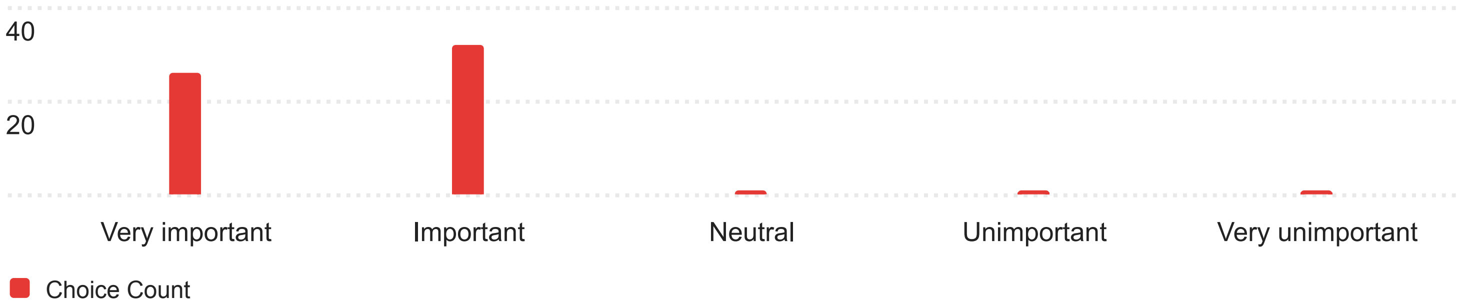
Q15 - To encourage walking: How important do you consider cleanliness and maintenance



Q15 - To encourage walking: How important do you consider cleanliness and maintenance

Field	Choice Count
Very important	18
Important	34
Neutral	6
Unimportant	0
Very unimportant	1

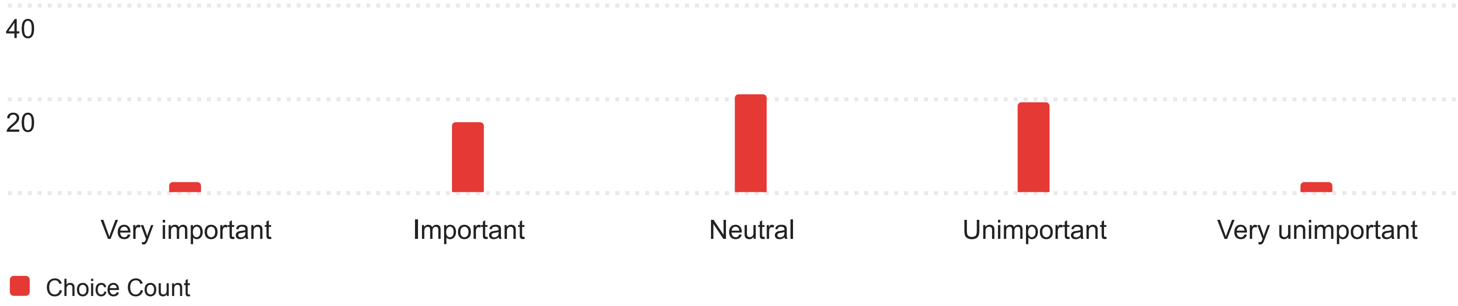
Q16 - To encourage walking: How important do you consider street trees and ornamental plants



Q16 - To encourage walking: How important do you consider street trees and ornamental plants

Field	Choice Count
Very important	26
Important	32
Neutral	1
Unimportant	0
Very unimportant	0

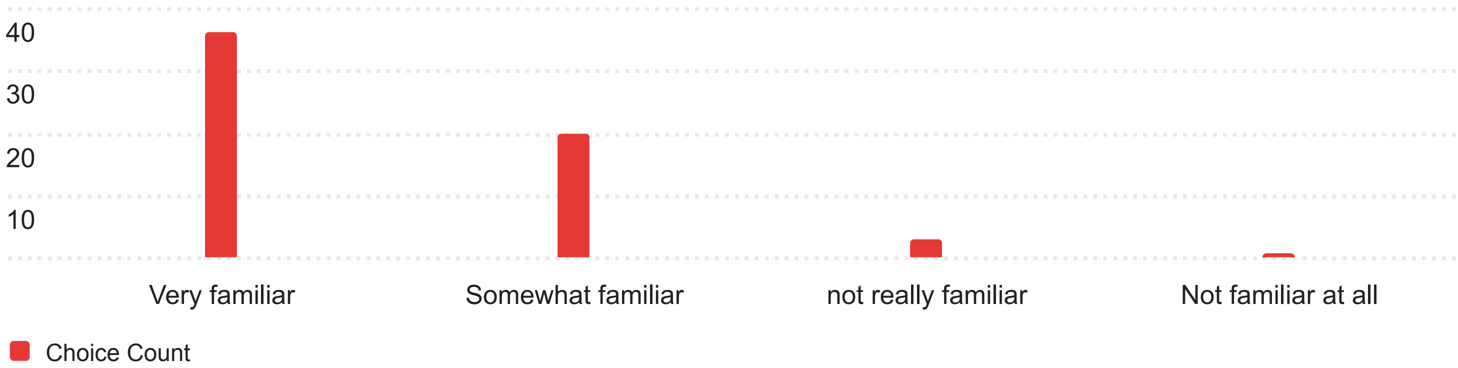
Q17 - To encourage walking: How important do you consider landmarks, murals and wall paintings



Q17 - To encourage walking: How important do you consider landmarks, murals and wall paintings

Field	Choice Count
Very important	2
Important	15
Neutral	21
Unimportant	19
Very unimportant	2

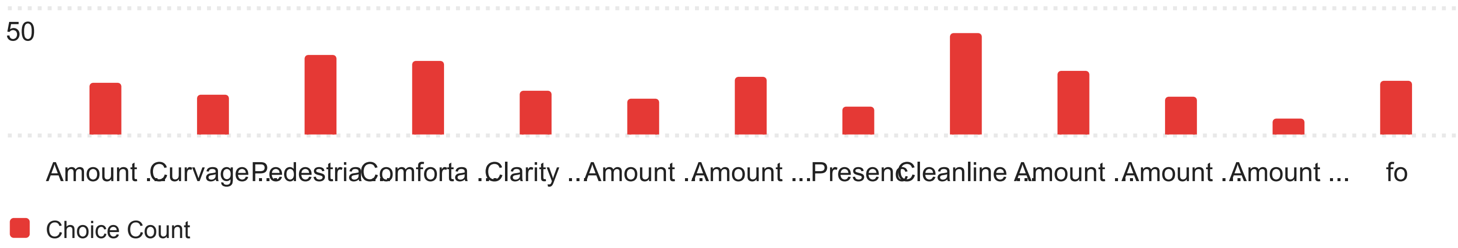
Q18 - How familiar are you with Mekelpark on campus?



Q18 - How familiar are you with Mekelpark on campus?

Field	Choice Count
Very familiar	36
Somewhat familiar	20
not really familiar	3
Not familiar at all	0

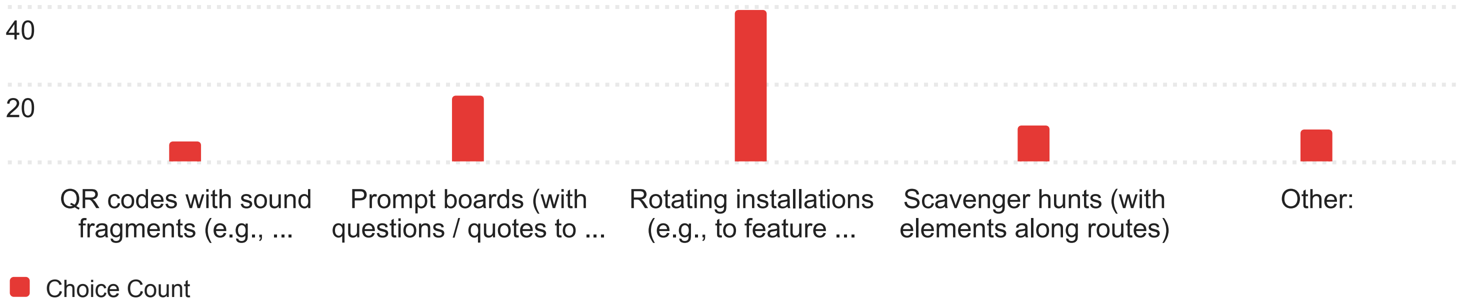
Q19 - To encourage walking: Which of Mekelparks elements you satisfied with and do not need change? (Multiple answers are possible, no need to answer if you are not familiar with the park)



Q19 - To encourage walking: Which of Mekelparks elements you satisfied with and do not need change? (Multiple answers are possible, no need to answer if you are not familiar with the park)

Field	Choice Count
Amount of different routes	20
Curvage of the routes	16
Pedestrian and bike separation	31
Comfortability of walkways	29
Clarity of road signs	17
Amount of street lightning	14
Amount of shaded areas	23
Presence of water dispensers	11
Cleanliness and maintenance	40
Amount of street trees and ornamental plants	25
Amount of landmarks, murals and wall paintings	15
Amount of construction work	6
Access for people with physical limitations	21

Q20 - To encourage walking: What would be your preferred kind of interaction on campus? (Multiple answers are possible) - Selected Choice



Q20 - To encourage walking: What would be your preferred kind of interaction on campus? (Multiple answers are possible) - Selected Choice

Field	Choice Count
QR codes with sound fragments (e.g., campus facts)	5
Prompt boards (with questions / quotes to spark reflection)	17
Rotating installations (e.g., to feature student work)	39
Scavenger hunts (with elements along routes)	9
Other:	8

Q20_5_TEXT - Other: - Text

Other: - Text
Outdoor study terrace
Sitting areas
none of this all
none, I enjoy nature and a conversation with a freiend, more than things along the route
Why would I need "interaction"?
None of these
Bring back the frisbee
None!

QID124 - Do you have any additional comments or feedback?

Do you have any additional comments or feedback?

Why is this in English, if you want that also employees fill in this questionaire consider that of them hardly speak or read in this languege

Studying in a hotter climate can be difficult, especially in poorly ventilated crowded buildings. For comfort, students seek study places outdoor to introduce fresh air, a breeze and a tan. A study terrace (including: tables - chairs - power sockets - shade) would be a nice additive to the Park.

The park is too short.

No

i don't want to interact on a walk. a walk is for time for yourself or with others. rotating installations are good at least because you can just view them and have something more to talk about

connection between different 'green' routes, e.g. mekelpark, jaffa, and the botanical garden

Very nice survey and project!!!

Instead of fancy distractions I'd appreciate good walkability from A to B without physical barriers, surface breaks, or big detours.

D

TU Delft distribution calculations

Original Distribution of ``Personnel''

Total "Personnel": 7,592

18% Faculty

$$0.18 \times 7,592 = 1,366.56 \approx 1,367$$

15% Other scientific staff

$$0.15 \times 7,592 = 1,138.8 \approx 1,139$$

29% PhD candidates

$$0.29 \times 7,592 = 2,201.68 \approx 2,202$$

38% Support staff

$$0.38 \times 7,592 = 2,884.96 \approx 2,885$$

Adjusted Distribution of ``Personnel'' (Excluding PhD Candidates)

Personnel without PhD = 7,592 $-$ 2,202 = 5,390

Faculty

$$\left(\frac{1,367}{5,390}\right) \times 100\% \approx 25.4\%$$

Other scientific staff

$$\left(\frac{1,139}{5,390}\right) \times 100\% \approx 21.1\%$$

Support staff

$$\left(\frac{2,885}{5,390}\right) \times 100\% \approx 53.5\%$$

Grouping for survey categories

Faculty and other scientific staff make up the "academic staff/professor" group.

$$25.4\% + 21.1\% = 46.5\%$$

Support staff represents the "non-academic staff" group.

$$= 53.5\%$$

Distribution Across University Roles

Status at university	Population	Distinctions
Student	26,196	53% BSc 47% MSc
PhD	3,537	
Personnel	5,390	46.5% Academic staff/professor 53.5% Non-academic staff

This gives a total of 35,123 for the TU Delft population. Below you can see the calculations for the percentages of the different statuses.

Bachelor

$$\frac{26,196 \times 0.53}{35,123} \times 100\% \approx 39.5\%$$

Master

$$\frac{26,196 \times 0.47}{35,123} \times 100\% \approx 35.1\%$$

PhD

$$\frac{3,537}{35,123} \times 100\% \approx 10.1\%$$

Academic staff/professor

$$\frac{5,390 \times 0.465}{35,123} \times 100\% \approx 7.1\%$$

Non-academic staff

$$\frac{5,390 \times 0.535}{35,123} \times 100\% \approx 8.2\%$$

Average Male-Female Ratio (Excluding PhD Candidates)

This is done following 3 different steps:

Step 1: Calculate male/female counts for total personnel

61.3% Male

$$0.613 \times 7,592 = 4,653.9 \approx 4,654$$

38.7% Female

$$0.387 \times 7,592 = 2,938.1 \approx 2,938$$

Step 2: Calculate male/female counts for PhD candidates
29% of Personnel: 2,202

68.8% Male

$$0.688 \times 2,202 = 1,515.0 = 1,515$$

31.2% Female

$$0.312 \times 2,202 = 687.0 = 687$$

Step 3: Adjusted Personnel (without PhD): 5,390

Male

$$\frac{4,654 - 1,515}{5,390} \times 100\% \approx 58.3\%$$

Female

$$\frac{2,938 - 687}{5,390} \times 100\% \approx 41.7\%$$

E

SPSS Results

Frequencies

Gender Distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	37	62,7	62,7	62,7
	Female	22	37,3	37,3	100,0
	Total	59	100,0	100,0	

Frequencies

Statistics (Age)

AGE EST

N	Valid	59
	Missing	0
Mean		29,2373
Std. Deviation		11,70041
Variance		136,900

Descriptives

Descriptive Statistics (How many times a week are participants on campus?)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
OFTEN EST	59	,50	5,50	3,5339	1,35145	-,237
Valid N (listwise)	59					

Descriptive Statistics (How many times a week are participants on campus?)

	Skewness	Kurtosis	
	Std. Error	Statistic	Std. Error
OFTEN EST	,311	-,194	,613
Valid N (listwise)			

Descriptives

Descriptive Statistics (How many of the breaks are used for walks?)

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
WALK EST	59	,00	100,00	25,0034	25,09383	629,700
Valid N (listwise)	59					

Descriptive Statistics (How many of the breaks are used for walks?)

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
WALK EST	1,279	,311	,881	,613
Valid N (listwise)				

Descriptives

Descriptive Statistics (What is the lengt of the walks?)

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
LENGTH EST	55	5,00	33,00	15,0455	8,08077	65,299
Valid N (listwise)	55					

Descriptive Statistics (What is the lengt of the walks?)

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
LENGTH EST	,444	,322	,194	,634
Valid N (listwise)				

Frequencies

Statistics (Walking behaviour of different genders)

Gender			OFTEN EST	WALK EST	LENGTH EST
Male	N	Valid	37	37	34
		Missing	0	0	3
	Mean		3,6892	27,3568	16,3824
	Median		3,5000	20,5000	17,5000
	Std. Deviation		1,37109	27,25564	8,10636
	Skewness		-,292	1,198	,398
	Std. Error of Skewness		,388	,388	,403
	Kurtosis		-,241	,502	,405
	Std. Error of Kurtosis		,759	,759	,788
Female	N	Valid	22	22	21
		Missing	0	0	1
	Mean		3,2727	21,0455	12,8810
	Median		3,5000	13,0000	17,5000
	Std. Deviation		1,30683	20,96454	7,74097
	Skewness		-,241	1,294	,575
	Std. Error of Skewness		,491	,491	,501
	Kurtosis		,268	1,289	,321
	Std. Error of Kurtosis		,953	,953	,972

Mann-Whitney Test

Test Statistics[a]

	OFTEN EST	WALK EST	LENGTH EST
Mann-Whitney U	341,500	362,500	277,000
Wilcoxon W	594,500	615,500	508,000
Z	-1,165	-,729	-1,596
Asymp. Sig. (2-tailed)	,244	,466	,110

a. Grouping Variable: Gender

Frequencies

Statistics (Walking behaviour of different statuses)

Status at TU Delft			OFTEN EST	WALK EST	LENGTH EST
Bachelor student	N	Valid	20	20	18
		Missing	0	0	2
	Mean		3,5000	21,0950	12,1111
	Median		3,5000	20,5000	11,2500
	Std. Deviation		1,25656	20,98785	8,13047
	Skewness		-,884	1,356	,878
	Std. Error of Skewness		,512	,512	,536
	Kurtosis		2,546	1,739	,611
	Std. Error of Kurtosis		,992	,992	1,038
Master student	N	Valid	22	22	22
		Missing	0	0	0
	Mean		3,5909	24,6818	15,3636
	Median		3,5000	20,5000	17,5000
	Std. Deviation		1,44450	23,87624	6,62280
	Skewness		-,069	1,194	,014
	Std. Error of Skewness		,491	,491	,491
	Kurtosis		-,929	,607	1,619
	Std. Error of Kurtosis		,953	,953	,953
PhD candidate	N	Valid	4	4	4
		Missing	0	0	0
	Mean		2,5000	22,9000	25,2500
	Median		2,5000	20,5000	25,2500
	Std. Deviation		1,15470	16,40244	8,94893
	Skewness		,000	,853	,000
	Std. Error of Skewness		1,014	1,014	1,014
	Kurtosis		-6,000	1,910	-6,000
	Std. Error of Kurtosis		2,619	2,619	2,619
Academic staff / professor	N	Valid	7	7	5
		Missing	0	0	2
	Mean		4,3571	12,5143	12,5000

Statistics (Walking behaviour of different statuses)

Status at TU Delft			OFTEN EST	WALK EST	LENGTH EST
	Median		3,5000	5,5000	17,5000
	Std. Deviation		1,06904	15,70036	6,84653
	Skewness		,374	1,915	-,609
	Std. Error of Skewness		,794	,794	,913
	Kurtosis		-2,800	3,553	-3,333
	Std. Error of Kurtosis		1,587	1,587	2,000
Non-academic staff	N	Valid	6	6	6
		Missing	0	0	0
	Mean		3,1667	55,1833	18,0000
	Median		3,5000	62,5500	17,5000
	Std. Deviation		1,50555	37,45212	8,88819
	Skewness		,313	-,256	,503
	Std. Error of Skewness		,845	,845	,845
	Kurtosis		-,104	-1,858	2,632
	Std. Error of Kurtosis		1,741	1,741	1,741

Kruskal-Wallis Test

Test Statistics[a,b]

	OFTEN EST	WALK EST	LENGTH EST
Kruskal-Wallis H	5,667	7,493	9,070
df	4	4	4
Asymp. Sig.	,225	,112	,059

a. Kruskal Wallis Test

b. Grouping Variable: status at TU Delft

Descriptives

Descriptive Statistics (EIS)

	N	Sum	Mean	Skewness		Kurtosis
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
DIFFERENT	59	217,00	3,6780	-,999	,311	1,030
SHAPE	59	197,00	3,3390	-,352	,311	-,609
SEPARATION	59	248,00	4,2034	-1,418	,311	3,599
COMFORTABILITY	59	217,00	3,6780	-,883	,311	1,535
SIGNS	59	149,00	2,5254	,131	,311	-,128
LIGHTNING	59	200,00	3,3898	-,351	,311	-,428
SHADE	59	193,00	3,2712	-,458	,311	-,509
WATER DISPENSERS	59	166,00	2,8136	,380	,311	-,544
MAINTENANCE	59	245,00	4,1525	-1,316	,311	4,469
GREENERY	59	261,00	4,4237	-,041	,311	-1,248
VISUALS	59	173,00	2,9322	,138	,311	-,605
Valid N (listwise)	59					

Descriptive Statistics (EIS)

	Kurtosis
	Std. Error
DIFFERENT	,613
SHAPE	,613
SEPARATION	,613
COMFORTABILITY	,613
SIGNS	,613
LIGHTNING	,613
SHADE	,613
WATER DISPENSERS	,613
MAINTENANCE	,613
GREENERY	,613
VISUALS	,613
Valid N (listwise)	

Wilcoxon Signed Ranks Test

Test Statistics (EIS)[a]

	SEPARATION - GREENERY	MAINTENANCE - SEPARATION	DIFFERENT - MAINTENANCE	COMFORTABILITY - DIFFERENT
Z	-1,794[b]	-,689[b]	-3,581[b]	,000[c]
Asymp. Sig. (2-tailed)	,073	,491	<.001	1,000

Test Statistics (EIS)[a]

	LIGHTNING - COMFORTABILITY	SHAPE - LIGHTNING	SHADE - SHAPE	VISUALS - SHADE
Z	-1,995[b]	-,407[b]	-,432[b]	-2,128[b]
Asymp. Sig. (2-tailed)	,046	,684	,665	,033

Test Statistics (EIS)[a]

	WATER DISPENSERS - VISUALS	SIGNS - WATER DISPENSERS
Z	-,803[b]	-1,508[b]
Asymp. Sig. (2-tailed)	,422	,132

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. The sum of negative ranks equals the sum of positive ranks.

Wilcoxon Signed Ranks Test

Test Statistics (EIS)[a]

	MAINTENANCE - GREENERY	SHADE - LIGHTNING	SIGNS - VISUALS
Z	-2,611[b]	-,778[b]	-2,493[b]
Asymp. Sig. (2-tailed)	,009	,437	,013

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Frequencies

Statistics (ESS)

		ESS_Different	ESS_Shape	ESS_Separation	ESS_Comfortability	ESS_Signs
N	Valid	59	59	59	59	59
	Missing	0	0	0	0	0
Mean		,8983	,6949	1,3390	1,2542	,7288
Sum		53,00	41,00	79,00	74,00	43,00

Statistics (ESS)

		ESS_Lightning	ESS_Shade	ESS_Water_Dispensers	ESS_Maintenance	ESS_Greenery
N	Valid	59	59	59	59	59
	Missing	0	0	0	0	0
Mean		,6271	1,0339	,5085	1,7797	1,1186
Sum		37,00	61,00	30,00	105,00	66,00

Statistics (ESS)

		ESS_Visuals	ESS_Construction	ESS_Accessability
N	Valid	59	59	59
	Missing	0	0	0
Mean		,6780	,2542	,8983
Sum		40,00	15,00	53,00

Wilcoxon Signed Ranks Test

Test Statistics (ESS)[a]

	ESS_Separation - ESS_Maintenance	ESS_Comfortability - ESS_Separation	ESS_Greenery - ESS_Comfortability	ESS_Shade - ESS_Greenery
Z	-1,921[b]	-,326[b]	-,268[b]	-,383[b]
Asymp. Sig. (2-tailed)	,055	,745	,789	,702

Test Statistics (ESS)[a]

	ESS_Different - ESS_Shade	ESS_Accessability - ESS_Different	ESS_Signs - ESS_Accessability	ESS_Shape - ESS_Signs
Z	-,647[b]	-,308[b]	-,896[b]	-,083[b]
Asymp. Sig. (2-tailed)	,518	,758	,370	,934

Test Statistics (ESS)[a]

	ESS_Visuals - ESS_Shape	ESS_Lightning - ESS_Visuals	ESS_Water_Dispensers - ESS_Lightning	ESS_Construction - ESS_Water_Dispensers
Z	-,104[c]	-,323[b]	-,730[b]	-1,639[b]
Asymp. Sig. (2-tailed)	,917	,747	,465	,101

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Frequencies

Statistics (Interaction Preferences)

		QR-Codes	Prompt Boards	Rotating Instalations	Scavenger Hunts	Other Choice
N	Valid	59	59	59	59	59
	Missing	0	0	0	0	0
Sum		5	17	39	9	8

Frequencies

Statistics (Interaction preferences of different genders)

What is your gender? - Selected Choice			QR-Codes	Prompt Boards	Rotating Instalations	Scavenger Hunts
Male	N	Valid	37	37	37	37
		Missing	0	0	0	0
	Sum		3	9	24	5
Female	N	Valid	22	22	22	22
		Missing	0	0	0	0
	Sum		2	8	15	4

Statistics (Interaction preferences of different genders)

What is your gender? - Selected Choice			Other Choice
Male	N	Valid	37
		Missing	0
	Sum		7
Female	N	Valid	22
		Missing	0
	Sum		1

Crosstabs

Chi-Square Tests Gender and QR-Codes

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,017[a]	1	,896		
Continuity Correction[b]	,000	1	1,000		
Likelihood Ratio	,017	1	,896		
Fisher's Exact Test				1,000	,623
Linear-by-Linear Association	,017	1	,897		
N of Valid Cases	59				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.86.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Gender and Prompt Boards

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,975[a]	1	,323		
Continuity Correction[b]	,476	1	,490		
Likelihood Ratio	,960	1	,327		
Fisher's Exact Test				,380	,244
Linear-by-Linear Association	,958	1	,328		
N of Valid Cases	59				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.34.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Gender and Rotating Instalations

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,068[a]	1	,795		
Continuity Correction[b]	,000	1	1,000		
Likelihood Ratio	,068	1	,794		
Fisher's Exact Test				1,000	,513
Linear-by-Linear Association	,067	1	,796		
N of Valid Cases	59				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.46.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Gender and Scavenger Hunts

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,233[a]	1	,630		
Continuity Correction[b]	,012	1	,914		
Likelihood Ratio	,228	1	,633		
Fisher's Exact Test				,715	,448
Linear-by-Linear Association	,229	1	,633		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.36.

b. Computed only for a 2x2 table

Chi-Square Tests Gender and Other Choice

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2,432[a]	1	,119		
Continuity Correction[b]	1,360	1	,244		
Likelihood Ratio	2,803	1	,094		
Fisher's Exact Test				,237	,120
Linear-by-Linear Association	2,391	1	,122		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.98.

b. Computed only for a 2x2 table

Frequencies

Statistics

Status at TU Delft			QR-Codes	Prompt Boards	Rotating Instalations
Bachelor student	N	Valid	20	20	20
		Missing	0	0	0
	Sum		4	8	13
Master student	N	Valid	22	22	22
		Missing	0	0	0
	Sum		1	5	15
PhD candidate	N	Valid	4	4	4
		Missing	0	0	0
	Sum		0	1	4
Academic staff / professor	N	Valid	7	7	7
		Missing	0	0	0
	Sum		0	1	2
Non-academic staff	N	Valid	6	6	6
		Missing	0	0	0
	Sum		0	2	5

Statistics

Status at TU Delft			Scavenger Hunts	Other Choice
Bachelor student	N	Valid	20	20
		Missing	0	0
	Sum		2	2
Master student	N	Valid	22	22
		Missing	0	0
	Sum		6	2
PhD candidate	N	Valid	4	4
		Missing	0	0
	Sum		0	0
Academic staff / professor	N	Valid	7	7
		Missing	0	0
	Sum		0	4
Non-academic staff	N	Valid	6	6
		Missing	0	0
	Sum		1	0

Crosstabs

Chi-Square Tests Merged Groups and QR-Qodes

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,544[a]	1	,214		
Continuity Correction[b]	,461	1	,497		
Likelihood Ratio	2,617	1	,106		
Fisher's Exact Test				,576	,274
Linear-by-Linear Association	1,518	1	,218		
N of Valid Cases	59				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.10.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Merged Groups and Prompt Boards

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,268[a]	1	,605		
Continuity Correction[b]	,029	1	,865		
Likelihood Ratio	,276	1	,599		
Fisher's Exact Test				,738	,444
Linear-by-Linear Association	,263	1	,608		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.75.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Merged Groups and Rotating Installations

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,118[a]	1	,290		
Continuity Correction[b]	,526	1	,468		
Likelihood Ratio	1,083	1	,298		
Fisher's Exact Test				,332	,232
Linear-by-Linear Association	1,099	1	,295		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.41.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Merged Groups and Scavenger Hunts

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,738[a]	1	,390		
Continuity Correction[b]	,178	1	,673		
Likelihood Ratio	,839	1	,360		
Fisher's Exact Test				,668	,358
Linear-by-Linear Association	,725	1	,394		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.98.

b. Computed only for a 2x2 table

Crosstabs

Chi-Square Tests Merged Groups and Other Choice

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4,213[a]	1	,040		
Continuity Correction[b]	2,541	1	,111		
Likelihood Ratio	3,603	1	,058		
Fisher's Exact Test				,062	,062
Linear-by-Linear Association	4,142	1	,042		
N of Valid Cases	59				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.76.

b. Computed only for a 2x2 table

Frequencies

Statistics (Max ESS)

FAMILIARITY

N	Valid	59
	Missing	0
Sum		151,00

F

EIS and ESS normalized values

Table F.1: Normalized values of the Element Importance Scores (EIS)

Walkability element	EIS	Nomalized EIS
Greenery	261	1
Separation	248	0,884
Maintenance	245	0,857
Different	217	0,607
Comfortability	217	0,607
Lightning	200	0,455
Shape	197	0,429
Shade	193	0,393
Visuals	173	0,214
Water dispensers	166	0,152
Signs	149	0

Table F.2: Normalized values of the Element Satisfaction Scores (ESS)

Walkability element	ESS	Nomalized ESS
Maintenance	105	0,695
Separation	79	0,523
Comfortability	74	0,490
Greenery	66	0,437
Shade	61	0,403
Different	53	0,351
Accessibility	53	0,351
Signs	43	0,285
Shape	41	0,272
Visuals	40	0,265
Lightning	37	0,245
Water dispensers	30	0,199
Construction	15	0,099

G

Consult CREFM

H

Use of AI

In the process of writing this thesis, OpenAI's ChatGPT is used for various purposes.

Firstly, ChatGPT was used to help translate thoughts into well-structured academic English, particularly in sections where articulating complex ideas were challenging. However, special attention was paid to adapting AI suggestions to match my own tone and writing style, in order to preserve the authenticity of my work.

In addition, it helped greatly with learning and applying SPSS. The software's statistical tools were essential for analyzing survey data, but as a beginner with SPSS, I encountered several technical questions throughout the process. AI was able to provide step-by-step explanations of various functions, such as how to transform variables or apply specific formulas. This contributed to a more accurate data analysis.

Importantly, all information, suggestions, and formulations generated through ChatGPT were critically reviewed with academic sources. The AI was not used to replace academic judgement or original thinking but rather to support the process of expressing it effectively. This way, I was able to focus more on the core analytical and conceptual work of the thesis.