Identifying the Characteristics of Well-Performing Hybrid Work Environments:

The Role of Layout, Occupancy, and Employee Perceptions.

A Case Study of the Netherlands Police Real Estate Portfolio

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Graduation group 6: Value and Valuation
June 2026

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Preface

This thesis was completed as part of the Master's programme in Management in the Built Environment at Delft University of Technology. The research was conducted during an internship at the Real Estate and Housing Management Department of the Netherlands Police between Febuary and June 2026.

I would like to thank my thesis supervisors, Monique Arkesteijn and Farley Ishaak, for their guidance and feedback throughout the graduation process. I also thank Anke Necke, my supervisor from the Netherlands Police, for her support and assistance during the internship.

The WiT Monitor survey data used in this study were made available by the Center for People and Buildings. I would particularly like to thank Mathilda du Preez for her involvement and practical support throughout the research process.

Katerina Papatheodoraki

Delft, June 2026

AI Use Disclaimer

This thesis was researched and written by Aikaterini Papatheodoraki. Generative AI tools were used during the writing and revision process as assistive tools. All research questions, analytical decisions, statistical analyses, interpretations, and conclusions are the sole intellectual work of the author. The use of AI is fully disclosed in Appendix D.

Abstract

Hybrid working has substantially reduced daily office attendance across large organisational portfolios, yet the spatial and behavioural characteristics that distinguish well-performing hybrid work environments remain poorly understood, particularly in the public sector, where real estate decisions carry significant financial and societal implications.

This study examines what layout and use characteristics contribute to the effective use of hybrid work environments in the Netherlands Police real estate portfolio. It integrates three data sources: building-level occupancy measurements from Measuremen across twelve office buildings; floor-plan analysis using the framework of Ruiz de Castañeda Altuna (2025); and employee perception data from the Werk in Transitie (WiT) Monitor survey, available for three buildings (n = 376 respondents). Seven hypotheses were tested through descriptive statistics, Pearson and Spearman correlations, one-way ANOVA, and hierarchical regression analysis.

The findings demonstrate that well-performing hybrid work environments are not distinguished by a particular layout typology but by the degree to which they provide adequate privacy, acoustic comfort, physical comfort, and collaborative infrastructure. Office layout typology and workspace ratio did not predict occupancy or perceived effectiveness. Privacy satisfaction, workplace comfort, and meeting space availability were the strongest predictors of perceived effectiveness, explaining 68.7% of the variance in the regression model. Targeted spatial quality improvements within existing layouts are likely to yield greater gains than typological redesign. The study contributes an empirically grounded analytical framework that integrates occupancy, floor-plan, and survey data and is applicable to other Police buildings as WiT coverage expands.

Keywords: hybrid work, office layout, perceived workplace effectiveness, building occupancy, spatial efficiency, Netherlands Police, workspace ratio, occupancy, perceived workplace productivity.

Summary

Background and Research Question

The transition to hybrid working has fundamentally changed how office buildings are used. In many large organisations, daily attendance has declined significantly, leaving substantial office capacity underutilised. For the Netherlands Police, one of the largest employers in the Netherlands, operating a geographically dispersed portfolio of office buildings, this raises urgent questions about which buildings to retain, adapt, or release, and what spatial characteristics distinguish offices that employees find effective and choose to attend.

This study addresses the following main research question: What layout and use characteristics distinguish effective hybrid work environments? The study focuses on the Netherlands Police real estate portfolio and draws on three integrated data sources: building-level occupancy measurements, floor-plan analysis, and employee perception surveys.

Methods

A quantitative, cross-sectional research design was applied. Observational occupancy data were collected by Measuremen across 12 Police office buildings during two- to three-week periods in spring 2024. Spatial characteristics were assessed through systematic floor-plan analysis using the framework of Ruiz de Castañeda Altuna (2025), covering five dimensions: layout typology, spatial organisation, functional variety, flexibility and workspace ratio, and density and environmental characteristics. Employee perceptions were measured using the Werk in Transitie (WiT) Monitor, a validated survey instrument applied in Dutch hybrid work contexts, with data available for three of the twelve buildings (n = 376 valid respondents).

Seven hypotheses were derived from the literature review and tested using descriptive statistics, Pearson and Spearman rank correlations, one-way ANOVA, and a four-block hierarchical regression analysis.

Key Findings

The average occupancy rate across the twelve buildings was 25.7%, with peak rates not exceeding 60.5% in any building. This confirms structural underutilisation across the portfolio under hybrid working conditions. Workspace ratios ranged from 71% (Building 7) to 161% (Building 3), but neither workspace ratio nor layout typology showed a statistically significant association with occupancy levels. Organisational factors, team-specific attendance policies, PTW registration, and mandatory presence requirements appear to be stronger determinants of attendance than the building's physical configuration.

From the employee perspective, collaboration-related items were rated most positively across all three survey buildings, with in-person meetings and working together in person approaching mean scores of 3.9 out of 5. Privacy, acoustics, focused work, and confidential conversations consistently scored below 3.0, indicating that the Police office buildings are experienced as more supportive of collaboration than of private or concentrated work.

The hierarchical regression model explained 68.7% of the variance in perceived workplace effectiveness. Privacy satisfaction was the strongest predictor ($\beta = .380$, $p < .001$), followed by workplace comfort ($\beta = .234$) and the availability of meeting and discussion spaces ($\beta = .193$). Office days per week were the only significant use-behaviour predictor ($\beta = .124$). Crucially, office layout typology, whether cellular, open-plan, or mixed, was not a significant predictor in any regression model. This indicates that perceived effectiveness is driven by the quality of the spatial experience within a layout, not by the layout type itself.

Spatial satisfaction was also positively associated with office attendance frequency: employees who were more satisfied with privacy, openness, and their ability to work in a focused manner attended the office more often. Self-reported general productivity (STAPLESOP and IWPQ) was not associated with spatial quality and showed a slight negative association with the frequency of office attendance, consistent with research indicating that individual, focused work is perceived as more productive at home.

Conclusions and Implications

The findings demonstrate that well-performing hybrid work environments are characterised not by a particular layout form but by the degree to which they provide adequate privacy, acoustic comfort, physical comfort, and access to collaborative spaces. Buildings that deliver these spatial qualities will be experienced as more effective, regardless of their typological classification.

For the Netherlands Police real estate portfolio, the practical implication is clear: investment in spatial quality improvements within existing buildings, particularly acoustic improvement, the provision of enclosed or semi-enclosed spaces for privacy and focused work, and the availability of meeting and discussion rooms, is likely to yield greater returns in perceived effectiveness than structural conversions between layout typologies. Reducing the workspace ratio alone, without addressing spatial quality, will not drive higher occupancy.

The study contributes an integrated analytical framework that combines occupancy measurement, floor-plan analysis, and survey data, providing a replicable template for evidence-based real estate decisions as WiT survey coverage expands across the Police portfolio.

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CHAPTER 1

Introduction

1. Introduction

1.1 Introduction

Hybrid work has become a defining characteristic of contemporary work environments, allowing employees to divide their work between the office, home, and other locations. This shift has changed the role of the office: rather than serving mainly as a place for daily presence, the office is increasingly expected to support collaboration, coordination, knowledge sharing, and social interaction. For organisations, this creates new challenges in managing office space, because attendance has become more variable and less predictable.

Hybrid work has become a defining characteristic of contemporary work environments, allowing employees to divide their time between the office, home, and other locations. This shift has fundamentally changed the role of the office: rather than serving as a place for daily presence, the office is increasingly expected to support collaboration, coordination, knowledge sharing, and social interaction (Center for People and Buildings, 2024). However, hybrid work also presents significant challenges for space utilisation. Many organisations report lower and more variable occupancy levels, with mid-week peaks and persistently low attendance on Mondays and Fridays (Center for People and Buildings, 2024). This trend has direct implications for real estate strategies, as building capacity and associated costs have not declined in proportion to the reduction in occupancy. Consequently, organisations are reassessing long-term space needs, and hybrid work has become a catalyst for broader workplace and portfolio transformation (Allen et al., 2024). Under hybrid conditions, attendance becomes a choice-based behaviour rather than a default, meaning occupancy increasingly reflects whether the office is perceived as adding value over remote alternatives (Allen et al., 2024; Bergefurt et al., 2024).

The public sector faces similar challenges but with additional constraints. Government organisations often control large, distributed real estate portfolios that must support administrative and knowledge-intensive activities, while also being accountable for efficient use of publicly funded space. Adjusting public-sector portfolios is generally slower and more complex than in the private sector due to procurement, governance, and planning procedures (OECD, 2022). Despite growing adoption of hybrid work, empirical knowledge about how public-sector office buildings perform under such conditions remains limited (Gupta, 2022).

Within this context, the Netherlands Police provides a relevant case. The Police manage a large and geographically dispersed real estate portfolio that includes district offices, operational facilities, and centrally located office buildings (Politie Nederland, 2020). Following the adoption of hybrid work, several administrative office buildings within the portfolio have experienced significantly reduced, uneven occupancy, resulting in inefficient use of expensive space. Although buildings differ widely in layout, function, accessibility, and user perceptions, little is known about which physical or perceptual characteristics contribute to better performance in a hybrid work

context. This knowledge gap hinders evidence-based decision-making concerning which buildings to retain, adapt, or release.

1.1.1 Research Problem

The core problem addressed in this research is the lack of empirical insight into the distinguishing layout characteristics that make certain office buildings more suitable for hybrid work than others, particularly within large public-sector portfolios such as that of the Netherlands Police. Despite widespread adoption of hybrid working arrangements, organisations lack the evidence needed to assess which buildings perform well, in terms of both measured space utilisation and employee-perceived effectiveness, and which buildings should be prioritised for adaptation, consolidation, or release. This research addresses that gap by examining how layout characteristics, individual use behaviour, and spatial efficiency relate to building-level occupancy and perceived workplace effectiveness across the Netherlands Police portfolio.

1.1.2 Research Goal

The goal of this research is to identify the layout and use characteristics associated with the efficient and effective use of office space under hybrid working conditions in the Netherlands Police real estate portfolio. By integrating three types of data, floor-plan analyses, building-level occupancy measurements, and employee perception surveys, this research aims to generate empirically grounded knowledge to support future portfolio decision-making, workplace strategy, and targeted spatial interventions.

1.1.3 Main Research Question

> *What are the distinguishing layout and use characteristics that contribute to the effective use of hybrid work environments?*

This main question is addressed through seven sub-questions, each corresponding to a distinct analytical stage of the research:

Sub-Questions

1. To what extent are different Police office buildings used efficiently under hybrid working conditions?
2. Which physical building characteristics define Police office buildings used for hybrid work?
3. How do employees perceive workplace effectiveness in the Netherlands Police office buildings under hybrid working conditions?
4. Which layout characteristics are associated with higher spatial efficiency?
5. How are employees' perceptions of workplace effectiveness related to spatial efficiency in the Netherlands Police office buildings?
6. How do layout characteristics influence employees' perceived workplace effectiveness in hybrid work environments?
7. To what extent are layout characteristics, use characteristics, and spatial efficiency associated with perceived workplace effectiveness in the Netherlands Police office buildings under hybrid working conditions?

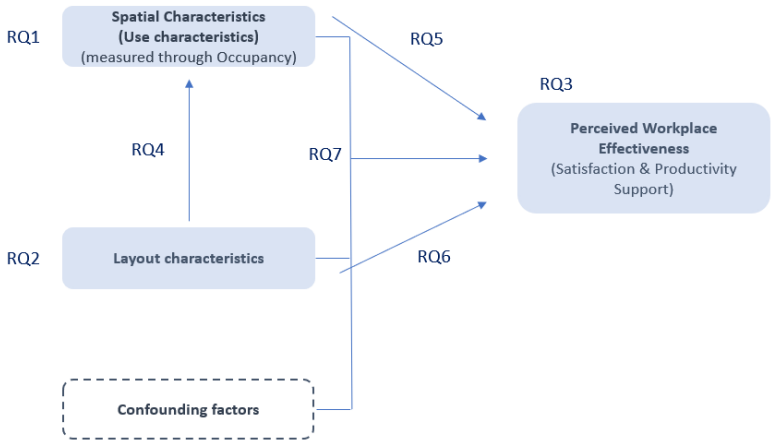

Figure 1: Conceptual Model

1.1.4 Scope of the Research

The research focuses on office buildings within the Netherlands Police portfolio and analyses performance at the building level. Three data sources are used in combination: floor-plan analyses conducted for 12 Police office buildings, occupancy measurement data collected by “Measuremen” across the same 12 buildings, and employee perception data from the Work in Transition (Werk in Transitie-WiT) Monitor survey, for which sufficient responses were available in 3 of the 12 buildings. The study does not investigate home-working environments, operational Police facilities (such as police stations or detention centres), or the design and implementation of new workplace interventions. Individual-level behaviour within buildings, such as which zones employees use or whether they prefer enclosed or open workspaces, is also outside the scope of this study, as data are available only at the building level.

1.2 Scientific and Societal Relevance

From a scientific perspective, the research contributes to emerging literature on hybrid working by linking employee perceptions, physical characteristics, and utilisation outcomes. While existing workplace and hybrid work research has examined employee satisfaction, collaboration, and productivity (Allen et al., 2024; Bergefurt et al., 2024), fewer studies have connected these findings to building-level performance or corporate real estate management. By analysing a large-scale dataset, this research provides empirical insights into workplace strategy and public-sector corporate real estate.

From a societal perspective, the efficient use of Police real estate is important given the scale of the portfolio and the public funding involved. Identifying buildings that perform well under hybrid conditions supports more sustainable space utilisation, reduces unnecessary operational costs, and contributes to the broader societal transition toward hybrid work. Insights may also be relevant for other public organisations, universities, and government agencies facing similar challenges.

1.3 Scope and Limitations

This research focuses specifically on:

- Office-type buildings within the Netherlands Police portfolio are used for administrative and support functions.
- Hybrid work environments in which employees have a choice over where they work.
- Buildings for which both floor-plan data and occupancy measurement data are available (12 buildings).
- Employee perception analyses are limited to the 3 buildings with sufficient WiT survey responses.
- Building-level performance indicators, not seat-level or zone-level utilisation patterns.

A key limitation of the dataset is that occupancy and presence are measured at the building level, without information on how space within buildings is used. It is therefore not known whether employees occupy private offices, dedicated desks, or shared workplaces, nor how different workspace typologies support hybrid activities. As a result, seat-level utilisation, zoning patterns, and activity-based workplace behaviour cannot be analysed, and the study is restricted to building-level performance indicators.

A further limitation is that employee perception data were available for only three of the twelve buildings, constraining the statistical power of the building-level analyses and limiting the generalisability of regression-based findings beyond the three-building sub-sample. Findings from the regression analysis should therefore be interpreted as indicative rather than conclusive, and the building-level Spearman correlations should be treated as exploratory associations.

1.4 Structure of the Thesis

This thesis is structured as follows. Chapter 2 reviews the relevant literature on hybrid work, office layout typologies, occupancy measurement, and perceived workplace effectiveness, and their relationships, and derives the hypotheses guiding the empirical analyses. Chapter 3 describes the research design, data sources, and statistical methods used to address the seven sub-questions. Chapter 4 presents the results, organised around the sub-questions and their corresponding analyses. Chapter 5 interprets the findings in relation to the literature and discusses their implications for the Netherlands Police real estate portfolio. Chapter 6 answers the main research question, summarises the study's contributions, and provides practical recommendations.

CHAPTER 2

Literature Review

2. Literature Review

This chapter reviews the existing literature relevant to the three central themes of this study: hybrid work and its implications for office use, building occupancy as an indicator of spatial efficiency, and office layout as a determinant of both occupancy patterns and perceived workplace effectiveness. The chapter is structured to build progressively toward an integrated analytical framework. Section 2.1 introduces the concept of hybrid work and its implications for the changing role of the office. Section 2.2 reviews the literature on perceived workplace effectiveness, covering its definition, measurement, and relationship to physical workplace conditions. Section 2.3 examines building occupancy as a spatial efficiency indicator, including how it is measured and how it relates to perceived effectiveness. Section 2.4 reviews office layout characteristics, how they are measured, and what is known about their relationship to both occupancy and perceived effectiveness. Section 2.5 integrates these relationships into a combined analytical model and derives the final hypothesis for the regression analysis. Section 2.6 discusses confounding factors that may independently influence hybrid work attendance. Sections 2.7 and 2.8 present the scientific knowledge gap and the conceptual framework that guides the empirical analysis. The chapter concludes in Section 2.9 with a summary of the identified gaps and a transition to the methods chapter.

2.1 Hybrid Work and the Changing Role of the Office

Hybrid working refers to a work arrangement that offers flexibility in terms of when and where work is performed, combining remote and on-site activities (Bergefurt et al., 2024). In hybrid models, employees may conduct individual and collaborative tasks at home, in the office, or in third places, depending on the nature of the work and organisational expectations. Although forms of remote work can be traced back to the 1970s (Nilles et al., 1976), adoption remained relatively limited and considered an exception rather than a standard arrangement (Illegems et al., 2001; Iscan & Naktiyok, 2005). It was not until the COVID-19 pandemic that remote and hybrid work were implemented at scale (Allen et al., 2024). This transition was mainly driven by the significant increase in the share of employees who usually work from home. Before the pandemic, around 11% of employees worked from home, while in 2021, approximately 22% did so at least part of the time (Eurofound, 2022).

The rise of hybrid work has changed the role of the office. Whereas offices were traditionally designed around attendance, visibility, and desk-based individual work, hybrid work has shifted their core function towards collaboration, knowledge sharing, coordination, and social interaction (Bergefurt et al., 2024; Allen et al., 2024). This shift has implications for both employees and organisations. For employees, hybrid work increases autonomy over how work tasks are distributed across time and place (Gibson et al., 2023). For organisations, hybrid work introduces uncertainty in workplace demand and attendance patterns (Bergefurt et al., 2024; Allen et al., 2024; Eurofound, 2022).

Hybrid work also creates challenges for managing office space. Because employees can choose where to perform certain tasks, offices must compete with alternative work environments, especially the home workplace, which may be perceived as more suitable for concentrated work (Centre for People and Buildings, 2024). This choice-based behaviour implies that the quality and suitability of the office environment influence employees' willingness to work from the office (Bergefurt et al., 2024). Consequently, hybrid work makes the quality of the office more important in people's decision to come in. Its role extends beyond providing space to offering value that cannot be replicated at home, such as opportunities for collaboration, interaction with colleagues, and access to resources (Bergefurt et al., 2024; Allen et al., 2024).

For large organisations, including the Dutch Police, this raises questions about portfolio strategies, space allocation, and the long-term function of office buildings (OECD, 2021; McKinsey, 2023). While hybrid work has behavioural, organisational, and cultural dimensions, it also introduces a spatial dimension that directly affects real estate performance and portfolio decision-making (Bergefurt et al., 2024).

The literature on hybrid work demonstrates that office attendance has become a choice rather than a routine, influenced by task types, perceived benefits, and user preferences. This shift changes the office's role from a place of mandatory presence to a value-adding environment for collaboration, coordination, and social interaction. For organisations, hybrid work introduces uncertainty into workplace demand and reduces the predictability of occupancy patterns, leading to inefficiencies and mismatches between space supply and use (JLL, 2022).

2.2 Perceived Workplace Effectiveness

Workplace design has increasingly shifted toward flexible and non-territorial office concepts in response to organisational change and new ways of working. These innovations aim not only to improve space efficiency but also to enhance communication, user satisfaction, and labour productivity (van der Voordt & Maarleveld, 2006). As a result, office performance is now evaluated through both organisational and user-based criteria rather than cost alone. Post-Occupancy Evaluation (POE) frameworks contribute to this shift by systematically assessing how workplaces are experienced, how space is used, and how the physical environment affects work outcomes (van der Voordt & Maarleveld, 2006). In the context of hybrid work, such evaluations are increasingly relevant, as office buildings should support new patterns of attendance, collaboration, and task allocation.

2.2.1 Definitions and Theoretical Background

A central distinction in this study is between workplace effectiveness, a performance outcome, and spatial satisfaction, a predictor of that outcome. Workplace effectiveness refers to the extent to which the office environment enables employees to perform their work well, be productive, maintain their health and well-being, and complete the tasks they need to complete. Spatial satisfaction, by contrast, refers to how pleased employees are with specific physical features of their environment, such as acoustics, privacy, or layout. While these two constructs are related, they are conceptually and empirically distinct and should not be conflated.

Defining workplace performance requires moving beyond cost and efficiency metrics to a model that captures both the objective use of space and the subjective experience of occupants. For van den Boogert et al. (2024), building performance is determined not only by efficient space use or real estate optimisation but also by how well the physical environment supports organisational processes, collaboration, and performance outcomes. From this perspective, buildings play an active role in enabling work and shaping workplace behaviour, particularly in hybrid work contexts where presence is optional and task-dependent.

A literature review by van der Voordt and Jensen (2023) demonstrates that healthy workplace characteristics positively influence employee satisfaction and productivity. They emphasise that the building environment affects employee health and connect these outcomes to organisational costs, framing healthy workplaces as a strategic investment rather than merely an operational expense. Prior research in workplace and building performance literature similarly highlights that buildings contribute to organisational outcomes through promoting employee health, supporting productivity, and enhancing satisfaction with the physical environment (Al Horr et al., 2016; Colenberg et al., 2021).

Studies that examined physical dimensions and workplace features found that the workplace setting and physical aspects relate to employees' perceived productivity in many ways (Brunia et al., 2016; Danielsson & Bodin, 2008; De Been & Beijer, 2014; de Croon et al., 2005; Kim & de Dear, 2013; Seddigh et al., 2014; Van der Voordt, 2004). Colenberg et al. (2021) emphasise the relationship between interior office space and employees' physical, psychological, and social well-being, showing that open-plan offices, shared rooms, and higher background noise are negatively related to health outcomes. Buildings that provide supportive environmental conditions and facilitate work activities are therefore considered to be higher-performing than those that minimise real estate costs.

In the context of hybrid work, perceived effectiveness is particularly relevant because employees actively evaluate the office against alternative work locations. When the office environment does not adequately support the tasks employees need to perform, whether focused individual work, confidential conversations, or collaborative meetings, they may choose to perform those activities elsewhere (Centre for People and Buildings, 2024). Perceived workplace effectiveness, therefore, functions as a mediating mechanism between physical building characteristics and actual occupancy behaviour: employees who perceive the office as effective are more likely to use it (Bergefurt et al., 2024; Schmitke, 2025).

A well-performing building, therefore, is one that promotes employee health, productivity, and satisfaction. This multidimensional definition provides the conceptual basis for evaluating hybrid work environments in the Netherlands Police real estate portfolio.

2.2.2 Measurement Approaches

Perceived workplace effectiveness has been measured in the academic literature using a variety of instruments, reflecting its multidimensional nature. Early workplace research relied on single-item or simple multi-item self-report scales that asked employees to rate overall satisfaction with their work environment or their self-

assessed productivity (Van der Voordt, 2004; Kim & de Dear, 2013). Van der Voordt (2004) used a seven-point satisfaction scale covering twelve distinct aspects of the office environment, including layout, privacy, communication, and comfort, while Kim and de Dear (2013) used a large-scale survey instrument, the Center for the Built Environment (CBE) Occupant Survey, covering 15 indoor environment quality (IEQ) factors alongside overall satisfaction and self-reported productivity support.

More recent studies have moved toward composite and multidimensional measures that distinguish among subcomponents of workplace effectiveness. De Been and Beijer (2014) differentiate between satisfaction with the physical environment and its perceived support for specific work activities such as concentration, communication, and confidential conversations. Brunia et al. (2016) use a similar multi-item instrument in the context of Activity-Based Workplaces to measure satisfaction with environmental conditions, spatial variety, and perceived productivity support across different workspace types. These approaches reflect an increasing awareness in the literature that a single summary score is insufficient to capture the full range of ways in which a workplace can succeed or fail in supporting work.

In the hybrid work literature, perceived workplace effectiveness has increasingly been measured through instruments that account for the choice-based nature of office attendance. Bergefurt et al. (2024) use a multi-item scale that covers both physical environmental quality and perceived support for specific activities, including focused work, collaboration, and hybrid meetings, recognising that employees evaluate the office against their home environment. The Center for People and Buildings (2024) applies a similar approach in the Work in Transition (WiT) Monitor, in which effectiveness is disaggregated into evaluations of collaboration support, concentration support, acoustic quality, and spatial functionality. This approach enables researchers to identify which dimensions of effectiveness drive overall workplace evaluation and which are most likely to influence attendance behaviour.

2.3 Occupancy as a Spatial Efficiency Indicator

2.3.1 What Is Known About Occupancy in Hybrid Settings

Occupancy has been used as a key metric in facilities management and corporate real estate. Traditionally, occupancy has been conceptualised as the proportion of available capacity that is actually used (NAO, 1996), and is frequently treated as a measure of workplace demand and portfolio performance, particularly in organisations seeking to optimise real estate costs or spatial provision (Valks et al., 2021). Recent research further shows that analysing occupancy patterns improves understanding of how space is used in flexible and hybrid work settings, contributing to space optimisation, resource allocation, operational efficiency, and future planning (Pan et al., 2023).

Hybrid work also increases the financial relevance of occupancy analysis. Because attendance levels fluctuate across days and locations, many organisations have introduced flexible workplace concepts such as desk sharing and adaptable layouts to improve space efficiency (Ruiz de Castañeda Altuna, 2025). These strategies aim to reduce rental, maintenance, and operational costs by more closely matching available capacity to actual use, particularly in situations where fixed workplace provision leads to structural underutilisation (Pan et al., 2023).

Recent studies show that hybrid workers attend the office for collaborative activities and social exchange, while concentration-intensive tasks are more frequently conducted at home (van den Boogert et al., 2024). This behaviour produces variable occupancy patterns, with pronounced mid-week peaks alongside persistently low attendance on Mondays and Fridays, as already mentioned, a pattern commonly observed in hybrid environments (CfPB, 2026). This has resulted in the reduction of average space utilisation across portfolios.

For large public-sector organisations such as the Netherlands Police, this shift introduces new challenges for portfolio management. Administrative functions can be performed remotely, while operational activities remain location-dependent. This creates heterogeneous demand across buildings, over time, and across task types (van Woudenberg-Swicegood, 2024). Under these conditions, occupancy reflects not only how efficiently space is used, but also how effectively the office supports hybrid work practices (JLL, 2022). Buildings that attract employees for collaborative tasks or to support productive work sessions can be considered more effective for hybrid use (van Woudenberg & Swicegood, 2024). In contrast, buildings with persistently low attendance may warn of a misalignment between layout provision, organisational needs, and user preferences (XY Sense, 2025)

In this thesis, occupancy is treated as an outcome indicator that reflects the efficiency of the Netherlands Police office buildings in hybrid work settings. Rather than only indicating how much office space is used, occupancy shows whether the workplace provides sufficient value for employees to choose on-site presence over remote alternatives. In hybrid work environments, where employees have greater autonomy over where to work, occupancy becomes an important indicator of how well the office's physical characteristics support organisational and user needs.

2.3.2 Measuring Building Occupancy

The evaluation of office occupancy in facilities management and corporate real estate literature has evolved in response to changing workplace models. Initial methods relied on manual head counts or badge-entry data, which provided only aggregate presence information and lacked spatial specificity (NAO, 1996; Valks et al., 2021). Recent research has adopted sensor-based measurement technologies, such as passive infrared sensors, WiFi tracking, CO_2 monitoring, and structured observational protocols, to capture occupancy at the workstation, room, or zone level (Pan et al., 2023; Göçer et al., 2019; Fissore et al., 2023).

The National Audit Office (1996) introduced an early measurement framework that integrates frequency and occupancy into a single utilisation metric: Utilisation = Frequency × Occupancy. In this context, frequency refers to how often a space is used relative to available hours, while occupancy indicates the number of users present relative to capacity. This framework is widely cited in space management literature and supports building-level efficiency metrics, including the desk-sharing ratio and the Physical Workplace Counting-Unit (FWTE) (Valks et al., 2021).

Hybrid work research by Appel-Meulenbroek et al. (2022) and the Center for People and Buildings (2024) has incorporated self-reported attendance data, such as the number of days per week spent in the office and the distribution of working time across

locations, alongside sensor-measured occupancy. This combination of evidence types aims to provide a more accurate understanding of occupancy patterns. This multi-method approach allows researchers to differentiate between administrative allocation (the number of employees assigned to a building) and actual behavioural attendance (the number present on a given day). Pan et al. (2023) emphasise that integrating sensor data with self-report measures is particularly important in hybrid environments, where administrative assignment, such as PTW registration, often overestimates actual presence.

Spatial efficiency at the building level is typically measured using two indicators. The desk-sharing ratio, defined as the number of available workstations divided by the number of assigned employees, reflects the extent of hot-desking or flexible seating implementation (Valks et al., 2021). The ratio represents the inverse relationship, indicating the number of full-time workplaces available per employee. These metrics are widely used in European public-sector organisations to benchmark spatial provision against workforce size and to identify opportunities for portfolio optimisation (OECD, 2022). This method is also used by the Netherlands police real estate & housing policy department.

2.3.3 The Relationship Between Occupancy and Perceived Workplace Effectiveness

Building occupancy is closely related to perceived employee effectiveness because the presence and density of people can influence employees' ability to concentrate, communicate, maintain privacy, and feel comfortable at work (CfPB, 2026). Higher occupancy may support collaboration and informal interaction, but it can also increase distractions, crowding, and a sense of loss of control when density becomes too high. This relationship is also closely linked to workplace layout, since the spatial configuration determines how occupancy is distributed, how often people encounter one another, and whether employees have access to private, quiet, or task-appropriate settings (Campos et al., 2007; Paradise et al., 2018). Research indicates that satisfaction with the amount of space available is one of the strongest predictors of overall building satisfaction, underscoring the importance of occupancy and spatial provision in employees' evaluations of their work environment (Paradise et al.).

Occupancy influences perceived effectiveness partly through spatial density, as the amount of space allocated per individual affects comfort, satisfaction, and perceived cognitive workload (Paradise et al., 2018; De Croon et al., 2005). Paradise et al. (2018) found that perceived effectiveness increases with greater space per person, but this benefit levels off at around eight square meters per individual. Beyond this point, additional space yields minimal further improvement. These findings indicate that optimal perceived effectiveness is achieved by maintaining occupancy levels that prevent spatial constraints, rather than by continually reducing occupancy or increasing space constraints.

Social density is another critical factor. In multi-occupancy offices, increased numbers of occupants do not necessarily diminish perceived work quality or heighten feelings of crowding until a specific threshold is reached. Paradise et al. (2018) report that negative outcomes become significant when occupancy approaches 32 individuals, at

which point distractions rise and perceived work quality declines. Thus, occupancy can be beneficial or tolerable until it begins to interfere with concentration and task performance. Single-occupancy rooms are often considered most effective for focused work, as they minimise both spatial and social density.

Privacy is another important mechanism linking occupancy to perceived effectiveness. The relationship between these two indicators is especially important in settings where sensitive tasks or interactions occur. In high-occupancy waiting areas, reception areas, or service areas, insufficient privacy can make communication more difficult and diminish the dignity of both staff and users (Campos et al., 2007). At the same time, spaces that are too visually isolated may become under-occupied or poorly controlled. Deep spaces that require movement through many other areas may lack natural surveillance and visual control, making them less attractive to occupy and more vulnerable to inappropriate use (Campos et al., 2007; Yaseen et al., 2024). Therefore, perceived effectiveness depends on whether occupancy is supported by a balance between visibility, privacy, and spatial control.

Environmental control further shapes the relationship between occupancy and perceived employee effectiveness. In more densely occupied environments, employees may be more sensitive to discomfort from lighting, temperature, noise, or a lack of personal control. When employees can adjust their environment or choose a setting that fits their task, the potentially negative effects of occupancy can be reduced. Moreover, the physical accessibility of environmental controls matters. Uddin et al. (2021) suggest that the distance between occupants and control points, such as lighting or HVAC switches, can influence whether people can effectively manage their comfort. In highly occupied spaces, limited access to control may increase frustration and reduce perceived productivity. Restorative design features, such as external views of nature, may also help mitigate the negative psychological effects of dense or crowded environments by supporting concentration and well-being (Paradise et al., 2018).

Occupancy should therefore be understood from both efficiency and effectiveness perspectives. From an efficiency perspective, higher occupancy may indicate reduced spatial inefficiency, improved utilisation rates, and a smaller real estate footprint per full-time employee (Center for People and Buildings, 2024). From an effectiveness perspective, however, occupancy reflects whether a building supports hybrid work, facilitates collaboration, and meets user needs. A building may be space-efficient but still ineffective if it does not support its users' work practices, while a building that supports employees well may still be inefficient if it is consistently oversized or underused. For the Netherlands Police, analysing occupancy from both perspectives is therefore important when deciding which buildings to retain, adapt, or divest under hybrid working conditions.

Overall, occupancy influences perceived employee effectiveness through density, co-presence, privacy, visibility and spatial and environmental control. Higher occupancy can support collaboration and communication when the layout enables meaningful interaction and provides access to appropriate work settings. However, when occupancy exceeds spatial or social thresholds, or when employees lack privacy and control, perceived work quality, satisfaction, and concentration can decline. The role of occupancy is therefore not separate from perceived effectiveness but central to

explaining how it is experienced. Effective workplace design must balance efficient use of space with the need for comfort, interaction, privacy, and individual control.

2.3.4 Hypothesis H1

Considering these points, occupancy should be seen as more than just the number of people in a building. Its link to workplace effectiveness depends on how employees experience factors like privacy, visibility, environmental control, and perceived density. In hybrid work settings, building occupancy rates can show how space is used, but they do not fully capture whether employees find the workplace effective. With this in mind, the following hypotheses are suggested:

H1: Perceived workplace effectiveness under hybrid working conditions is more strongly associated with employees' office-use behaviour and satisfaction with workplace conditions than with aggregate building-level occupancy rates.

H2: Employees who report higher satisfaction with privacy, visibility, environmental control, and perceived density tend to use the office more frequently.

2.4 Layout Characteristics of Office Buildings

2.4.1 Office Layout and Its Role in Hybrid Work

The physical workplace includes a range of environmental and spatial characteristics that influence how employees experience, use, and evaluate office environments. Previous studies show that physical workplace features affect employee satisfaction, well-being, and productivity, particularly in office-based knowledge work (Al Horr et al., 2016; Colenberg et al., 2021). Al Horr et al. (2016) classify these characteristics into several categories, including indoor air quality, thermal comfort, lighting, noise and acoustics, office layout, biophilia and views, look and feel, and location and amenities. Together, these dimensions shape the sensory, functional, and psychological experience of the workplace.

In hybrid work settings, the role of the physical office becomes more important because employees have greater autonomy in deciding where to work. As a result, the office needs to offer qualities that make on-site presence more valuable than working from home (Bergefurt et al., 2024). Within the broader set of physical workplace characteristics, office layout is especially relevant for this research because it directly shapes collaboration, privacy, interaction, coordination, and access to different work settings. These factors are closely related to both occupancy behaviour and perceived workplace effectiveness. Therefore, this thesis focuses on office layout to examine how different spatial configurations relate to hybrid office use and perceived workplace performance.

Office layout refers to the arrangement of workspaces, objects, and functional areas within a building (Lee, 2010). In hybrid work settings, the layout is important because it shapes how people interact, collaborate, and coordinate, activities that are more difficult to support remotely. Layout also signals power dynamics and organisational culture. It also expresses power relations and organisational culture: cellular offices,

assigned desks, and layouts designed for close monitoring reflect hierarchical, control-based cultures, whereas open, flexible layouts reflect flatter structures and greater autonomy (Ruiz de Castañeda Altuna, 2025). High levels of formalisation can help organisations use flexible layouts efficiently, while low formalisation may encourage creativity but also lead to informal hierarchies (Koch, 2003; Penn et al., 1999).

Research shows there are trade-offs between how space is assigned and how teams are grouped. Keeping departments together can improve coordination within a unit, but may make it harder for teams to work across departments. On the other hand, mixing seating arrangements can encourage innovation but might lower efficiency for routine tasks (Coradi et al., 2015; Sailer & Thomas, 2020). Sharing spaces and moving around the office help people collaborate and interact more effectively than relying solely on digital tools. This highlights the value of in-person presence, especially in knowledge-based work (Ruiz de Castañeda Altuna, 2025).

Activity-Based Working (ABW) uses different types of workspaces to support a range of activities. Studies show that ABW can improve integration and collaboration, especially when combined with effective information and communication technology (ICT) and clear behavioural guidelines (Kim & Juan, 2011). Research also suggests that large teams benefit from open layouts that allow flexibility and changes in team size. In contrast, smaller, stable teams may perform better in enclosed, shared offices that foster social ties and encourage knowledge sharing (Baccarini & Bateup, 2008; Ferguson et al., 2020).

From a corporate real estate (CRE) perspective, office layout is a strategic tool that should align with the organisation’s structure and goals to enhance organisational performance (Arkesteijn & Heywood, 2021). CRE alignment theory indicates that real estate adds value when it supports the organisation's goals, and that mismatches between space and structure can lead to inefficiency and poor communication (Allen, 2007; Duffy, 1974a, 1974b; Sailer & Thomas, 2020). Recent research shows that productivity, performance, and job satisfaction are higher when the office layout fits the organisation’s structure. For example, placing teams that work closely together near one another and providing spaces that support coordination, privacy, and decision-making can help. In hybrid work environments, layout becomes even more important as organisations rethink how office spaces support collaboration, coordination, and social interaction, things that are harder to achieve at home (Colenberg et al., 2021). As a result, hybrid strategies need layouts that support different activities and encourage employees to come to the office, setting new expectations that go beyond traditional desk-based work.

For police office buildings, layout decisions are more complex because they must address confidentiality, controlled access, hierarchy, and coordination within the organisation. A cellular layout, with corridors and enclosed rooms, offers more privacy and keeps departments separate. In contrast, an open-plan layout with large open desk areas and shared workstations can support flexibility and more interaction. A mixed layout uses both approaches, aiming to balance the benefits of enclosed and open spaces.

Table 2.1. Layout typologies and their expected relevance for hybrid work environments. Based on Ruiz de Castañeda Altuna (2025) and Campos et al. (2007).

Layout typology	Key spatial characteristics	Expected strengths for hybrid work	Expected limitations
Cellular	Enclosed rooms along corridor structures, departmental separation	Privacy, concentration, confidentiality, controlled access	Limited flexibility; can hinder cross-unit interaction
Open-plan	Large shared desk areas, open spatial structure	Flexibility, interaction, and adaptability to variable attendance	Noise, limited privacy for focused or confidential work
Mixed	A combination of enclosed offices and open co-working areas	A broader range of work settings, supports both collaboration and focused work	Complexity of management; potential design conflicts between zones

Note. Mixed layouts combine elements of both cellular and open-plan configurations.

2.4.2 Measuring Office Layout Characteristics

The measurement of office layout characteristics in the literature has centred on typological classification, distinguishing among cellular, open-plan, and flexible or Activity-Based Working environments, and on more detailed spatial-configuration analysis using Space Syntax methods (de Croon et al., 2005; Danielsson & Bodin, 2008; Gjerland et al., 2019; Ruiz de Castañeda Altuna et al., 2025). Ruiz de Castañeda Altuna et al. (2025) identify a broad set of layout variables for describing office environments, including office type, function, openness, spatial density, spatial flexibility, partitions, workspace ratio, and zoning.

Space Syntax analysis provides a more spatially precise approach to measurement by quantifying connectivity, integration, and depth of individual spaces within a floor plan using a graph-based method (Campos et al., 2007; Peponis et al., 2007; Yaseen et al., 2024). These measures allow researchers to link the geometric configuration of a layout to patterns of movement, interaction, and occupancy, going beyond typological labels to capture how spatial structure shapes behaviour (Peponis et al., 2007; Sailer & Thomas, 2020). For example, Sailer and Thomas (2020) applied spatial analysis alongside organisational network analysis to show that spatial configuration can influence communication patterns independently of formal organisational structure.

In workplace strategy and corporate real estate research, floor-plan analysis has been used to assess layouts against organisational criteria such as zoning, spatial eligibility, functional diversity, and the range of available work settings (Arkesteijn & Heywood, 2021; Ruiz de Castañeda Altuna et al., 2025). This approach moves beyond simple typological classification by assessing the functional appropriateness of spatial configurations for the activities and organisational requirements of the occupying organisation. Ruiz de Castañeda Altuna et al. (2025) develop a structured framework that links spatial characteristics, including zoning, office type, spatial eligibility, diversity of settings, and meeting room provision, to organisational functions such as communication, task performance, and access control. This framework is particularly relevant for organisations such as the Netherlands Police, where hybrid work must be balanced with requirements for confidentiality, hierarchy, coordination, and controlled access.

This framework is applied in the present study to assess the 12 Police office buildings. The variable selection criteria, operationalisation, and a complete overview of all 26 framework variables, including variables assessed but excluded and the reasons for their exclusion, are described in Section 3.3.2 and Appendix C, respectively.

2.4.3 The Relationship between Layout and Occupancy

The relationship between building layout and occupancy is complex and operates in two directions. How spaces are arranged influences where people gather, while the needs of building users also shape how the building is designed and used. (Campos et al., 2007; Yaseen et al., 2024). Many traditional building models use fixed schedules and assume people will follow predictable routines. However, in practice, how people use spaces is often unpredictable and varies across people (Feng et al., 2015).

Spaces like lift lobbies or central corridors, which are easy to reach, often have more people. In contrast, areas that are harder to reach because you have to pass through several zones usually have fewer people (Campos et al., 2007; Yaseen et al., 2024). Simple ring or race-track layouts make it easier for people to move around and talk to each other, while long corridors can separate people and reduce casual interactions (Campos et al., 2007). Space Syntax theory suggests that a building's layout can either facilitate or hinder people from gathering informally.

At the same time, research shows that organisational factors can complicate the link between layout and occupancy. Things like attendance rules, PTW (Plaats van Tewerkstelling, meaning official place of employment) registration, team makeup, and job-specific attendance needs can affect occupancy more than the building’s layout alone (Center for People and Buildings, 2026; Appel-Meulenbroek et al., 2022). For example, in the Netherlands Police, the PTW allows employees to be assigned to a building even if they do not regularly go there. Also, some units have mandatory attendance rules that increase occupancy, regardless of how the space is designed. Because of this, we cannot assume that layout alone determines occupancy.

While it makes sense that layout and occupancy are related, few studies directly link specific layout types to actual building occupancy rates, especially in hybrid work settings (Campos et al., 2007; Yaseen et al., 2024). Most research examines features such as connectivity and openness, as well as how people move through them, rather

than comparing general layout types, such as cellular and co-working layouts. This lack of direct evidence shows why this analysis is exploratory.

2.4.4 Hypothesis H3 and H4

Building layout may influence occupancy by shaping movement patterns, accessibility, and opportunities for informal interaction. However, occupancy under hybrid conditions is also affected by organisational factors such as attendance policies, PTW registration, and team-specific work requirements, meaning that layout cannot be treated as the sole explanatory factor (Center for People and Buildings, 2026; Appel-Meulenbroek et al., 2022). Two hypotheses are proposed to investigate whether differences in spatial provision and layout typology are associated with differences in building-level occupancy.

The first hypothesis concerns layout typology. Open-plan buildings, designed for shared and flexible use, would be expected to show higher occupancy than cellular buildings, which are structured around more fixed departmental allocation and enclosed individual offices. If the spatial openness and flexibility of open-plan layouts attract more attendance, a typological effect on occupancy would be expected:

H3: Differences in layout typology are associated with differences in building-level occupancy under hybrid working conditions.

The second hypothesis concerns workstation provision. A common assumption in facilities management is that reducing the number of available desks relative to the assigned workforce, that is, lowering the workspace ratio, creates a form of spatial scarcity that incentivises attendance (Valks et al., 2021). Under this reasoning, employees plan their office days more deliberately when workstations are scarce, leading to more consistent utilisation. This logic underpins desk-sharing strategies widely adopted across public- and private-sector organisations seeking to reduce their real estate footprint. An alternative view, however, cautions that under choice-based hybrid attendance, workstation scarcity may discourage rather than stimulate office use, employees who anticipate difficulty finding a desk may instead choose to work from home (Allen et al., 2024; Bergefurt et al., 2024). Both directions are therefore possible, and the hypothesis is treated as exploratory:

H4: Buildings with a lower workspace ratio, fewer workstations relative to assigned employees, tend to exhibit higher building-level occupancy rates under hybrid working conditions.

Both hypotheses are tested empirically in Section 4.3 using occupancy and spatial efficiency data for the 12 Police office buildings. Given the limited sample size, findings are interpreted as exploratory associations rather than statistically generalisable conclusions.

2.4.5 The Relationship between Layout and Perceived Workplace Effectiveness

Research demonstrates that spatial configuration influences perceived effectiveness through several mechanisms. First, layout structures opportunities for communication and collaboration. Employees working in highly connected environments experience

greater interaction, whereas complex circulation systems can limit communication and inhibit knowledge sharing (Campos et al., 2007). When a building is easy to understand and navigate, people expend less mental effort finding their way and can manage their daily work more efficiently (Campos et al., 2007).

Layout also shapes the availability of privacy and focused work conditions. The ability to perform deep, concentrated work is a major component of perceived effectiveness and depends on the level of physical and visual privacy offered by the spatial configuration (Paradise et al., 2018; Yaseen et al., 2024). Perceived work quality is consistently highest in single-occupancy rooms, where distractions are minimised (Paradise et al., 2018). Open-plan offices, conversely, can create problems with noise, interruptions, and a lack of privacy, making concentration more difficult and potentially reducing task accuracy and productivity (Westover, 2026). These conditions can make certain layouts structurally less appropriate for focused or confidential police work.

Moreover, the availability of varied settings supports Activity-Based Working. ABW environments that provide a variety of settings, collaborative hubs, quiet focus rooms, meeting spaces, and informal areas allow employees to select environments suited to their current task, improving both perceived productivity and personal comfort (Paradise et al., 2018). Access to quiet focus areas in particular is seen as essential for an effective workplace (Schmitke, 2025). Conversely, when employees have difficulty finding a workspace that fits their current task, satisfaction with concentration-related work decreases (Mosselman et al., 2009).

Individual differences in personality moderate the relationship between layout and perceived effectiveness. Employees who are more outgoing or cooperative may be more susceptible to visual distractions in open-plan layouts, while those who are highly responsible and organised tend to be more aware of personal space boundaries. (Paradise et al., 2018). This implies that the effectiveness of any given layout varies across the workforce and cannot be fully captured by aggregate measures alone.

Göçer et al. (2019) found that workplace configuration is strongly associated with employees' perceived productivity in the office. Candido et al. (2021) identified interior design as an important predictor of perceived productivity across different sectors. These findings indicate that employees are more likely to view the workplace as effective when the layout supports the tasks they need to perform.

2.4.6 Hypothesis H5 and H6

The literature reviewed in this section consistently points to layout as a significant determinant of how employees experience and evaluate their workplace. Two hypotheses are proposed to capture this relationship, each addressing a different dimension: the quality of specific spatial conditions and the effect of overall layout typology.

The first hypothesis concerns the role of privacy and acoustic conditions. Research shows that open-plan offices, shared rooms, and higher background noise levels are associated with poorer concentration, reduced satisfaction, and lower self-reported productivity (Kim & de Dear, 2013; Colenberg et al., 2021; Danielsson & Bodin, 2008).

For the Netherlands Police, where employees regularly handle confidential information and sensitive conversations, privacy and acoustic quality matter more than in most office environments. Layouts that fail to provide adequate privacy or expose employees to high levels of noise are therefore expected to be evaluated as less effective:

H5: Office layouts with lower levels of privacy and higher levels of background noise are associated with lower perceived workplace effectiveness.

The second hypothesis concerns the effect of layout typology more broadly. Different typologies are expected to support different kinds of work. Cellular layouts may be more suitable for concentration and confidential work because they offer greater privacy and spatial separation. Open-plan layouts may better support interaction and spontaneous collaboration. Mixed layouts, combining enclosed offices with open areas, may offer a balance between these two needs. These expected differences lead to the following hypothesis:

H6: Layout typology affects employees' perceived workplace effectiveness, with mixed and cellular layouts providing better support for privacy and focused work, and open-plan layouts providing better support for collaboration and interaction.

Both hypotheses are tested in Chapter 4.

2.5 Integrated Relationship Between Layout, Occupancy, Spatial Efficiency, and Perceived Workplace Effectiveness

2.5.1 What Is Known about the Combined Relationship

Prior sections have examined the individual relationships between layout and occupancy (Section 2.3.3), layout and perceived effectiveness (Section 2.4.3), and occupancy and perceived effectiveness (Section 2.3.5). When considered together, these relationships suggest that office buildings operate as complex systems in which physical characteristics, space use patterns, and employee experience are mutually interdependent.

The literature identifies perceived workplace effectiveness as a mediating mechanism between layout characteristics and occupancy behaviour. Layouts that are perceived as effective because they support a range of work activities, provide adequate privacy, and facilitate both collaboration and concentration are more likely to attract employees in hybrid settings. Conversely, layouts that fail to support employees' task needs may reduce perceived effectiveness and shift activity to home or third places. This mechanism places perceived effectiveness at the intersection of physical characteristics and occupancy outcomes (Bergefurt et al., 2024; Schmitke, 2025).

Physical characteristics, particularly office layout and spatial quality, are further linked to occupancy through the concept of activity support. Employees attend the office for activities that benefit from co-presence, including collaboration, coordination, and social interaction (Appel-Meulenbroek et al., 2022; Center for People and Buildings, 2026). Layouts that provide a broader range of settings, including collaborative areas, quiet zones, and meeting rooms, are therefore better positioned to attract employees

for diverse activities and to sustain higher, more stable occupancy under hybrid conditions.

At the same time, the relationship between spatial efficiency and perceived effectiveness is complex. A building with high average occupancy does not automatically provide conditions that are experienced as effective. Overcrowding, noise, and a lack of available workstations (conditions that may arise with very high occupancy in open-plan buildings) can reduce perceived privacy and the conditions for focused work, thereby negatively affecting perceptions of effectiveness (Paradise et al., 2018; Kim & de Dear, 2013). Conversely, very low occupancy may create a sense of underutilisation and social disconnect, reducing the perceived value of office attendance (Center for People and Buildings, 2026).

Organisational and individual confounding factors further moderate these relationships. Demographics (age, gender, household composition), commuting distance, managerial responsibility, collaboration dependency, and task profiles all influence both office attendance and workplace perceptions (Center for People and Buildings, 2026). In the Netherlands Police context, PTW registration and mandatory or optional attendance policies create systematic variation in occupancy unrelated to spatial quality, requiring that confounders be accounted for in any integrated analysis.

2.5.2 An Integrated Analytical Model

Building on the individual relationships reviewed above, the integrated model for this study treats perceived workplace effectiveness as the primary dependent variable and examines its relationship with three groups of predictors: layout characteristics, occupancy and spatial efficiency indicators, and office-use behaviour. Demographic and contextual characteristics are included as potential confounders.

This integrated model reflects the theoretical expectation that perceived effectiveness cannot be explained by any single predictor. Layout shapes the spatial conditions for work; occupancy reflects the pattern and intensity of use; and individual activity orientation captures the extent to which employees actually use the office for their work. Together, these predictors are expected to explain a meaningful proportion of the variance in perceived workplace effectiveness.

The literature particularly supports the expectation that individual office-use behaviour will be a stronger predictor of perceived effectiveness than building-level occupancy, as employees who actively use the office for their work are more likely to evaluate it positively (Bergefurt et al., 2024; Schmitke, 2025).

2.5.3 Hypothesis H7

Taken together, the literature suggests that perceived workplace effectiveness is not shaped by layout, occupancy, or spatial efficiency separately, but by how these factors interact. A workplace may be spatially efficient, but this does not necessarily mean that employees experience it as effective. Similarly, a well-designed layout may only improve perceived effectiveness when employees actually use the office for activities that benefit from being there. Therefore, the integrated analysis examines how layout characteristics, spatial efficiency indicators, and office-use behaviour jointly relate to perceived workplace effectiveness under hybrid working conditions. This leads to the following hypothesis:

H7: Perceived workplace effectiveness is associated with layout characteristics, spatial efficiency indicators, and office-use behaviour under hybrid working conditions.

2.6 Confounding/ Control Factors in Hybrid Work Attendance

As previously mentioned, hybrid work environments allow employees to exercise greater autonomy over their work location. As a result, office occupancy no longer reflects only space supply and organisational policy, but also behavioural choices shaped by demographic, job-related, activity-based, and environmental factors. These factors may confound the relationship between building characteristics and occupancy because employees may select locations for reasons unrelated to the building's physical quality.

Studies consistently show that task requirements influence location choice. For example, individuals tend to select the office for collaborative and coordination-intensive activities, while choosing the home for focused or concentration-based work (Appel-Meulenbroek et al., 2022; Center for People and Buildings, 2026). Demographic factors can further shape hybrid preferences: women have been found to be more likely than men to work from home (Xiong et al., 2023), suggesting potential gender-based variation in attendance patterns independent of building performance.

Evidence from the Dutch (semi-)public sector reinforces that hybrid attendance is influenced by personal characteristics and job context rather than only by spatial availability or organisational mandates, and based on responses from more than 17,000 employees, the Center for People and Buildings identified six “location choice profiles” that ranged from home-oriented to office-oriented workers (Center for People and Buildings, 2026). These profiles were associated with age, commuting time, managerial responsibility, autonomy, dependency on collaboration, and workplace appreciation, rather than with physical building characteristics. For instance, younger employees, those living closer to the office, and those engaged in collaborative work were more likely to attend the office. In contrast, employees with concentration-intensive tasks, greater autonomy, or longer commuting distances demonstrated stronger preferences for homeworking (Center for People and Buildings, 2026).

For large public organisations such as the Netherlands Police, these confounding factors are particularly relevant. Administrative staff perform knowledge work that is portable and autonomy-based, while operational functions remain location-dependent. Attendance may therefore vary by work type, age composition, managerial responsibilities, and interdependencies among roles, and may be independent of building performance. Consequently, any analysis of occupancy as a proxy for building performance in hybrid contexts must account for behavioural confounders to avoid overstating the role of physical characteristics.

Controlling for confounding factors is critical to interpreting occupancy as an indicator of building performance. Without this, low occupancy could be incorrectly attributed to physical or architectural shortcomings rather than to demographic, task-based, or

motivational differences. Where data availability allows, confounders such as an individual's role, commuting distance, and task profiles will be considered.

2.7 Scientific Knowledge Gap

Although recent studies have begun to examine the behavioural and experiential dimensions of hybrid work, focusing on aspects such as productivity, satisfaction, collaboration, and activity support (Allen et al., 2024; Bergefurt et al., 2024), research linking hybrid work to building-level performance remains limited. The majority of existing studies investigate outcomes at the individual or organisational level, while the building, as a unit of analysis, remains underexplored. Consequently, limited empirical knowledge exists regarding how physical building characteristics (e.g., layout, accessibility, and flexibility) relate to occupancy patterns, space efficiency, or the perceived suitability of offices for hybrid work. Furthermore, workplace literature does not integrate user perception data with measured utilisation data, even though such integration is essential for understanding the alignment between user experience and space efficiency. This gap constrains the ability to identify which office buildings perform well under hybrid working conditions and why.

2.8 Conceptual Framework

The conceptual framework of this study integrates three analytical dimensions: physical building characteristics, spatial efficiency, and perceived workplace effectiveness. At the same time, it examines how they relate to one another in hybrid work environments. The framework is grounded in the literature reviewed in the preceding sections and is operationalised through the specific datasets available for the Netherlands Police real estate portfolio.

2.8.1 Theoretical Foundation

Workplace research consistently demonstrates that office buildings function as more than neutral containers for work. Physical characteristics shape behaviour, influence employee experience, and reflect organisational strategy (Sailer & Thomas, 2020; Arkesteijn & Heywood, 2021). Within the hybrid work context, this relationship is amplified: because employees exercise choice over where to work, the office must actively attract attendance by offering spatial conditions that cannot be replicated remotely. The conceptual framework is therefore anchored in three propositions drawn from the literature:

- Physical layout shapes how space is used by structuring movement, interaction, privacy, and access to different work settings (Campos et al., 2007; Ruiz de Castañeda Altuna, 2025).
- Spatial efficiency reflects how well the building is matched to hybrid attendance patterns under real conditions (Valks et al., 2021; Center for People and Buildings, 2026).
- Perceived workplace effectiveness captures whether employees experience the office as a productive and supportive environment for their work activities (Bergefurt et al., 2024; Kim & de Dear, 2013).

Together, these three dimensions constitute a multidimensional view of building performance in which efficiency and effectiveness are treated as complementary but distinct concepts. A building can achieve high spatial efficiency (i.e., high occupancy relative to capacity) without being perceived as effective if it fails to support the quality of work employees need to perform. Conversely, a building may be experienced as highly effective yet remain underutilised due to organisational, demographic, or policy-related factors unrelated to its spatial quality.

2.8.2 The Conceptual Model

The conceptual model presented in Figure 1 (Chapter 1.1.3) positions layout characteristics and spatial efficiency indicators as independent variables, and perceived workplace effectiveness as the primary dependent variable. A set of individual and organisational-level control variables, including demographics, commuting distance, task profiles, and attendance policies, is included to account for confounding factors that may independently influence both occupancy and employee perceptions (Center for People and Buildings, 2026; Appel-Meulenbroek et al., 2022).

The model distinguishes between two analytical levels. At the building level, layout characteristics (office type, zoning, diversity of settings, meeting room provision, etc.) and spatial efficiency indicators (average occupancy rate, desk-sharing ratio, FWTE) are compared across the twelve measured buildings. At the individual level, survey responses from the WiT Monitor dataset are used to examine employee perceptions of workplace effectiveness, activity-based office use, and satisfaction with spatial conditions across three buildings.

Perceived workplace effectiveness is understood as a multidimensional construct encompassing satisfaction with privacy and concentration support, collaboration support, acoustic conditions, spatial functionality, and overall suitability for hybrid work (de Been & Beijer, 2014; Brunia et al., 2016; Center for People and Buildings, 2026). This composite definition allows the analysis to identify which spatial dimensions are most strongly associated with overall perceived effectiveness and which are most sensitive to differences in layout typology.

2.8.4 Scope and Boundaries of the Framework

The conceptual framework is deliberately bounded by the data available for this study. Variables that are theoretically relevant but unavailable, such as Space Syntax integration values, workstation design, commuting costs at the individual level, or real estate cost per employee, are acknowledged as boundary conditions of the model rather than omissions. The framework, therefore, does not aim to provide a comprehensive theory of hybrid workplace performance but rather a structured and empirically testable model for analysing the relationships among layout, occupancy, and employee perceptions within the specific context of the Netherlands Police portfolio.

Furthermore, the framework treats occupancy as both an independent variable (when examining its association with perceived effectiveness) and as an outcome variable (when examining the influence of layout on space use). This dual role reflects the reality that building performance in hybrid settings is multidirectional: layout influences

how intensively space is used, and the intensity of use, in turn, shapes the spatial experience of employees present. The framework thus accommodates this dual relationship while preserving a clear analytical logic for each research question.

2.9 Conclusion of the Literature Review

The literature reviewed in this chapter reveals that hybrid working has fundamentally altered the function and use of office buildings, yet the building itself, as a unit of analysis, remains quite underexplored in empirical research. Several gaps are identified. First, while occupancy patterns under hybrid conditions have been documented at the overall level, few studies directly link specific layout characteristics or indicators of workspace provision to building-level occupancy rates, particularly in public-sector contexts. Second, although perceived workplace effectiveness has been studied extensively at the individual level, the physical and spatial predictors of that effectiveness, especially in environments that combine open-plan, cellular, and mixed layouts, remain poorly understood. Moreover, existing literature rarely integrates measured space utilisation data with employee perception data within a single analytical framework, even though such integration is necessary to understand both the efficiency and the experienced quality of office buildings simultaneously. Finally, the specific context of large public-sector real estate portfolios, where organisational constraints such as PTW registration, mandatory attendance policies, and governance procedures complicate the relationship between spatial provision and actual use, has received limited empirical attention.

This study responds directly to these gaps. Using a combined dataset of occupancy measurements, floor-plan analyses, and employee perception surveys across 12 Netherlands Police office buildings, it investigates which layout and use characteristics distinguish well-performing from poorly performing hybrid work environments. The 7 hypotheses derived in the previous sections concerning workspace ratio, layout typology, and perceived workplace effectiveness provide the empirical focus for the analyses described in the following chapter. Chapter 3 outlines the research design, data sources, and analytical methods used to test these hypotheses and answer the seven sub-questions.

The table below summarises the seven hypotheses derived from the literature review. Each hypothesis is linked to the sub-question it addresses and the section in which it is derived.

Table 2.2. Overview of hypotheses derived from the literature review (H1–H7).

H	§	RQ	Hypothesis statement	Tests
Occupancy and spatial efficiency (RQ3)				
H3	2.4.3	RQ4	Differences in layout typology are associated with differences in building-level occupancy under hybrid working conditions.	Layout typology → occupancy
H4	2.4.3	RQ4	Buildings with a lower workspace ratio — fewer work points relative to total workplace capacity (FWTE) — tend to exhibit higher building-level occupancy rates under hybrid working conditions.	Workspace ratio → occupancy
Office-use behaviour and effectiveness (RQ5)				
H1	2.3.4	RQ5	Perceived workplace effectiveness is more strongly associated with employees' office-use behaviour and satisfaction with workplace conditions than with aggregate building-level occupancy rates.	Office-use behaviour + satisfaction → effectiveness
H2	2.3.4	RQ5	Employees who report higher satisfaction with privacy, visibility, environmental control, and comfort tend to use the office more frequently.	Spatial satisfaction → office-use frequency
Layout and perceived workplace effectiveness (RQ6)				
H5	2.4.5	RQ6	Office layouts with lower privacy and higher background noise are associated with lower perceived workplace effectiveness.	Privacy & acoustics → effectiveness
H6	2.4.5	RQ6	Layout typology affects employees' perceived workplace effectiveness, with mixed and cellular layouts providing better support for privacy and focused work, and co-working layouts providing better support for collaboration.	Layout typology → perceived effectiveness
Integrated model (RQ7)				
H7	2.5.3	RQ7	Perceived workplace effectiveness is associated with layout characteristics, spatial efficiency indicators, and office-use behaviour under hybrid working conditions.	Layout + occupancy + use behaviour → effectiveness

CHAPTER 3

Research Methodology

3. Research Methods

This chapter presents the methodology of the current study, outlining the approach adopted to conduct the quantitative analyses. First, the data collection procedures and the overall methodological approach are described, followed by a detailed explanation of the research design. Subsequently, the research's reliability and validity are discussed. The chapter concludes with an overview of the statistical analysis methods applied in this study.

3.1 Research Design

This research employs a quantitative research design to identify patterns and relationships between physical building characteristics, occupancy data, and user perceptions in hybrid work environments. Quantitative research is particularly suitable for this study because it enables systematic comparison across a large number of cases and supports statistical analysis of relationships between variables (Bryman, 2016; Blaikie & Priest, 2019).

The study is based on the analysis of secondary quantitative data, including large-scale survey data from the *Work in Transitions* dataset of the Centre of People and Buildings (CfPB) and measured occupancy and space utilisation data from Measurement (Measurement, n.d.), provided by the Netherlands Police. These datasets enable the examination of variations in building performance and the identification of factors associated with the efficient and effective use of office space.

The quantitative approach is appropriate because the research seeks to measure differences among buildings and test associations between variables, rather than explore individual experiences in depth (Blaikie & Priest, 2019). By analysing objective indicators (e.g., occupancy rates) alongside aggregated user-perception scores, the research aims to identify statistically significant characteristics that distinguish well-performing from poorly performing hybrid work environments.

Additional contextual information regarding hybrid work implementation and portfolio decision-making is obtained through an internship at the Netherlands Police Real Estate and Housing Policy Department. This information supports interpretation but is not used as a primary data source.

3.2 Case Study Selection

The selection of buildings was determined by the availability of occupancy measurement data provided by Measuremen, a workplace analytics provider that conducts structured on-site observational measurements of workspace use (Measuremen, n.d.). Measurements were available for 12 Police office buildings across five regional units: Noord-Holland, Amsterdam, Rotterdam, Oost-Brabant, and the Police Data Centre (PDC). These 12 buildings form the building-level sample for the occupancy and layout analyses.

The buildings were selected by the Netherlands Police as part of their ongoing evaluation of the real estate portfolio. This means that the sample is purposive at the organisational level, determined by practical data availability rather than by random or stratified sampling. As a result, the findings are most directly generalizable to the Netherlands Police portfolio and to comparable large public-sector organisations with hybrid office environments, rather than to office buildings in general.

The buildings span a range of sizes, layout typologies, regional locations, and organisational functions. They include buildings from 202 to 1,186 available workspaces. This variation supports meaningful comparative analysis of how spatial and organisational characteristics relate to occupancy patterns and employee perceptions. Table 2.1 presents an overview of the twelve selected buildings, including their regional units and measurement periods. For privacy reasons, the building names are anonymised using codes in the table below.

Nr.	Region unit	Measurement period (2024)
Building 1	PDC	07 April – 18 April
Building 2	PDC	12 May – 23 May
Building 3	Amsterdam	12 May – 23 May
Building 4	Noord-Holland	18 March – 02 April
Building 5	Noord-Holland	17 March – 28 March
Building 6	Amsterdam	12 May – 23 May
Building 7	Amsterdam	12 May – 23 May
Building 8	Rotterdam	31 March – 11 April
Building 9	Rotterdam	31 March – 11 April
Building 10	Oost-Brabant	31 March – 11 April
Building 11	Oost-Brabant	31 March – 11 April
Building 12	PDC	31 March – 11 April

Table 3.1. Buildings included in the study, by region, unit, and measurement period.

The map below illustrates the distribution of buildings across the Netherlands.

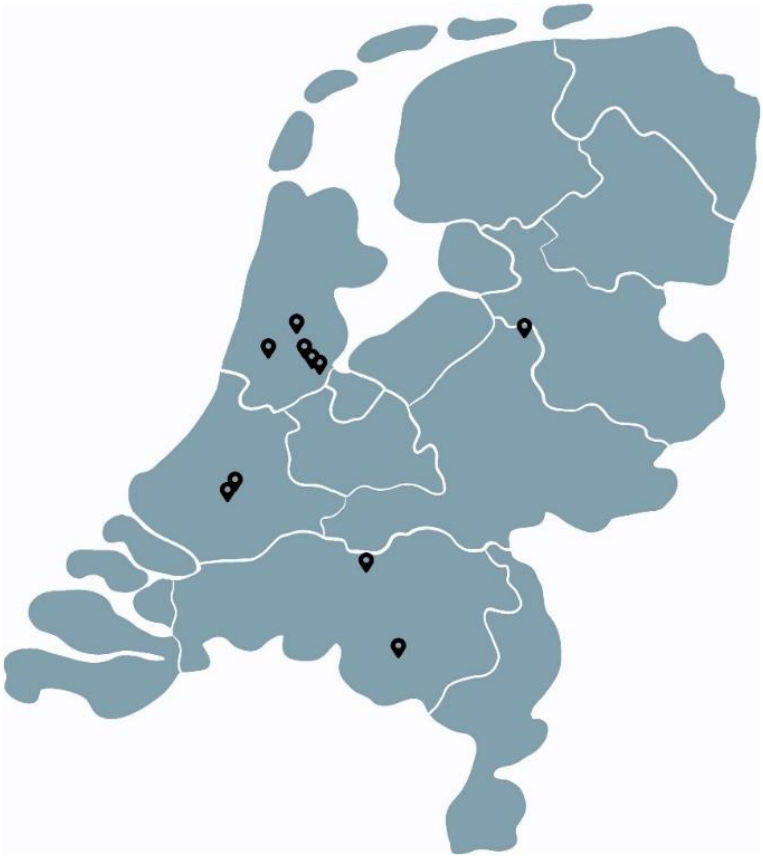

Figure 2: Geographical overview of the 12 Police Buildings of the study.

For the employee perception analysis (WiT survey data), sufficient responses were available for only 3 of the 12 buildings: Building 1 (n = 219), Building 2 (n = 117), and Building 3 (n = 40). These three buildings, therefore, form the survey-level sub-sample. They cover three distinct layout typologies (open-plan, open-plan, and mixed, respectively), and a range of building sizes, providing meaningful variation for the perception analyses despite the limited number of cases.

3.3 Data Collection

3.3.1 Occupancy and Spatial Efficiency Data

Occupancy data were obtained from Measuremen, a specialist workplace analytics provider that conducts structured observational measurements of workspace occupancy in office environments (Measuremen, n.d.). Observers recorded whether individual workstations and other bookable spaces were occupied at scheduled intervals throughout the working day, in accordance with a standardised observation protocol. Measurements were conducted across two- to three-week periods in spring 2024, as shown in Table 3.1.

The data were compiled at the building level and used to calculate four occupancy indicators for each building: average space occupancy rate (the proportion of available spaces occupied on a typical working day), peak space occupancy rate (the highest proportion observed during the measurement period), average peak space occupancy

(the average of daily peak observations), and the number of average and peak occupied spaces. Average occupancy rate is the primary spatial efficiency indicator used in this study, as it provides a direct and comparable measure of how intensively each building is used under hybrid working conditions.

Supplementary spatial efficiency data were provided by the Netherlands Police Real Estate and Housing Management Department. These included the number of Full-Time Equivalents (FTE, based on PTW (= place of employment) registration), the number of available workstations (work points), the number of seats in meeting rooms, and the Physical Workplace Counting-Unit (Fusieke Werkplek Tel Eenheid - FWTE). The FWTE is calculated as follows: (1.0 × number of work points) + (0.5 × number of meeting seats). The workspace ratio was calculated by dividing the number of FTE by the FWTE. It should be noted that PTW registration reflects administrative workplace assignment rather than actual attendance, so the denominator in occupancy calculations may overstate the number of employees who regularly use the building.

No personal information was collected or processed. All measurements were conducted at the workspace level and subsequently aggregated at the building level, ensuring that no individual employee could be identified (Measuremen, n.d.).

3.3.2 Layout Characteristics Data

Layout data were collected through systematic floor-plan analysis of the 12 office buildings. The Netherlands Police provided floor plans. For each building, the first office floor was selected as the primary analytical unit because it was considered the most representative and was largely replicated on the upper floors. The ground floor was excluded because it primarily accommodates the entrance, reception, restaurant, and support functions rather than office workspaces.

Floor plans were edited in Adobe Photoshop to colour-code distinct functional areas according to a consistent legend, enabling systematic comparison across buildings. The following spatial categories were distinguished: open-plan areas, meeting rooms, cellular offices/concentration rooms, coffee areas/restaurant, informal collaboration areas, utilities, staircases, circulation and movement spaces, and grey areas (spaces for which no data were available). This categorisation allowed differentiation between workspaces, collaborative areas, support facilities, and circulation zones.

The colour-coded floor plan analysis was conducted for the three survey buildings, Building 1, Building 2, and Building 3, for which sufficient WiT survey data were available. For the remaining nine buildings, layout characteristics were assessed through direct floor-plan analysis without colour-coding, using the same spatial categories and classification criteria. The annotated floor plans of the three survey buildings are presented in Appendix C.

The analytical framework applied to the floor plans was developed by Ruiz de Castañeda Altuna (2025) and provides a structured approach for linking physical workplace characteristics to workplace strategy, including how office environments support communication, task performance, organisational control, and adaptation to hybrid work. Each building was classified according to its dominant layout typology, cellular, open-plan, or mixed, and assessed on a set of spatial variables selected from this framework. The selection criteria and full variable list are described below.

Of the 26 variables identified in the Ruiz de Castañeda Altuna (2025) framework, 13 were included in the empirical analysis based on two criteria: theoretical relevance to hybrid work performance and the availability of consistent data across all 12 buildings. Variables requiring Space Syntax calculations, unavailable organisational data (such as the positioning of managerial roles or the number of distinct work groups per building), or showing no variance across the three-building survey sample were excluded from the analysis. A complete overview of all 26 framework variables, including excluded variables and the reasons for their exclusion, is provided in Appendix B.

The selected variables span four dimensions of layout quality. Layout typology and spatial organisation are captured through office type, zoning, number of floors, and vertical partitions. Functional variety is assessed through spatial differentiation and the number and types of available work settings. Flexibility and workplace sharing are measured through spatial flexibility, standardisation, and workspace ratio. Density and environmental characteristics are addressed through the number of occupants, openness, and the presence of windows. The operationalisation of each variable, including scoring methods and SPSS coding, is presented in Table 3.2 below.

Table 3.2 presents the operationalisation of the thirteen layout and building-level variables included in the empirical analysis, grouped by the four dimensions described above.

Table 3.2. Operationalisation of objective building-level variables based on Ruiz de Castañeda Altuna (2025).

Variable	SPSS name	Definition	Scoring method	Scale/range	Used in
1. Layout typology and spatial organisation					
Office type	CellularDummy MixedDummy	The dominant spatial concept of the building: co-working (open-plan), cellular (enclosed rooms), or mixed (combination of both).	Classification based on floor-plan analysis. Recoded as two binary dummy variables: CellularDummy (1 = cellular, 0 = otherwise) and MixedDummy (1 = mixed, 0 = otherwise). Reference category = co-working.	Binary: 0 / 1	Regression (Block 1) Spearman corr.
Functional zoning	Zoning	The degree to which the office layout is divided into distinct functional areas, delineated by corridors, partitions, or other spatial boundaries.	Binary assessment from floor-plan analysis: 0 = weak or no zoning (spaces are largely undifferentiated), 1 = clear	Binary: 0 / 1	Regression (Block 1) Spearman corr.

Variable	SPSS name	Definition	Scoring method	Scale/range	Used in
			functional zoning present.		
Number of floors	NumberofFloors	Total number of floors occupied by the organisation within the building.	Direct count from building documentation. Values in this sample: 4 or 7 floors.	Continuous: 4 – 7	Spearman corr.
2. Functional variety and diversity of settings					
Spatial differentiation	SpatialDifferentation	The diversity of workspace setting types available in the building, capturing the variety of spaces employees can use for different activities.	Ordinal scale: 1 = low differentiation (few setting types), 2 = medium, 3 = high differentiation (many distinct setting types). Assessed from floor-plan analysis.	Binary: 0 / 1	Spearman corr.
Number of meeting spaces	MeetingSpaces	Total number of dedicated meeting and collaborative spaces available in the building.	Direct count from floor-plan analysis. Range in this sample: 41 – 98 spaces.	Continuous: 41 – 98	Spearman corr.
Meeting space seats	MeetingSpaceSeats	Total number of seats available across all dedicated meeting and collaborative spaces in the building.	Calculated from floor-plan analysis by summing seat capacity across all meeting rooms. Range: 268 – 550 seats.	Continuous: 268 – 550	Regression (Block 1) Spearman corr.
3. Flexibility and workplace sharing					
Workspace ratio	WorkspaceRatio	The ratio of available work points (desks) to the number of employees (FTE) assigned to the building. Indicates the degree of desk sharing.	Calculated as: FTE ÷ FWTEtotal. Values below 1.0 indicate more employees than desks (desk sharing); values above 1.0 indicate surplus	Continuous: 0.62 – 1.14	Regression (Block 1) Spearman corr.

Variable	SPSS name	Definition	Scoring method	Scale/range	Used in
			provision. Range: 0.62 – 1.14.		
Work points (total)	WorkPoints	Total number of individual work points (desks) available in the building.	Direct count from floor-plan analysis. Range: 670 – 1,011 work points.	Continuous: 670 – 1,011	Regression (Block 1) Spearman corr.
FTE total	FTEtotal	Total number of full-time equivalent employees assigned to the building.	Obtained from Police HR data. Range: 945 – 1,247 FTE. Note: perfectly collinear with Zoning and NumberofFloors across the three survey buildings.	Continuous: 945 – 1,247	Spearman corr.

Note. 'Used in' indicates the analytical stage in which each variable appears: Regression = hierarchical regression model (Chapter 4, Section 4.5); Spearman corr. = Spearman rank correlations with productivity and health outcomes (Chapter 4, Section 4.3); Pearson corr. = Pearson correlations with OfficeEffectiveness. † FTEtotal, NumberofFloors, and Zoning are perfectly collinear across the three survey buildings (rs = 1.000) and should not be interpreted as independent effects. Reference category for office type dummies = open-plan layout.

Each building was assigned scores on all five variables based on the floor-plan assessment. These scores were subsequently used in correlation and regression analyses alongside the occupancy and survey data.

3.3.3 Employee Perception Data

Employee perception data were obtained from the Work in Transition (WiT) Monitor, a survey instrument developed by the Center for People and Buildings (CfPB) to assess employees' perceptions of hybrid work conditions, workplace effectiveness, and spatial satisfaction. The WiT survey covers a broad set of work-related dimensions, including collaboration, privacy, focused work, acoustic conditions, spatial functionality, facility services, and self-reported productivity and health. It has been applied across multiple organisations in the Netherlands public and semi-public sector, enabling benchmark comparisons.

The WiT survey was distributed to employees of the Netherlands Police working under hybrid arrangements, excluding staff whose roles require mandatory daily on-site presence. Survey responses were collected at the individual level and subsequently linked to the building in which each respondent was registered. Data were available for all 12 Police office buildings, but sufficient response counts for statistical analysis

were available for only three buildings: Building 1 (n = 219), Building 2 (n = 117), and Building 3 (n = 40), resulting in a total survey sample of 376 valid responses. These 3 buildings form the sample for all individual-level perception analyses.

All perception variables used in this study were measured on five-point Likert scales. Satisfaction items were rated from 1 (very dissatisfied) to 5 (very satisfied), or from 1 (strongly disagree) to 5 (strongly agree), depending on the item type. Frequency items were rated from 1 (never) to 5 (always). Items measuring productivity support asked respondents to rate the extent to which the office environment supports productivity, on a scale from 1 (not at all) to 5 (very much). Items measuring productivity support asked respondents to rate the extent to which the office environment supports their productivity, on a scale from 1 (not at all) to 5 (very much). For the TUEMHAWnk scale, four negatively worded items, feeling stressed, trouble concentrating, waking up too early, and exhaustion after work, were reverse-coded before computing the composite score, so that higher scores consistently reflect better mental health. Composite scores were computed as the means of the respective item sets, with minimum response thresholds applied where specified. All composites are described in Sections 3.4 and 3.5.

The survey items used in this study are listed in Appendix A. The full WiT Monitor instrument is available from the Center for People and Buildings (Center for People and Buildings, 2026).

3.4 Operationalization of Variables

This section describes the operationalisation of the key variables used in the statistical analyses. Variables are grouped by analytical role: the dependent variable, the perceptual predictors, and the objective building-level characteristics.

I. Dependent Variable: OfficeEffectiveness

The primary dependent variable is OfficeEffectiveness, a composite measure of perceived workplace effectiveness and office-perceived productivity support. It was computed as the mean of seven survey items: in-person collaboration, combining online and in-person collaboration, hybrid meetings, focused work, communication and interactions with colleagues, perceived support for own productivity, and perceived support for team productivity. Items measuring privacy, acoustics, comfort, and workspace functionality were intentionally excluded from the composite because these variables were analysed separately as predictors in the regression model, thereby reducing conceptual overlap between the dependent and independent variables. The composite was computed using SPSS's MEAN.5 function, which requires at least 5 valid responses. Higher scores on OfficeEffectiveness indicate stronger perceived support for work activities.

II. Perceptual Predictor Variables

Perceptual variables were derived from individual WiT survey items and used as predictors in the correlation and regression analyses. These included: satisfaction with acoustics, satisfaction with privacy in the workplace, satisfaction with the comfort of the workplace, satisfaction with facility services in the building, satisfaction with the layout of the immediate work environment, satisfaction with the range of different types of desk workstations, and satisfaction with the availability of various types of spaces

for meetings and discussions. All items were measured on a five-point satisfaction scale.

Office-use behaviour was measured through two individual-level variables: the number of days worked in the office during an average workweek, and the percentage of working time spent at the respondent's own office. These variables capture the frequency and extent of employees' physical use of the office, independent of any building-level occupancy measurement.

III. Objective Building-Level Characteristics

Objective building-level characteristics were derived from the floor-plan analysis and the spatial efficiency dataset. These included: office layout type (classified as open-plan, mixed, or cellular and recoded as dummy variables for the regression analysis), functional zoning (scored 0–1 for the regression sample), spatial differentiation (scored 0–1 for the regression sample), workspace ratio (number of FTEs divided by assigned FWTE), number of work points, number of meeting spaces, total meeting space seats, building-level average occupancy rate, and an accessibility score. These variables were used in Spearman rank correlations with the outcome variables. In the regression model, the layout type was represented by two dummy variables (Cellular and Mixed, with open plan as the reference category), and functional zoning was retained as the only layout variable with sufficient variance across the three survey buildings.

IV. Productivity and Health Variables

Three additional outcome constructs were operationalised for the productivity and health analysis. Office-perceived productivity support was measured through two items asking the extent to which the office environment supports the respondent's own productivity and their team's productivity (scale: 1 = not at all, 5 = very much). Self-reported productivity was measured using the STAPLESOP scale (six items; 1 = strongly disagree, 5 = strongly agree; Staples et al., 1998) and the task-performance subscale of the Individual Work Performance Questionnaire (IWPQ; five items; 1 = never, 5 = always; Koopmans et al., 2014). Both instruments were administered through the Werk in Transitie (WiT) Monitor (Center for People and Buildings, 2026). Mental health was assessed using the TUEMHAWnk scale (six items; 1 = never, 5 = always), with four negatively worded items reverse-coded so that a higher composite score consistently reflected better mental health (Bergefurt et al., 2026).

3.5 Data Analysis

All statistical analyses were conducted using IBM SPSS Statistics. The analyses were organised into four stages corresponding to the seven sub-research questions: descriptive statistics, correlation analysis, one-way analysis of variance (ANOVA), and hierarchical multiple regression. Each stage is described in the sub-sections below, together with the rationale for the analytical choices made.

3.5.1 Descriptive Statistics

Descriptive statistics were computed for all key variables to characterise the building and survey respondent samples before conducting inferential analyses. For building-level data, means, medians, standard deviations, and ranges were calculated for occupancy indicators (average occupancy rate, peak occupancy rate, average peak occupancy) and spatial efficiency metrics (workspace ratio, number of work points,

number of meeting spaces, meeting space seats). These statistics are reported in Section 5.3.1 and support the answer to RQ1.

For the survey sample, descriptive statistics were computed for all WiT satisfaction items, the OfficeEffectiveness composite, and the productivity and mental health scales. All items were measured on five-point scales. Means and standard deviations are reported for both the full three-building sample and each building separately, enabling comparison across spatial contexts. Frequency distributions were computed for categorical variables, including office type, gender, and educational level. These results are reported in Section 5.3.3 and support the answer to RQ4.

For the layout characteristics, binary variables derived from floor-plan analysis were summarised as counts of buildings scoring positively or negatively on each spatial characteristic, as reported in Section 3.3.2. No inferential statistics are applied at this stage; the descriptive results serve as the foundation for the subsequent correlation and regression analyses.

3.5.2 Correlation Analysis

Three sets of correlation analyses were conducted to examine bivariate relationships between variables, corresponding to RQ3, RQ5, and RQ6.

i. Layout characteristics and occupancy (RQ3)

Pearson correlations were computed between the desk-sharing ratio, FWTE, and the average building-level occupancy rate across the twelve buildings. This analysis tested whether buildings with more or fewer workstations per employee tended to exhibit higher or lower occupancy. A comparison of mean occupancy rates by layout typology (open-plan, cellular, mixed) was also conducted at the descriptive level. Because the sample comprised only 12 buildings, no formal test of differences in typology was conducted; the results are treated as exploratory.

ii. Layout satisfaction and outcome variables (RQ5)

For RQ5, which examined how perceptions of effectiveness are related to spatial efficiency, Pearson correlations were computed between five office-use indicators, openness of the work environment, layout of the immediate work environment, acoustics, privacy in the workplace, comfort of the workplace, ability to work in a focused manner, and all five outcome variables: office-perceived productivity support for one's own and team productivity, self-reported productivity measured with the STAPLESOP and IWPQ composites (Staples et al., 1998; Koopmans et al., 2014), and mental health measured with the TUEMHAWnk composite (Bergefurt et al., 2026), using data from the Werk in Transitie Monitor (Center for People and Buildings, 2026). One-way ANOVAs were additionally conducted to examine whether outcome variables differed significantly across the three survey buildings.

iii. Office-use indicators and outcome variables (RQ6)

For RQ6 (how do layout characteristics influence perceived effectiveness), Pearson correlations were computed between six layout satisfaction items (openness of the work environment, layout of the immediate work environment, acoustics, privacy in the workplace, comfort of the workplace, and ability to work in a focused manner) and five employee outcome variables: office-perceived productivity support for one's own and team productivity, self-reported productivity measured with the STAPLESOP and

IWPQ composites (Staples et al., 1998; Koopmans et al., 2014), and mental health measured with the TUEMHAWnk composite (Bergefurt et al., 2026), using data from the Werk in Transitie Monitor (Center for People and Buildings, 2026). OfficeEffectiveness was not included as an outcome variable in this correlation analysis because several of the satisfaction items, specifically privacy and focused work, are components of that composite, which would produce a circular relationship. Spearman rank correlations were additionally computed between 12 physical building characteristics and the same 5 outcome variables, as several building-level variables are ordinal or have limited variance across the 3 survey buildings. One-way ANOVA tests were conducted to examine whether satisfaction with privacy, focus, and collaboration-related conditions differed significantly across the three survey buildings. Effect sizes were estimated using eta squared (η^2).

3.5.3 Linear Regression Analysis

Linear regression analysis was conducted to address the study's seventh sub-question, examining the extent to which layout characteristics, use characteristics, and spatial efficiency are associated with perceived workplace effectiveness in the Netherlands Police office buildings under hybrid working conditions. Multiple linear regression was chosen because perceived workplace effectiveness is likely influenced by several interrelated factors simultaneously, and regression allows the unique contribution of each predictor to be assessed while holding all other variables constant (Field, 2018; Pallant, 2020).

i. Dependent Variable

The dependent variable for the regression analysis was OfficeEffectiveness, a composite score computed as the mean of eight survey items capturing perceived workplace effectiveness across a broad range of work-related dimensions: focused work, privacy, confidential conversations, workspace functionality, comfort, in-person collaboration, hybrid meetings, and self-reported productivity, as already mentioned. Prior to use in the regression, the internal consistency of the composite was assessed using Cronbach's alpha, confirming that the items measured a coherent underlying construct (Field, 2018; Pallant, 2020).

ii. Selection of Layout Variables

The layout characteristics assessed through floor-plan analysis, including office type, spatial eligibility, and diversity of settings, were originally coded as ordinal variables for the full twelve-building sample. However, for the regression analysis, only the three buildings with sufficient WiT survey data were included: Building 1, Building 2, and Building 3. When the layout variables were recoded as dummy variables (0 = No, 1 = Yes) for this reduced three-building sample, there was no variance in the responses for most layout characteristics: all three buildings scored 1 on every variable. Because variables with no variance cannot contribute explanatory power to a regression model, these variables were excluded from the analysis (Pallant, 2020). The only exception was functional zoning, where Building 3 scored 0 while the other two buildings scored 1, providing the minimum variance necessary for inclusion. Zoning was therefore the only layout variable retained in the regression model.

iii. Hierarchical Regression Strategy

The regression was conducted using a hierarchical (sequential) entry method, in which predictors were introduced into the model in four distinct blocks. This approach allows for evaluating how much additional variance in the outcome is explained at each step, beyond what the predictors entered in earlier blocks already accounted for (Pallant, 2020). The four blocks and their rationale are presented in Table 3.3 below.

Table 3.3. Overview of predictor blocks in the hierarchical regression analysis.

Block	Predictors	SPSS variable names	Rationale
1	Demographic & building characteristics	HW_Q45727DAGEN (office days/week), Q1 (gender), Q50 (age), CellularDummy, MixedDummy, MeetingSpaceSeats, WorkPoints, WorkspaceRatio, Zoning	Controls for baseline attendance, demographics, office type, workstation provision, and functional zoning before testing perceptual variables
2	Acoustics & privacy satisfaction	SO_TEV6_Q1245 (acoustics), SO_TEV5_Q16 (privacy in the workplace)	Tests whether satisfaction with the two lowest-rated spatial conditions predicts effectiveness above baseline
3	Comfort & facility services	SG_TEV9_Q17b (comfort of workplace), SO_TEV9_Q23 (facility services in building)	Tests the incremental contribution of broader environmental quality beyond specific spatial conditions
4	Spatial functionality & diversity	S_TEV7_Q14 (layout of immediate work environment), SL_TEV7_Q5343 (range of desk workstation types), SL_TEV7_Q5344 (availability of meeting/discussion spaces)	Tests the incremental contribution of spatial variety and layout satisfaction

Note. All models applied listwise deletion for missing values and used the ENTER method within each block. Reference category for office type dummies = open-plan layout.

iv. **Block descriptions**

Block 1 entered nine control variables capturing individual demographics, attendance behaviour, and objective building characteristics: the number of days worked in the office during an average workweek (HW_Q45727DAGEN), gender (Q1), age (Q50), two layout dummy variables (CellularDummy and MixedDummy, with open-plan as the reference category), the number of meeting space seats (MeetingSpaceSeats), the total number of work points (WorkPoints), the workspace ratio, and the degree of functional zoning (Zoning). By entering these variables first, their effects were statistically controlled before any perceptual predictors were introduced, ensuring that

any subsequent contribution observed from satisfaction items cannot be attributed to differences in attendance frequency, demographics, or objective building provision.

Block 2 introduced satisfaction with acoustics (SO_TEV6_Q1245) and satisfaction with privacy in the workplace (SO_TEV5_Q16). Both variables were selected based on their strong correlations with OfficeEffectivenessProd in the preceding correlation analysis, and because acoustics and privacy represented the lowest-rated spatial conditions across all three survey buildings in the descriptive analysis.

Block 3 added satisfaction with the comfort of the workplace (SG_TEV9_Q17b) and satisfaction with facility services in the building (SO_TEV9_Q23), representing broader dimensions of environmental quality beyond the specific spatial conditions tested in Block 2.

Block 4 introduced three items measuring spatial functionality and diversity: satisfaction with the layout of the immediate work environment (S_TEV7_Q14), satisfaction with the range of desk workstation types (SL_TEV7_Q5343), and satisfaction with the availability of various types of spaces for meetings and discussions (SL_TEV7_Q5344). These were entered last to test whether spatial variety added explanatory power beyond the environmental quality predictors in the earlier blocks.

v. Assumption Checks

Prior to interpreting the regression results, the following diagnostic checks were conducted to verify that the model met the core assumptions of ordinary least squares regression.

- **Normality of residuals:** A histogram and a normal P-P plot of standardised residuals were inspected. The histogram showed an approximately bell-shaped distribution centred around zero; the P-P plot showed observed values closely following the expected diagonal, both consistent with the normality assumption.
- **Homoscedasticity:** A scatterplot of standardised residuals (*ZRESID) against standardised predicted values (*ZPRED) was inspected. No systematic funnelling or curvature was observed, indicating that the homoscedasticity assumption was not violated.
- **Independence of residuals:** The Durbin-Watson statistic was 2.144 for the final model, indicating no meaningful autocorrelation in the residuals (acceptable range: 1.5–2.5).
- **Multicollinearity:** Tolerance values and the Variance Inflation Factor (VIF) were inspected for all predictors in the final model. All predictors had tolerance values above .42 and VIF values below 2.4, well within acceptable limits (tolerance > .10, VIF < 10).
- **Outliers and influential cases:** Cook's Distance and Leverage values were saved using the SAVE COOK LEVER subcommand and inspected. No cases were found to exert disproportionate influence on the model estimates.

These diagnostics were produced using the SPSS REGRESSION procedure with the subcommands SCATTERPLOT(*ZRESID, *ZPRED), RESIDUALS DURBIN HISTOGRAM(ZRESID), NORMPROB(ZRESID), and SAVE COOK LEVER ZRESID.

The resulting diagnostic plots (histogram, P-P plot, and ZRESID/ZPRED scatterplot) should be inserted as figures at this point in the final submitted version.

vi. **Reporting**

For each block, the R^2, Adjusted R^2, standard error of the estimate, R^2 change (ΔR^2), F change, and associated p-value are reported. For the final model, unstandardised regression coefficients (B), standard errors, standardised beta coefficients (β), t-values, p-values, 95% confidence intervals, and VIF values are reported for all predictors. Statistical significance was evaluated at $\alpha = .05$ (two-tailed). The final regression sample comprised n = 211 after listwise deletion across all predictor and outcome variables.

3.6 Research Quality, Ethics, and Data Management

3.6.1 Reliability

The internal consistency of composite scales was assessed using Cronbach's alpha prior to their use in the analyses (Tavakol & Dennick, 2011). The OfficeEffectiveness composite demonstrated acceptable reliability. The reliability of the STAPLESOP and IWPQ composites was confirmed in prior validation studies (Staples et al., 1998; Koopmans et al., 2014). For the TUEMHAWnk scale, negatively worded items were reverse-coded before computing the composite to ensure directional consistency (Field, 2018; Pallant, 2020), with higher scores reflecting better mental health (Bergefurt et al., 2026).

3.6.2 Occupancy Measurement Reliability

Observational occupancy data were collected by Measuremen using a structured protocol with fixed observation intervals across two- to three-week measurement periods. While this approach provides a reliable snapshot of occupancy behaviour, the measurements were conducted in spring 2024 and may not reflect seasonal variation in attendance. Additionally, the Measuremen protocol counts workstations, meeting rooms, and other bookable spaces as individual units, meaning that a reported occupancy rate reflects the proportion of all available space units occupied, not the proportion of all seating capacity used. This should be considered when interpreting occupancy percentages.

3.6.3 Validity

The use of secondary data from the WiT Monitor and Measuremen introduces constraints on measurement validity, as the researcher did not design the survey instruments or the occupancy observation protocol. However, the WiT Monitor is a validated and widely applied instrument in the Dutch hybrid work context, and Measuremen employs a standardised observational methodology used across multiple organisations. The combination of individual-level perception data with building-level occupancy data enhances the validity of the analysis by triangulating subjective assessments with objective indicators of building performance (Bryman, 2016). The use of floor-plan analysis as a third data source further strengthens this triangulation by adding a spatial dimension that is independent of both self-report bias and measurement-interval constraints.

External validity is limited by the purposive nature of the building sample. The 12 buildings were selected by the Netherlands Police based on data availability rather than through random or stratified sampling. As a result, findings are most directly applicable to the Police portfolio and to comparable large public-sector organisations operating hybrid office environments in the Netherlands. Caution should be exercised when generalising the findings to other sectors, smaller organisations, or countries with different hybrid work cultures or regulatory contexts. The additional constraint that employee perception data were available for only three of the twelve buildings further limits the statistical power of building-level comparisons and reinforces the exploratory nature of several analyses.

3.7 Research Ethics

3.7.1 Protection of Research Participants

This research exclusively uses secondary quantitative data. No new human participants were recruited, and no direct interaction occurred with individual respondents. Survey responses from the Werk in Transitie (WiT) Monitor are provided in anonymised form, and no individual respondent can be identified from the dataset provided to the researcher. Occupancy and space utilisation data provided by the Netherlands Police contain no personal identifiers, as measurements are conducted at the workspace level and consolidated before analysis. Floor plan data obtained from the Netherlands Police are used solely for building-level spatial analysis and contain no personal information. Building names used in this report correspond to publicly known addresses and do not reveal personal information about any individual.

3.7.2 Scientific Integrity

Scientific integrity is safeguarded through adherence to established methodological standards, transparent documentation of data sources, and explicit reporting of analytical assumptions and limitations. When statistical techniques are used, assumptions are checked prior to analysis to ensure their validity, proper application, and interpretation. The use of multiple data sources, survey data, occupancy measurements, and floor-plan analyses enhances the robustness of the research through triangulation, and the quantitative research design supports the reproducibility of findings.

The use of generative AI tools, specifically ChatGPT (OpenAI), Claude (Anthropic), and Grammarly, during the writing and revision process is fully disclosed in Appendix B, in accordance with TU Delft guidelines on the use of AI in academic work. All research questions, methodological decisions, statistical analyses, interpretations, and conclusions are the sole intellectual work of the researcher.

3.7.3 Societal Impact

The research concerns the evaluation of hybrid work environments within a public-sector organisation. Insights from this study may contribute to more efficient and effective use of office space, with potential societal benefits including the responsible use of publicly funded real estate, reduced environmental impact from underutilised buildings, and improved workplace conditions for employees. The research also contributes to the growing body of knowledge on hybrid working, a structural transition that affects a broad segment of the workforce in both the public and private sectors. No negative societal impacts are foreseen.

3.7.4 Human Research Ethics Committee (HREC) Considerations

Because the study relies solely on anonymised secondary data and does not involve direct collection of sensitive or personal data from individuals, formal approval from the Human Research Ethics Committee (HREC) is not required.

3.8 Data Management

Data management procedures ensure compliance with TU Delft research policies and protection of organisational privacy. Data are stored on secure institutional storage environments, specifically TU Delft OneDrive or Research Drive, with restricted access and password protection. No data is stored on personal devices or external drives. The Data Management Plan (DMP) outlines specific storage and backup arrangements.

In line with GDPR requirements, all datasets used in this research are anonymised before access. WiT survey data are provided in anonymised form at the individual response level, and no individual employee can be identified. Police occupancy and space utilisation data contain no personal identifiers and relate solely to buildings. Floor plan data are used for spatial analysis purposes only and contain no personal information. Organisational documents obtained through the internship are used for contextual interpretation and do not contain personal or sensitive operational information.

The final thesis will be publicly accessible through the TU Delft repository. However, the underlying dataset, Netherlands Police occupancy and space data, and Werk in Transitie survey data, are not publicly available. Police data are subject to organisational confidentiality requirements, while WiT data may be shared with researchers under data-sharing agreements with the Center for People and Buildings. The thesis may be shared within the Werk in Transitie research community, as informally agreed with the Center for People and Buildings.

CHAPTER 4

Results

4. Results

4.1 Introduction to the Results Chapter

This chapter presents the results of the statistical analyses conducted to address the seven sub-research questions of this study. The analyses draw on two complementary datasets: building-level occupancy data from Measuremen covering 12 Netherlands Police office buildings, and individual-level survey data from the WiT Monitor covering employees' perceptions in three of those buildings. Together, these datasets enable a multi-level examination of occupancy patterns, physical building characteristics, and employee perceptions of workplace effectiveness under hybrid working conditions.

The chapter is structured as follows. First, the sample is described at both the building and respondent levels. Then, the descriptive results for occupancy and spatial efficiency (RQ1), layout characteristics (RQ2), and employee perceptions (RQ3) are presented. Section 4.4 examines correlations between layout characteristics and occupancy (RQ4), layout and perceived workplace effectiveness (RQ5), and occupancy and perceived effectiveness (RQ6). Lastly, section 4.5 presents the hierarchical multiple regression analysis predicting perceived workplace effectiveness (RQ7). The chapter concludes with a summary of the main findings.

4.2 Representative Sample

4.2.1 Building-Level Sample

Occupancy data were collected by Measuremen (a workplace analytics company specialising in occupancy and utilisation studies) across 12 Netherlands Police office buildings located in five regional units: Noord-Holland, Amsterdam, Rotterdam, Oost-Brabant, and the PDC (Police Data Centre). Measurements were conducted through structured on-site observations during two- to three-week measurement periods in spring 2024.

4.2.2 Survey Sample

WiT Monitor survey data were available for 3 of the 12 buildings, with sufficient sample sizes for statistical analysis: Building 1 (n = 219), Building 2 (n = 117), and Building 3 (n = 40), resulting in 376 valid survey responses. The survey was distributed exclusively to employees working under hybrid arrangements, excluding employees whose roles require daily office presence. Thirteen respondents had missing data on the building variable, leaving a valid total of 376 for building comparisons. The overall analytical regression sample size ranged from N = 221 to 274, depending on the analysis and listwise deletion of missing values.

4.3 Descriptive Results

4.3.1 Occupancy and Spatial Efficiency of the Office Buildings

This section presents the descriptive results for Sub-Research Question 1: *To what extent are different Police office buildings used efficiently under hybrid working conditions?*

Across the 12 analysed office buildings, a total of 7,807 workspaces were available. The overall average occupancy rate was 25.7%, corresponding to approximately 2,007 occupied workspaces on a typical working day. Peak occupancy reached 43.6%, with a maximum of 3,405 occupied workspaces across the portfolio. Even at peak moments, the mean peak occupancy was only 27.6%, confirming that hybrid working has significantly reduced daily attendance across the Police real estate portfolio.

Table 4.1. Building-level occupancy rates under hybrid working conditions. Source: Measuremen (Measurement, n.d.), spring 2024.

Building	Layout type	Available spaces	Avg. occupancy	Avg. occupied (n)	Peak occupancy	Peak occupied (n)
1	Open-plan	1,186	18.5%	219.6	31.9%	378
2	Open-plan	819	26.5%	216.7	46.9%	384
3	Mixed	771	15.3%	118.0	24.5%	189
4	Cellular	430	22.0%	94.5	34.0%	146
5	Open-plan	596	25.9%	154.5	39.6%	236
6	Cellular	720	28.6%	206.1	43.2%	311
7	Open-plan	596	27.0%	160.9	39.1%	233
8	Cellular	527	39.6%	208.9	60.5%	319
9	Open-plan	1,072	28.0%	300.3	46.5%	499
10	Cellular	523	34.1%	178.4	46.7%	244
11	Open-plan	354	31.7%	112.3	45.8%	162
12	Cellular	213	19.7%	41.9	37.1%	79
Portfolio total/average		**7,807**	**25.7%**	**2,007**	**43.6%**	**3,405**

Note. Average occupancy = mean proportion of available spaces occupied across all observation intervals during the measurement period. Peak occupancy = the highest proportion recorded on any single observation day. Available spaces = total number of spatial units (workstations and meeting rooms) counted by Measuremen; a space is counted as one unit regardless of its size or capacity. Average and peak occupied are the absolute number of spaces in use at the respective occupancy levels. Avg. occupancy colour coding: green ≥ 35% (high); yellow 25–34% (moderate); red < 25% (low). Portfolio row shows column totals for space counts and portfolio-wide averages for occupancy percentages.

The mean building-level occupancy rate was 25.7% (median = 26.73%, SD = 6.88%), reflecting a relatively balanced distribution. Rates ranged from 15.3% (Building 3) to 39.6% (Building 8), indicating considerable variation in use intensity across the buildings.

4.3.2 Layout Characteristics of the Office Buildings

This section presents the descriptive results for Sub-Research Question 2: *Which physical building characteristics define Police office buildings used for hybrid work?* The analysis draws on floor-plan assessments and the building catalogue data for all 12 buildings in the sample. Each building was classified by its dominant layout typology and assessed using a set of binary spatial variables derived from Ruiz de Castañeda Altuna's framework (2025), as described in Section 2.3.2. The results are organised around three themes: layout typology, spatial characteristics, and workspace provision.

i. Layout Typology

Of the 12 buildings assessed, 6 were classified as open-plan (Buildings 1, 2, 5, 7, 9, and 11), 5 as cellular offices (Buildings 4, 6, 8, 10, and 12), and 1 as a mixed typology combining open-plan and cellular spaces (Building 3). This distribution reflects the diversity of spatial approaches across the Police real estate portfolio and provides a meaningful basis for comparative analysis.

Open-plan buildings are characterised by large shared desk areas, open or semi-open floorplates, and layouts designed to support flexible, non-assigned work. Building 1, the largest building in the sample with a total office area of 18,889 m², features a deep floorplate with expansive desk environments and central circulation axes serving both operational and support functions. Building 2 follows an extended linear floorplate, with desk areas distributed along long corridors interspersed with meeting and support spaces. Building 9, also among the larger buildings at 27,002 m², features an extended, linear bar layout organised around a single primary corridor, yet offers limited spatial diversity for its size. Building 11 is the smallest open-plan building in the sample (9,966 m²). It comprises multiple interconnected volumes with separate wings, resulting in a more fragmented spatial configuration than the other open–plan buildings.

Cellular buildings are organised primarily around enclosed offices and smaller rooms arranged along corridor structures. Building 4 consists of multiple separated spatial bars connected by bridges and corridors, with distinct zones and smaller individual rooms. Building 6, which uses a central core structure with radiating wings, accommodates larger co-working areas alongside meeting and concentration rooms, so its cellular classification reflects its access-controlled, corridor-based organisation rather than the absence of open space. Building 8 has a compact, deep floorplate organised around a central core, with a mix of open-plan desks and enclosed rooms that create distinct meeting and working zones. Building 10 comprises large, enclosed,

open-plan work areas with clustered meeting and support spaces rather than a single continuous open floorplate. Building 12 is the smallest building in the sample, with only 3,654 m² and a single floor, featuring a compact central core surrounded by open-plan desks and enclosed functional rooms.

Mixed-use: Building 3 is the only mixed-use building. With a total area of 27,990 m² and two internal voids creating ring circulation around atria, it combines open shared spaces with enclosed individual offices, offering the widest range of spatial conditions of any building in the sample.

Table 4.2 provides an overview of all twelve buildings, including their layout typology, floor plan description, number of floors, office area, and scores on the key binary spatial variables.

Table 4.2. Layout typology and spatial characteristics of the twelve Police office buildings.

Building	Layout typology	Floor plan description	Floors	Area (m²)	Openness	Spatial diff.	Spatial flex.	Zoning
1	Open plan	Large deep floorplate with desk environments, operational/support functions, and central axes.	7	18,889	✓	✓	✓	✓
2	Open plan	An extended linear floorplate with desk areas, meeting and support spaces, and repetitive circulation.	5	10,479	✓	✓	✓	✓
3	Mixed (Open plan & cellular)	Two internal voids; mixed open and enclosed zones with shared and smaller offices.	4	27,990	✓	✓	✓	✗
4	Cellular offices	Multiple separated bars connected by bridges and corridors; distinct spatial zones.	4	8,683	✗	✓	✗	✗
5	Open plan	Ring/courtyard layout with smaller office rooms along a double-loaded corridor.	4	19,480	✗	✗	✗	✓
6	Cellular offices	Central core with radiating wings; large open- plan area with meeting and concentration spaces.	8	19,070	✓	✓	✓	✓
7	Open plan	Linear corridor-based layout with individual offices, shared rooms, and meeting spaces.	4	19,140	✗	✓	✗	✓

Building	Layout typology	Floor plan description	Floors	Area (m²)	Openness	Spatial diff.	Spatial flex.	Zoning
8	**Cellular offices**	Compact, deep floorplate around a central core with open-plan desks, enclosed rooms, and meeting and working zones.	9	31,998	✓	✓	✓	✗
9	**Open plan**	Elongated linear bar with primary corridor; offices and shared desks; limited spatial diversity.	7	27,002	✗	✗	✗	✓
10	**Cellular offices**	Large enclosed open-plan work areas with clustered meeting and support spaces and smaller enclosed rooms.	9	13,054	✓	✓	✓	✓
11	**Open plan**	Multiple interconnected volumes forming a clustered layout with separate wings.	3	9,966	✗	✓	✗	✓
12	**Cellular offices**	Compact central core with surrounding open-plan desks and enclosed functional rooms.	1	3,654	✓	✓	✓	✓

Note. Spatial characteristics are binary assessments from floor-plan analysis (✓ = present / applies; ✗ = absent / does not apply). Openness = presence of open spatial structure without full enclosure; Spatial diff. = spatial differentiation (diversity of workspace setting types); Spatial flex. = spatial flexibility (layout can be reconfigured to accommodate changes in team size or use); Zoning = clear functional zoning present. Area refers to the total office floor area in square metres. Sources: Netherlands Police building catalogue; floor-plan analysis.

ii. Spatial Characteristics

The floor-plan assessment identified notable variation across the 12 buildings on several binary spatial variables (Table *4.2*). All 12 buildings scored positively on standardisation, vertical partitions, windows, and zoning, indicating that modular or repeated spatial patterns, the presence of walls or enclosed rooms, facade windows, and a degree of functional zoning are universal characteristics across the portfolio. These results confirm that even in the most open-plan buildings, physical demarcation of space and access to natural light are consistent features.

Openness and spatial flexibility showed more variation. Seven of the twelve buildings (Buildings 1, 2, 3, 6, 8, 10, and 12) were scored as open or mixed-open in spatial configuration. In comparison, five (Buildings 4, 5, 7, 9, and 11) were assessed as predominantly enclosed or corridor-based. Spatial flexibility was coded as present in the same seven buildings that scored positively on openness. This alignment is expected, as open and shared layouts are generally easier to reconfigure than fixed cellular arrangements.

Spatial differentiation, defined as the presence of a clear variety of distinct spatial types within the layout, was observed in 10 of the 12 buildings. The two exceptions were Building 5 and Building 9. Building 5 follows a ring/courtyard configuration with smaller office rooms arranged uniformly along a double-loaded corridor, offering limited variation in space types. Building 9, the elongated linear bar, similarly presents a repetitive spatial structure with limited diversity of settings beyond the corridor-office arrangement.

Table 4.3. Summary of binary spatial characteristics across the twelve Police office buildings.

Variable	Present (N buildings)	Absent (N buildings)	Description
Openness	7 / 12 (58%)	5 / 12	Open or mixed-open layout without full spatial enclosure
Spatial differentiation	10 / 12 (83%)	2 / 12	A variety of distinct workspace setting types are available
Spatial flexibility	7 / 12 (58%)	5 / 12	Layout is open or shared and likely reconfigurable
Standardisation	**12 / 12 (100%)**	**0 / 12**	Modular or repeated spatial/furniture pattern visible throughout
Vertical partitions	**12 / 12 (100%)**	**0 / 12**	Walls or enclosed rooms present in the layout
Windows	**12 / 12 (100%)**	**0 / 12**	Facade windows or natural light openings are visible
Zoning	**9/ 12 (75%)**	**3/ 12**	Clear functional areas delineated by corridors or partitions

Note. All characteristics were assessed through floor-plan analysis based on the framework of Ruiz de Castañeda Altuna (2025). Present = characteristic observed in the building's floor plan; Absent = characteristic not observed. Green cells indicate universal presence or absence across all twelve buildings. Red cells indicate the characteristic was absent in 30% or more of buildings.

iii. Workspace Provision

Workspace provision varied considerably across the 12 buildings (Table 3.5). The total number of work points ranged from 189 (Building 12) to 1,011 (Building 1), reflecting substantial differences in building scale. The number of workstations, defined as individually assignable work positions, ranged from 202 (Building 12) to 1,109 (Building 10). Meeting room seats varied widely, from 23 in Building 11 to 550 in Building 3. Building 3 also had the highest number of meeting seats per work point, because it is a mixed-typology building with many enclosed meeting spaces.

The workspace ratio ranged from 0.56 (Building 8) to 1.14 (Building 3). A workspace ratio below 1.0 indicates that individual desk positions account for less than the total workplace capacity, meaning a greater share of capacity is provided through meeting spaces rather than individual workstations. Building 8 had the lowest ratio (0.56), indicating that individual desks accounted for only 56% of the building's total workplace

capacity, with the remaining capacity allocated to meeting spaces. In contrast, Building 3 had a ratio of 1.14, indicating that individual work points slightly exceeded the total workplace capacity as defined by the FWTE formula, suggesting a relatively desk-heavy provision with comparatively less meeting space relative to the overall capacity. This is consistent with Building 3's mixed typology, which combines enclosed individual offices with open co-working areas.

Notable differences also emerged in the provision of meeting rooms relative to workstations. Building 11 had only 23 meeting seats despite 326 work points, representing by far the most limited meeting provision in the sample. Building 9, by contrast, had 447 meeting seats alongside 957 work points, suggesting a relatively generous provision of collaborative spaces relative to its desk supply. Building 7 showed the inverse pattern, with 1,048 workstations but only 98 meeting seats, indicating a spatial emphasis on individual work over collaborative spaces.

Table 4.4. Workspace provision indicators across the twelve Police office buildings.

Building	Layout type	Work points	Meeting seats	FTE	FWTE	Workspace ratio
1	Open-plan	1,011	473	1,625	1,247	77%
2	Open-plan	736	268	1,113	870	78%
3	Mixed	670	550	586	945	161%
4	Cellular	376	161	477	456.5	96%
5	Open-plan	531	194	609	628	103%
6	Cellular	669	290	663	814	123%
7	Open-plan	549	98	846	598	71%
8	Cellular	456	255	810	586	72%
9	Open-plan	957	447	1,182	1,180.5	100%
10	Cellular	456	183	601	547.5	91%
11	Open-plan	326	23	325	337.5	104%
12	Cellular	189	74	217	226	104%

Note. Work points = the total number of individual desk positions available. Workstations = number of assigned/bookable workstations. Meeting seats = total seat capacity across all meeting rooms.

FWTE is calculated as (1.0 × number of workstations) + (0.5 × number of meeting seats). Workspace ratio = work points ÷ FWTE; values below 1.0 indicate fewer desks than assigned employees (desk sharing); values at or above 1.0 indicate surplus provision. Workspace ratio colour coding: red < 0.70 (high desk scarcity); white/blue 0.70–0.99 (moderate sharing); green ≥ 1.00 (surplus). Source: Netherlands Police Real Estate and Housing Department.

Workspace ratios ranged from 71% (Building 7) to 161% (Building 3), indicating considerable variation in workplace capacity across the portfolio. A ratio below 100% indicates that the total workplace capacity, calculated as work points plus half the meeting seat capacity, is less than the number of assigned employees, meaning not all employees can be accommodated simultaneously. A ratio above 100% indicates surplus capacity relative to the assigned workforce.

Building 3 had the highest workspace ratio (161%) and yet the lowest average occupancy (15.3%), while Building 6 had a workspace ratio of 123% and the highest occupancy (39.6%). This inverse pattern, where buildings with more generous provision show lower attendance, suggests that workspace ratio alone does not predict occupancy, a finding examined further in Section 4.4.1.

Two organisational factors should be noted when interpreting occupancy data. First, PTW registration (Plaats van Tewerkstelling = official place of employment) reflects administrative assignment rather than actual attendance, meaning the FTE factor of the workspace ratio may overstate the number of employees who regularly use the building. Second, some organisational units have mandatory on-site attendance policies, which structurally elevate occupancy in those buildings independently of spatial quality or workspace provision.

iv. Summary

The descriptive layout analysis reveals a portfolio characterised by typological and spatial diversity. Open-plan buildings dominate numerically (6 out of 12) but vary considerably in their spatial organisation, from deep linear floorplates (Buildings 1 and 2) to ring/courtyard configurations (Building 5) and multi-volume clusters (Building 11). Cellular buildings also show internal variation, ranging from multi-bar arrangements (Building 4) to compact deep-core structures (Building 8) and single-floor configurations (Building 12). Building 3 stands out as the only mixed-typology building, offering the broadest range of spatial settings in the sample.

Across all buildings, standardisation, vertical partitions, windows, and functional zoning were universal. Openness, spatial flexibility, and spatial differentiation were more variable and closely aligned with layout typology: open-plan and mixed buildings tended to score positively on these characteristics. In contrast, cellular buildings showed more mixed patterns. Workspace provision indicators, work points, workstations, meeting seats, and workspace ratios varied substantially and did not follow a simple typological logic, with some cellular buildings providing generous workspace ratios and others offering limited meeting-room provision relative to their desk supply. These descriptive results provide the foundation for the subsequent analyses.

4.3.3 Employee Perceptions of Workplace Effectiveness

The following analyses use OfficeEffectiveness as the outcome variable, which represents a composite of perceived workplace satisfaction and productivity support.

Descriptive statistics for individual layout-related satisfaction items and key perceptual variables are presented below. All items were measured on a five-point scale (1 = very dissatisfied / strongly disagree; 5 = very satisfied / strongly agree).

Table 4.5. Descriptive statistics for Workplace Effectiveness variables (n = 270–278). Scale: 1–5.

Variable	N	M	SD	Interpretation
Layout-related satisfaction items				
Layout of the immediate work environment	271	**2.90**	1.06	Moderate; the highest-rated of the three layout items
Openness of the work environment	274	**2.88**	1.16	Moderate; very close to layout satisfaction
Acoustics (sound absorption and reflection)	270	**2.62**	1.14	Lowest-rated spatial characteristic across the sample
Workspace satisfaction items				
Functionality of workspace	274	**3.39**	0.97	Highest-rated individual item in the workspace satisfaction index
Comfort of the workplace	272	**3.19**	1.02	Intermediate item in the workspace satisfaction index; significant regression predictor (β = .234)
Privacy and focused-work items				
Privacy in the workplace	278	**2.51**	1.13	Below moderate; consistently the lowest-rated dimension across all three survey buildings
Ability to work in a focused manner	278	**2.51**	1.18	Below moderate; closely associated with privacy satisfaction
Composite outcome variable				
OfficeEffectiveness (composite)	276	**3.21**	0.68	Overall moderate perceived workplace effectiveness and productivity support; used as the dependent variable in the regression analysis

Note. M = mean; SD = standard deviation. All items were rated on a five-point Likert scale (1 = very dissatisfied / strongly disagree; 5 = very satisfied / strongly agree). Mean colour coding: green ≥ 3.50 (positive); yellow 3.00–3.49 (moderate); red < 3.00 (below moderate. OfficeEffectiveness was computed using MEAN.5 (minimum five valid responses required).

Across all 3 buildings with sufficient WiT data, collaboration-related items received the most positive evaluations. In-person meetings (M = 3.90–3.93 across buildings) and working together in person (M = 3.81–3.93) were rated highest. Privacy, focused work,

confidential conversations, and acoustics consistently received the lowest scores, all below 3.0 across all three buildings. This pattern indicates that the Police office buildings are generally perceived as more supportive of collaboration and interaction than of concentrated, private, or confidential work.

Standard deviations were moderate for most items (SD ≈ 1.0), indicating some variation in employee responses. Collaboration-related items, such as in-person meetings, showed lower standard deviations, reflecting more consistent evaluations. In contrast, items related to privacy and concentrated work showed somewhat greater variation, suggesting that individual experiences with these spatial conditions differed more across employees.

Table 4.6. Key variables by survey building. Values: M (SD). Scale: 1–5.

Variable	Building 1	Building 2	Building 3
Overall hybrid work experience			
Overall hybrid work suitability	3.31 (1.10)	3.60 (1.06)	3.42 (1.08)
Collaboration-related items			
Working together in person	3.81 (0.85)	3.86 (0.81)	3.93 (0.88)
In-person meetings	3.90 (0.65)	3.92 (0.69)	3.93 (0.84)
Privacy, focus, and acoustic conditions			
Privacy in the workplace	2.39 (1.08)	2.71 (1.18)	2.72 (1.22)
Ability to work in a focused manner	2.39 (1.12)	2.62 (1.19)	2.90 (1.42)
Confidential conversations	2.52 (1.21)	2.72 (1.24)	2.79 (1.18)
Acoustics (sound absorption and reflection)	2.57 (1.16)	2.63 (1.12)	2.93 (1.07)
Workspace functionality			
Functionality of workspace	3.37 (0.95)	3.44 (0.96)	3.41 (1.12)
Composite outcome variable			
OfficeEffectiveness(composite)	**3.15 (0.70)**	**3.31 (0.65)**	**3.37 (0.64)**

Note. Values presented as Mean (SD). All items were rated on a five-point Likert scale (1 = very dissatisfied / strongly disagree; 5 = very satisfied / strongly agree). Mean colour coding: green ≥ 3.50 (positive); yellow 3.00–3.49 (moderate); red < 3.00 (below moderate). Building 1 (n = 219); Building 2 e (n = 117); Building 3 = (n = 40). OfficeEffectiveness composite computed using MEAN.5.

4.3.4 Employee Perceptions of Productivity and Mental Health Outcomes

This section presents descriptive results for the three productivity and mental health constructs measured in the WiT survey across the three Police office buildings. The measures used are described in Section 3.4 of the Methods chapter.

i. Office-Perceived Productivity Support

Across all three buildings, perceived support for individual productivity was moderate, with an overall mean of M = 2.82 (SD = 1.09), suggesting that the office environment was perceived as moderately supportive of individual productivity. Perceived support for team productivity was somewhat higher (M = 3.14, SD = 0.97), suggesting again that employees view the office as more conducive to collaborative work than to individual performance. This pattern is consistent with the findings from Section 4.3.3, where collaboration-related items also received higher ratings than privacy and focused-work items.

Table 4.7. Office-perceived productivity support by building. Scale: 1–5 (higher = more supportive).

Variable	N	M (SD)	Building 1	Building 2	Building 3
Office supports its own productivity	270	2.82 (1.09)	2.77 (1.08)	2.85 (1.08)	3.04 (1.19)
Office supports team productivity	266	3.14 (0.97)	3.01 (0.99)	3.40 (0.94)	3.24 (0.78)

Note. Values: Mean (SD). n per building: Building 1= 169–219, Building 2= 73–117, Buildong 3 = 25–40.

At the building level, Building 3 reported the highest mean for individual productivity support (M = 3.04), and Building 2 the highest for team productivity support (M = 3.40), while Building 1 scored lowest on both items (M = 2.77 and M = 3.01, respectively). These differences are small and should be interpreted cautiously, given the small sample size of Building 3 (n = 25–27).

ii. Self-Reported Productivity

Table 4.8. Self-reported productivity by building — STAPLESOP and IWPQ scales.

Variable	N	M (SD)	Rotterdam	Zwolle	Amsterdam
STAPLESOP — self-reported productivity (1 = strongly disagree, 5 = strongly agree)					
I think I am an effective employee	299	4.24 (0.59)	4.23 (0.61)	4.21 (0.56)	4.32 (0.59)
I am a very productive employee	297	4.12 (0.70)	4.13 (0.68)	4.11 (0.67)	4.15 (0.86)
I am satisfied with the quality of my own work	298	4.18 (0.61)	4.19 (0.60)	4.18 (0.57)	4.15 (0.80)
I work very efficiently	298	3.94 (0.74)	3.94 (0.75)	3.95 (0.65)	3.94 (0.90)

Within my team, I rate my performance in the top 25%	278	3.98 (0.79)	4.01 (0.76)	3.91 (0.79)	4.00 (0.95)
My manager thinks I work efficiently	249	4.06 (0.65)	4.05 (0.64)	4.13 (0.66)	3.96 (0.65)
STAPLESOP composite (scale mean)	240	4.12 (0.54)	4.11 (0.54)	4.14 (0.49)	4.07 (0.67)
IWPQ — individual work performance (1 = never, 5 = always, past 3 months)					
Able to plan work so it was finished on time	307	4.06 (0.84)	4.09 (0.87)	4.00 (0.74)	4.03 (0.92)
Kept in mind the results I needed to achieve	309	4.38 (0.69)	4.37 (0.73)	4.43 (0.61)	4.35 (0.65)
Able to distinguish main from side issues	307	4.24 (0.60)	4.29 (0.60)	4.21 (0.56)	4.03 (0.73)
Did job with as little time and effort as possible	306	3.72 (0.79)	3.76 (0.80)	3.65 (0.75)	3.62 (0.85)
Created an optimal schedule	300	3.67 (0.85)	3.67 (0.89)	3.66 (0.71)	3.67 (0.96)
IWPQ composite (scale mean)	295	4.01 (0.53)	4.03 (0.56)	3.98 (0.48)	3.94 (0.51)

Note. Values: Mean (SD). Composite scores are scale means. n per building: Building 1 = 153–191, Building 2 = 62–85, Building 3 = 25–34.

STAPLESOP item means were consistently high across all buildings, ranging from M = 3.94 (I work very efficiently) to M = 4.24 (I think I am an effective employee), with a composite scale mean of M = 4.12 (SD = 0.54). Standard deviations were consistently low (SD ≤ 0.79 for all items), indicating strong consensus in self-assessments. Between-building differences were very small, with no item differing by more than 0.17 points across buildings.

IWPQ item means were similarly high, ranging from M = 3.67 (I created an optimal schedule) to M = 4.38 (I kept in mind the results I needed to achieve), with a composite mean of M = 4.01 (SD = 0.53). Between-building variation was again minimal: Building 1 (M = 4.03), Building 2 (M = 3.98), and Building 3 (M = 3.94) all scored within a narrow range. Efficiency and scheduling items showed somewhat greater variability (SD ≈ 0.79–0.85) than goal-orientation items, suggesting more diverse experiences with time management across the sample.

iii. Mental Health in the Workplace

As discussed in the literature, a well-performing building is not only one that uses space efficiently and promotes productivity and satisfaction, but also one that supports employee health. For this reason, employees' health-related perceptions of the office

environment were also considered relevant to this research. For the police, only mental health WiT data were available.

Table 4.9. Mental health indicators by building — TUEMHAWnk scale (1 = never, 5 = always).

Variable	N	M (SD)	Building 1	Building 2	Building 3
Negative indicators — lower score = better (1 = never, 5 = always)					
Feeling stressed	225	2.54 (1.00)	2.55 (1.00)	2.41 (0.98)	2.84 (0.96)
Trouble concentrating	226	2.59 (0.90)	2.63 (0.89)	2.37 (0.89)	2.90 (0.91)
Waking up too early (sleep disruption)	226	2.31 (1.14)	2.35 (1.16)	2.14 (1.07)	2.60 (1.23)
Usually exhausted/tired after work	226	2.62 (0.99)	2.67 (0.98)	2.49 (1.02)	2.55 (1.00)
Positive indicators — higher score = better (1 = never, 5 = always)					
In good physical condition	226	3.65 (0.84)	3.60 (0.81)	3.75 (0.84)	3.68 (1.06)
Work is a positive challenge	224	3.59 (0.83)	3.54 (0.81)	3.73 (0.85)	3.53 (0.96)
TUEMHAWnk composite (higher = better mental health)	223	3.54 (0.68)	3.49 (0.66)	3.68 (0.68)	3.41 (0.84)

Note. Values: Mean (SD). For negative indicators, lower scores indicate better mental health. For positive indicators, higher scores indicate better mental health. The composite score is computed from both reversed-negative and positive items, so that a higher score indicates better overall mental health. n per building: Building 1 = 146–148, Building 2 = 59, Building 3 = 18–20.

Negative indicator scores were moderate across all buildings. Stress was experienced 'sometimes' on average (M = 2.54, SD = 1.00), as were trouble concentrating (M = 2.59, SD = 0.90) and exhaustion after work (M = 2.62, SD = 0.99). Sleep disruption was the least frequently reported negative indicator (M = 2.31, SD = 1.14). Positive indicators were rated more favourably: employees reported being in good physical condition (M = 3.65, SD = 0.84) and experiencing work as a positive challenge (M = 3.59, SD = 0.83) with moderate-to-high frequency.

The TUEMHAWnk composite mean was M = 3.54 (SD = 0.68), indicating moderate overall mental health. Building 2 showed the most favourable profile (M = 3.68), followed by Building 1 (M = 3.49) and Building 3 (M = 3.41). Building 3 also showed the highest scores on stress (M = 2.84) and trouble concentrating (M = 2.90), and the largest standard deviations across health items, suggesting greater variation in employee experiences. Given the small Building 3 subsample (n = 18–20), these differences should be interpreted with caution.

4.4 Correlation Analysis

4.4.1 Relationship Between Layout Characteristics and Occupancy/Spatial Efficiency

To examine whether layout characteristics were associated with building-level occupancy, Spearman rank correlations were calculated between five layout variables and average occupancy rate across the twelve buildings. Spearman's rho was used because zoning, spatial differentiation, and spatial flexibility are ordinal or binary variables.

None of the five layout variables showed a statistically significant association with average building occupancy. Functional zoning showed a very weak positive correlation ($\rho = .139$, $p = .666$), spatial differentiation showed no association ($\rho = .000$, $p = 1.000$), and spatial flexibility showed a negligible negative correlation ($\rho = -.073$, $p = .821$). Openness was similarly non-significant ($\rho = -.073$, $p = .821$).

The correlation between the workspace ratio and average workstation occupancy was very weak and not statistically significant: $r = .13$, $t(10) = 0.42$, $p = .684$. This indicates that buildings with higher or lower workspace ratios did not exhibit consistently different occupancy levels. Similarly, the correlation between FWTE and average workstation occupancy was weak, negative, and not statistically significant ($r = -.266$, $t(10) = -0.87$, $p = .403$). In other words, buildings with a higher workplace capacity relative to the number of assigned employees tended to have slightly lower occupancy, but the relationship was not statistically significant.

A comparison of layout typologies also revealed no clear pattern. Open-plan buildings had a mean occupancy of 27.8%, while cellular buildings had a slightly lower mean occupancy of 25.3%. The only mixed-typology building, Building 3, had the lowest average occupancy in the sample at 15.3%. However, because the sample included only 12 buildings and there was considerable variation within each typology, no statistically significant association between layout typology and occupancy could be established.

These results do not support H3 (differences in layout typology are associated with differences in building-level occupancy) or H4 (a lower workspace ratio is associated with higher occupancy). Neither spatial configuration nor workstation provision showed a meaningful association with observed occupancy rates, suggesting that other factors may play a greater role in determining building-level attendance than the office's physical layout.

4.4.2 Relationship Between Layout Characteristics and Perceived Workplace Effectiveness

This section examines associations between six layout satisfaction items and five employee outcome variables. OfficeEffectiveness is not used as an outcome variable here because several satisfaction items, including privacy and focused work, are components of that composite, creating a circular relationship. Instead, the outcomes examined are: office-perceived productivity support (own and team), self-reported

productivity (STAPLESOP and IWPQ composites), and mental health (TUEMHAWnk composite). The analysis proceeds in two steps: first, Pearson correlations between layout satisfaction items and the outcome variables; second, one-way ANOVA tests examining whether outcomes differed across the three survey buildings.

i. Layout satisfaction items - Pearson correlations

Pearson correlations were computed between six layout satisfaction items and the five outcome variables. The items covered included openness of the work environment, layout of the immediate work environment, acoustics, privacy in the workplace, comfort in the workplace, and the ability to work in a focused manner.

Table 4.10. Pearson correlations between layout satisfaction items and employee outcome variables (n ≈ 219–278).

Layout satisfaction Variable	Own Productivity Support	Team Productivity Support	STAPLESOP	IWPQ	TUEMHAWnk
Openness of the work environment	**.540*** **	**.466*** **	−.149*	−.039	.173*
Layout of the immediate work environment	**.559*** **	**.462*** **	−.144*	.009	.149*
Acoustics (sound absorption and reflection)	.372***	.240***	−.085	−.027	.247***
Privacy in the workplace	**.543*** **	**.462*** **	−.147*	.075	.260***
Comfort of the workplace	**.455*** **	.349***	−.137*	.001	.148*
Ability to work in a focused manner	**.587*** **	**.453*** **	−.182**	.051	.215**

*Note. * p < .05, ** p < .01, *** p < .001. Non-significant correlations shown without asterisks. All correlations were computed using pairwise deletion. Own and Team Productivity Support = office-perceived productivity support items. STAPLESOP = self-rated productivity composite. IWPQ = Individual Work Performance Questionnaire composite. TUEMHAWnk = mental health composite (higher = better). Green = r > .40; yellow = r .20–.40; red = significant negative association.*

All six satisfaction items showed strong positive associations with perceived productivity support at the office. The ability to work in a focused manner showed the strongest correlation with own productivity support (r = .587, p < .001), followed by layout satisfaction (r = .559), privacy (r = .543), openness (r = .540), comfort (r = .455), and acoustics (r = .372, all p < .001). For team productivity support, all six items were also significantly and positively correlated, though the correlations were somewhat lower (r = .240 to .466). Employees who rated their office's spatial quality more positively consistently perceived it as more supportive of both individual and team productivity.

For self-reported productivity, the pattern was different. STAPLESOP scores showed small but significant negative correlations with five of the six items, focused work (r = −.182, p < .01), openness (r = −.149), privacy (r = −.147), layout (r = −.144), and comfort (r = −.137, all p < .05). Employees who rated their spatial environment more

positively did not rate themselves as more productive overall. IWPQ scores showed no significant associations with any satisfaction item. This confirms that office-perceived productivity support and general self-reported productivity are empirically distinct constructs.

Mental health (TUEMHAWnk) showed small but consistently positive associations with all six items. Privacy (r = .260, p < .001) and acoustics (r = .247, p < .001) showed the strongest associations, followed by focused work (r = .215, p < .01), openness (r = .173, p < .05), layout (r = .149, p < .05), and comfort (r = .148, p < .05). Employees in environments they perceived as more private, acoustically comfortable, and supportive of focused work tended to report better mental health.

ii. Building-level differences - one-way ANOVA

One-way ANOVA tests were conducted to examine whether satisfaction with privacy, focus, and collaboration-related conditions differed across the three survey buildings.

Table 4.11. One-way ANOVA results: building differences in satisfaction with workplace conditions.

Satisfaction Variable	F	df	p	η^2	Building means (B1 / B2 / B3)	Sig.
Confidential conversations	4.09	2, 267	.018	.030	3.06 / 3.69 / 3.69	*
Privacy in the workplace	2.79	2, 275	.063	.020	2.39 / 2.71 / 2.72	ns
Ability to work in a focused manner	2.75	2, 275	.066	.019	2.39 / 2.62 / 2.90	ns
Collaboration items (all)	< 1.0	2, 275	> .05	—	—	ns

*Note. * p < .05.. B1 = Building 1; B2 = Building 2; B3 = Building 3. η^2 = eta squared.*

Satisfaction with confidential work differed significantly between buildings, F(2, 267) = 4.09, p = .018, η^2 = .030. Building 2 and Building 3 both scored highest (M = 3.69), while Building 1 scored lowest (M = 3.06), suggesting that Building 1's open-plan layout provides less support for confidential work. Privacy satisfaction and focused-work satisfaction approached statistical significance (p = .063 and p = .066, respectively), suggesting a possible tendency for these conditions to vary across buildings that the current sample size was insufficient to confirm. No statistically significant differences were found for any collaboration-related item across buildings.

iii. Physical building characteristics - Spearman correlations

Spearman's rank correlations were computed between 12 physical building-level characteristics and 5 outcome variables. These characteristics were derived from floor-plan analysis and Police real estate data. An important methodological note applies: Zoning, Number of Floors, and FTE total are perfectly collinear across the three survey buildings (rs = 1.000 for all pairs) and reflect the same underlying building-level contrast, they cannot be interpreted as independent effects.

Table 4.12. Spearman correlations between physical building characteristics and employee outcome variables.

Building characteristic	Own Productivity rs	Team Productivity rs	STAPLESOP rs	IWPQ rs	TUEMHAWnk rs
Layout & spatial provision					
Functional zoning	−.063	−.025	−.001	.040	.057
Spatial differentiation	.084	.171**	.027	−.063	.082
Number of floors †	−.063	−.025	−.001	.040	.057
Workspace ratio (FTE/ FWTE)	.075	.167**	.025	−.052	.076
Work points (total)	−.075	−.167**	−.025	.052	−.076
FTE total †	−.063	−.025	−.001	.040	.057
Meeting & collaborative spaces					
Number of meeting spaces	−.060	−.190**	−.030	.043	−.113
Meeting space seats (total)	.001	−.138*	−.024	.002	−.140*
Occupancy & accessibility					
Occupancy rate (%)	−.001	.138*	.024	−.002	.140*
Office layout type (dummies; reference = co-working)					
Cellular office dummy	.089	.011	−.030	−.039	−.006
Mixed office dummy	.058	.024	.088	.019	.065

*Note. * p < .05, ** p < .01. Non-significant correlations shown without asterisks. † Zoning, Number of Floors, and FTE total are perfectly collinear (rs = 1.000) across the three survey buildings. Reference category for office layout dummies = co-working layout.*

For own productivity support, none of the objective building characteristics showed a statistically significant correlation. All correlations were small, suggesting that objective spatial characteristics were not meaningfully associated with employees' perceived support for individual productivity.

For team productivity support, several small but significant associations were found. Spatial differentiation was positively correlated with team productivity support (r_s = .171, $p < .01$), suggesting that buildings with a greater variety of workspace settings were associated with higher perceived support for teamwork. Workspace ratio was also positively correlated with team productivity support (r_s = .167, $p < .01$). In contrast, work points, number of meeting spaces, meeting space seats, and accessibility were negatively associated with team productivity support, likely reflecting building-scale effects, where larger buildings provide more physical resources but are not necessarily experienced as more supportive of teamwork.

For self-reported productivity (STAPLESOP and IWPQ), no meaningful associations were found with any objective building characteristic. For mental health, only three small significant associations were found: meeting space seats and accessibility were negatively correlated with TUEMHAWnk, while occupancy rate was positively correlated. These associations were weak and inconsistent and should be interpreted cautiously.

iv. Overall summary

Survey-based layout satisfaction items showed strong and consistent associations with office-perceived productivity support and mental health, but not with general self-reported productivity. Physical building characteristics showed limited and inconsistent associations across all outcome variables. The strongest objective relationship was between spatial differentiation and support for team productivity. These findings should be interpreted with caution: satisfaction items were measured at the individual level, and were available for only three buildings, limiting the generalisability of the building-level correlations.

These results provide partial support for H5 (lower privacy and noise are associated with lower perceived effectiveness) and partial support for H6 (layout typology affects perceived effectiveness differently across typologies). The ANOVA confirmed a significant building difference for confidential work satisfaction, consistent with H5 and H6, but privacy and focused-work differences did not reach statistical significance. Neither H5 nor H6 is fully confirmed, but the direction of findings is consistent with both hypotheses.

4.4.3 Relationship Between Occupancy/Spatial Efficiency and Perceived Workplace Effectiveness

This section examines associations between three office-use indicators and six employee outcome variables. Unlike Section 4.4.2, OfficeEffectiveness is included here as an outcome because office-use indicators are not components of the composite, and there is no circularity issue. Pearson correlations are reported first, followed by one-way ANOVAs examining whether outcomes differed across the three survey buildings.

i. Pearson correlations

Table 4.13. Pearson correlations between office-use indicators and employee outcome variables (n ≈ 214–223).

Office-use indicator	Office-Effectiveness	Own Productivity Support	Team Productivity Support	STAPLESOP	IWPQ	TUEMHAWnk
Office days per week	**.349*** **	**.419*** **	**.336*** **	−.190**	−.199**	.007
% working time at own office	.287***	**.398*** **	.290***	−.094	−.181**	.023
Occupancy rate	.056	−.001	.145*	.034	−.017	.130

*Note. * p < .05, ** p < .01, *** p < .001. Non-significant correlations shown without asterisks. All correlations were computed using pairwise deletion. Green = positive significant association; red = significant negative association. Building-level occupancy rate is an aggregate measure from Measuremen; other indicators are individual-level self-report variables.*

Both self-reported office attendance indicators, office days per week and percentage of working time at own office, were significantly and positively associated with OfficeEffectiveness. Office days per week showed a moderate positive correlation (r = .349, p < .001), and the percentage of working time at one's own office showed a similar positive association (r = .287, p < .001). Occupancy rate was not significantly associated with OfficeEffectiveness (r = .056, p = ns), confirming that building use does not predict individual perceived effectiveness.

The same pattern held for office-perceived productivity support. Office days per week were positively correlated with own productivity support (r = .419, p < .001) and team productivity support (r = .336, p < .001). The percentage of working time at one's own office showed similar positive associations (r = .398 and r = .290, both p < .001). Building-level occupancy rate showed no significant association with own productivity support and only a small positive association with team productivity support (r = .145, p < .05), which should be interpreted with caution given the small building-level sample size.

For self-reported productivity, the associations were opposite. Office days per week were negatively correlated with STAPLESOP (r = −.190, p < .01) and IWPQ (r = −.199, p < .01). Percentage of working time at own office was also negatively correlated with IWPQ (r = −.181, p < .01), though not significantly with STAPLESOP (r = −.094). Employees who attended the office more frequently rated their overall productivity

slightly lower. Building-level occupancy rate showed no significant association with either scale.

Mental health (TUEMHAWnk) was not significantly associated with any office-use indicator. Office days per week (r = .007), percentage of working time at own office (r = .023), and building-level occupancy rate (r = .130) all fell short of statistical significance, suggesting that the frequency of office use does not have a meaningful relationship with employee mental health in this sample.

ii. Building-level differences - one-way ANOVA

One-way ANOVAs were conducted to examine whether outcome variables differed across the three survey buildings.

Table 4.14. One-way ANOVA: building differences on all outcome variables.

Outcome variable	F	df	p	η²	Building means (B1 / B2 / B3)	Sig.
Perceived effectiveness & productivity support						
OfficeEffectiveness composite	2.29	2, 274	.104	.016	3.15 / 3.31 / 3.37	ns
Own productivity support	0.746	2, 267	.475	.006	2.77 / 2.85 / 3.04	ns
Team productivity support	4.380	2, 263	.013	.032	3.01 / 3.40 / 3.24	*
Self-reported productivity						
STAPLESOP composite	0.157	2, 237	.855	.001	4.11 / 4.14 / 4.07	ns
IWPQ composite	0.556	2, 292	.574	.004	4.03 / 3.98 / 3.94	ns
Mental health						
TUEMHAWnk composite	1.888	2, 220	.154	.017	3.49 / 3.68 / 3.41	ns

*Note. * p < .05. ns = not significant. η² = eta squared. B1 =Building 1; B2 = Building 2; B3 = Building 3*
OfficeEffectivenessProd means corrected from earlier version using verified data values.

The only significant building difference was found for team productivity support, F(2, 263) = 4.380, p = .013, η² = .032. Building 2 reported the highest mean (M = 3.40), followed by Building 3 (M = 3.24) and Building 1 (M = 3.01). Although the effect size was small, this indicates that employees in Building 2 perceived the office as more supportive of team productivity than those in Building 1. No significant differences in building-level outcomes were found for OfficeEffectiveness, own productivity support, self-reported productivity (STAPLESOP and IWPQ), or mental health (all p > .05), suggesting these outcomes were broadly consistent across buildings.

Overall, individual-level office-use behaviour was positively associated with perceived effectiveness and office-perceived productivity support, but negatively associated with general self-reported productivity. Building-level occupancy rate showed no meaningful associations with any outcome variable except for a small association with team productivity support. Mental health was unrelated to all office-use indicators. These findings highlight the importance of distinguishing between how employees evaluate the office as a productive environment and how they evaluate their own general productivity as workers.

These results support H1: perceived effectiveness is more strongly associated with individual office-use behaviour than with aggregate building-level occupancy. Office days per week ($r = .349$, $p < .001$) and the percentage of working time at own office ($r = .287$, $p < .001$) were both significantly and positively associated with OfficeEffectiveness, whereas building-level occupancy rate was not ($r = .056$, $p = ns$). H1 is supported.

These results also support H2. Employees who were more satisfied with spatial conditions, including privacy ($r = .309$), openness ($r = .376$), and focused work ($r = .366$, all $p < .001$), attended the office more frequently, confirming that spatial quality is positively associated with office attendance.

4.5 Linear Regression Analysis

This section presents the results of the hierarchical linear regression analysis conducted to examine the extent to which layout characteristics, use behaviour, and spatial satisfaction are associated with perceived workplace effectiveness in the 3 Netherlands Police office buildings for which survey data were available. The analytical approach, variable construction, and assumption checks are described in Section 3.5.3 of the Methods chapter.

4.5.1 Model Fit Across Blocks

Table 4.15 presents the model summary for all four steps of the hierarchical regression. R^2 represents the proportion of variance in OfficeEffectiveness explained by the predictors in each cumulative model, and ΔR^2 indicates the additional variance explained by each new block of predictors.

Table 4.15. Model summary for the hierarchical regression predicting OfficeEffectiveness (n = 211).

Model	R	R^2	Adj. R^2	Std. Error	ΔR^2	F Change	df1	df2	Sig. F Change
1	.431	.186	.158	.639	**.186**	6.611	7	203	< .001
Model 1 adds: *Zoning, Mixed office dummy, Age, Gender, Office days per week, MeetingSpaceSeats, Cellular office dummy*									
2	.736	.542	.522	.481	**.357**	78.350	2	201	< .001
Model 2 adds: *+ Acoustics satisfaction + Privacy in the workplace*									

Model	R	R^2	Adj. R^2	Std. Error	ΔR^2	F Change	df1	df2	Sig. F Change
3	.803	.645	.626	.426	**.103**	28.850	2	199	< .001
Model 3 adds: *+ Facility services satisfaction + Comfort of workplace*									
4	.829	.687	.665	.403	.042	8.761	3	196	**< .001**
Model 4 adds: *+ Availability of meeting/discussion spaces + Range of desk workstation types + Layout of immediate work environment*									
Durbin-Watson (Model 4) = 2.144 - no problematic autocorrelation (acceptable range: 1.5–2.5)									

Note. Dependent variable: OfficeEffectivenessProd. n = 211 after listwise deletion. ΔR^2 colour coding: green ≥ .30 (large increment); yellow .10–.29 (moderate increment); grey < .10 (small increment). Predictor rows (italicised, grey background) list the variables added at each block — all previous block predictors are retained in subsequent models. Durbin-Watson = 2.144 for Model 4, confirming independence of residuals.

Block 1, comprising building characteristics and individual use variables, explained 18.6% of the variance in OfficeEffectiveness (R^2 = .186), $F(7, 203) = 6.611$, $p < .001$. While statistically significant, this relatively modest proportion indicates that objective building features and individual attendance patterns alone account for only a limited share of perceived workplace effectiveness.

The addition of Block 2, acoustics satisfaction and privacy satisfaction, produced the largest single increase in explained variance across all four steps: ΔR^2 = .357, $\Delta F(2, 201) = 78.350$, $p < .001$. Adding just two satisfaction items, acoustics and privacy, increased the explained variance from 18.6% to 54.2%, nearly tripling it in a single step. This finding underscores the central importance of acoustic quality and perceived privacy in shaping employees' evaluations of the effectiveness of their office environment.

Block 3, adding satisfaction with workplace comfort and facility services, produced a further significant increase: ΔR^2 = .103, $\Delta F(2, 199) = 28.850$, $p < .001$, bringing the total explained variance to 64.5%. This indicates that comfort and service quality contribute meaningfully to perceived effectiveness, beyond privacy and acoustics.

Block 4, which introduced spatial functionality and diversity items, again produced a significant increase: ΔR^2 = .042, $\Delta F(3, 196) = 8.761$, $p < .001$. Although this increment was the smallest of the four blocks, it remained statistically significant, confirming that the availability and variety of spatial settings contributed independently to perceived effectiveness. The final model explained 68.7% of the variance in OfficeEffectiveness (R^2 = .687; Adjusted R^2 = .665).

4.5.2 Predictors in the Final Model

Table 4.16 presents the regression coefficients for all predictors across all four models. Predictors marked with ✦ were statistically significant in the final model (Model 4). The standardised beta coefficient (β) allows comparison of the relative strength of predictors in standard deviation units, independent of the original measurement scales.

Table 4.16. Regression coefficients for all four models (dependent variable: OfficeEffectivenessProd).

Predictor	B	Std. Error	β	t	p	95% CI Lower	95% CI Upper	VIF
(Constant)	1.524	.346	—	4.407	< .001	.842	2.205	—
Office days per week ✦	.084	.030	.124	2.805	.006**	.025	.143	1.231
Gender	−.069	.060	−.049	−1.140	.255	−.188	.050	1.164
Age	.000	.004	.051	.051	.959	−.008	.008	1.045
Cellular office dummy	−.075	.182	−.019	−.412	.680	−.435	.284	1.386
Mixed office dummy	.069	.065	.046	1.051	.294	−.060	.198	1.184
Meeting space seats	.000	.000	−.054	−1.189	.236	−.001	.000	1.309
Degree of functional zoning	−.133	.123	−.054	−1.085	.279	−.375	.109	1.526
Acoustics satisfaction	−.011	.031	−.017	−.339	.735	−.072	.051	1.602
Privacy satisfaction ✦	.231	.036	.380	6.357	< .001***	.160	.303	2.243
Comfort of workplace ✦	.158	.037	.234	4.325	< .001***	.086	.231	1.827
Facility services in the building	.057	.041	.066	1.383	.168	−.024	.139	1.445
Layout of the immediate work environment	.045	.040	.070	1.134	.258	−.034	.124	2.378
Range of desk workstation types	.053	.038	.076	1.383	.168	−.022	.128	1.884

Availability of meeting/discussion spaces ✦	.128	.032	.193	3.955	< .001***	.064	.192	1.491

*Note. Values shown are from Model 4 (final block). ✦ = significant in the final model. ** p < .01, *** p < .001. Reference category for office type dummies = co-working layout.*

In the final model, three satisfaction-based predictors and one office-use indicator were statistically significant: privacy satisfaction (β = .380), comfort of workplace (β = .234), availability of meeting and discussion spaces (β = .193), and number of office days per week (β = .124). Privacy satisfaction was the strongest perceptual predictor (B = .231, β = .380, t = 6.357, p < .001). For every one-point increase in privacy satisfaction on the five-point Likert scale, OfficeEffectiveness increased by an average of .231 points, controlling for all other variables. With the highest standardised beta among all perceptual predictors, privacy satisfaction made the largest independent contribution to perceived workplace effectiveness.

Comfort of the workplace was also a significant positive predictor (B = .158, β = .234, t = 4.325, p < .001). Employees who rated the overall comfort of their workplace more positively tended to perceive it as significantly more effective, regardless of privacy or other controls. This confirms that the experienced quality of the physical environment, beyond any specific spatial feature, plays an important role in shaping overall evaluations of effectiveness.

The availability of various types of meeting and discussion spaces was a significant positive predictor in the final block (B = .128, β = .193, t = 3.955, p < .001). Even after controlling for privacy and comfort, employees who were more satisfied with the provision of meeting space tended to rate the office as more effective. This indicates that the office's collaborative infrastructure contributes independently to perceived effectiveness, alongside individual work-support conditions.

The number of days worked in the office per week was also a significant predictor in the final model (B = .084, β = .124, t = 2.805, p = .006). Employees who attended the office more frequently tended to report higher perceived effectiveness. This may reflect that employees who perceive the office as effective are more inclined to attend, or it may indicate that more frequent presence leads to greater familiarity with, and more positive evaluation of, the environment.

Several predictors that were significant in earlier models became non-significant in the final model. Most notably, acoustics satisfaction had a large effect in Block 2 (β = .626, p < .001 in Model 2) but became non-significant in Model 4 (β = −.017, p = .735). This is attributable to conceptual overlap between acoustic satisfaction and the comfort and privacy predictors introduced in later blocks: once these related dimensions were controlled, the independent effect of acoustics diminished. This does not mean acoustics is unimportant, but rather that, in the presence of those variables, acoustics did not add unique explanatory power.

Office type, represented by the cellular and mixed dummy variables, was not a statistically significant predictor in any of the four models (all p > .10). Once individual attendance patterns and perceptual quality variables were accounted for, whether a building had a cellular, open plan, or mixed layout did not independently predict perceived workplace effectiveness. This suggests that the experienced quality of the

spatial environment matters more to employees than the typological category of the layout.

These findings support H7, perceived workplace effectiveness is associated with layout characteristics, use behaviour, and spatial efficiency indicators. The final regression model explained 68.7% of the variance in OfficeEffectiveness ($R^2 = .687$, Adjusted $R^2 = .665$).

4.5.3 Summary of Findings

The hierarchical regression analysis produced four principal conclusions:

1. **Privacy satisfaction is the strongest perceptual predictor of perceived workplace effectiveness.** With β = .380 in the final model and the largest single increment in explained variance when introduced in Block 2 ($\Delta R^2 = .357$), privacy satisfaction accounted for more additional variance than any other predictor block. Offices that fail to provide adequate privacy will be perceived as less effective, regardless of their typological category or the number of workstations they offer.
2. **Workplace comfort contributes independently to perceived effectiveness.** Beyond privacy and acoustics, the overall comfort of the workplace was a significant predictor (β = .234, $p < .001$), indicating that employees evaluate the office holistically. Targeted improvements to the physical comfort of the work environment are likely to have a measurable effect on perceived effectiveness.
3. **The availability of meeting and collaborative spaces is a significant predictor.** Even after controlling for privacy and comfort, satisfaction with meeting space provision independently predicted perceived effectiveness (β = .193, $p < .001$), confirming that the office's collaborative infrastructure matters alongside individual work support.
4. **Office layout typology does not independently predict perceived effectiveness.** Cellular, open-plan, and mixed buildings did not differ significantly in perceived effectiveness after controlling for perceptual quality. This suggests that improving spatial quality within existing layouts, particularly privacy provisions, acoustic conditions, and comfort, is a more effective strategy than changing a building's typological classification.

Together, these findings indicate that perceived workplace effectiveness in the Netherlands Police office buildings is primarily driven by the perceived quality of the spatial environment rather than by the layout type or the number of workstations provided. The implications of these findings for the Netherlands Police real estate portfolio are discussed in Chapter 5.

CHAPTER 5

Discussion

5. Discussion

5.1 Introduction

This chapter interprets the findings presented in Chapter 4 in relation to the research questions, the theoretical framework, and the existing literature on hybrid work, office layout, occupancy, and perceived workplace effectiveness. The central aim of this study was to identify the distinguishing layout and use characteristics that contribute to the effective use of hybrid work environments within the Netherlands Police real estate portfolio. The chapter then examines the implications of these findings for the Netherlands Police real estate portfolio and closes with an acknowledgement of limitations and directions for future research.

Table 5.1 summarises all seven hypotheses and their empirical outcomes. Results are discussed in Sections 5.2 through 5.6.

Table 5.1. Overview of hypotheses and empirical outcomes (H1–H7).

H	§	RQ	Hypothesis statement	Tests	Result
Occupancy and spatial efficiency (RQ3)					
H3	2.4.3	RQ4	Differences in layout typology are associated with differences in building-level occupancy under hybrid working conditions.	Layout typology → occupancy	**Not supported**
H4	2.4.3	RQ4	Buildings with a lower workspace ratio — fewer work points relative to total workplace capacity (FWTE) — tend to exhibit higher building-level occupancy rates under hybrid working conditions.	Workspace ratio → occupancy	**Not supported**
Office-use behaviour and effectiveness (RQ5)					
H1	2.3.4	RQ5	Perceived workplace effectiveness is more strongly associated with employees' office-use behaviour and satisfaction with workplace conditions than with aggregate building-level occupancy rates.	Office-use behaviour + satisfaction → effectiveness	**Supported**
H2	2.3.X	RQ5	Employees who report higher satisfaction with privacy, visibility, environmental control, and comfort tend to use the office more frequently.	Spatial satisfaction → office-use frequency	**Supported**
Layout and perceived workplace effectiveness (RQ6)					
H5	2.4.5	RQ6	Office layouts with lower privacy and higher background noise are associated with lower perceived workplace effectiveness.	Privacy & acoustics → effectiveness	**Partial support**

H6	2.4.5	RQ6	Layout typology affects employees' perceived workplace effectiveness, with mixed and cellular layouts providing better support for privacy and focused work, and co-working layouts providing better support for collaboration.	Layout typology → perceived effectiveness	**Partial support**
Integrated model (RQ7)					
H7	2.5.3	RQ7	Perceived workplace effectiveness is associated with layout characteristics, spatial efficiency indicators, and office-use behaviour under hybrid working conditions.	Layout + occupancy + use behaviour → effectiveness	**Supported (R^2 = .687)**

Note. Supported = directional prediction confirmed at $p < .05$. Not supported = no significant association in predicted direction. Partial support = significant for some but not all dimensions. Green = supported; red = not supported; yellow = partial support. R^2 = .687 for the final regression model (Model 4, n = 211).

5.2 Occupancy and Spatial Efficiency Under Hybrid Working Conditions

The occupancy analysis revealed that hybrid working has substantially reduced daily office attendance across the Netherlands Police portfolio. An overall average occupancy rate of 25.7%, with peak rates not exceeding 60.5% in any building, confirms the pattern observed in broader research on post-pandemic office use, where midweek attendance peaks and persistently low attendance on Mondays and Fridays are consistently reported (Centre for People and Buildings, 202). This significant underutilisation has direct implications for real estate portfolio strategy: building capacity and associated costs have not been proportionally reduced despite markedly lower attendance.

It should also be noted that the Measuremen occupancy methodology counts all available space units, including meeting rooms, as individual workstations regardless of their size. A reported occupancy rate of, say, 19% occupancy in meeting spaces, therefore, does not mean that 19% of all available chairs are occupied, but that 19% of all bookable spatial units are in use. This should be considered when comparing occupancy rates across buildings with different ratios of desk-based to meeting-room provision.

5.3 Physical Layout Characteristics

The floor-plan analysis identified three dominant layout typologies across the 12 buildings: cellular (five buildings), open-plan (six buildings), and mixed (one building). This typological variation reflects different spatial strategies adopted across the Police portfolio. Beyond typology, buildings varied considerably in their spatial characteristics. Standardisation, vertical partitions, windows, and functional zoning were near-universal across the portfolio, indicating a shared baseline of spatial organisation. Spatial differentiation, the diversity of available workspace setting types, showed more variation, with some buildings offering a richer mix of settings than others. Workspace ratios ranged from 71% (Building 7) to 161% (Building 3), indicating that workstation provision relative to workplace capacity has not been applied

consistently. These descriptive findings confirm that the Police portfolio encompasses a genuinely diverse range of spatial configurations, providing a meaningful basis for comparative analysis.

5.4 Employee Perceptions of Workplace Effectiveness

The survey data from the three WiT buildings revealed that collaboration-related aspects of the office were evaluated considerably more positively than privacy, concentration, and acoustic conditions. In-person meetings and working together in person received mean scores approaching 3.9 out of 5 across all three buildings, while privacy, focused work, confidential conversations, and acoustics all scored below 3.0. This pattern reflects the changing role of the office under hybrid working conditions: employees attend primarily for activities that benefit from co-presence, while concentration-intensive and confidential tasks are increasingly performed from home (van den Boogert et al.,2024; Center for People and Buildings, 2026).

The descriptive comparison across buildings showed that Building 3, the only mixed-layout building, consistently scored highest on both collaboration and privacy-related indicators, despite having the lowest average occupancy (15.3%). Building 1, with an open-plan layout, consistently received the lowest satisfaction scores on privacy, focused work, and acoustics. This pattern suggests that the mixed layout, combining enclosed cellular offices with open-plan areas, provides a broader range of spatial conditions suited to different work activities.

5.5 Layout Characteristics and Spatial Efficiency

To examine whether layout characteristics were associated with building-level occupancy, Spearman rank correlations were computed between five layout variables and average occupancy rate across the twelve buildings. None of the five layout variables showed a statistically significant association with average building occupancy. A comparison of occupancy by layout typology showed that open-plan buildings averaged 27.8% and cellular buildings averaged 25.3%, but this difference was not statistically significant.

These results are informative rather than merely negative. They indicate that spatial configuration and workstation provision, as currently constituted within the Police portfolio, do not translate directly into differences in attendance. Organisational policies, task profiles, and PTW registration are likely more powerful determinants of occupancy than layout type. This is consistent with research showing that hybrid work attendance is primarily choice-driven and shaped by organisational context rather than spatial provision (Appel-Meulenbroek et al., 2022; Center for People and Buildings, 2026; Valks et al., 2021).

A critical finding was that the workspace ratio did not significantly predict building-level occupancy. This aligns with research showing that hybrid work attendance is a choice-based behaviour shaped by perceived benefits, task requirements, and individual preferences rather than spatial availability (Allen et al., 2024; Bergefurt et al., 2024). Adjusting the workspace ratio alone is therefore unlikely to substantially increase attendance.

5.6 Employee Perceptions and Spatial Efficiency

The correlation analysis between office-use indicators and employee outcome variables revealed a consistent and theoretically meaningful pattern. Both individual-level office-use indicators were significantly and positively associated with OfficeEffectiveness. Building-level occupancy rate was not significantly associated with OfficeEffectiveness. This confirms that how actively individual employees use the office matters more for perceived effectiveness than how busy the building is in aggregate.

The same pattern held for office-perceived productivity support: both individual-level indicators were positively associated with own and team productivity support, while building-level occupancy rate showed no significant association with own productivity support and only a small association with team productivity support. For self-reported general productivity (STAPLESOP and IWPQ), the pattern reversed; employees who attended the office more frequently rated their own general productivity slightly lower. This reflects the finding that individual, focused work is often perceived as more productive at home, where interruptions are fewer (Appel-Meulenbroek et al., 2022; Center for People and Buildings, 2026). Mental health was not significantly associated with any office-use indicator.

5.7 Layout Characteristics and Perceived Workplace Effectiveness

The correlation analysis between layout satisfaction items and employee outcomes showed that all six satisfaction items were strongly and positively associated with perceived support for office productivity and mental health. The ability to work in a focused manner showed the strongest correlation with own productivity support, followed by layout satisfaction, privacy, openness, comfort, and acoustics. For self-reported general productivity, the associations were absent or weakly negative, confirming that spatial quality predicts how supportive employees perceive the office to be for their work, but not their perceived productivity.

The ANOVA analysis showed a significant building-level difference for satisfaction with confidential work, with Building 3 and Building 2 scoring highest and Building 1 lowest. Privacy satisfaction and focused-work satisfaction both approached statistical significance but did not reach it. No significant differences in building were found for collaboration-related items. This pattern tentatively supports the expectation that layout typology influences privacy-related dimensions of the workplace experience, but the evidence is not strong enough to fully confirm it.

5.8 Integrated Model: Layout, Use, and Spatial Efficiency

The hierarchical regression analysis produced the most theoretically and practically significant findings of this study. The final model explained 68.7% of the variance in OfficeEffectiveness, strong explanatory power for a survey-based study. Three perceptual predictors and one office-use indicator were statistically significant in the final model.

Privacy satisfaction emerged as the strongest perceptual predictor, followed by workplace comfort and the availability of meeting and discussion. The number of office

days per week was the only significant predictor of use behaviour. Office layout typology, represented by the cellular and mixed dummy variables, was not a statistically significant predictor in any of the four regression models. Building-level occupancy rate was also not a significant predictor.

The dominance of privacy satisfaction is consistent with Kim and de Dear's (2013) finding that privacy and acoustic control are more important determinants of workplace satisfaction than the office's typological category. It also aligns with Colenberg et al. (2021), who show that open-plan offices and higher background noise are negatively associated with health and concentration outcomes. In the Police context, where employees may need to conduct confidential conversations and process sensitive information, the importance of privacy is amplified beyond what is typically observed in general knowledge work.

The independent contribution of workplace comfort confirms that employees evaluate the office holistically. As van der Voordt and Jensen (2023) note, comfortable workplace conditions function as a strategic investment because they directly affect employee satisfaction and perceived productivity. The significant effect of meeting space availability reflects the office's changing function under hybrid conditions. Collaboration and social interaction are the primary drivers of office attendance, and spaces that support these activities are valued independently of privacy and comfort conditions.

The positive association between office days per week and perceived effectiveness needs careful interpretation. Two explanations are possible: employees who perceive the office as effective may be more inclined to attend; alternatively, more frequent presence may build familiarity with the environment and generate more positive evaluations. The cross-sectional design of this study does not allow these explanations to be distinguished.

Crucially, the null finding for office layout typology as a predictor of perceived effectiveness suggests that the frequently debated open-versus-cellular typology distinction matters less than the quality of the experienced spatial conditions within those typologies. This is consistent with Sailer and Thomas (2020) and Arkesteijn and Heywood (2021), who argue that what makes a workplace effective is not the type of layout it has, but how well that layout fits the organisation's needs and work activities.

5.9 Comparison with Literature

The findings of this study are broadly consistent with the emerging literature on hybrid workplace performance and also contribute several empirically grounded extensions.

The observation that hybrid working has produced persistently low occupancy aligns closely with patterns reported by the Centre for People and Buildings (2024) and Appel-Meulenbroek et al. (2022), who document mid-week concentration patterns and structural underutilisation in Dutch public-sector organisations. The failure of workspace ratio adjustments to predict occupancy replicates findings by Valks et al. (2021), who caution against treating spatial efficiency metrics as direct proxies for attendance behaviour.

The primacy of privacy satisfaction as the strongest predictor of perceived workplace effectiveness directly corroborates Kim and de Dear's (2013) finding that privacy is the most important unmet need in open-plan offices and the strongest driver of workspace dissatisfaction. The consistent underperformance of privacy across all three Police buildings suggests that current spatial configurations do not adequately meet this need.

Finally, the modest positive associations between acoustic satisfaction, privacy, and mental health outcomes are consistent with Colenberg et al. (2021) and van der Voordt and Jensen (2023), who identify acoustic comfort and privacy as dimensions of the physical environment that directly affect employee stress and well-being.

5.10 Implications for the Netherlands Police Real Estate Portfolio

The findings carry several practical implications for the Netherlands Police's approach to its real estate portfolio under hybrid working conditions. Overall, the results suggest that portfolio decisions should not be based on occupancy data or layout typology alone. Instead, they should consider how existing buildings can be improved to better support employees' work activities, particularly privacy, concentration, acoustics, and collaboration.

i. **Prioritise spatial quality over typological transformation.**

Since office type did not independently predict perceived effectiveness once spatial quality was controlled, full structural conversions from open-plan to cellular layouts are not supported as a general strategic intervention. This is particularly relevant for the Netherlands Police, where most portfolio interventions concern adaptations of existing buildings rather than the development of entirely new workplaces. In these cases, changing the complete layout is often costly and may not be necessary. The findings suggest that improving specific spatial conditions within existing layouts, particularly privacy provisions, acoustic quality, and the availability of enclosed spaces, may yield greater benefits for employees at lower cost.

This also aligns with the emerging concept of **"**Passende Kwaliteit**"**, or appropriate quality, within the organisation. Rather than applying a single ideal workplace standard to all buildings, this approach allows quality levels to be adjusted to the organisation's needs and the existing building's capabilities. The results of this study support this approach, as they show that targeted improvements in spatial quality may be more relevant than a full typological transformation.

ii. **Prioritise spatial quality over typological transformation.**

Acoustics received the lowest satisfaction scores across the analysed buildings. This indicates that acoustic quality should be prioritised in future workplace improvements, particularly in buildings with open-plan layouts. Measures such as sound-absorbing materials, improved partitioning, and dedicated quiet zones may help reduce distractions and improve employees' ability to concentrate.

iii. Ensure adequate provision of private and enclosed spaces.

Privacy satisfaction was one of the strongest predictors of perceived workplace effectiveness. This is especially important in the Police context, where employees may need to conduct confidential conversations, focus on individual work, or perform tasks involving sensitive information. Therefore, all buildings should provide sufficient enclosed or semi-enclosed spaces. These spaces do not necessarily require a full transformation of the building layout, but they should be deliberately included when adapting existing buildings.

Together, the findings on acoustics and privacy can help the real estate department direct limited budgets toward the aspects of the workplace that matter most from the user perspective. Instead of investing in complete and expensive redesigns, targeted interventions can improve the quality of more workplaces and benefit a larger group of employees.

iv. **Do not rely on flex ratio adjustments alone.**

The absence of a significant relationship between desk-sharing ratio and occupancy indicates that reducing the number of workstations will not automatically increase attendance or improve spatial efficiency. This has important implications for portfolio reduction strategies. Although low occupancy levels may suggest that employees can be moved from underused buildings to other existing buildings, this should be done only in conjunction with improvements in spatial quality.

If more employees are placed in an existing building without improving acoustic conditions, privacy, and the availability of task-appropriate spaces, the workplace may become less comfortable and less effective. This could discourage employees from coming to the office and increase remote work, undermining the intended benefits of consolidation. Therefore, portfolio reduction should be combined with investment in the quality of the receiving buildings.

v. **Investigate Building 3 as a potential design benchmark.**

Building 3 had the lowest average occupancy among the three survey buildings, but it scored highest in perceptions of privacy, focused work, and collaboration. This suggests that its mixed layout, which combines enclosed spaces with open co-working areas, may offer useful lessons for future renovations or workplace policy development. Further investigation is needed to understand which specific layout features contribute to higher user satisfaction.

This is especially relevant because the analysed buildings were not necessarily designed in accordance with the current workplace policy documents. A useful follow-up step would be to compare James Wattstraat 84 with these policy documents and determine whether its layout is more closely aligned with current workplace principles than those of the other buildings. Insights from this comparison could help refine future policy documents and support improvements in other buildings.

5.11 Limitations of the Study

Several limitations must be acknowledged. First, the building-level occupancy analysis is restricted to 12 buildings, which limits statistical power to detect associations between layout and occupancy and prevents causally definitive conclusions. The heterogeneity of organisational contexts across police buildings adds further complexity, reflecting the variation in the types of work carried out.

Second, the WiT survey dataset was available for only three of the 12 buildings with sufficient response counts. This severely limits the ability to examine building-level effects on employee perceptions, making building-level regression models prone to multicollinearity and requiring cautious interpretation. Layout variables were statistically indistinguishable in the three-building dataset because they functionally captured the same buildings.

Moreover, all employee perception measures are self-reported, making them susceptible to response bias, social desirability bias, and individual differences in rating tendencies. Also, the observed associations between spatial satisfaction and perceived effectiveness may be confounded by unmeasured variables, such as team climate, management quality, or individual work-style preferences. Lastly, occupancy data were collected during specific measurement periods in spring 2024 and may not fully capture seasonal or longitudinal variation in attendance patterns.

A further methodological limitation concerns the way layout was operationalised in the perception analyses. In addition to objective layout indicators derived from floor-plan analysis, several perceived spatial-quality variables, such as satisfaction with privacy, openness, acoustics, and workplace comfort, were included in the correlation and regression models. Although these variables are relevant to workplace experience, they partly capture employees' subjective evaluation of the layout rather than the physical layout itself. This creates a risk of construct overlap between layout, spatial satisfaction, and perceived workplace effectiveness, especially because both the predictor and outcome variables were partly based on self-reported survey data. As a result, some associations may be inflated by common-method bias or may reflect general workplace satisfaction rather than independent effects of objective layout characteristics. The findings should therefore be interpreted as suggestive of perceived spatial quality rather than as direct evidence of causal effects of layout design.

A related methodological limitation concerns the treatment of occupancy in the regression analysis. Building-level occupancy rates were not meaningfully correlated with perceived workplace effectiveness, which limited their explanatory value as predictors in the individual-level regression model. Including aggregate occupancy in the model could, therefore, have complicated the interpretation without adding clear analytical insight, particularly because occupancy was measured at the building level

while perceived effectiveness was measured at the individual employee level. For this reason, the regression model used the self-reported number of office days per week as an indicator of office-use behaviour. However, this decision also has limitations. Office days per week capture how often an employee attends the office, but they do not measure actual building occupancy, density, or how space is used within the building. It is also based on self-report and may be influenced by individual preferences, job requirements, team norms, or mandatory attendance expectations. Therefore, the results should be interpreted with caution, as they reflect office attendance behaviour rather than actual occupancy levels.

5.12 Recommendations for Future Research

Future research should aim to increase both the number of buildings and the number of survey respondents per building, enabling more robust statistical testing of associations between layout effectiveness and building-level outcomes. Longitudinal designs would allow examination of how perceptions and attendance change as hybrid working arrangements evolve and as spatial interventions are implemented.

Qualitative methods, such as interviews or focus groups, would add contextual richness to the quantitative findings, particularly regarding how employees navigate privacy and collaboration trade-offs across different spatial configurations and why some buildings attract higher attendance despite apparently similar characteristics.

Incorporating objective measures of spatial efficiency, occupancy sensor data at the room or zone level, space-per-employee calculations, and utilisation rates by workspace type would allow more precise triangulation of findings and a clearer separation of spatial efficiency from perceived effectiveness.

Future studies should also investigate whether the identified predictors of perceived effectiveness vary across police work types (administrative, operational) and whether individual privacy preferences moderate the relationship between spatial satisfaction and perceived effectiveness.

CHAPTER 6

Conclusion

6. Conclusion

6.1 Answer to the Main Research Question

This study set out to answer the following main research question:

> *What are the distinguishing layout and use characteristics that contribute to the effective use of hybrid work environments?*

The findings demonstrate that the distinguishing characteristics of well-performing hybrid work environments are not primarily structural or typological, but experiential and behavioural. Across the Netherlands Police portfolio, perceived workplace effectiveness was most strongly predicted by the quality of the spatial experience, particularly privacy satisfaction, workplace comfort, and the availability of meeting spaces, and by how actively employees use the office for their work activities. Office layout typology, whether cellular, open-plan, or mixed, did not independently predict perceived effectiveness once spatial quality and individual use behaviour were controlled. Spatial efficiency indicators, including workspace ratio and building-level occupancy rate, similarly showed no significant association with perceived effectiveness.

The central conclusion of this study is therefore that well-performing hybrid work environments are characterised not by a particular layout form, but by the degree to which they provide employees with adequate privacy, acoustic comfort, physical comfort, and access to collaborative spaces, and by the extent to which employees actually use the office for a range of work activities. Buildings that deliver these conditions, regardless of their typological classification, will be experienced as more effective and are more likely to attract and retain voluntary attendance under hybrid working conditions.

6.2 Answers to the Sub-Questions

> *RQ1: To what extent are different Police office buildings used efficiently under hybrid working conditions?*

Average occupancy across the 12 Police buildings was 25.7%, with peak occupancy not exceeding 60.5% in any building. Hybrid working has substantially reduced and made the daily use of Police office buildings more variable, confirming structural underutilisation across the portfolio. Neither the FTEs nor the FWTEs showed a significant relationship with observed occupancy rates.

> *RQ2: Which physical building characteristics define Police office buildings used for hybrid work?*

The 12 buildings spanned three layout typologies: six open-plan, five cellular, and one mixed. All buildings shared universal characteristics, including standardisation, functional zoning, windows, and vertical partitions. Openness, spatial flexibility, and spatial differentiation varied more closely, aligning with typology. Workspace provision indicators, work points, workstations, meeting seats, and workspace ratios varied substantially and did not follow a simple typological logic. Workspace ratios ranged from 71% (Building 7) to 161% (Building 3).

RQ3: How do employees perceive workplace effectiveness in the Netherlands Police office buildings under hybrid working conditions?

The overall OfficeEffectiveness composite mean was M = 3.21 (SD = 0.68). Collaboration-related items were rated most positively, with in-person meetings averaging M = 3.90–3.93 across the three survey buildings. Privacy, acoustics, focused work, and confidential conversations all scored below 3.0 across all three buildings. Office-perceived productivity support items were moderate (own M = 2.82; team M = 3.14). Self-reported productivity was uniformly high (STAPLESOP M = 4.12; IWPQ M = 4.01) and showed no meaningful variation across buildings. Mental health was moderate overall (TUEMHAWnk M = 3.54), with Building 2 scoring highest.

RQ4: Which layout characteristics are associated with higher spatial efficiency?

No statistically significant associations were found between layout typology or workspace provision indicators and building-level occupancy rates. Spearman correlations between layout variables and average occupancy were all non-significant. Open-plan buildings had slightly higher occupancy (27.8%) than cellular buildings (25.3%), but the difference was not statistically significant. H3 (layout typology is associated with occupancy differences) and H4 (lower workspace ratio is associated with higher occupancy) were not supported, indicating that organisational factors are stronger determinants of occupancy than spatial configuration.

RQ5: How do physical building characteristics influence employees' perceived workplace effectiveness in hybrid work environments?

Individual-level office-use indicators (office days per week ($r = .349$, $p < .001$) and percentage of working time at the own office ($r = .287$, $p < .001$)) were positively and significantly associated with OfficeEffectiveness. Building-level occupancy rate showed no significant association ($r = .056$, p = ns). Office attendance was also positively associated with office-perceived productivity support but negatively associated with self-reported general productivity, a pattern consistent with the literature on task-location preferences in hybrid work. Mental health was unrelated to all office-use indicators. H1 was supported: perceived effectiveness was more strongly associated with individual office-use behaviour than with building-level occupancy. Additionally, H2 was supported: employees who were more satisfied with spatial conditions, including privacy ($r = .309$), openness ($r = .376$), and focused work ($r = .366$, all $p < .001$), attended the office more frequently.

RQ6: How are employees' perceptions of workplace effectiveness related to spatial efficiency in the Netherlands Police office buildings?

Layout satisfaction items, particularly the ability to work in a focused manner ($r = .587$), privacy ($r = .543$), openness ($r = .540$), and layout of the immediate work environment ($r = .559$), were strongly and positively correlated with office-perceived productivity support. For general self-reported productivity, no positive associations were found. Mental health showed small but consistently positive associations with privacy ($r = .260$) and acoustics ($r = .247$). H5 (lower privacy and noise are associated with lower perceived effectiveness) received partial support: the direction of effects was consistent, but statistical significance was not reached across all dimensions. H6

(layout typology affects perceived effectiveness) also received partial support: a significant building difference was found for satisfaction with confidential work ($F(2, 267) = 4.09$, $p = .018$), but not for overall perceived effectiveness or collaboration.

> *RQ7: To what extent are layout characteristics, use characteristics, and spatial efficiency associated with perceived workplace effectiveness in Dutch Police office buildings under hybrid working conditions?*

The hierarchical regression model explained 68.7% of the variance in OfficeEffectivenessP ($R^2 = .687$, Adjusted $R^2 = .665$). The three significant perceptual predictors were privacy satisfaction ($\beta = .380$, $p < .001$), comfort of the workplace ($\beta = .234$, $p < .001$), and availability of meeting and discussion spaces ($\beta = .193$, $p < .001$). Office days per week were the significant predictor of use behaviour ($\beta = .124$, $p = .006$). Office layout typology was not a significant predictor in any of the four models (all $p > .10$). Building-level occupancy rate was also not a significant predictor. H7 was supported: perceived workplace effectiveness is associated with layout characteristics, office-use behaviour, and spatial efficiency indicators in an integrated model.

6.3 Main Contributions of the Study

6.3.1 Scientific Contributions

This study contributes to the emerging literature on hybrid workplace performance in three main ways. First, it provides empirical evidence from a real-world public-sector portfolio that office layout typology alone has limited explanatory power for understanding perceived workplace effectiveness. The analyses did not identify a clear relationship between objective layout typology and perceived workplace effectiveness, whereas several perceived spatial-quality variables showed stronger associations with effectiveness outcomes. At the same time, this contribution should be interpreted with caution, as some of the spatial-quality variables used in the analysis were based on employee perceptions rather than objective layout measurements. The findings, therefore, indicate that employees' experiences of the workplace may be more important for perceived effectiveness than the physical layout typology itself, while also illustrating the challenges of distinguishing objective spatial characteristics from subjective workplace evaluations.

Moreover, it separates office-perceived productivity support from general self-reported productivity, demonstrating empirically that these are distinct constructs responding differently to spatial conditions and use behaviour. This distinction has implications for how researchers operationalise and measure productivity in workplace studies.

Lastly, it integrates building-level occupancy data with individual-level perception data within a single analytical framework, demonstrating that spatial efficiency and perceived effectiveness are complementary but empirically distinct dimensions of building performance. A building can be spatially efficient without being perceived as effective, and vice versa, a conceptual distinction that is important for evidence-based portfolio management.

6.3.2 Practical Contributions

For the Netherlands Police Real Estate Department, this study provides concrete evidence that investment in spatial quality, particularly privacy provisions, acoustic treatment, and the availability of meeting space, yields greater returns in perceived effectiveness than the typological reclassification of buildings. It also demonstrates that

workspace ratio adjustments alone are insufficient to increase occupancy and that portfolio consolidation should be accompanied by spatial quality improvements in receiving buildings.

The findings support the Passende Kwaliteit approach: rather than applying a single ideal workplace standard, targeted quality improvements calibrated to the specific conditions and needs of each building are more likely to improve user experience at proportionate cost. The study also provides a methodological template that combines occupancy measurement, floor-plan analysis, and WiT survey data and can be replicated in other Police buildings as survey coverage expands.

6.5 Final Reflection

This study set out to identify the factors that distinguish well-performing hybrid work environments within a large public-sector portfolio. The answer that emerges is both clear and practically consequential: what distinguishes effective hybrid offices is not how they are classified, but how they are experienced. Privacy, comfort, and collaborative infrastructure are the currencies of perceived effectiveness, not typological labels or occupancy metrics.

For the Netherlands Police, this has a direct implication: improving the quality of the spaces employees already use will do more to enhance workplace performance than transforming buildings from one layout typology to another. In a portfolio as large and geographically dispersed as that of the Police, targeted and evidence-based spatial improvements are not only more effective but also more financially sustainable than wholesale redesign.

More broadly, this study reinforces the argument that understanding hybrid workplace performance requires integrating spatial, behavioural, and experiential data. Occupancy tells us how much a building is used, but perceptions tell us whether it is used well. Only by examining both together can organisations make portfolio decisions that genuinely serve the people who work in them.

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Appendix A. Overview of WiT Dataset Variables

This appendix presents a complete overview of all 139 variables in the WiT dataset (202603_DataKaterina_.sav) used in this study. Variables are grouped by their role in the analysis. The dataset contains responses from 463 respondents in total, of whom 376 had a valid building assignment and are included in the analyses. N valid refers to the number of respondents with a non-missing value for each variable across the full dataset.

Scale types: Binary = two response options; Ordinal/Likert = ordered categories (typically 1–5); Continuous = numerical range; Composite = computed mean of multiple items; Composite input = reverse-coded item used within a composite; Nominal = unordered categories.

Table A1. Complete variable overview of the WiT dataset (N = 463 respondents, 139 variables).

Variable code	Question / item label	Scale	Response options / range	N valid
A. Sample descriptors				
Q41678Politie3	Which building do you work in most often?	Nominal	507 Police locations (multi-cat)	376
Q50091WiT	How would you best describe your own office?	Ordinal	1=Cellular; 2=Open-plan; 3=Mixed	276
Q1	What is your gender?	Nominal	1=Man; 2=Vrouw; 3=Anders	228
Q50	How old are you?	Continuous	32 – 69 years	228
Q3	What is your level of education?	Ordinal	1=Primary … 6=Other (6 levels)	227
Q45001T	What is the composition of your household?	Nominal	Multi-category	228
B. Dependent variable				
OfficeEffectiveness	Composite: in-person collaboration, hybrid collaboration, hybrid meetings, focused work, communication, own & team productivity support (MEAN.5)	Composite	1 (low) – 5 (high)	278
C. Regression predictors — Block 1: Demographic & building controls				

Variable code	Question / item label	Scale	Response options / range	N valid
HW_Q45727DAGEN	How many days do you work in the office during an average workweek?	Ordinal	0=No days; 1=1 day … 5=5 days	254
Q1	What is your gender? (see A)	Binary	1=Man; 2=Vrouw	228
Q50	How old are you? (see A)	Continuous	32 – 69 years	228
CellularDummy	Cellular/small-room office dummy (1 = cellular, 0 = otherwise)	Binary dummy	0 / 1	389
MixedDummy	Mixed office dummy (1 = mixed, 0 = otherwise)	Binary dummy	0 / 1	389
MeetingSpaceSeats	Total number of meeting room seats in the building	Continuous	268 – 550	375
WorkPoints	Total number of work points (desks) in the building	Continuous	670 – 1,011	375
WorkspaceRatio	Ratio of work points to assigned FTE	Continuous	0.62 – 1.14	375
Zoning	Degree of functional zoning within the office layout	Ordinal	0 = weak; 1 = strong	375
D. Regression predictors — Block 2: Acoustics & privacy				
SO_TEV6_Q1245	Acoustic conditions in the office	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	270
SO_TEV5_Q16	Workplace privacy	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	278
E. Regression predictors — Block 3: Comfort & facility services				
SG_TEV9_Q17b	Workplace comfort	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	272

Variable code	Question / item label	Scale	Response options / range	N valid
SO_TEV9_Q23	Building and facility services	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	268
F. Regression predictors — Block 4: Spatial functionality & diversity				
S_TEV7_Q14	Immediate work-area layout	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	271
SL_TEV7_Q5343	Variety of individual workstation types	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	270
SL_TEV7_Q5344	Variety of meeting and discussion spaces	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	271
G. Additional WiT satisfaction items (correlation analyses only)				
SL_TEV5_Q15	Degree of openness in the work environment	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	274
SO_TEV5_Q19	Support for focused work	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	278
SH_TEV11_1	Overall satisfaction with hybrid work at the office	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	348
S_TEV12_Q50018WiT	In-person collaboration	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	276
S_TEV12_Q50019WiT	Integration of online and in-person collaboration	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	272
SG_TEV12_Q50020WiT	Online meeting experience	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	270
SO_TEV12_Q50021WiT	In-person meeting experience	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	277

Variable code	Question / item label	Scale	Response options / range	N valid
S_TEV12_Q50022WiT	Hybrid meeting experience	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	269
SO_TEV5_Q20	Opportunities for colleague interaction	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	277
SO_TEV5_Q30271	Support for confidential conversations	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	278
SO_TEV5_Q50086WiT	Support for handling confidential work	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	270
SO_TEV6_Q1241	Workspace lighting conditions	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	273
SO_TEV7_Q5341	Availability of desk spaces	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	272
SL_TEV7_Q9504	Availability of meeting and discussion areas	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	274
SO_TEV9_Q17a	Workspace functionality	Ordinal / Likert	1=Very dissatisfied … 5=Very satisfied	274
H. Objective building-level characteristics (Spearman correlations)				
SpatialDifferentation	Number of different workspace settings available in the building	Ordinal	1=low; 2=medium; 3=high	375
NumberofFloors	Number of floors occupied by the organisation in the building	Continuous	1 – 9 floors	375
FWTEtotal	Full-time workplace equivalent (total assigned FTE)	Continuous	337.5 – 1,247	375
MeetingSpaces	Number of dedicated meeting /	Continuous	41 – 98 spaces	375

Variable code	Question / item label	Scale	Response options / range	N valid
	collaborative spaces			
OccupancyRate	Average building-level occupancy rate (%) from Measuremen	Continuous	15.3% – 39.6%	375
Accessibility	Accessibility score of the building location	Ordinal	4 – 5	376
J. Productivity and mental health outcomes: STAPLESOP, IWPQ, TUEMHAWnk, and WiT scores				
PROD1_Q26	Perceived support for individual productivity	Ordinal	1=Not at all … 5=Very much	270
PROD1_Q27	Perceived support for team productivity	Ordinal	1=Not at all … 5=Very much	266
STEL18STAPLESOP_Q50090WiTSTAPLESOP1	Self-rated employee effectiveness	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	299
STEL18STAPLESOP_Q50090WiTSTAPLESOP2	Self-rated performance relative to team	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	278
STEL18STAPLESOP_Q50090WiTSTAPLESOP3	Satisfaction with own work quality	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	298
STEL18STAPLESOP_Q50090WiTSTAPLESOP4	Self-rated work efficiency	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	298
STEL18STAPLESOP_Q50090WiTSTAPLESOP5	Self-rated productivity	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	297
STEL18STAPLESOP_Q50090WiTSTAPLESOP6	Perceived manager assessment of efficiency	Ordinal / Likert	1=Strongly disagree … 5=Strongly agree	249

Variable code	Question / item label	Scale	Response options / range	N valid
SCHAALSTAPLESOP	Self-rated productivity composite score	Composite	1 (low) – 5 (high)	240
FREQ1IWPQ_Q50001WiTIWPQ1	Timely completion of planned work	Ordinal / Likert	1=Never … 5=Always	307
FREQ1IWPQ_Q50001WiTIWPQ2	Focus on intended work outcomes	Ordinal / Likert	1=Never … 5=Always	309
FREQ1IWPQ_Q50001WiTIWPQ3	Prioritisation of key work issues	Ordinal / Likert	1=Never … 5=Always	307
FREQ1IWPQ_Q50001WiTIWPQ4	Efficient task execution	Ordinal / Likert	1=Never … 5=Always	306
FREQ1IWPQ_Q50001WiTIWPQ5	Work scheduling effectiveness	Ordinal / Likert	1=Never … 5=Always	300
SCHAALIWPQ	Individual work performance composite score	Composite	1 (low) – 5 (high)	295
STEL20TUEMHAWnk_Q50094WiTTUEMHn1	Work-related stress frequency	Ordinal / Likert	1=Never … 5=Always	225
STEL20TUEMHAWnk_Q50094WiTTUEMHn5	Concentration difficulty frequency	Ordinal / Likert	1=Never … 5=Always	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn8	Early waking frequency	Ordinal / Likert	1=Never … 5=Always	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn10	Perceived physical condition	Ordinal / Likert	1=Never … 5=Always	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn13	Positive work challenge	Ordinal / Likert	1=Never … 5=Always	224
STEL20TUEMHAWnk_Q50094WiTTUEMHn16	Post-work exhaustion frequency	Ordinal / Likert	1=Never … 5=Always	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn1_REVERSED	Reversed stress indicator	Composite input	1–5 reversed	225
STEL20TUEMHAWnk_Q50094WiTTUEMHn5_REVERSED	Reversed concentration-difficulty indicator	Composite input	1–5 reversed	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn8_REVERSED	Reversed early-waking indicator	Composite input	1–5 reversed	226
STEL20TUEMHAWnk_Q50094WiTTUEMHn16_REVERSED	Reversed post-work exhaustion indicator	Composite input	1–5 reversed	226

Variable code	Question / item label	Scale	Response options / range	N valid
SCHAALTUEMHAWnk	Mental health and well-being composite score	Composite	1 (low) – 5 (high)	223

Note. Variables in groups C–F were used as predictors in the hierarchical regression analysis. Variables in group B constitute the dependent variable. Groups G–L contain variables used in descriptive, correlation, and ANOVA analyses or included for completeness. SPSS-saved diagnostic variables (ZRE, COO, LEV) and computed building dummy variables (Building 2, Building 3) are omitted from this table as they are analytical outputs rather than survey items. Productivity and mental health outcome variables in Section J include both individual survey items and composite scores. The STAPLESOP self-reported productivity scale is based on Staples et al. (1998), and the IWPQ work performance scale is based on Koopmans et al. (2014). The TUEMHAWnk mental health and well-being composite is based on the Mental Health at Work scale developed by Bergefurt et al. (2026), with negatively worded items reverse-coded before computing the composite score. These productivity and mental health measures were administered as part of the Werk in Transitie (WiT) Monitor, designed by the Center for People and Buildings, and are discussed in the five-year Werk in Transitie research report (CFPB et al., 2026).

Appendix B. Full Overview of Layout Variables - Ruiz de Castañeda Altuna (2025) Framework

The table below presents all 26 layout variables identified by Ruiz de Castañeda Altuna (2025) as relevant for describing and assessing office environments. For each variable, the table indicates whether it was included in the empirical analysis of this study, and where excluded, provides the specific reason for exclusion. Variables included are marked with ✓ Yes (green); excluded variables are marked with ✗ No (red); the variable Windows received a partial assessment (yellow) because only presence of windows — not percentage of glazing or proximity — could be consistently assessed across all twelve buildings.

Of the 26 framework variables, 13 were included in the analysis, 12 were excluded, and 1 was partially assessed. The most common reason for exclusion was the unavailability of consistent data across all twelve buildings, followed by the absence of variance across the Police portfolio (e.g., hot-desking and spatial eligibility, where Police policy eliminates variation). Variables requiring Space Syntax calculations (spatial accessibility, spatial connectivity, spatial integration, spatial proximity) were excluded because no Space Syntax measurements were conducted in this study.

Table B1. Complete overview of layout variables from the Ruiz de Castañeda Altuna (2025) framework, with inclusion decisions and measurement approaches.

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
Customization	Ability to adjust workplace settings to accommodate individual or departmental preferences.	For departments; For individuals	✓ Yes	—	Assessment of the level of individual or departmental ability to modify workplace settings.
Function	Describes the purpose of different spaces within the office layout, such as collaboration, formal and informal meetings, planned or unplanned encounters, focused work, circulation, relaxation, or individual work. Includes the number and variety of these settings.	Collaboration areas; Meeting rooms; Formal/informal areas; Quiet/noisy spaces; Concentrated areas; Circulation spaces; Workstations; Amenity spaces; Relax areas; Individual work areas	✓ Yes	—	Counting the total number and recording the variety of specific settings, such as meeting rooms or focus areas.
Hot-desking	Indicates whether desks are assigned to specific individuals or shared among employees.	Non-assigned desks; Assigned desks	✗ No	Police policy stipulates that all desks are shared — no variance across buildings.	Categorisation of desks as assigned or shared.

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
Image	The overall aesthetic of the layout shaped by materials and colours used in the design.	Use of materials; Colour	✗ No	Not possible to assess consistently across all twelve buildings from available data.	Evaluating design elements such as specific materials and colours utilised.
Number of floors	Total number of floors occupied by an organisational unit or the entire organisation within a specific building.	—	✓ Yes	—	Direct numerical count of the floors occupied by the unit or organisation.
Number of occupants	Total headcount associated with the office layout, distinguishing between employees assigned to the space and those physically present and currently working in the office.	Number of employees; Designated headcount; Current headcount	✓ Yes	—	Counting the total headcount, designated staff, and employees physically present.
Number of organisational units	Count of distinct work groups allocated within the office layout, often linked to spatial boundaries.	Number of work groups	✗ No	Not possible to determine where every organisational unit is placed within each building's layout.	Counting the number of distinct work groups or departments allocated within the layout.
Office area	Represents the total space occupied by the office, measured in square meters or square feet.	Building size; Floor size	✓ Yes	—	Calculation of square meters of the building or floor.
Office type	Refers to the overarching office concept adopted for the layout design. Common examples include open-plan, cellular offices, or activity-based working.	Single offices; Shared offices; Open plan; Cubicles; Small rooms; ABW/AFO; Cellular office; Combi office; Flexible workplace arrangements	✓ Yes	—	Identifying and categorising the dominant office design concept.

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
Openness	Refers to the extent to which a space is divided by partitions, shaping how visible and connected individuals and teams are to the broader environment. Encompasses privacy, shared presence, and the spatial experience of being co-located.	Enclosedness; Awareness; Privacy; Co-presence; Spatial visibility; Step depth	✓ Yes	—	Assessment of partitioning levels, spatial visibility, and Space Syntax metrics like step depth.
Plants & greenery	Inclusion of plants or greenery in the office layout.	—	✗ No	No data available for all twelve buildings.	Identification and recording of greenery within the layout.
Positioning of control mechanisms	Strategic placement of supervisory devices, such as managerial roles, in relation to employees, to monitor behaviour.	Space accounting	✗ No	No data available on managerial positioning across buildings.	Mapping the strategic placement of managerial roles or supervisory devices in relation to employees.
Spatial accessibility	Depth of a particular workstation or spot to the entrance of that space.	—	✗ No	No data available to calculate across all buildings.	Measuring the 'depth' or distance of a specific spot relative to its nearest entrance.
Spatial connectivity	Space Syntax measure. Refers to the number of spaces immediately connecting a space of origin.	—	✗ No	No Space Syntax measurements available for calculation.	Calculation of the number of spaces directly connected to a specific space of origin.
Spatial density	Ratio of occupants to office area, often described as floor space per person.	Space efficiency; Density of occupation; Floor space per person; Staff density	✗ No	No consistent floor space per person data available across all buildings.	Calculation of the ratio of occupants to the office area, expressed as floor space per person.

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
Spatial differentiation	At the overall layout level, refers to the diversity of spatial settings within the office — the variety and number of distinct spaces. At the specific setting level, reflects the degree of variation between similar settings in design, size, or functionality.	Diversity of settings; The number of each type of space	✓ Yes	—	Evaluating the variety and number of distinct spaces and the degree of variation between similar settings.
Spatial eligibility	Defines the criteria used to allocate individuals and teams within the office layout, based on hierarchical level, organisational affiliation, personal preferences, or functional requirements.	Based on hierarchical level; Based on organisational affiliation; Based on personal preference; Based on function	✗ No	Desk allocation is not determined by hierarchical position according to Police policy — no variance across buildings.	Identification and mapping of the specific criteria (rank, department, or function) used to determine seating allocation.
Spatial integration	Space Syntax measure. Normalised measure of distance from any element to all other elements in a system. Deeper spaces are less integrated; shallow spaces are more integrated.	Shallow spaces = more integrated; Deeper spaces = less integrated; Metric choice/movement choice; Shape of spaces	✗ No	No Space Syntax measurements available.	Quantitative calculation of the normalised distance from one spatial element to all others within the system using Space Syntax analysis.
Spatial flexibility	The capacity of the office layout to adapt to changes in team size, departmental arrangements, and organisational needs. Includes the ability to support mobile work styles.	Flexibility of team size; Fixed/adaptable designs; Mobile/stationary work	✓ Yes	—	Assessing the layout's ability to be reconfigured or adapted to accommodate changes in headcount or organisational structure.
Spatial proximity	Spatial closeness between entities within the overall layout, including individual workers, organisational	Co-location; Proximity between business units; Proximity to colleagues within/across units; Proximity to windows; Mean	✗ No	No available measurements for calculating physical distances between	Physical distances between workstations or entities, often calculated as the mean distance

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
	units, or spatial settings.	distance between coworkers		workstations or entities.	between coworkers.
Standardisation	Use of modular, repeatable design solutions in furniture, partitions, and spatial settings.	Modular design	✓ Yes	—	Evaluating the degree to which modular furniture, repeatable spatial settings, and uniform partitions are utilised across the layout.
Symbolic value	Tacit meaning implied by the design of the layout, related to cultural values.	—	✗ No	No available data on the status of individuals occupying each office or desk.	Analysing how spatial arrangements (such as office size or location) represent hierarchy, status, or organisational culture.
Vertical partitions	Refers to the presence and characteristics of partitions within the office layout, specifically their height (low, medium, or high) and transparency, influencing the level of separation between spaces.	Height of partitions; Transparency of partitions	✓ Yes	—	Recording the specific height levels and degree of transparency of partitions used to separate office spaces.
Windows	Presence of windows, the percentage of openable or fixed windows, and their proximity to employees.	Percentage of fixed/openable glazed fenestration; Proximity to windows	Partial	Only the presence of windows could be assessed; the percentage of openable glazing and proximity to employees were not available for all buildings.	Identification of the presence of windows, calculation of the percentage of fixed vs. openable glazing, and measuring the physical distance of employees to windows.
Workstation design	Positioning of workstations, their orientation, the geometrical disposition of clusters, and the number of workstations per cluster.	Positioning of workstations; Clusters/rows; Close proximity; Number of people per cluster	✗ No	No data available for all buildings on cluster arrangements and workstation orientation.	Mapping the geometrical arrangement (e.g., clusters or rows), orientation, and counting the number of workstations per cluster.

Variable	Definition	Synonyms / related concepts	Included	Reason if excluded	Measurement approach
Workspace ratio	Number of workstations available per employee in the office.	—	**✓ Yes** **Netherlands Police definition:** Workspace ratio = FWTE ÷ FTE		Calculating the ratio of total workstations relative to the total number of employees (headcount) assigned to the office space.
Zoning	Division of the layout into different areas, usually delineated by corridors, partitions, or other spaces.	—	**✓ Yes**	—	Identification and mapping of the distinct areas within a layout and the physical boundaries (e.g., corridors or partitions) used to define them.

Note. ✓ Yes = included in empirical analysis; ✗ No = excluded; Partial = only partially assessable with available data. All measurement approaches based on Ruiz de Castañeda Altuna et al. (2025). Source: Ruiz de Castañeda Altuna, A. (2025). Linking office layout to organisational performance: A framework for hybrid work environments [Doctoral dissertation]. Delft University of Technology.

Appendix C. Annotated Floor Plans of the Three Survey Buildings

The following floor plans present the first office floor of each of the three survey buildings. Floor plans were edited in Adobe Photoshop to colour-code distinct functional areas according to the legend below. The first office floor was selected as the primary analytical unit because it was considered most representative of the building's layout and was largely replicated on upper floors. The ground floor was excluded as it primarily accommodates entrance, reception, restaurant, and support functions rather than office workspaces.

Figure D0. Colour legend for annotated floor plans.

C.1 Building 1

Layout typology: Open-plan (co-working). The floor plan shows a large, deep floorplate with open desk environments arranged along central circulation axes, meeting rooms distributed across the plan, and support functions at the periphery.

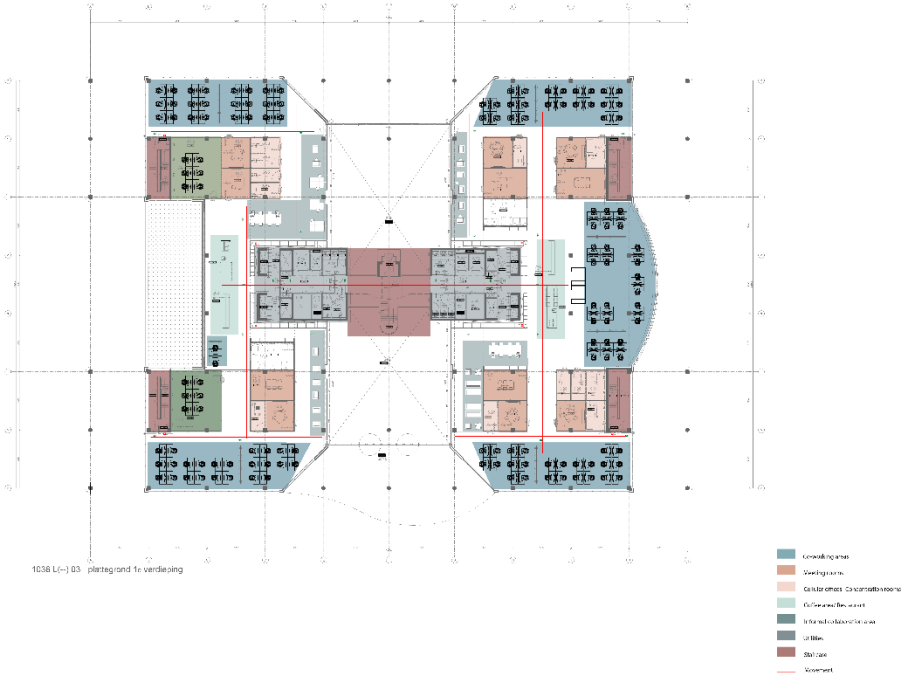

Figure D1. Annotated floor plan of Building 1. First office floor. Source: Netherlands Police Real Estate Department; colour-coding by author.

C.2 Building 2

Layout typology: Open-plan (co-working). The floor plan shows an extended linear floorplate with open desk areas, meeting and support spaces distributed along the perimeter, and repetitive circulation patterns.

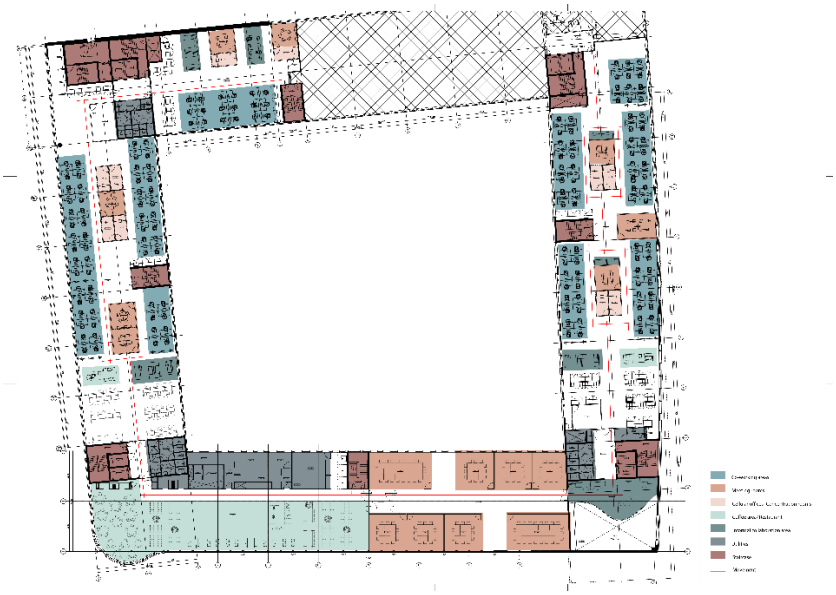

Figure D2. Annotated floor plan of Building 2. First office floor. Source: Netherlands Police Real Estate Department; colour-coding by author.

D.3 Building 3

Layout typology: Mixed (open-plan and cellular). The floor plan shows a combination of open co-working areas and enclosed cellular offices, with two internal voids that provide natural light and create shared collaborative spaces in the centre.

Figure D3. Annotated floor plan of Building 3. First office floor. Source: Netherlands Police Real Estate Department; colour-coding by author.

Appendix D. Use of Generative AI

This appendix describes how generative AI tools were used during the research and writing of this thesis, in accordance with TU Delft's guidelines on the use of AI in academic work.

Tools and purpose

Table D1. Overview of AI tools used.

Tool	When	Purpose	Researcher's role
ChatGPT (OpenAI)	Literature phase	Exploring themes and identifying candidate sources	All sources were independently retrieved, read, and verified
Claude (Anthropic)	Writing and revision phase	Refining draft text, checking consistency, formatting tables, and identifying errors in numbering and cross-references	All content, arguments, analyses, and conclusions are the researcher's own
Grammarly	Throughout writing	Grammar and spelling correction	All suggestions reviewed and accepted or rejected by the researcher

Note. All AI-generated text was reviewed, edited, and approved by the researcher before inclusion.

What AI did not do

AI tools were not used to design the research, collect or analyse data, interpret results, draw conclusions, or generate literature reviews. All statistical analyses were conducted independently in IBM SPSS Statistics. All arguments, hypotheses, and conclusions are the researcher's own.

Reflection

AI was most useful for tasks requiring systematic attention to detail, checking that table numbers matched text references, ensuring variable names were consistent across chapters, and formatting tables. For writing, AI was used to refine and clarify text already drafted by the researcher, not to generate ideas from scratch. The researcher takes full academic responsibility for the content of this thesis.

Appendix F. Personal Reflection

F.1 Relevance

The Management in the Built Environment (MBE) track of the MSc Architecture, Urbanism and Building Sciences programme focuses on how real estate can be strategically aligned with organisational needs and goals. This thesis sits at the intersection of that strategic perspective and a concrete, real-world challenge: what happens to office buildings when the people who are supposed to use them simply choose not to come in as often as before?

When I started orienting on a research topic in November 2024, hybrid working was already well established as a permanent feature of Dutch working life. Yet the practical implications for real estate management, particularly in large public-sector portfolios, were still poorly understood. The Netherlands Police offered a compelling case: a geographically dispersed portfolio of office buildings, a workforce operating under hybrid arrangements, and a real estate department actively grappling with questions about which buildings to keep, adapt, or release. The combination of scientific relevance and immediate practical applicability made this topic feel both urgent and meaningful.

What struck me throughout the research was how often people assume that spatial problems have spatial solutions, that changing a building's layout from open-plan to cellular, or reducing the number of workstations, will change how people use the space. The findings of this study challenge that assumption in a concrete and data-driven way. The most important factors for perceived workplace effectiveness turned out not to be the type of layout a building has, as I initially expected, but whether it provides adequate privacy, comfort, and meeting space, and whether employees actually use it. That is a message with implications not just for the Police but for any large organisation navigating the transition to hybrid work.

F.2 Methodology

F.2.1 Working with secondary data from multiple sources

One of the defining methodological features of this study was the integration of three entirely separate data sources: occupancy measurements from Measuremen, WiT Monitor survey data from the Center for People and Buildings, and floor-plan data from the Netherlands Police Real Estate Department. Each source used different units of analysis, variable definitions, and grouping levels. Bringing them together into a coherent analytical framework required considerable time spent on data preparation, variable alignment, and understanding the assumptions embedded in each dataset.

Another challenge was that variables that seemed straightforward turned out to be more complex than expected. The workspace ratio, for example, is defined differently by the Police than by Ruiz de Castañeda Altuna (2025), whose framework was used as the primary analytical reference. The Police definition includes meeting-seat capacity in addition to individual workstations, which fundamentally changes what the workspace ratio measures and how it should be interpreted. Identifying and resolving this discrepancy required careful cross-checking between the dataset, the building documentation, and the theoretical framework.

Working with secondary data also meant accepting constraints that a primary data collection design would not have imposed. The Measuremen dataset was not designed specifically for this research, and some variables that would have been analytically useful, such as zone-level occupancy data or measures of task type, were simply not available. Learning to work productively within those constraints and to be transparent about them in the thesis was an important part of the research process.

F.2.2 Statistical analyses

Quantitative research and SPSS were entirely new to me when I began this project in November 2024. I had no prior experience with correlation analysis, analysis of variance, or multiple regression. The early weeks of the analytical phase were characterised by a great deal of trial and error, running analyses without fully understanding what the output meant, and then working backwards to understand the assumptions and logic behind each technique.

A specific methodological issue that emerged late in the analysis was multicollinearity: several of the satisfaction items I initially intended to use as predictors were also components of the OfficeEffectiveness composite, which was the dependent variable. Recognising and correcting this required restructuring part of the analysis, and it reinforced the importance of thinking carefully about the conceptual relationship between variables before running any analysis.

F.2.3 Structuring the thesis

Structuring a thesis that integrates multiple data sources, multiple analytical stages, and seven sub-questions was more complex than I had anticipated. The initial draft had the Methods chapter before the Literature Review, which created confusion about the basis for analytical decisions. Reorganising the chapter sequence, with Literature Review first, followed by Methods, Results, Discussion, and Conclusion, was a significant revision that improved the logical flow of the document.

The numbering of hypotheses was also confusing. With seven hypotheses distributed across five sections of the literature review and tested across four sections of the results, and ensuring that each hypothesis was clearly stated, tested, and discussed in the right place, required careful attention throughout the revision process.

F.2.4 The limited number of survey buildings

Perhaps the most fundamental methodological limitation of this study was that WiT Monitor survey data were available for only 3 of the 12 buildings in the occupancy dataset. This considerably constrained the statistical power of the building-level analyses and resulted in layout variables being statistically indistinguishable across the three survey buildings in most analyses. It also meant that the regression model, despite explaining a substantial proportion of variance in individual perceived effectiveness, could not be generalised to the full twelve-building portfolio.

DATA MANAGEMENT CHECKLIST

Instruction

This checklist is relevant for all graduation projects of the Master AUBS. The form is intended to highlight common aspects of graduation projects that require particular attention with regard to planning the research and data management. Relevant information and supplementary sources regarding each question are provided below each question.

With this checklist, the faculty wants to avoid that students unexpectedly find themselves in complex and stressful situations, in which ethical or privacy matters and/or other laws and regulations become an issue. In projects involving humans, certain types of data processing increase the risks to the human participants: planning such projects requires additional evaluations and advice from university staff before ethical approval can be received and the project can begin. In the case of a graduation project, obtaining additional advice or permits may delay the project with an extra education period or semester. To avoid this, it is recommended that students set up a graduation project with a low level of risk. Therefore, all students have to check their risk, by completing this checklist before their A1.

The first section of the checklist (A) should be completed by all students, together with their supervisor, during the planning of the graduation project, before the A1. It does not need to be submitted to anyone for review or approval. Please consider questions 1 to 3 carefully in relation to the intended graduation project, and answer with 'yes' or 'no'.

The second section of the checklist (B) should only be completed if the graduation project involves working with data from human participants. In that case, the student and their supervisor must apply for and receive ethical approval from the Human Research Ethics Committee (HREC) before the project can begin (see the paragraph 'Explanation and follow-up' after the questions). The student can submit the application to the HREC, but the supervisor is responsible for making sure that the project is compliant with relevant privacy regulations and ethical policies.

Section A. General considerations	yes	no
1. Is the graduation project conducted as part of an internship (at a company), or as part of a research project at TU Delft? If a student's graduation project is conducted at a company or as part of a research project at the university, questions of data ownership and intellectual property rights need to be addressed in a written graduation or internship agreement before the project begins. Students and their supervisor should consult the Intellectual Property Rights of Students webpage. Additional information can also be found in the Extended Personal Research Data Workflow.	✔	
2. Does the project involve conducting (part of) the research outside the Netherlands? Students who intend to travel abroad (even to other EU countries) for study, exchange, research, internship, or graduation project purposes need to follow the Travel Safety Protocol. This includes attending a mandatory Travel Safety Training Session: see the Disclaimer.		✔
3. Will the research involve processing data from humans, such as running a survey, conducting interviews or workshops, collecting data through social media or internet forums, or re-using existing datasets about humans provided by a third party? (If 'yes', see follow-up questions 4 to 13 in Checklist B.) Students who work with data from human participants must complete the next section and apply for and receive ethical approval from the Human Research Ethics Committee (HREC) before conducting the research.	✔	

Section B. Extended risk factors (only if question 3 has been answered with 'yes'.)	yes	no
4. Will the project involve participants who may be considered vulnerable, such as the elderly, refugees or asylum seekers, ethnic minorities, patients, or people with disabilities? Participants who may suffer very adverse consequences (for instance, due to discrimination) if their personal data became publicly available can be considered vulnerable.		✔
5. Will the project involve participants who cannot themselves give informed consent for taking part in the project, but for whom consent must be obtained from a legal guardian? Participants who cannot give informed consent can include, for instance, children or participants with intellectual disabilities, mental disorders, or dementia. Such participants are also considered vulnerable in the context of the General Data Protection Regulation (GDPR).		✔
6. Will the project involve processing any of the special categories of personal data below? - Race - Ethnicity - Criminal offence data - Political opinion - Union membership - Religious or philosophical beliefs - Sex life and/or sexual orientation - Health data (including measurements such as heart rate) - Biometric or genetic data (including fingerprints, iris scanning, facial recognition) The General Data Protection Regulation (GDPR) defines a stricter rules for processing special categories of personal data. If it is necessary to process these data in a project, it is it is important to provide additional safeguards.		✔
7. Will the project involve processing personal data that could be considered sensitive, such as the ones listed below? - Information about a person's income, debts, or other payments - Information about a person's (un-)employment status - Information about a person's performance at school or work - Information about relationship problems or (gambling) addiction - Information about poverty, domestic violence, or youth welfare/social work involvement Some types of personal data are considered sensitive, because they can have a high impact on the privacy of the data subject if other persons gain access to these data. Sensitive personal data should only be processed if necessary: in such cases, additional safeguards need to be put in place.		✔
8. Will the project involve processing video-recordings, or photographs of participants? TU Delft considers photographic and video-materials of research participants to be sensitive personal data. If such data need to be processed, additional safeguards must be put in place.		✔

Section B. Extended risk factors (only if question 3 has been answered with 'yes'.)	yes	no
9. Will the project involve sharing or transferring personal data between multiple partners or collaborating organisations involved, such as between TU Delft and an internship company? According to privacy law, sharing personal data between organisations requires a privacy agreement to be in place: setting this up takes time, and requires support from additional university staff. Furthermore, personal data sharing can potentially expose research participants to different types of risks: these risks must be considered in the ethical application.	✔	
10. Will the project involve deception, or covert observation of participants? In some types of research, obtaining informed consent for processing participants' personal data is not an option: for instance, if the research involves deception, or the research is covert (conducted without participants knowing about it). In such situations, the steps to mitigate risks to participants are important, and an alternative legal basis for processing the participant's data needs to be established with the help of additional support staff.		✔
11. Will the project involve working with social media data? Social media data are personal data, but since it is usually not possible to ask for informed consent for processing social media data, another legal basis for processing the participant's data needs to be established. Processing of social media data also involves legal considerations related to terms of use of data from third-party platforms: therefore, research with social media data requires expert support on privacy, ethics, and legal matters.		✔
12. Will the project involve using learning algorithms or other AI to analyse, combine, or otherwise process data from participants? The use of AI in research involves many considerations in terms of data protection, ethics, security, and intellectual property: for more information, see TU Delft's Instructions for use of Generative AI.		✔
13. Will the project involve participants who are based in a country or countries outside of the EU? Students affiliated with TU Delft must comply with Dutch and EU regulations of personal data processing (GDPR). Furthermore, the student and their supervisor must make sure that the research complies with local (privacy) legislations of any foreign destinations. Additional support from an external (local) expert may be required.		✔

Explanation and follow-up

If you have answered 'no' to all questions 4 to 13, your project is likely to be considered low or minimal-risk: see the paragraph 'Projects with minimal or low-risk' on the next page.

If you have answered 'yes' to one or more of the questions 4 to 13, your research likely involves extended or high risks to participants, according to the General Data Protection Regulation (GDPR) and TU Delft's privacy and ethical policies: for information regarding such projects, see the paragraph 'Projects with extended or high-risk' on the next pages.

Projects with minimal or low-risk

If you have answered 'no' to questions 4 to 13, your project is likely to be considered low-risk. This does not mean that the project involves no risks at all, but suggests that these risks can likely be addressed by the student and supervisor in the application to the Human Research Ethics Committee (HREC) within the timeline for a graduation project and without need for additional support.

Compiling the HREC application:
An application to the HREC generally involves a Data Management Plan (DMP), a risk-identification and mitigation checklist, and informed consent materials. Master's students at ABE who intend to compile a HREC application are advised to make use of the following support documents:

- the student guide
- the Example Data Management Plan for MSc projects

The graduation supervisor is responsible for the student's project and ethical application, and must provide support for compiling the HREC application documents.

Additional support
For low-risk student graduation projects, compiling of the HREC application documents should be done by the student in consultation with the supervisor. The Faculty Data Steward can be contacted for individual questions at datasteward-BK@tudelft.nl: however, the Data Steward does not provide detailed feedback on student DMPs for low-risk HREC applications.

Additional resources
The HREC has guides available for completing the checklist and for compiling informed consent materials. Additionally, the Guide to the Extended Personal Research Data Workflow has been created to help researchers and students who work with human participants comply with both GDPR principles and TU Delft's policies on Data Management and Human Research Ethics.

Timeline
Minimal or low-risk HREC applications are generally processed faster than extended or high-risk applications (see the paragraph below). Nevertheless, the initial evaluation by the HREC usually takes approximately 2 weeks, and may take longer during busy periods or holiday: see the HREC website for up-to-date information. Additionally, the application may require revisions before final approval is granted. If you do not receive an initial response about your ethical application after 4 weeks from the time of submission, you may follow up with the HREC to enquire about an update.

Projects with extended or high-risk

If you have answered 'yes' to one or more of questions 4 to 13, there are potential increased risks related to how data from human participants will be processed in your project. These risks will need to be addressed in consultation with the Data Steward and other relevant support staff before submitting the ethical application to the Human Research Ethics Committee (HREC).

Compiling the HREC application
An application to the HREC generally involves a Data Management Plan (DMP), a risk-identification and mitigation checklist, and informed consent materials. Master's students at ABE who intend to compile a HREC application are advised to make use of the following support documents:

- the Ethical Approval & Data Management Planning Student Information
- the Example Data Management Plan for MSc projects

The graduation supervisor is responsible for the student's project and ethical application, and must provide support for compiling the HREC application documents.

Additional support
Once the DMP has been compiled and reviewed by the supervisor, feedback should be requested from the Data Steward via DMPonline. After this, any other necessary support staff will need to be contacted. Crucially, if the project involves one or multiple ways of personal data processing that could result in high-risk to the participants according to the GDPR, the TU Delft Privacy Team must be consulted to establish whether or not a Data Protection Impact Assessment (DPIA) is required.

Additional resources
The HREC has guides available for completing the checklist and for compiling informed consent materials. Additionally, the Guide to the Extended Personal Research Data Workflow has been created to help researchers and students who work with human participants comply with both GDPR principles and TU Delft's policies on Data Management and Human Research Ethics.

Timeline
It can take a long time to compile a complete research plan and HREC application for projects involving extended risks. DMP feedback from the Data Steward usually takes around 2 weeks, but can take longer during busy periods or holidays. Receiving additional support from other staff, such as the Privacy Team, can take anywhere from a few days to multiple weeks, depending on the project and capacity of university staff. If a DPIA is deemed necessary, it can take anywhere from 4 weeks to several months.

It is important to note that advice from the Privacy Team or other support staff, as well as any additional documents (such as necessary contracts, or a DPIA, if needed) must be in place before the application is submitted to the HREC. The initial evaluation by the HREC can be processed in 2 weeks, but may take longer during busy periods or holidays: see the HREC website for up-to-date information. Additionally, the application may require revisions before final approval is granted. If you do not receive an initial response about your ethical application after 4 weeks from the time of submission, you may follow up with the HREC to enquire about an update.

Considering the limited time available for students conducting their graduation projects, students working with data from human participants are strongly advised to prioritise low-risk research projects. If a student project necessitates processing data in ways that are considered extended or high-risk, both student and supervisor need to be aware of the extended processing times involved in obtaining ethical approval and beginning the graduation project.