THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

THE QUEST FOR THE ROOM OF REQUIREMENT

WHY SOME ACTIVITY-BASED FLEXIBLE OFFICES WORK WHILE OTHERS DO NOT

MARAL BABAPOUR

CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Industrial and Materials Science
Division Design & Human Factors
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2019

The Quest for the Room of Requirement –
Why Some Activity-based Flexible Offices Work While Others Do Not
MARAL BABAPOUR
ISBN: 978-91-7905-109-9

Doktorsavhandlingar vid Chalmers tekniska högskola.
Serie nr 4576
ISSN 0346-718X

Published and distributed by
Department of Industrial and Materials Science
Division Design & Human Factors
Chalmers University of Technology
SE-412 96, Gothenburg, Sweden
Telephone +46(0)31-772 1000

All photographs and illustrations by Maral Babapour (except for the original architectural drawings).

Cover by Mikael Johansson

Printed by Chalmers Reproservice
Gothenburg, Sweden 2019

ABSTRACT

The overarching purpose of this thesis is to develop further knowledge of the consequences of relocating to Activity-based Flexible Offices (AFOs). As workspace design innovations, AFOs are increasingly implemented in organisations. AFOs comprise a variety of workspaces for employees to choose from depending on their preferences or activities. Workspaces in AFOs are shared, instead of every employee having their own desk. Research results are inconsistent regarding employee satisfaction with AFOs, and research into employees' appropriation of AFOs and organisations' processes of adopting AFOs is sparse. In response to these knowledge gaps, the thesis aims to explain why some AFOs work while others do not.

The thesis builds on five case studies: (i) three cases with recently implemented AFOs, and (ii) two cases with AFOs implemented at least two years prior to the study. Data collection in all the case studies involved semi-structured interviews with employees and facility managers, observations and collection of secondary data such as process overviews, and layout drawings. For data collection and analysis, a theoretical framework was developed and used consisting of Activity Theory, artefact ecology, as well as theories of innovation adoption and appropriation.

The findings show that individuals' usage of AFOs varies considerably due to personal circumstances and work-related preconditions. Drawing on Activity Theory, three types of matches/mismatches were identified in employees' activity systems: Employee ↔ AFO, Activity ↔ AFO, and Employee ↔ Activity. Furthermore, individuals' usage preferences and non-preferences highlighted sub-optimal design features in the AFOs: (a) ambiguity and insufficient communication of rules; (b) undesirable ambient features; (c) exposure to stimuli; (d) difficult to interpret workspaces; and (e) dysfunctionality and insufficiency of the collective instruments. In summary, AFOs work in the absence of mismatches related to individuals' personal and work-related preconditions and sub-optimal design features.

The employees' processes of appropriating AFOs involved first encounters, exploration, and stable phases, during which various types of adaptations occurred: (i) on an individual level: acquired insights, and behavioural, social and hedonic adaptations, as well as (ii) in the AFO solutions: rule-related, spatial and instrument adaptations. Furthermore, the AFO adoption process in organisations varied considerably. Procedural shortcomings during the planning process led to a limited understanding of AFO users and thus the sub-optimal AFO designs, while shortcomings during the routinising stage involved restrictions on making post-relocation improvements in AFOs and inadequate Occupational Health & Safety management.

To conclude, AFOs work provided (i) they match individuals' personal circumstances and work-related preconditions; (ii) they facilitate flexibility and shared use of spaces through well-designed rules, workspaces and instruments; (iii) individuals' appropriation processes reach a stable phase where mismatches are resolved and fruitful symbiosis is achieved in their activity systems; and (iv) the organisations' process of adopting AFOs is successful both during the planning and the post-relocation routinising stages, leading to a collective sense of ownership among employees.

Keywords: Activity-based working (ABW); Activity Theory; Appropriation and adoption of innovations; Occupational Health & Safety (OHS); Office ergonomics; Process evaluation; Workspace design.

PREFACE

The term 'Room of Requirement' is borrowed from Harry Potter's Hogwarts; a room in the school that changes according to what people need and wish for. To open the room, the users had to walk three times past an area with a hidden door, thinking of what they needed. The door to the room would then appear, and the room would be equipped with artefacts that the user needed. For example, if the user needed a place to study, walked past the area of the door three times thinking, *"I need a place to study"*, then the door would appear for the user to enter and find everything necessary for studying, such as books, desks, chairs, bookshelves and so on. The room took on a variety of shapes and was used for various purposes by single or multiple users; it was everything from a hiding place to a meeting place.

Per definition, Activity-based Flexible Offices (AFOs) resemble the 'Room of Requirement', in that they provide a variety of workspaces for employees to choose from depending on their activities or preferences. In other words, the intention behind implementing AFOs is to make a 'Room of Requirement' that is equipped for people depending on what they need. The difference is that AFOs comprise rooms that are already equipped and do not necessarily change to conform to whatever the employees need them to be. Nonetheless, just like with the 'Room of Requirements', office employees are required to search through the various office areas in the quest for a workspace.

Organisations that implement or contemplate implementing AFOs also go on a quest to find optimal real-estate solutions that can help them realise strategic goals such as increased collaboration, productivity and work environment satisfaction, as well as reduced occupancy costs and energy consumption.

My quest in the course of this research has been to understand the impacts of the transition from traditional offices to AFOs, from having own desks to sharing workspaces. Based on five case studies, the work presented in this thesis examines how well implementations of AFOs succeed in providing rooms of requirement and meeting employees' needs.

ACKNOWLEDGEMENTS

It takes a village to raise a thesis! I was fortunate to be surrounded by a supportive, encouraging, and inspiring community throughout the years of research that led to this thesis. First and foremost, I wish to express my deepest gratitude to my examiner and supervisors. MariAnne Karlsson, you have my warmest thanks for giving constructive feedback from early drafts to the last versions of this thesis. You have been a great source of inspiration throughout my studies, and I am glad to have had the opportunity to develop as a researcher under your guidance. Anna-Lisa Osvalder, you were a truly positive and supportive supervisor and encouraged me in everything I did. Thank you! I am glad to have been given the opportunity to grow as an independent researcher. My co-supervisor, Oskar Rexfelt, thank you for enduring all the turns that my PhD studies took. I greatly appreciate your endless support in everything from kneading my data to reading and re-reading my thesis. You also reminded me to have fun, and if this was a computer game, I would exit with a GG.

There is one person who sadly left this 'village' too soon. His contributions to my development in the early years of my PhD studies were invaluable and words fail me in adequately describing my gratitude to him. Viktor Hiort af Ornäs, rest in peace!

I wish to express my gratitude to the individuals who volunteered to participate in my studies, and who dedicated time and generously shared their insights and experiences about working in Activity-based Flexible Offices. Writing this thesis would not have been possible without you. Thank you!

I am also grateful for the inspiring atmosphere at the Division Design & Human Factors that kept my spirits high during my studies. To my current and former colleagues at the division I want to say that I have truly cherished your company, openness, expertise, and humour. I am indebted to a number of colleagues for their advice and support, and to the strong sisterhood I enjoyed over the years: Anneli Selvefors, Eva Simonsen, Ingrid Pettersson, Isabel Ordoñez, Helen Strömberg, Sara Renström and Siw Eriksson. Your support was invaluable for getting me through the many ups and downs of this endeavour. Thank you for everything! Furthermore, I would like to thank some relative newcomers to the division who cheered me up in the final phases: Antonio Cobadela, Cecilia Berlin, Fjölle Novakazi, Fredrik Ekman, Göran Smith, Jana Sochor, and Mikael Johansson. I am also grateful for all the events and the fruitful courses at the Human-Technology-Design research school, that gave me a sense of direction during my studies. Lars-Ola Bligård and Oskar Rexfelt, your joint effort in running the the school is exemplary. And special thanks to Håkan Almius, Johan Heinerud, Pontus Wallgren and Sanna Dahlman for compassionate discussions about boats, bikes, mountains, form & colour, materials, and even surface modelling. Thanks also to Ulrike Rahe for providing support in the early phases of my PhD studies.

My co-authors had a crucial role in my development as a researcher. Linda Rolfö, thank you for your generosity in sharing your work, thoughts, data, contacts, seminars and course materials. You gave me a superpower, and that was the power to simultaneously be in different places and expand my learning experiences – and also to cross the toughest line! Antonio Cobadela, I am so happy to have found a partner in crime at the division. Thank you for including me in your work. I truly

enjoyed our collaboration. Finally, I wish to express my gratitude to Mette Harder and Christina Bodin Danielsson, two co-authors who generously shared with me their perspectives and expertise so that I could understand the world from the viewpoint of the architect. Thank you all! I look forward to our future collaborations.

During the last phase of bringing this thesis together, I received invaluable feedback from Marie Strid at the division of Building Design at Chalmers. Thank you for an inspiring and constructive discussion of my thesis. I would like also to thank Jonserendsstiftelsen for providing a grant that allowed me to stay at the beautiful Villa Martinson and work on this thesis. I also wish to thank Mikael Johansson for the greatest cover design I could ever imagine, and Ilya Meyer for his rigorous language editing.

A very special thanks to my friends, including some of my colleagues, for all the climbing and craft sessions, game nights, and forest runs. I am back, with my A-game. But first, let's go out for a drink!

Finally, none of this would have been possible without the support of my family. Mom, dad and my only best sister in the world, Maryam, thank you for continuing to call me and send me motivational messages even when I did not have time to answer your calls. Above all, I am indebted to my partner for standing by me during every single day of my struggles and successes, and for contributing to my general wellbeing with lunch dates, late-night tea and snacks. Thank you, Kashif!

Maral Babapour | Gothenburg | March 2019

APPENDED PAPERS

Paper One

Babapour, M., Karlsson, M. A., & Osvalder, A. L. (2018). Appropriation of an Activity-based Flexible Office in daily work. *Nordic Journal of Working Life Studies, 8* (Special issue 3), 71-94. doi:10.18291/njwls.v8iS3.105277

Contribution: Babapour planned the study, and collected and analysed the data. Babapour wrote the paper with feedback from Karlsson and Osvalder.

Paper Two

Babapour, M., Rolfö, L. (2019). Policies in Activity-based Flexible Offices -'I am sloppy with clean-desking. We don't really know the rules.' *Ergonomics*. doi:10.1080/00140139.2018.1516805

Contribution: Babapour and Rolfö planned the studies, and collected the data (Jointly: Case 1, Rolfö: Case 2-3, and Babapour: Case 4). Analyses, writing and editing of the paper were carried out in collaboration between the authors.

Paper Three

Babapour, M., Harder, M., & Bodin Danielsson, C. (under review). Users' workspace preferences in Activity-based Flexible Offices – lessons learned from two case studies. *Submitted to Applied Ergonomics on 20-March-2019*.

Contribution: Babapour and Harder planned the studies and collected the data (Case 1: Harder, Case 2: Babapour). Analyses were carried out in collaboration between the authors, where Babapour did the main work. She wrote the manuscript with feedback from Harder and Bodin Danielsson.

Paper Four

Babapour, M. (under review). Co-adapting with Office Alterations – Resolving Mismatches between Employees' Work and Activity-based Flexible Offices. *Submitted to Theoretical Issues in Ergonomics Science* on 20-June-2018.

Contribution: Babapour planned the studies, collected and analysed the data, and wrote the manuscript.

Paper Five

Babapour, M. (under review). From Fading Novelty Effects to Emergent Appreciation of Activity-based Flexible Offices in two case organisations – A comparison of adaptations after relocation. *Submitted to Applied Ergonomics on 16-Oct-2018*.

Contribution: Babapour planned the studies, collected and analysed the data, and wrote the manuscript.

ADDITIONAL PUBLICATIONS

The following publications are related to the topic of work environment in office spaces, but not appended in the thesis.

Babapour, M. & Osvalder, A. L. (2017). Use profiles in Activity-based Flexible Offices – A case study. *In:* Proceedings of the Nordic Ergonomics Society Conference (NES2017). Lund, Sweden.

Rolfö, L. & Babapour, M. (2017). Policies for sharing workspaces in Activity-based Flex Offices. *In:* Proceedings of ACE-ODAM 2017 – 48th Annual Conference of the Association of Canadian Ergonomists, Banff, Alberta, Canada.

Cobaleda Cordero, A. & Babapour, M. (2017) Discrepancies between intended and actual use in Activity-based Flexible Offices – A literature review. *In:* Proceedings of the Nordic Ergonomics Society Conference (NES2017). Lund, Sweden.

Rolfö, L., Jahncke, H., Järvholm, L. S., Öhrn, M. & Babapour, M. (2019). Predictors of Preference for the Activity-based Flexible Office. *In:* Proceedings of the 1st International Conference on Human Systems Engineering and Design (IHSED2018). Reims Champagne-Ardenne, France.

Cobaleda Cordero, A., Babapour, M. & Karlsson, M. A. (Accepted) Feel well and do well at work – A post-relocation study on the relationships between employee wellbeing and office landscape. *Journal of Corporate Real Estate.*

TERMINOLOGY

Some of the terms in this thesis are used in a specific way, referring to theoretical concepts or typology of workspaces. They are defined when introduced in the text.

Activity-based Flexible Office (AFO)	A type of office design that provides a variety of workspaces to be shared among employees, instead of having own workstations.
Activity	A collection of goal-oriented actions and routinised operations of an individual or a group for achieving a desired outcome, mediated through purposeful interaction with surrounding artefacts.
Appropriation	Ways in which artefacts are acquired, shaped and then used in everyday life.
Adaptations	Ways in which elements of an activity system adjust to new circumstances
Artefact	Material or immaterial manmade things, aka instruments in this thesis.
Artefact ecology	Usage of several artefacts within the same work situation.
Innovation	Material or immaterial artefact that is perceived as new by an individual or organisation.
Interdependency	Reciprocal relations or interplays between two or more elements of a system that are mutually reliant on one other.
Occupational Health & Safety (OHS)	Management practices for fostering a healthy and safe work environment.
Precondition	A predefined condition in the activity system that relates to personal or work-related circumstances.
Preference	Individuals' evaluative judgements in the sense of liking or disliking something over something else.
Symbiosis	A state that describes the stable phase of appropriation of an innovation that occurs over time through adaptations in individuals' activity systems.
Use	Deploying something as a means of achieving a purpose. In this thesis, use refers to instances of deploying something while usage refers to more common use.

Typology of workspaces in AFOs

Active zones	Workspaces with an open-plan character that provided fully-equipped workstations intended for both solitary and collaborative work.
Break-out spaces	Spaces designed for informal meetings or recreational activities.
Meeting rooms	Enclosed spaces intended for meetings.
Open zones	An umbrella term for workspaces with an open-plan character.
Open meeting spaces	Workspaces intended for meetings or project work located in open zones.
Quiet zones	Workspaces intended for concentrative and solitary work that accommodate more than three employees. Quiet zones have different characters ranging from open to semi-enclosed and enclosed spaces. The common denominator is provision of fully-equipped workstations and the application of a quiet speech policy.
Semi-quiet zone	Workspaces intended for concentrative and solitary work but allowing some interruptions. Semi-quiet zones provide fully-equipped workstations for more than three employees, and have open or semi-enclosed characters.
Touch-down spaces	Workspaces intended for short-duration use.
Walk-in rooms	Individual rooms intended for solitary or side-by-side work. Walk-in rooms are used on a first-come-first-served basis and cannot be booked in advance.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

In the biannual Swedish work environment reports, Activity-based Flexible Offices* (AFOs) appeared as an office type for the first time in 2015, and the proportion of office workers in AFOs had already risen to 15% in 2017 (Arbetsmiljöverket, 2016; 2018). Organisations worldwide increasingly implement AFOs in the hope of realising strategic goals such as increased collaborations, productivity and work environment satisfaction, as well as reduced occupancy costs and energy consumption (e.g. Appel-Meulenbroek et al., 2011; Kim et al., 2016; van der Voordt, 2004; Wohlers & Hertel, 2016). AFOs are seen to enable achievement of such goals by introducing new ways of exploiting workspaces, specifically in terms of collaborative use of office environments, shared between individuals and teams with different backgrounds within the same or different organisations.

Per definition, AFOs are innovations in design of offices that provide a variety of workspaces for employees to choose from depending on their activities or preferences (Appel-Meulenbroek et al., 2011; Wohlers & Hertel, 2016). One distinguishing feature of AFOs is the sharing of workspaces (Wohlers & Hertel, 2016). AFOs are typically dimensioned for 70% of the workforce (Bodin Danielsson & Bodin, 2008). The design of AFOs varies (Bodin Danielsson & Bodin, 2008), but they normally have an open character (De Been & Beijer, 2014) to support conversation and collaboration, with additional semi-open work locations and enclosed back-out spaces for concentrated work, informal and formal meetings and private phone calls (Bodin Danielsson & Bodin, 2008; Wohlers & Hertel, 2016). One significant difference between AFOs and other common types of offices** (e.g. Cell- and Open-Plan Offices) is the desk-sharing

* Various terms are used to refer to AFOs with somewhat different delineations: Activity-Based Workplace/Working (ABW), Activity-Based Office (ABO), Activity oriented office, New Ways of Working (NWW), multispace office, non-territorial office, open space flexible office, flex officeand hot-desking office (and in Swedish: aktivitestbaserade kontor, aktivitestbaserade arbetssätt, or verksamhetsanpassat kontor). In this thesis, Activity-based Flexible Offices (AFO) refers to office solutions with a desk-sharing policy that provide a variety of workspaces to be shared among employees.

** Office solutions can be divided into different types: cell offices and individual rooms; shared offices for 2-3 employees; small, medium, or large open-plan offices; as well as flex and combi offices (Bodin Danielsson & Bodin, 2008). Activity-based Flexible Offices (AFOs) are a subcategory of flex offices.

policy (aka. clean-desking/hot-desking), introduced to mediate collaborative use of workspaces, facilitate rotation of individuals and teams, and ensure workstation availability. The desk-sharing policy, according to Knight and Haslam (2010), entails using workstations on a first-come-first-served basis and requires the employees to leave a clean and undecorated desk behind after use.

Relocation to AFOs often involves moving from other office types where employees have individual workstations, thereby introducing changes in the employees' work environment. One major change is the transition from having one's own workstation to the collaborative use of workstations, mediated by the introduction of the desk-sharing policy. Another change is the provision of a variety of spaces that the employees may not have had access to in their prior workspaces such as quiet zones, break-out spaces, touch-down spaces or open meeting spaces. These changes are to be adopted by employees and integrated into their existing work contexts in order to achieve the strategic goals which organisations hope to achieve by implementing AFOs. However, there seems to be a discrepancy between employees' usage of AFOs and the expected behaviours with regard to the desk-sharing concept (Appel-Meulenbroek et al., 2011; Elsbach, 2003; Hirst, 2011; Tagliaro & Ciaramella, 2016). For example, 70% of respondents in a post-occupancy evaluation study across seven organisations report that they switched workstations 1-2 times a week or less, while 4% frequently switched workstations on a daily basis (Hoendervanger et al., 2016). This indicates that individuals may have different work environments in AFOs depending on their usage preferences, which has not been addressed in the literature on AFOs. A recent literature review by Engelen and colleagues-(2019) showed that research results are ambiguous in terms of employee satisfaction with AFOs and contradictory in terms of the consequences of relocating to AFOs for employees' work and work environment.

The *overarching purpose* of this thesis is to develop further knowledge of the consequences of relocating to AFOs in terms of employees' work and work environments, and to explain why some AFOs work while others do not, by addressing interdependencies between employees, their work and AFO solutions.

1.1. Previous Research and Knowledge Gaps

Despite perceived general benefits of AFOs, such as increased flexibility and cost-reductions (e.g. Appel-Meulenbroek et al., 2011; Kim et al., 2016; van der Voordt, 2004; Wohlers & Hertel, 2016), research results are conflicting regarding employees' workplace satisfaction and self-reported performance (see literature review by Engelen et al., 2019). While some studies found increased workplace satisfaction in AFOs due to the ability to choose a workstation according to personal preferences and task-related needs (e.g. Bodin Danielsson & Bodin, 2008; Seddigh et al., 2014), others reported dissatisfaction due to having unassigned workstations and lack of privacy (e.g. Morrison & Macky, 2017; van der Voordt, 2004). Furthermore, general functionality of spaces was found satisfactory in some studies (e.g. De Been & Beijer, 2014; van der Voordt, 2004). In contrast, other studies showed either no effects on perception of workspace functionality (Brunia et al., 2016; De Been & Beijer, 2014; Gorgievski et al., 2010), or dissatisfaction with specific functions such as insufficient storage (Kim et al., 2016). Therefore, ambiguities remain in

explaining why some organisations succeed in implementing AFOs that lead to employee satisfaction while other do not.

Research results are also inconsistent regarding whether AFOs support employees' solitary and collaborative activities. For example, some studies showed that AFOs entail increased distractions and thereby impede solitary and concentrative work (Appel-Meulenbroek et al., 2011; Brunia et al., 2016; De Been & Beijer, 2014), while others identified positive effects on concentrative work (e.g. van der Voordt, 2004). Cross-sectional studies that compare different office types have also shown that employees in offices with desk-sharing principle are least satisfied with access to supportive facilities (in comparison with other office designs), specifically in terms of spaces for concentrated work (Bodin Danielsson & Theorell, 2018). Furthermore, in some studies the implementation of AFO solutions led to improved communication and increased collaboration (e.g. Boutellier et al., 2008; van der Voordt, 2004; Vos & van der Voordt, 2002), while it entailed decreased communication between employees in other studies (De Been & Beijer, 2014; Kim et al., 2016). The inconsistencies in research results on outcomes of the implementation of AFOs indicate significant discrepancies between cases. Specifically, contextual discrepancies between organisations implementing AFOs, such as design specificities of the AFOs or the organisational processes for adopting AFOs, remain ambiguous. Part of the explanation could be that most of the research outlined above is based on surveys and contextualised studies are scarce (exceptions are Elsbach, 2003; Hirst, 2011). This calls for more in-depth contextualised studies of AFOs to explain why AFO implementations succeed and/or fail in supporting employees' work.

To address the inconsistent research results outlined above, four themes for investigation were identified to further understand the discrepancies in the implementation and outcome of AFOs, and to explain why some organisations succeed in implementing AFOs that lead to employee satisfaction while other do not. These themes specifically focus on contextual differences in AFO implementations: (i) interdependencies between AFOs and employees with diverging needs, activities and preferences, (ii) the role of design specifies in AFOs, (iii) temporality of employees' appropriation of AFOs, and (iv) process-related factors regarding planning and adaptations. These themes are motivated in the following sections, drawing on the existing literature.

1.1.1. Interdependencies

Relocation to AFOs involve changes in the workspaces for employees such as (i) provision of a variety of spaces that they may not have had access to earlier such as quiet spaces, open meeting areas, or break-out or touch-down spaces, (ii) collaborative use of these spaces mediated by desk-sharing rules rather than having own workstations, and (iii) alterations in work instruments* such as new information and communication technologies or toolboxes for carrying things and digitalisation of archives. However, studies of AFOs report discrepancies between intended and actual use of AFOs. As outlined above, it has been found that employees do not switch workstations (Appel-Meulenbroek et al., 2011; Hoendervanger et al., 2016;

* Instruments refer to material or immaterial artefacts that employees use in their daily work.

Tagliaro & Ciaramella, 2016), or tend to claim and make sure they use the same workstations by leaving things behind (Elsbach, 2003; Hirst, 2011). Such territorial behaviours are however associated with decreased employee performance and workplace satisfaction (Brunia & Hartjes-Gosselink, 2009; Hoendervanger et al., 2016). Misuse of AFOs is also identified in previous studies, for instance quiet zones that are not used for concentrative work (Appel-Meulenbroek et al., 2018), or marking group areas (Tagliaro & Ciaramella, 2016). The deviation from expected use indicates that employees either do not choose workstations that match their activities* or have activities that do not require different kinds of workspaces. These differences in use may partly explain the conflicts in research results for perceived performance and satisfaction with AFOs. Hence, more research is necessary to provide elaborations of particular use situations, the types of workspaces that are preferred and/or claimed by employees, the reasons behind employees' workspace choices and their deviation from expected use. To understand the conflicting research results regarding employees' satisfaction with AFOs and their impact on employees' performance, it is important to address interdependencies between employees' preferences, their activities and workspace choices. This leads to the first research question:

RQ1. What (if any) are the interdependencies between employee(s), their activities, and AFOs, and how do these interdependencies impact employees' satisfaction with AFOs?

1.1.2. The role of design in AFOs

Models that are proposed for understanding AFO impact on employees' work conditions highlight design features such as the openness of the spaces (Wohlers & Hertel, 2016); or layout and space ratios, that is to say the number of different spaces available per employee (Rolfö, 2018a). In addition, spatial diversity has been highlighted to contribute to satisfaction with AFOs (Brunia et al., 2016). Other conceptual models for understanding office environments' impacts on employees' health and performance highlight openness and distance between workspaces as important elements of the office layout (De Croon et al., 2005). While all these features are important in AFOs, they address design of AFOs on a macro level and little attention is paid to the different types of workstations and their design on a micro level, such as the choices of chairs, screens, and other standard instruments. Approaches for addressing design of AFOs on both macro and micro levels may help further explain the mixed findings on outcomes of implementing AFOs such as employee satisfaction and perceived performance.

Design is here defined as outcomes of a problem-solving process that involves *"changing existing situations into preferred ones"* by searching through numerous possibilities in the environment (Simon, 1988), and producing material or immaterial

* The term 'Activity' is used in a specific way in the thesis, drawing on Activity Theory. It refers to a collection of goal-oriented actions and routinised operations of an individual or group for achieving a desired outcome, mediated through a purposeful interaction with surrounding artefacts (See Chapter 2 for further elaborations).

products, services or systems. In implementation of AFOs, workspace design involves changing (or moving from) an existing office environment, where employees often have their own workstations and artefacts. Therefore, the design of AFOs encompasses new rules for sharing workspaces, spatial features and technological artefacts integrated into the office environment.

Workspace design (including AFOs) refers to the design of spatial and technological dimensions of a workplace in accord with organisational and financial dimensions (cf. Seim & Broberg, 2010). In the context of AFOs, the design of spatial and technological dimensions is a response to organisational and financial dimensions present in a workplace. Nonetheless, to arrive at a good design solution, various demands of different stakeholders have to be reconciled into a coherent whole (Lawson & Dorst, 2009). In the design of AFOs, the needs and requirements of employees with different roles and responsibilities, as well as line managers and facility managers should be taken into consideration.

Thus, identifying design-related features in AFOs that support and/or impede employees' activities may further explain employee dis/satisfaction and establish whether the design of AFOs meets the needs of employees. The second research question addresses the role that design plays in implementation of AFOs:

RQ2. How does the design of AFOs influence employee satisfaction?

1.1.3. Employees' appropriation of AFOs

Most of the studies on AFOs are carried out between three to nine months post-relocation and thereby report on short-term consequences of AFO implementations (e.g. Gerdenitsch et al., 2017; Rolfö et al., 2018; Rolfö, 2018b). A few studies address the long-term consequences of relocating to AFOs, but yield different results regarding employees' workspace satisfaction and perceived performance in AFOs over time. They range from an increase in perceived performance (Meijer et al., 2009) and satisfaction (Ekstrand & Hansen, 2016), and productivity (Mosselman et al., 2010) to a gradual decrease in satisfaction (Gerdenitsch et al., 2017). Research is sparse regarding why and how employees' perceived performance and workplace satisfaction increases or decreases over time. Exceptions are Ekstrand and Hansen (2016) who suggest that improving the concept and acclimatisation may resolve the initial challenges and reported negative impacts of AFOs, and Gerdenitsch and colleagues (2017) who argue that the decrease in perceived benefits is due to fading novelty effects. The way employees acclimatise to AFOs, appropriate* the innovations in their office environment, and resolve the initial work environment challenges over time remains unclear in the literature. Thus, more research is necessary to understand how employees deal with work environment challenges in AFOs, and why employees' perceived performance and workplace satisfaction may increase or decrease over time. Hence, the third research question addresses employees' appropriation of AFOs:

RQ3. How do employees appropriate AFO solutions?

* Appropriation refers to ways in which innovations are adopted, shaped according to one's preferences and then integrated and used in everyday life (See Chapter 2 for further elaborations).

1.1.4. Planning and adaptation process

The process of implementation of AFOs varies across cases (Bjerrum & Bødker, 2003). A typical AFO implementation lacks process and investigation of tasks, and applies a general concept solution (ibid.). According to consultants from Veldhoen + Company, one of the leading consultancies in implementing AFOs worldwide, the implementation process involves different phases before and after relocation such as (i) defining organisational goals and ambitions for the implementation, (ii) design, procurement and realisation, (iii) advising and coaching the new work style, and (iv) monitoring and evaluating the new work environment followed by further developments (van Koetsveld & Kamperman, 2011). However, research is limited regarding planning process-related factors and their impact on the outcomes of AFOs. Exceptions are Rolfö (2018b) and Brunia and colleagues (2016) who emphasise user involvement in the design process of AFOs and its significance for successful implementation of AFOs. Further research is required to understand process factors in the planning of AFOs, specifically in terms of innovation adoption processes in organisations and their impact on employee satisfaction.

Post-relocation processes of adopting AFOs, such as supervision (Brunia et al., 2016), training (Robertson et al., 2008) and adjustments to standardised AFO solutions (Ekstrand & Hansen, 2016), are suggested for getting employees to use the premises as expected, assist employees in dealing with ergonomic problems and make the AFO concept work. Morrison & Macky (2017) have highlighted the importance of having continuous evaluations to assess whether AFOs are the right match for organisations, and whether they are implemented in an appropriate manner. However, little research is available on post-relocation measures and adaptations for identifying and resolving work environment problems and disturbances that emerge after relocation to AFOs.

A need to investigate the role of implementation process and management of AFOs for reaching the desired outcomes has been highlighted by Gerdenitsch and colleagues (2017). The planning and adaptation process may influence the employee-AFO relationship. This relationship may be fruitful, provided the employees reach a phase in their appropriation of the AFO where they experience minimal work environment problems. Reaching a fruitful symbiosis allows employees to focus on their work at hand, rather than the work environment problems, thus improving their productivity. Therefore, the fourth research question concerns process-related factors to understand how work environment problems can be reduced and resolved in practice prior to and after relocation to AFOs:

RQ4. What (if any) process-related aspects influence employees' satisfaction with AFOs?

1.2. Aims and Research Questions

To address the identified gaps in the literature, it is here suggested that more in-depth contextualised studies of AFOs are required. These studies should help identify the reasons behind the mixed findings on the outcomes of implementing AFOs, showing when and why their implementation succeeds and/or fails to support employees' work, thus improving the work environment.

The overarching purpose of this thesis is to develop further knowledge of the consequences of relocating to AFOs in terms of employees' work and work environments, and to explain why some AFOs work while others do not. The aims of the work in this thesis are to: (i) contribute new insights to the research community and practitioners on the consequences of relocating to AFOs by addressing interdependencies between employees, their activities and the AFOs, (ii) provide further understanding of the role of design and its impact on employee satisfaction with AFOs, (iii) provide knowledge of individuals' processes of appropriating AFOs over time, (iv) identify success factors in the organisations' processes of adopting of AFOs from planning to management of work environment issues post-relocation, both for practitioners and organisations who want to implement or have implemented AFOs, and finally, (v) develop tentative design and planning guidelines for practitioners and organisations contemplating implementation of AFOs. Consequently, four research questions were posed based on the identified gaps in previous research:

RQ1. What (if any) are the interdependencies between employee(s), their activities, and AFOs, and how do these interdependencies impact employees' satisfaction with AFOs?

RQ2. How does the design of AFOs influence employee satisfaction?

RQ3. How do employees appropriate AFO solutions?

RQ4. What (if any) process-related aspects influence employees' satisfaction with AFOs?

The first research question is both descriptive and explanatory; seeking to (i) describe interrelations and patterns between employee(s), work activities, and AFOs, and (ii) explain the design-related aspects that support employees' work and improve their work environment in AFOs. RQ2 aims to explain the role that design has for reaching employees' satisfaction with AFOs. RQ 3 is of a descriptive nature, describing and mapping the appropriation process. RQ4 has an explanatory character, addressing success and failure factors in the planning and adaptation process.

1.3. Thesis Structure

The Introduction (Chapter 1) is followed by the Theoretical Framework (Chapter 2) consisting of Activity Theory, Artefact Ecology, and theories of adoption of technological innovations. The research approach is presented in Chapter 3. A summary of each of the five case studies is presented in Chapter 4. The results from a cross-case analysis are put together in Findings (Chapter 5) to answer the research questions. Chapter 6 provides a discussion of the results and research approach, followed by a summary of contributions (Chapter 7). Lastly, five publications are appended at the end of the thesis.

The thesis should be read as a monograph. Each of the case studies included in the thesis is summarised independently of the appended papers, to allow for a synthesis and cross-case comparisons.

CHAPTER 2
THEORETICAL STARTING POINT

The research in this thesis is positioned in the field of user-oriented design and development of technical products, services or systems. Guided by this tradition, the theoretical framework adopted to address the research questions of the thesis involves an Activity Theoretical perspective. In this view, employees are regarded as users, and AFOs are regarded as a technical system consisting of multiple artefacts, such as new furniture, collectively used mouses and keyboards, and digital applications, which are introduced and provided for office users post-relocation. The new artefacts are to be chosen, appropriated, and used with other artefacts (such as laptops and mobile phones) that the users or the organisation bring from their former premises, building together users' artefact ecologies. This chapter explains the theoretical framework.

2.1. Activity Theory Perspective

In this thesis, Activity Theory is used as a socio-technical systems perspective for understanding ways in which AFOs may support or impede employees' work activities over time. Activity Theory refers to the cultural-historical school of Russian psychology developed by Vygotsky and Leont'ev in the 1920s and 1930s (Engeström et al., 1999). This section elaborates on the definition and elements of an activity from an Activity Theoretical perspective.

Activity, from an Activity Theoretical perspective, is defined as a purposeful interaction of individuals with their surroundings, and is the key source for individuals' development (Kaptelinin & Nardi, 2006). The concept of activity as a unit of analysis has three constituents: individual subject, object of the activity, and mediating artefacts* (see Figure 2.1). The individual subjects direct their doings towards an object; this involves transforming the object into an outcome. The object

* Artefacts encompass a wide range of material and immaterial things that may support individuals in their everyday activties. Examples are tools, signs, procedures, machines, methods, laws, or forms of work organisation. Scholars use different terms for referring to mediating artefacts in activity systems such as Tools (cf. Karlsson, 1996) or Instruments (cf. Bødker & Klokmose, 2011). In this thesis, instruments and artefacts are used interchangeably for referring to mediators of individuals' activities.

of activities may be tangible (e.g. in weaving a basket, the object of the activity is the roots, while the outcome is the basket) or intangible (solving sudoku puzzles, the object may be the numbers, and the outcome is the finished puzzle). Individuals' activities and interactions with their surroundings are seldom direct; rather, they are mediated through a complex arrangement of artefacts (Kuutti, 1996). Mediation is a key principle in Activity Theory. The mediating artefacts shape the interactions between the subject and the object by allowing for certain interactions while restricting alternative ones. Applying an Activity Theoretical perspective enables understanding of the subject, the object, and the surrounding material and immaterial conditions of the activity (ibid.).

Activities have a hierarchical structure; see Figure 2.1. First, the overall *activity* may have several motives (Kaptelinin & Nardi, 2006). Second, participation in any activity is defined as performing a series of solitary and collaborative *actions* that are conscious and have immediate goals. Third, actions consist of a collection of routinised *operations* in the context and conditions of an activity. Goal-directed actions turn into routinised operations through repetition and practice. The borders between activities, actions and operations are blurred: an activity can lose its motives and turn into an action; actions can turn into operations through practice; and routinised operations can turn into goal-directed actions upon changing conditions of the activitv.

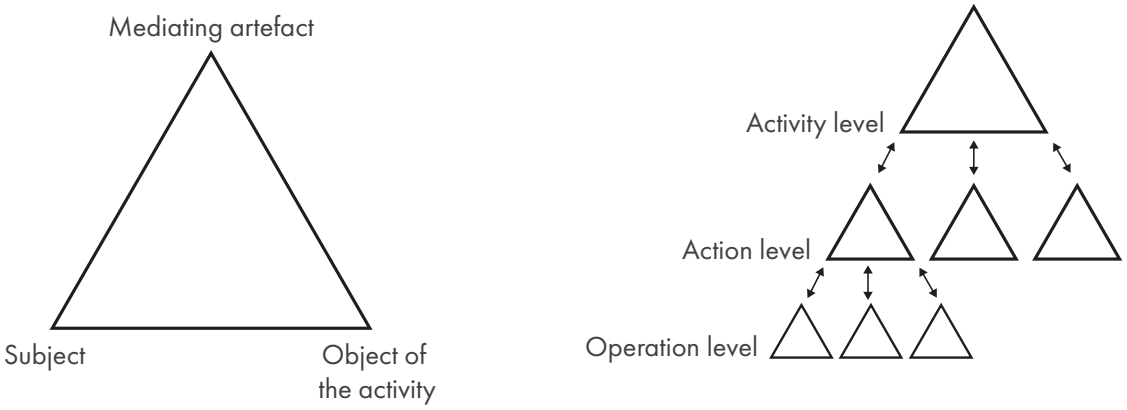


Figure 2.1. The basic structure of an activity (Left) and its hierarchical make up (Right) according to Activity Theory (cf. Kaptelinin & Nardi, 2006).

The collective nature of activity is realised in (i) the rules that mediate the relationship between the individuals and the community, such as temporal rhythms of work or use of resources, and (ii) the division of labour, that is to say allocation of roles and responsibilities between members of the community for achieving the outcomes of the activity (Engeström et al., 1999). The concept of rules in Engeström's interpretation of Activity Theory (ibid.) has relevance for studying AFOs, as rules can be seen as immaterial artefacts specified to mediate use of spatial resources between individuals and the community.

Activity Theory is used for understanding individuals in their technologically mediated and socially contextualised everyday activities (Nardi, 1996). The constituents of individuals' activities are dynamic and change over time depending on alterations in the technological instruments or the social and cultural-historical context of the activity (Kaptelinin & Nardi, 2006). Due to this dialectical nature of activities, changes in an activity system give rise to *contradictions* between the

different elements of the system, for example when new parts of the system collide with the remaining elements or the standard ways of working (Engeström, 2000). The results may be narrowing, expanding, repeating, and dividing activities. As the technological artefacts develop, the individual's activity also develops (Bødker & Klokmose, 2011). Contradictions caused by alterations in instruments, also known as *breakdowns,* draw the individuals' focus towards the instrument instead of allowing them to focus on their ongoing work (Bødker & Klokmose, 2011; Karlsson, 1996). Whether or not the instruments allow for focusing on the object of activity depends on the design of the tool and the action repertoire of the user (Bødker & Klokmose, 2011). Breakdowns occur due to *mismatches*[*] either between (i) possibilities or capacities of the instruments and what individuals want to do, or (ii) the instruments and individuals' pre-conditions, for instance preferences, physical conditions, training and action possibilities (Bødker & Klokmose, 2011). While the introduction of new instruments in individuals' activity systems will always give rise to breakdown situations, it also provides learning and improvement opportunities (Karlsson, 1996, p. 137). Therefore, to understand the impacts of introducing new artefacts in an existing activity system, it is important to address the mismatches triggered by introduction of the new artefacts, as well as the learning and improvements that emerge as a result of experiencing those mismatches.

The Activity Theoretical perspective has been applied in the fields of organisational research and development (see examples in Engeström et al., 1999); Human-Computer Interaction (e.g. Kaptelinin & Nardi, 2006; Nardi, 1996), and User-oriented Product Design (Engelbrektsson, 2004; Hiort, 2010; Karlsson, 1996; Rexfelt, 2008; Selvefors, 2015; Strömberg, 2015). Previous applications of Activity Theory on design of office environment were not identified in the literature. This thesis applies the Activity Theoretical perspective to understand the mediating role of Activity-based Flexible Offices and the consequences of introducing AFOs in employees' activity systems. In this view, AFOs are seen as a new workspace design that entails a re-mediation of employees' activities, in other words providing a new functionality, finding a new form to make an artefact more attractive, inventing a way to produce it more economically (Kuutti, 1996). This view allows for understanding complex interactions between technology and users of technology.

In AFOs, different workstations and zones are designed to mediate employees' different activities and actions. Furthermore, desk-sharing rules are employed to mediate use of spatial resources between individuals and the community. Relocating to AFOs brings about alterations in the activity systems of employees. These alterations include working from different workstations instead of having their own workstation; using individual instruments such as laptops together with a multitude of collective instruments (e.g. chairs, screens, keyboards) provided at workstations. In order to identify how the design of AFOs may support or impede employees' work, it is important to understand the employees' activity systems and address the matches and mismatches that are entailed by relocating to AFOs.

---

* Contraditions, breakdowns and mismatches are sometimes used interchangeably in the literature. It is important to note that breakdowns are a type of contradiction. They occur as a result of mismatches, also called misfits, that are introduced by changes in artefacts which mediate individuals' activities. In this thesis, attention is paid to identifying and understanding these mismatches.

This involves investigating whether AFOs provide instruments that match (i) what individuals want to do in their daily work, and (ii) the individuals' pre-conditions and preferences. However, to apply the Activity Theoretical framework for analysing AFOs, there is a need to expand the notion of a mediating artefact to include a multitude of artefacts arranged in different constellations. For this reason, the next section provides an overview of the concept of artefact ecologies instead of a single artefact to be incorporated in the Activity Theory perspective.

2.2. Artefact Ecology Perspective

The concept of artefact ecologies has a central role in this thesis: it is used for expanding the notion of artefacts in Activity Theory from single immediate 'instruments' to a multitude of artefacts (cf. artefact system in Bødker & Klokmose, 2011; Karlsson, 1999). Artefact ecologies* are here defined as the artefacts that *"a person owns, has access to, and uses"* (Jung et al., 2008) in the context of AFOs. Other definitions specify artefact ecologies as *"multiple artefacts built for similar purposes, but with slight variations and no clear delineation of when to use which artefact"* (Bødker & Klokmose, 2011). Another similar concept is the constellation of technologies introduced by Rossitto and colleagues (2014): *"people's usage of several technological artefacts and applications within the same cooperative work situation"*. Forlizzi (2008) suggests a similar concept to describe product use in a social context (see Figure 2.2); a product-centred framework that includes:

"… the products; the surrounding products and other systems of products; the people who use it, and their attitudes, disposition, roles, and relationships; the physical structure, norms and routines of the place the product is used; and the social and cultural contexts of the people who use the product and possibly even the people who make the product".

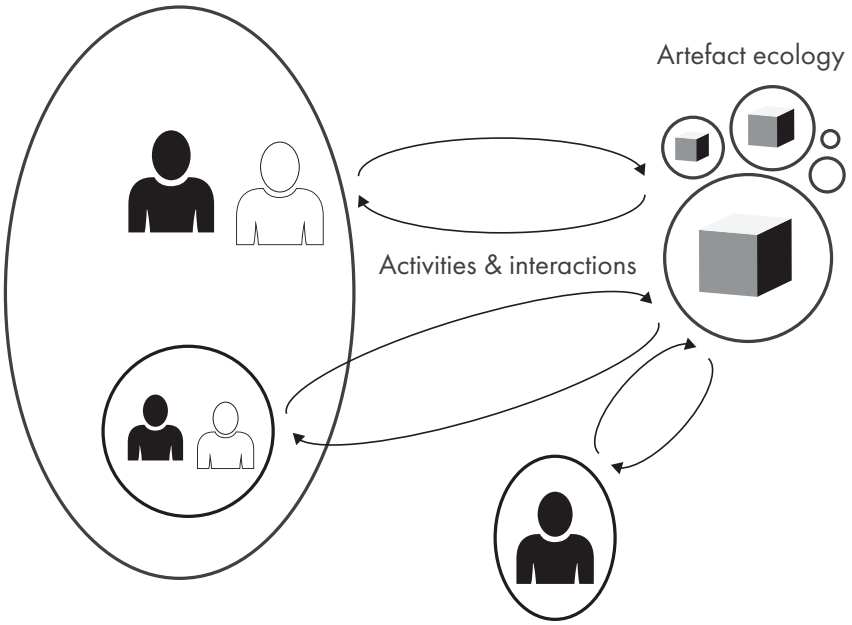


Figure 2.2. Product ecology, its constituents and attributes (adopted from Forlizzi, 2008).

* Other terminologies used to describe artefact ecologies are: product ecology (Forlizzi, 2008), multi-mediation and assemblage of mediators (Bødker & Andersen, 2005); constellation of technologies (Rossitto et al., 2014); device ensembles (Sambasivan et al., 2009).

In AFOs, multiple artefacts are provided in constellations (e.g. a desk, a chair, a screen, a docking station as a workstation). Multiple constellations can be used for similar purposes, that is to say the large number of workstations and spaces from which to choose. Therefore, using the artefact ecology as a theoretical perspective may help in understanding how AFOs are used and adopted by individuals in their organisational contexts.

The artefact ecology framework seeks to find differences among individuals that inform product use and adoption (Forlizzi, 2008). Individuals may use the same artefact in multiple activities, for example use of laptop or phone in an office for different activities. Furthermore, artefacts can be substituted for carrying out the same activity, for instance different screens, desks, or chairs can be used for the same activity in an office (cf. ibid.). The choices users make between different artefacts depend on their activities and the intended outcomes (Bødker & Klokmose, 2011; 2012). Users' artefact ecologies are not always in use and users' choices include occasional non-use of artefacts (Sambasivan et al., 2009), for instance when users disregard or resist using artefacts.

Artefacts building up an individual's artefact ecology are connected in different ways: co-occurring, organised in levels, and assembled in chains (Bødker & Andersen, 2005; Bødker & Klokmose, 2011). Co-occurring artefacts are used at the same time. In an AFO, *co-occurring artefacts* can be a laptop, a mouse, an office chair and a desk used at the same time to enable employees to engage in their different activities and actions. *Chain* relation refers to when outcomes of using one artefact result in an artefact that is used to mediate another action. In an office, this relation can represent itself in various ways, for example a printed report or instruction that is reviewed earlier is used to inform and mediate in writing an email or making changes to another document. *Levels* refer to the number and types of artefacts used in a certain action, for instance a couch may be used for reading emails, while various co-occurring artefacts in a workstation are used for writing a complex report, or an online meeting. Taking these relationships into consideration can help in understanding the interdependencies between AFOs, employees, and their activities, particularly in relation to how people use and adopt AFOs.

Applications of the artefact ecology perspective have mainly been within the realm of digital artefacts (e.g Bødker & Klokmose, 2012; Jung et al., 2008; Rossitto et al., 2014). Nonetheless, it has been shown to give an in-depth understanding of mediation in different contexts such as work environments (e.g. Bødker & Andersen, 2005) or consequences of introduction of new technologies in households (e.g. robot vacuum cleaners in Forlizzi, 2008).

Artefacts are the main unit of analysis in the artefact ecology perspective. Several aspects are important to consider from this perspective. First, each artefact – with functional, social, emotional, symbolic and aesthetic qualities – has its own ecology, resulting in subjective and individual experiences (Forlizzi, 2008). Second, the artefact ecology as a whole – the collection of artefacts – also has functional, social, emotional, symbolic and aesthetic qualities and thereby results in subjective and individual experiences. Third, constituents of artefact ecologies are interconnected, and may be co-occurring, organised in levels, or assembled in chains (Bødker & Klokmose, 2011). Fourth, the analysis of artefact ecologies seeks to identify differences among individuals in terms of product use and adoption. Non-use and

disengagement are important dimensions of use that should be considered when analysing artefact ecologies as people's needs may change over time. Temporal changes in use trigger other changes in the ecology, for example if an artefact is not used by one person, it may be used by another person, remain unused, or get replaced (Forlizzi, 2008). Finally, attention should also be paid to the physical environment in which an artefact ecology is used, as it can encourage/discourage some activities and certain use of the artefacts.

The outlined aspects will be examined in order to investigate the interdependencies between individuals, artefacts and activities in an AFO context. This will help overcome the limitation of Activity Theory that focuses mainly on single-instrument mediation. One of the main aspects to consider from an artefact ecology perspective was time. The individual's activities are dynamic and may change, as too may the individual's needs and priorities. Relocating to an AFO introduces major changes in the employees' artefact ecologies, including the desk-sharing rule, introduction of a variety of spaces, and collective instruments at workstations to be shared with other employees. Therefore, it is important to pay attention to the changes that relocating to AFOs trigger in employee activities, use of their artefact ecologies, as well as needs and priorities. However, Activity Theory and artefact ecology perspectives do not provide frameworks for understanding temporality with respect to introduction of a new concept. Therefore, the following section reviews the theory of appropriation of technology that addresses temporal aspects of the process of adopting technological innovations.

2.3. Appropriation of Technological Innovations

Relocating to AFOs introduces changes in employees' activity systems. These changes can be seen as innovations in the work context due to (i) the introduction of new work practices such as desk-sharing and new design of workspaces, and (ii) perceived newness when relocating from other office types, although the organisation may not be the first one to implement AFOs. Innovation is defined as an idea or practice, or an object 'that is perceived new by an individual or other unit of adoption' (Rogers, 1995). Thus, the perceived newness for the individual determines whether the concept is an innovation or not (ibid.). Relocating to AFOs requires users to adopt and appropriate the new artefact ecology in their activity systems. It is therefore important to consider how the activity system evolves over time, in other words, how individuals' activities may change as a result of breakdowns in the activity system and how individuals deal with these breakdowns.

Appropriation of technological innovations is defined as 'the way in which technology or technological artefacts are adopted, shaped and then used', initiated when users decide to experiment with the technology (Carroll et al., 2002). This can either lead to integration of the technology into the users' everyday lives or rejection of the technology. Non-appropriation is when the users fail to/choose not to experiment with or evaluate the technology (ibid.). A closely related concept is Roger's innovation-decision process (1995): 'the process through which an individual passes (i) from first knowledge of an innovation, (ii) to forming an attitude toward the innovation, (iii) to a decision to adopt or reject, (iv) to implementation of the new idea, and (v) to confirmation of this decision'. In this

process individuals evaluate a new idea or technology and choose either to reject it or integrate it into their everyday lives.

The users go through different phases when appropriating a new technology starting with first encounters (cf. unsatisfactory state in Bødker & Klokmose, 2012; the first three stages in Roger's innovation-decision process, 1995) where the user identifies a need for change in their existing artefact system, gains knowledge about an innovation and decides to acquire a new technology. According to Rogers (1995), this is a mental process that involves dealing with uncertainties and deciding about a new alterative to replace the existing ones.

The next phase of appropriation is exploratory (cf. excited state in Bødker & Klokmose, 2012; implementation stage in Rogers, 1995) where users experiment with the new technology to explore its potential. According to Bødker & Klokmose (2012), this involves a mix of old and newly developed routines and various setup problems that introduce tensions to the users' ongoing activities. According to Rogers (1995), the individuals seek to avoid or reduce this tension.

The last phase of appropriation is long-term integration of the technology into the users' everyday webs-of-activities (cf. stable state in Bødker & Klokmose, 2012; confirmation stage in Rogers, 1995). The stability in this phase refers to having resolved the issues that may occur in the initial phases of appropriating an innovation, thereby reaching a ***symbiosis***. From an Activity Theoretical perspective, this entails a lack of mismatches in individuals' activity systems, leading to reinforcement of the innovation. However, this phase may also entail reversing a previous decision and dis-appropriates the technology due to identification of new needs or persistence of initial mismatches (cf. Bødker & Klokmose, 2012; Carroll et al., 2002; Rogers, 1995). The appropriation of technology involves extra work that goes into making the artefact ecology work (Rossitto, et al., 2014). For example, examining university students' processes of appropriating technology, Rossitto and colleagues (ibid.) conclude that a central part of mobile work is the 'practices around orchestrating the constellation of technologies', in other words the digital platforms in use. This involves choosing from the alternatives to find support for varying needs of the individuals in their activities (ibid.).

The extent of adoption of an innovation is determined by different variables: (i) perceived attributes of innovation, that is relative advantage, complexity, trialability, compatibility, and observability, (ii) type of innovation-decision, (iii) nature of the social system, (iv) communication channels, and (v) extent of change agents' promotion efforts (Rogers, 1995). Relative advantage is defined as 'the extent to which an innovation is perceived as better than the idea it supersedes' (ibid.). Relative advantage concerns aspects such as economic profitability, a decrease in discomfort, social status, savings in time and effort, and the immediacy of the rewards (ibid.). Compatibility is defined as the perceived consistency of the innovation with existing values, past experiences and needs of adopters. Complexity relates to how difficult the innovation is to understand and use. Trialability relates to whether the innovation may be experimented with on a limited basis. Finally, observability relates to the visibility of the results of innovation.

Regarding office innovations, relative advantage, complexity and compatibility involve immediate impacts on users and their activities in their contexts. In contrast, trialability and observability may not influence users and their activities, and may

instead relate to the characteristics of the innovation and how it is implemented and perceived by the users. To allow for observability and trialability, showcases, prototypes or demonstrations may be used during the planning process to communicate the office innovations with the employees and remove ambiguities regarding the innovation. These may impact the employees' perception of relative advantage, complexity and compatibility of the innovation before relocation, while the employees' perceptions change post-relocation once they put the innovation into use.

Relocation to AFOs is different from appropriating one artefact or software application. First, appropriation of AFOs is a contingent decision for employees, in other words it follows a prior decision made by the organisation and/or the facility management to implement AFOs (cf. contingent decision in Rogers, 1995, p.372). In studies on appropriation of technology, users make an active choice in acquiring and discarding artefacts (e.g. Bødker and Klokmose, 2012; Jung et al., 2008). In an organisational context, the employees may have limited freedom in acquiring and/or discarding technological resources. Second, appropriating AFOs is more complex than appropriating one artefact or software application. It involves choices for integrating a large number of new artefacts as well as new policies and usage conditions (i.e. desk-sharing and speech policies) in one's artefact ecology. Therefore, attention should be paid to adoption of AFOs both on an individual and organisational level.

The organisational processes of adopting innovations involves five stages: (i) agenda-setting, for instance when a need for innovation emerges in an organisation, (ii) matching, for example finding an innovation to address the identified need, (iii) redefining the innovation to match the organisations' need, (iv) clarifying occurs when the innovation is put into widespread use in the organisation; (iv) routinising, that is to say when the innovation becomes an ongoing element in the organisation's activities (Rogers, 1995). With respect to AFOs, the first three stages concern planning processes. It is during the fourth stage – clarifying – that relocation occurs and the employees' processes of appropriating AFOs commence. The fifth stage of organisational process overlaps the individuals' stable phase of appropriation. Figure 2.3 illustrates the organisations' and individuals' processes of adopting innovations, with respect to planning and adaptations of AFOs.

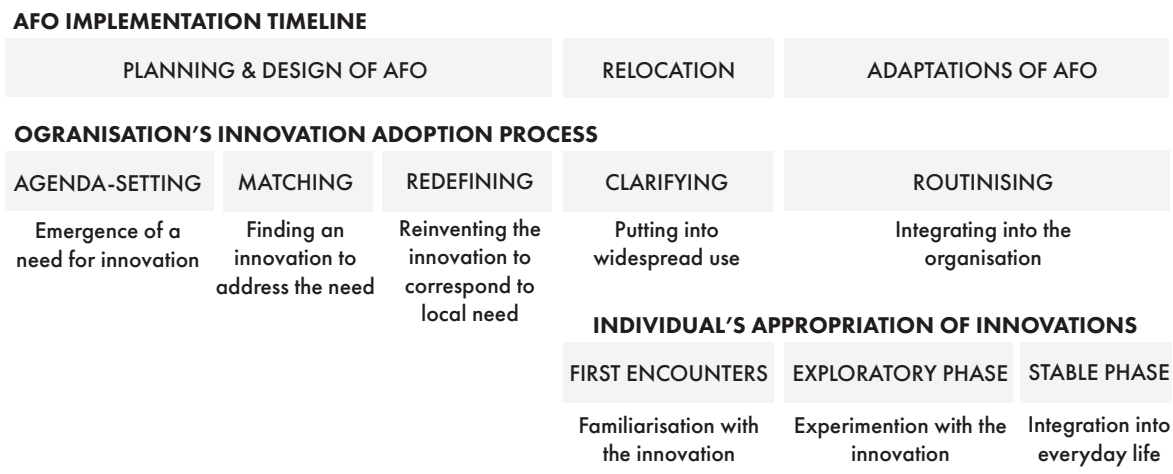


Figure 2.3. The organisational and individuals' processes of adopting an innovation, in relation to planning and adaptation processes of AFOs.

2.4. Reflections on Theory

The theoretical framework presented in this chapter has provided concepts necessary for investigating why some Activity-based Flexible Offices work while others do not. First, the Activity Theoretical perspective allows for investigating consequences of relocating to AFOs in individuals' activity systems.

- Taking Activity as a unit of analysis allows for capturing an in-depth understanding of individuals and their activities, motives and preconditions in the context of AFOs.
- Artefacts – here, AFOs – play a central role in mediating individuals' activities.
- An activity system is dynamic and under continual development through the interplay between its elements, that is to say the artefacts, individuals and their activities.
- The interplay between different elements of an activity system is conceptualised as matches and mismatches.

Second, the artefact ecology perspective makes it possible to examine the changes that occur in individuals' composition and use of artefacts in their activities after relocation to AFOs.

- The artefact ecology perspective allows for expanding the notion of artefacts in Activity Theory from single immediate 'instruments' to a multitude of artefacts.
- Taking artefacts as unit of analysis allows for understanding of design features and qualities of the artefacts in isolation and the artefact ecology as a whole.
- Non-use and disengagement is an important dimension to consider when analysing artefact ecologies, making it possible to capture undesirable design features of artefacts.
- The artefact ecology perspective enables exploration of differences among individuals in the use and adoption of products or systems within the same cooperative work situation.

Finally, the adoption and appropriation of the technology perspective enables capture of the temporal dimension of implementing AFOs on individual and organisational levels.

- The three-staged process of appropriating innovations among individuals helped in understanding the role that time and adaptations play in reaching a symbiosis in individuals' activity systems.
- The structured process facilitates organising the empirical findings and opening the black box of individuals' appropriation processes of AFOs.
- The five-stage innovation adoption process in organisations provides a starting point for exploring the roles played by planning and adaptation processes in ensuring employees' satisfaction with AFOs.
- The structured process facilitates organising the empirical findings regarding planning of AFOs and the otherwise unexplored adaptation processes post-relocation.

The implications that the theoretical framework outlined above has for the methodological approach are discussed in the next chapter.

CHAPTER 3
RESEARCH APPROACH AND METHODOLOGY

Three components are involved in defining the research approach: (i) research interest and the worldview of the researcher, (ii) the overall methodological approach, and (iii) the specific research methods for data collection and analysis (Creswell, 2013). This chapter provides a detailed description of the research approach and its components. The chapter concludes with the strategies that were used for confirming the findings.

3.1. Research Interest and the Worldview

Curiosity has been the underpinning driver of the research work presented in this thesis. The motto I tried to base my work on was: "*If you know where you're going, you're not going to find anything really interesting*"*. Specifically, I had no prior experience of working in AFOs and had a neutral opinion about them. Having a background in Industrial Design Engineering, my main research interests were to examine the interrelations between users and the surrounding products, services or systems that they use in their everyday life (here employees and AFOs). This user-oriented design and development perspective is built on interpretations of Activity Theory (Engelbrektsson, 2004; Hiort, 2010; Karlsson, 1996; Rexfelt, 2008).

The Activity Theoretical viewpoint adopted in the thesis shares common ontoepistemological premises with pragmatism, primarily with Dewey's philosophy, in that the nature of reality is dynamic and cannot be studied in terms of fixed permanent components (Miettinen, 2006a; 2006b). Both perspectives have an antidualism underpinning, that is to say the truth "*is not based on a duality between reality independent of the mind or within the mind*" (on a pragmatic worldview in Creswell, 2013); rather, it is based on materialistic dialectics, the "*endless mutual transformation*" of the activity and things in response to each other, formed through mediated action (Miettinen, 2006a). The two views also share epistemological similarities, that is to say knowledge is both constructed

* The quote is from a Lecture by the Nobel Leaureate in Chemistry, Micheal Levitt in 2015.

and based on the external objective reality. In both views, knowledge and development occur within human activities that have a collective and material nature (Engeström et al., 1999; Miettinen, 2006b). While the pragmatic viewpoint does not advocate a certain methodological approach and leaves the choice of approach to the researcher to find out what works best for the intended outcomes (Creswell, 2013), the Activity Theoretical viewpoint has specific methodological implications.

The main object of inquiry in Activity Theory is to understand the interrelations between individuals, other people, and artefacts in everyday activity (Nardi, 1996). Similarly, the main object of this thesis has been to understand employees' activities in their AFO contexts to learn about how well the AFO works. The methodological implications of taking an Activity Theoretical viewpoint is: (i) having a timeframe that is long enough to capture the changing nature of activities that occurs as a result of adopting, developing and using new artefacts; (ii) a commitment to comprehensively understanding the people's viewpoint and their context, which requires dialogue between researchers and the people they study (Miettinen, 2006a; Nardi, 1996). These implications are taken into consideration in devising the methodological approach in this thesis.

3.2. Methodological Approach

A case study approach was chosen for an in-depth investigation of the consequences of relocating to AFOs. Case studies are designed to collect detailed information about a contemporary phenomenon in a case or multiple cases (Merriam, 2009), by using multiple sources of data (Creswell, 2013). The research questions posed in this thesis aim at understanding contextual conditions under which AFOs support and/or impede employees' work. They are either descriptive (to gain an in-depth understanding of what is happening/what has happened), or explanatory in their nature (to explain how and why something happened). Explanatory research questions that require an in-depth contextual understanding are best answered by means of case studies, particularly because cases studies are conducted in a natural setting when the researcher has limited control over the events and the way they unfold (Yin, 2018). This enables researchers to trace events and processes over time and explain the otherwise unclear boundaries of the context and the studied phenomena (ibid.). Allowing for examining employees' activities in context, the case study approach is in line with the Activity Theoretical viewpoint (cf. Kaptelinin & Nardi, 2006). Therefore, the case study approach was found appropriate for understanding (i) the interdependencies between employees, their activities, and AFOs, (ii) employees' processes of appropriating AFO solutions, and (iii) the process-related aspects during planning and adaptation of AFOs that influence employees and their work.

It is also important to note that the case-study approach is consistent with the theoretical perspectives adopted in this thesis. In the Activity Theoretical view, the unit of analysis is the individual's activities and their goal-directed actions that are mediated by technical instruments in a social world. In order to understand the individual's activities as a whole, it is important to understand the elements of their activity system and the interdependencies between these elements. As the concept of mediation is central in Activity Theory, the real-life use of technology and the way it facilitates individuals' activities and actions in natural settings become important.

Following recommendations by Nardi (1996) in applying Activity Theory, the approach chosen in this thesis allows for examining human activities on a broad level rather than analysing small episodes of an activity in isolation, meaning that attention is paid to employees' activities and actions rather than their routinised operations.

In the artefact ecological view, the artefacts are the main unit of analysis, with the aim of understanding individuals' use of artefacts and the context of use (Forlizzi, 2008). In both Activity Theory and artefact ecology perspectives, use of contextual inquiries that involved qualitative and ethnographical methods are recommended for studying conditions of activities in actual real-world situations. In particular, the use of mix of methods such as interviews and observations is recommended (Forlizzi, 2008; Karlsson, 1996; Nardi, 1996). Another common denominator in the outlined perspectives is understanding individuals, their activities and use of artefacts with an emphasis on individual differences. In this particular respect, a case-study approach is an appropriate strategy for investigation of interdependencies between users and their environment in the context of their activities. When relocating to AFOs, changes occur in the way technology, that is to say instruments and workspaces in AFOs, mediate employees' activities. In other words, relocation to AFOs presents opportunities to understand and explain interdependencies between individualsAFOsIndividuals' activities. Finally, it is crucial to take temporal aspects of individuals' use of technology into consideration both from Activity Theory, artefact ecology and appropriation of technology perspectives. Taking these aspects into consideration, the next section elaborates on the case studies selected for the thesis.

3.2.1. The case studies

The work in the thesis builds on five cases of AFO implementations in Sweden in 2015-2018 (Figure 3.1). Altogether, eight organisations that had implemented AFOs were contacted to participate in the research. The aims of the research were presented for contact persons at each organisation (e.g. staff managers, facility managers and process managers). Four of the organisations agreed to take part and assigned a contact person to facilitate data collection. In one of the organisations, two groups were studied (Cases 3 & 4): one that had recently relocated and another that had relocated 2 years prior to the data collection.

CASES STUDIES	SIZE - SECTOR	OFFICE TYPE PRE-RELOCATION	MONTHS POST-RELOCATION	
1 - The Science Park	Small - Private	Cell Offices	1-6	
2 - The Health and Safety Knowledge Provider	Small - Private	Open-plan Offices	3	wave 1
3 - The IT Group (Pharmaceutical Company)	Large - Private	Open-plan Offices	3	
4 - The Regulatory Group (Pharmaceutical Company)	Large - Private	Mixed Offices	26	wave 2
5 - The Section for Care and Elderly Support (Municipality)	Large - Public	Cell Offices	38	

Figure 3.1. An overview of the case studies included in the thesis.

The selection of multiple cases was made to achieve maximum variation with respect to employees' activities and organisations (cf. Flyvbjerg, 2006). This allowed for triangulating by data sources to overcome the expected biases in a single-case study, and include different persons, organisations, AFOs, and times (cf. Miles & Huberman, 1994, p. 267). The five cases were selected since: (i) they represented different types of organisations, (ii) they belonged to organisations of different sizes, and (iii) they allowed for studying the consequences of AFOs either immediately or within 2-3 years after relocation. The latter criteria were chosen to allow for understanding of temporal differences and adaptations in AFOs. Therefore, the case studies are grouped together in two waves: (i) 1-7 months after relocation, and (ii) 2-3 years after relocation.

3.3. Data Collection Procedure

Consistent with a case-study approach, multiple methods of data collection (i.e. observations, interviews, secondary data) were combined to identify interdependencies in individuals' activity systems in AFOs, success factors in design of AFOs, the individuals' processes of appropriating AFOs, as well as the organisation's processes for planning and adaptation of AFOs. A mixed-methods approach with an embedded design was chosen for data collection, in other words sequential collection of different types of data prior to, during, and after a major data collection (Creswell, 2013; Creswell & Clark, 2011). The major data collection involved semi-structured interviews with employees, as users of AFOs, for obtaining detailed views and specific personal experiences of individuals with respect to AFOs. The embedded data enhanced the interpretation of the major data collection through:

- studies of space usage to gain a more complete understanding of the use of AFOs, based on observations, annotations of informants marking preferred workspaces on architectural drawings and, when available, data retrieved from the organisations' occupancy sensors. The data collection for space usage studies was in parallel with the major data collection.
- implementation process inquiries to obtain a deep understanding of planning and adaptations of AFOs, consisting of interviews with process managers and collection of secondary data, to gather insights on the AFO solution and the specifications of the workspaces, the design and implementation process as well as results of internal evaluations. The data for the implementation process inquiry was collected prior to the major data collection.

Both the major and the embedded data collection methods involved contextual inquiries (such as interviews and observations) to gain qualitative insights into implementation of AFOs. Figure 3.2 provides an overview of the data collection procedure and sampling in each case study.

3.3.1. Study of AFO users' perspective: interviews with employees

The choice of semi-structured interviews as the major data collection approach was motivated by the need to address a pre-defined set of themes that were based on the Activity Theoretical framework, and at the same time allow for elaborations and reflections regarding the working in AFOs (cf. Kvale, 1996). A total of 72

semi-structured interviews were held, investigating interdependencies in employees' activity systems in 5 AFOs (4 organisations). For recruiting of informants, an invitation e-mail and/or a sign-up list was sent to all the employees from the participating groups. The interviews took between 30-60 minutes, and were held at the respective organisations' premises.

The interview questions addressed several themes: informants' activities, their usage of spaces and changes over time, how the physical environment and the desk-sharing policy supported/obstructed their activities and interactions, how they perceived the organisations' motives behind relocation and their satisfaction with the solution and the design and implementation process. Architectural drawings of the AFO solutions were used to facilitate the conversation and document the informants' workstation preferences. The interview questions and the different themes they addressed are provided Appendix A.

CASE STUDIES	STUDY OF AFO USER'S PERSPECTIVE	SPACE USAGE STUDY	PROCESS INQUIRY
Case 1 – The Science Park	Semi-structured interviews: 12 employees	Weekly shadowing sessions during a 6-month period (start 1 month post-relocation)	Collection of secondary data Semi-structured interview with the interior designer
Case 2 – The Knowledge and Training Provider	Semi-structured interviews (video-conference): 24 employees	Secondary data gathered by another researcher: 14 rounds of observation in two days	Collection of secondary data Semi-structured interview with the administrative manager
Case 3 – The IT group at the Pharmaceutical Company	Semi-structured interviews: 10 employees	Direct observations: 24 rounds over a 6-day period Data from occupancy sensors	Collection of secondary data Semi-structured interview with the facility manager
Case 4 – The Regulatory Group at the Pharmaceutical Company	Semi-structured interviews: 12 employees*		
Case 5 – The Section for Care and Elderly Support at the Municipality	Semi-structured interviews: 14 employees*	Direct observations: one session	Collection of secondary data Semi-structured interview with the process team

Figure 3.2. Overview of the case studies (* A total of four informants in Cases 4 and 5, i.e. two in each case, had not worked in the AFO as long as the others in their respective groups, due to more recent recruitments).

3.3.2. Space usage study: observations and occupancy data

The data collection for space usage studies varied between cases. The space usage study involved shadowing in Case 1 and direct observations in Cases 2-5 (cf. Czarniawska, 2007; 2014). The shadowing sessions and the direct observations involved walking a pre-defined route that covered all the workstations in the premises and taking structured field notes. The field notes included use and non-use of different spaces and instruments, as well as interactions between employees in the workspaces. The shadowing sessions were carried out during a 6-month period post-relocation in Case 1, while the direct observations were held in connection with the interviews.

During the semi-structured interviews with employees in Cases 1, 3, 4 and 5, architectural drawings were used for annotating and logging of the informants' interactions and workspace preferences: (i) the nature of activities, i.e. solitary work, meetings, information exchange, and informal interactions, (ii) the number of people, (iii) whether the employees were on phone or video calls, (iv) the workstations used during the activities, (v) the unattended and disregarded workstations, and (v) the process of setting up and packing away.

In Cases 3 and 4, space usage from occupancy sensors was available and retrieved to further understand usage of spaces. This was put together by *Sony Mobile Analytics Team* and covered all bookable and walk-in rooms over a 1-month period prior to the study. The occupancy sensors logged occupancy when employees were in the enclosed walk-in and bookable rooms. This was used to complement the data from direct observations and interviews.

3.3.3. Process inquiry: secondary data and interviews with AFO project groups or process managers

The process inquiry involved (i) collecting secondary data such as floor plans, planning documents, changes after relocation and internal reports, and (ii) a semi-structured interview at each organisation with the facility manager/process manager/staff manager or the AFO project groups to gain insights on the AFO solution, the specifications of the workspaces, the intended usage of the premises, and the design and implementation process. Depending on the number of months elapsed post-relocation at the time data collection, attention was paid either to the planning and design process or to evaluations and further development of the concept after relocation. The further developments included for instance suggestions by employees and modifications that were made to further develop and improve the concept. These were documented by the facility management and retrieved to investigate changes in the AFO solution over time.

3.4. Data Analysis Procedure

The data gathered from the different cases studies was analysed and the results presented in the 5 appended papers*. The appended papers focus on different aspects relating to the research questions in isolation.

---

* **Paper 1** investigates the appropriation process and usage preferences in Case 1, based on the data from the shadowing study.

Paper 2 focuses on desk-sharing and speech rules in AFOs, as well as the planning process, adoption of rules and their consequences for the employees' work conditions. This paper is based on the interview data and the secondary data from Cases 1 & 2, in addition to two cases that are not addressed in this thesis.

Paper 3 applies the artefact ecological perspective and focuses on use and non-use of spaces based on the interview and observation data. The paper reports on results from case 5 in addition to another case that is not addressed in this thesis.

Paper 4 applies the Activity Theoretical perspective and reports on short- and long-term consequences of relocating to AFOs in a large organisation. This paper is based on result of the data from Cases 3 & 4.

Paper 5 focuses on adaptations and OHS (Occupational Health & Safety) management processes. This paper is based on the data from Cases 4 and 5.

To consolidate answers to the research questions and contribute to the overarching purpose of the research, all the data required interpretation, both within and between cases, developing further knowledge of contextual consequences of relocating to AFOs for employees' work environment. Therefore, the data from the five case studies was revisited and analysed anew. This involved two streams: (i) a descriptive approach for addressing the research questions in each case (presented in Chapter 4), and (ii) a comparative approach between cases for identifying and developing patterns to explain the reasons behind informants' dis-/satisfaction with AFOs, differences in informants' appropriation of AFOs, as well as the success factors in design and implementation of AFOs (presented in Chapter 5). Each of these streams was conducted in different steps, and this is further explained in this section.

3.4.1. The descriptive approach

The descriptive approach (Chapter 4) for summarising the results from each case study consisted of three main steps.

Step 1. The Activity Theoretical perspective: the interdependencies in informants' activity systems were identified based on the interview and space usage studies. The analysis of interviews was theory-driven and involved: *starter coding* that isolated the data concerning the informants' activity systems, for example their activities, actions, motives, preferences, and the artefacts they used (cf. Miles and Huberman, 1994, p.57-58); and *open coding* through iterative reading of the verbatim interviews, reduction of data and identification of recurring themes that addressed usage of AFOs and the informants' reflections on how the AFO solution supported/impeded (cf. Miles and Huberman, 1994, p.61). For space usage studies, the annotations on architectural drawings from interviews and observations were compiled to compare workspace preferences between informants, and identify over- and under-used workspaces (see e.g. Figure 3.3).

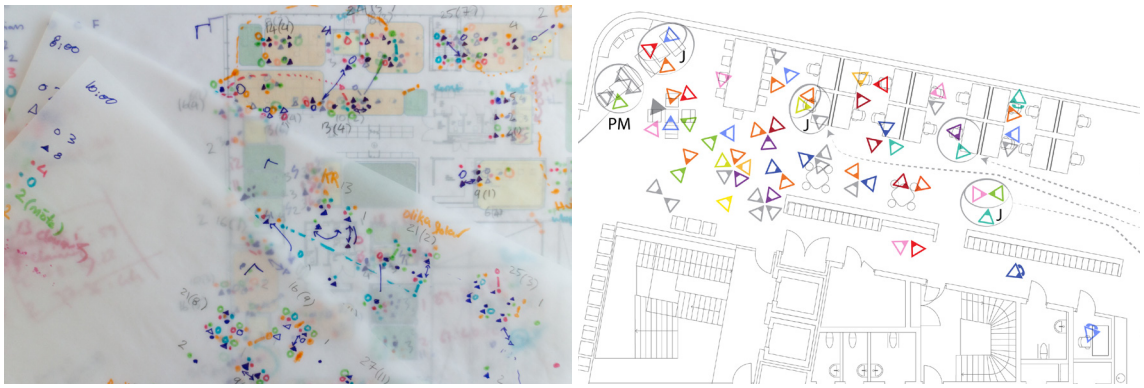


Figure 3.3. Analysis of annotations on architectural drawings made during the interviews and observations. The focus was space usage and the partatipants' interactions.

The two main themes that are addressed in this step are (a) the informants' preferences for following/disregarding desk-sharing, usage of workstations, the instruments that they included in their artefact ecologies, and the reasons behind the informants' preferences, and (b) the matches/mismatches in the informants' activities by analysing the informants' reflections on how the AFO solution supported/impeded their activities and whether the solution matched their preferences. A further analysis of the identified matches/mismatches led to identification of three categories of matches/mismatches that were used as a basis for summarising the results (see Figure 3.4):

- **Informants' preferences ↔ AFO:** matches/mismatches relating to the fulfilment of the informants' needs, desires, or preferences for comfort and wellbeing.
- **Informants' activities ↔ AFO:** matches/mismatches concerning facilitation or obstruction of the informants' activities and actions.
- **Informant ↔ Activities:** matches/mismatches between the informants and the motives for their activities, as a result of working in AFOs, concerned changes in the nature and motives of the informants' activities.

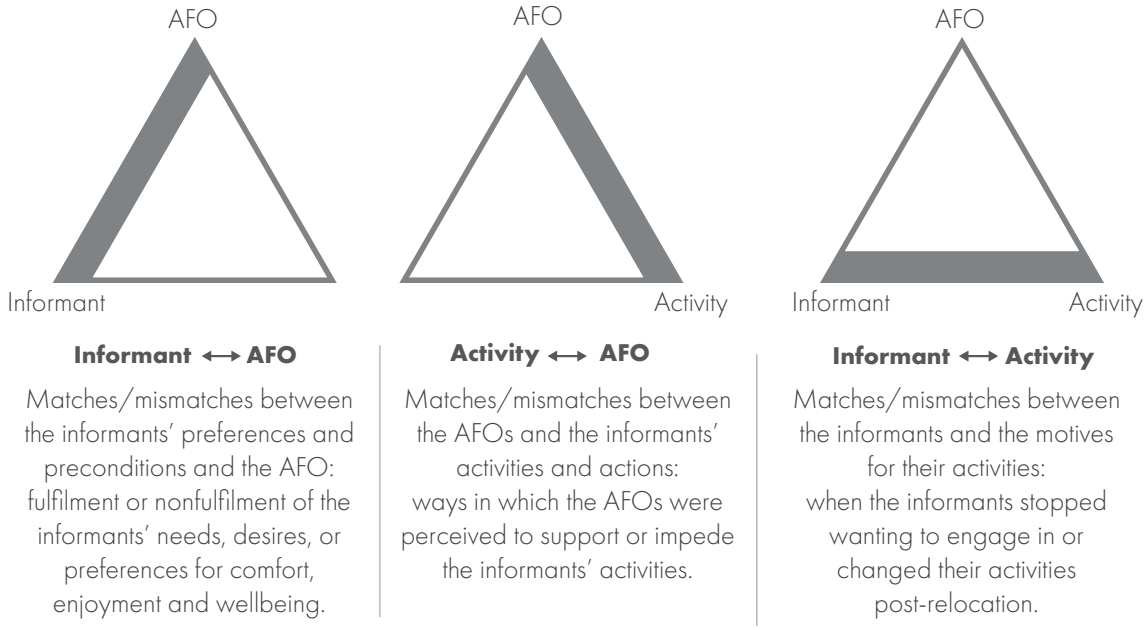


Figure 3.4. Three categories of matches/mismatches in the informants' activity systems identified during the analysis and used comparisons between individuals and explaining reasons behind individuals' dis-/satisfaction.

The outlined analysis was conducted for each of the informants, and compared to other informants in each of the case studies. This involved an iterative process for finding similarities and differences between the informants in each case. Typical examples of informants who were satisfied and dissatisfied with the AFO solution in each case, with typical quotes from the interviews, were used to illustrate the main findings.

Step 2. Appropriation of technology perspective: the informants' processes of appropriating AFOs were mapped by analysing the parts of interviews that involved recollections of how the informants perceived the AFO in early post-relocation (cf. *starter coding* Miles and Huberman, 1994, p.57-58), whether their usage preferences and social context had changed and why, specific problems that had been resolved, and strategies and individual solutions for coping with the work

environment problems (cf. *open coding* Miles and Huberman, 1994, p.61). These were categorised as different types of adaptations (ibid.), and further grouped according to the appropriation of technology perspective, in three phases of first encounter(s), experimentation, and stability.

Step 3. Planning and Adaptation process perspective: the success factors in the planning process were identified by comparing the informants' recollection of their engagement in the process, and whether they had been able to give input, and if their needs were taken into consideration (cf. *open coding* Miles and Huberman, 1994, p.61). The success factors in the adaptation process were identified by comparing the informants' recollection of changes made in the AFO solution post-relocation, whether they had been able to give input and make modifications in the solution, and how work environment problems were resolved in the respective case (ibid.). The informants' recollections were compared with the data from process inquiries. Analysis of the data from process inquiries involved making timelines and identifying critical events and activities (cf. Miles and Huberman, 1994, p.110) during the planning process, as well as post-relocation.

3.4.2. The comparative approach

The comparative approach (Chapter 5) involved a comparison of findings from the different cases, both between individuals and between cases, for identifying and developing patterns and explanations in order to provide answers to research questions. In order to identify interdependencies between individuals, their activities and AFOs (**RQ1**), the findings regarding usage of AFOs, and matches/mismatches between AFOs and the informants' usage preferences and activities were compiled and compared on an individual level. In addition, the identified matches/mismatches were further categorised in three levels for a fine-grained analysis of AFOs: the desk-sharing rule, workstations or instruments. The identified matches/mismatches were compared among informants with different usage preferences to explain why the informants were satisfied/dissatisfied with the AFO solutions. To understand the role that design plays for a successful implementation of AFOs (**RQ2**), the matches and mismatches identified from the interviews and the data from observations were used for a cross-case comparison. This comparison enabled identification of successful and sub-optimal design features in AFOs. In order to explain the individuals' processes of appropriating AFOs (**RQ3**), the informants' adaptations in different phases of appropriation were compared on a case level. For identification of process factors in implementation of AFOs (**RQ4**), Roger's staged process of adopting innovations in organisations was used to organise the identified success factors in planning and adaptation processes and make comparisons between cases.

3.5. Strategies for Confirming Findings

The studies included in this thesis and the choice of methods and aspects were influenced by the knowledge gaps, theoretical perspectives and traditions within the field of user-oriented design. This involved the use of contextual inquiries (such as interviews and observations) to gain qualitative insights into implementation of AFOs and how these influence employees' activities and work environment over

time. In comparison with surveys that are commonly used for understanding of the influences of AFOs on employees' work, the contextual inquiries allowed for acquiring a holistic perspective to study employees' activities and the contexts of AFOs, rather than being restricted to predefined answers. The semi-structured interviews and the embedded data made it possible to obtain a deep understanding of the informants' experiences in AFOs over time, as well as exploration and elaboration of aspects in design, implementation and adaptations of AFOs that influence employees and their activities. Different strategies were used to ensure the quality of findings and ensure fulfilment of the criteria that are used to evaluate the quality of conclusions drawn from qualitative research (cf. Miles and Huberman, 1994). Each of the criteria for confirming the quality of findings and the strategies used to ensure these is described below.

Confirmability (also known as objectivity) involves ensuring that the conclusions depend on the subjects and conditions of the study rather than on the researcher. This was ensured by providing descriptions of data collection and analysis procedures explicitly and in detail, allowing for the reader to link the data to conclusions. In addition, triangulation between different methods allowed for confirmation and comparison of the findings from interviews, space usage studies and process inquiries. Furthermore, triangulation between data sources allowed for exploration of rival explanations between individuals, organisations, AFOs, and time frames. Moreover, discussions on analyses and interpretation of the data with supervisors, as well as the joint analysis of the data by multiple researchers with co-authors in papers 2 and 3, made it possible to confirm the findings and avoid assumptions and biases.

Dependability (also known as reliability or auditability) concerns whether the logic leading from data to interpretation is made explicit. This was ensured by providing a detailed description of data collection and analysis procedures. Specifically, the analysis and structuring of the findings within and between cases was based on the research questions. This structuring was critical for making the logic from analysis to interpretation explicit.

Transferability (also known as fittingness or external validity) is achieved by clarifying the contexts in which the findings are likely to hold. The transferability of findings was strengthened by triangulation between different data sources, for example cases, times, and individuals. Another strategy for achieving transferability was the provision of detailed and clear descriptions of case organisations, informants' activities, and the AFO solutions to allow for comparison with other contexts. Checking the congruency of findings with prior studies also made it possible to clarify the contexts in which the findings hold.

Credibility (also known as authenticity or internal validity) addresses whether the findings reflect informants' understandings. The different strategies to ensure credibility of the findings were: respondent validations and member checks that were integrated into each of the case studies to check accuracy of findings; and discussions on analyses and interpretation of the data with supervisors. Furthermore, joint analysis of the data by multiple researchers, in Papers 2 and 3, allowed for further development of coding and ensuring that the findings reflected the data.

Utilisation and application concerns the findings' contributions for different stakeholders. In all the case studies, the findings were presented to the informants, the line managers and, when applicable, the facility management. These presentations

had an evaluative character and highlighted the strengths and weaknesses of the AFO solution in each case, suggesting improvements and adjustments of the solution to better match the informants' activities. An ethical consideration in this process was to empower the participants by ensuring that their voices, experiences and desires were communicated to senior staff. Another ethical consideration was anonymity of the participants and data privacy. In Case Studies 1-4, which were conducted prior to the introduction of GDPRs (the EU General Data Protection Regulation, see practical guide by Voigt & von dem Bussche, 2017), verbal consent was sought prior to data collection and recording of the interviews. In Case 5, which was conducted after the introduction of GDPRs, written consent was gathered prior to data collection. In line with GDPRs, anonymity was guaranteed in communication of results in all the studies.

Appendix B provides an overview of how the outlined strategies were applied in order to confirm the findings in each of the appended papers.

CHAPTER 4
FINDINGS FROM THE CASE STUDIES

This chapter provides a summary of findings from each case study, involving: (i) an overview of the employees' activities and responsibilities in each case organisation and specification of different workspaces provided in their AFO solution, (ii) identified interdependencies between the AFO solutions and the informants' activities and preferences, (iii) the informants' processes of appropriating AFO solutions, (iv) the planning and adaptation processes, and (v) a section highlighting the main takeaways from the case study.

4.1. Case 1: The Science Park

The Science Park (C1) provided collaboration platforms to bring together stakeholders from industry, academia, and city government to address societal challenges such as sustainable urban development. The organisation had relocated to an AFO one month prior to the study. Their relocation was part of a larger development of facilities and amenities in the area and involved: (i) moving from a cell-office to an AFO, (ii) sharing the premises with some of the organisation's owners and partners, and (iii) providing co-working spaces as part of their services. They were among the first tenants to use the premises full-time and follow the desk-sharing concept, while the remaining tenants had either allocated workstations, or permanent workstations at their organisations elsewhere and would use the workspaces mostly for collaborative work.

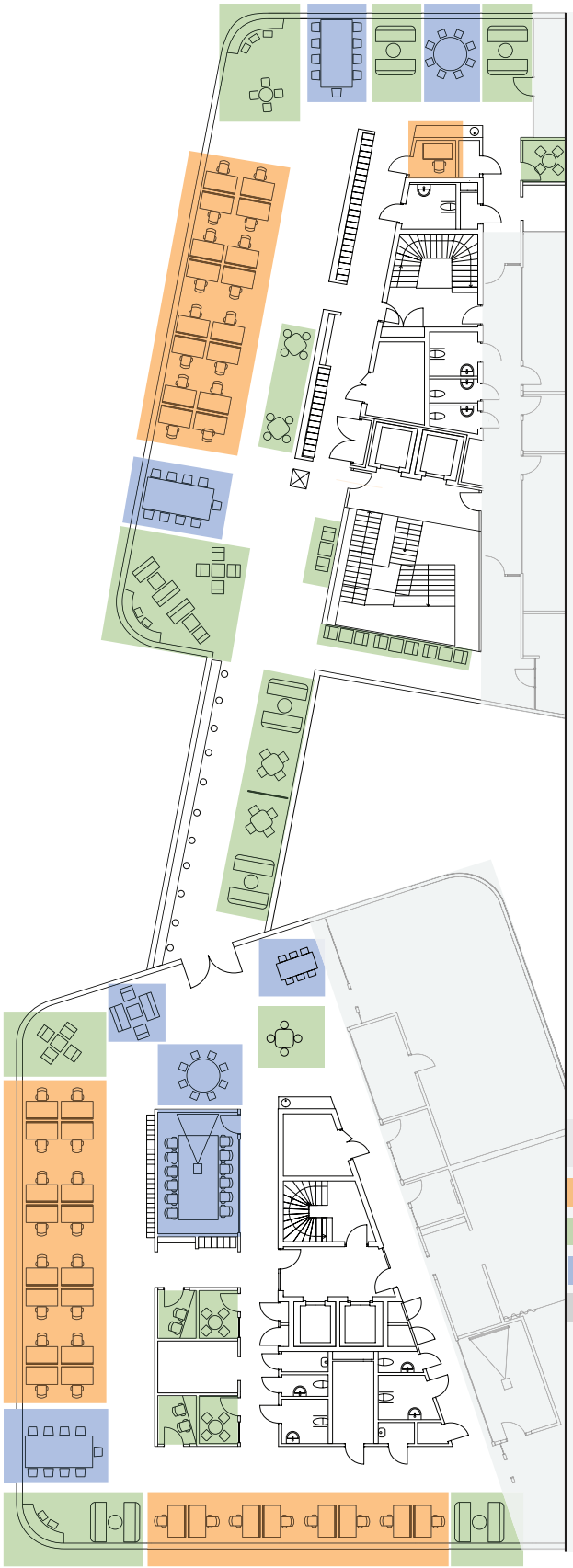
The Science Park had 12 full-time employees who participated in the study. The informants' main responsibility was to contribute to the creation of collaboration platforms in different ways. Their activities involved engaging different stakeholders from academia, industry and city government for (i) writing applications to obtain resources for project collaborations, (ii) coordinating development projects, (iii) authoring project reports, and (iv) disseminating knowledge through seminars and other communication channels. The themes of these projects varied from urban development to energy and materials technology. In addition, they provided a network of enterprises with support services such as marketing, business development, and access to events and seminars for knowledge sharing and competence development.

The AFO solution in Case 1 (Figure 4.1) was located on the second floor of two buildings that were connected together via a bridge. The solution comprised workspaces for solitary and collaborative work in proximity to each other, with limited spaces for uninterrupted work.

4.1.1. Interdependencies between employee(s), their activities and the AFO solution in Case 1

The identified interdependencies in informants' activity systems are described here by summarising (i) usage preferences with respect to the desk-sharing rule, workspaces, and work instruments, and (ii) matches and mismatches between the AFO solution and the informants' activities (in general and with regard to their actions), thereby identifying features of the AFO solution that support or impede employees' activities.

Usage preferences – The informants' usage of the AFO varied considerably in terms of following/rejecting the desk-sharing policy, preferred workspaces and instruments. Half the informants (6/12) returned to the same workstation and left their belongings overnight, while others either switched workstations on a daily basis or periodically shifted between switching workstations and dwelling. Nonetheless, the booking system was disregarded by all the informants, since it was easier to grab a workstation instead of standing at the front desk and booking one. Disregarding the desk-sharing concept and the booking system had no consequence for the other informants due to the large number of workstations and few tenants. Most of the workspaces in the open zones (Figure 4.1) were frequently used except for the furniture that was considered 'childish', for example wobbly stools or low-height chairs (Figure 4.2). In contrast, the walk-in or small meeting rooms were rarely used due to undesirable ambient conditions such as lacking windows and poor ICT coverage (Figure 4.2). The informants' workspace choices were the result of trade-offs made between preferences for ambient conditions (light and views), exposure to noise and visual distractions, proximity to colleagues, and quick access to belongings (in the case of people who did not switch workstations). The informants who returned to the same workstations (6/12) used unique instruments, for instance mouse, keyboard, desk lamp and so on, while others relied mainly on their laptops (Figure 4.3). However, some of the informants (3/12) in the latter group struggled with discarding their mouse and keyboard and periodically resumed using these instruments. Among the collective instruments provided at each workstation, the office chairs were found to have insufficient adjustment and led to physical discomfort. One of the informants brought an older office chair that was adjusted according to his preferences. Another cause of discomfort was the height-adjustable desks that were not sufficiently adjustable for the informants who were taller than average.



Case 1 - The Science Park

Relocation year: 2015

Time elapsed post-relovation: 1- 6 months

No. of participants: 12

No. of employees sharing the offices: max 60

Workstation/employee ratio: max 0.68 (varied depending on the number of tenants using the coworking spaces)

Office type before relocation: cell-offices

Motives behind relocation: col-ocating with some of the organisation's owners and partners, and further development of their services as a collaboration platform by providing coworking spaces and meeting arenas.

Use policies

Desk-sharing rules: employees were instructed to book the desks via a booking system placed at the entrance and vacate workstations when leaving/by the end of the day.

The different spaces and zones for solitary work had no pre-determined speech policies.

Collective instruments

Each workstations for solitary work (41/41) was equipped with a height-adjustable desk, adjustable office chair, one screen, and a docking station.

All employees had shelves and lockers for personal storage, in addition to the collective storage shelves.

Layout specification

Number of workstations and their intended functions	Open zones	Enclosed rooms (no. of rooms)
Solitary work	40	1 (1)
Collaborative work (2-4p)	78	16 (5)
Collaborative work (5p+)	55	12 (1)
Total no. of workstations	173	29

Areas marked in grey (in the blueprint) were separated from the AFO for other organisations with assigned workstations.

There were additional facilities in the building for holding events and meetings.

Figure 4.1. An overview of the AFO solution in Case 1: usage policies, specification of layout and the collective instruments included in the AFO solution.

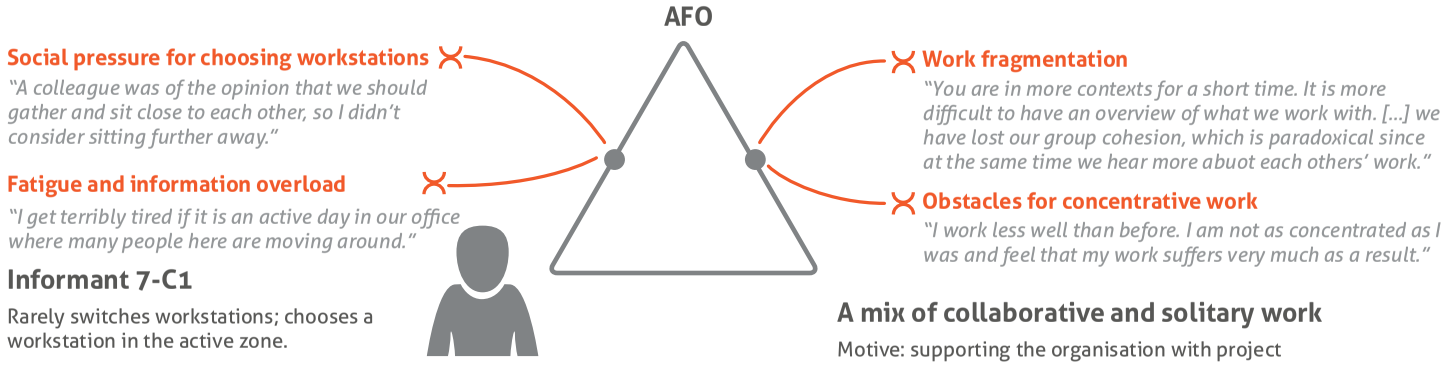
Figure 4.2. Example of underused spaces. Left: low-height chairs in proximity to other meeting spaces. Left: walk-in rooms for meetings that were disregarded due to being 'too small' and lacking windows and daylight.

Figure 4.3. Left: example of a workstation that was used by informants who switched workstations, next to a workstation that was implicitly dedicated to one informant (Right). The workstation to the left was personalised with personal instruments such as an individual chair and desk-lamps, and work-related belongings such as folders, office supplies, etc.

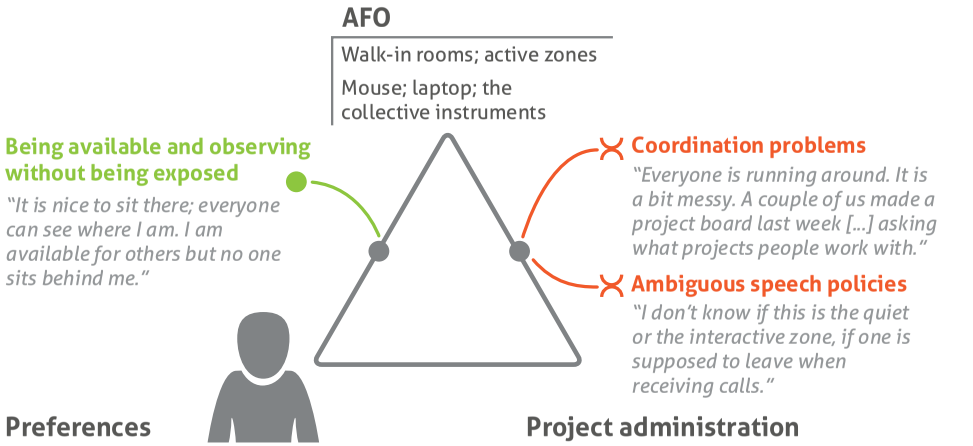
Perceived work support – The majority of informants (8/12) in Case 1 were dissatisfied with the AFO solution and reported negative impacts on their performance. These informants had activities consisting of a mix of solitary and collaborative actions, for instance writing project reports and project administration that involved collaboration with mostly external stakeholders (Figure 4.4). They frequently attended meetings elsewhere, for instance in the conference and meeting facilities on the first floor of the building. They wanted a home base to visit in between their meetings, and therefore did not follow the desk-sharing rule. Various mismatches were identified between their activities and the AFO solution that led to the reported workspace dissatisfaction (exemplified in Figure 4.4). *On activity level*, the mismatches were: work fragmentation and fatigue due to information overload; obstacles for concentrative work; obstacles for concentrative work; unresolved conflicts between individual preferences, for example privacy and expectations such as being available. *For actions* that required collaboration such as project administration, one common mismatch was unpredictability of colleagues' presence leading to coordination problems. *For actions* that required concentration, for instance writing a report, the mismatches were: lack of speech policies, insufficient quiet spaces, and undesirable walk-in rooms; conflicting preferences such as seeking privacy and social inclusion simultaneously. Some of the informants – including the staff manager – felt that they could not continue working in the AFO. In other words, the AFO solution introduced a mismatch between the informants and their activities and actions. This prompted investigations into alternative solutions for thriving during their rental period, such as finding an allocated room for one of the informants.

Some of the informants (4/12) were satisfied with the workspaces and believed that the AFO solution supported their activities. These informants had activities consisting of a mix of solitary and collaborative actions, including some requiring concentration and others collaboration mostly with intra-team colleagues (Figure 4.5). They therefore spent more time in the office. These were also informants who followed the desk-sharing rule, switched workstations frequently, and started benefiting from using the different workspace solutions. *On activity level*, proximity to colleagues and satisfaction of individual needs, such as for daylight, views and privacy were identified as common matches. However, mismatches were also identified in the informants' activity systems, despite their reported satisfaction with the workspaces. These mismatches involved lacking storage solutions for dealing with printed documents, and a negative climate due to their colleagues' dissatisfaction and complaints regarding the AFO. *For actions* that required collaboration such as making a communication plan, common matches were quick access to colleagues and information exchange. *For actions* that required concentration, for example handling of social media updates, the mismatches were: distractions due to lack of speech policies and insufficient quiet spaces; worrying about distracting others; and set-up problems concerning the screens. A common match with regard to concentrative actions was deriving pleasure from working in different locations that were both desirable and functional such as touch-down spaces with power outlets and open meeting spaces with whiteboards.

ACTIVITY LEVEL



ACTION LEVEL



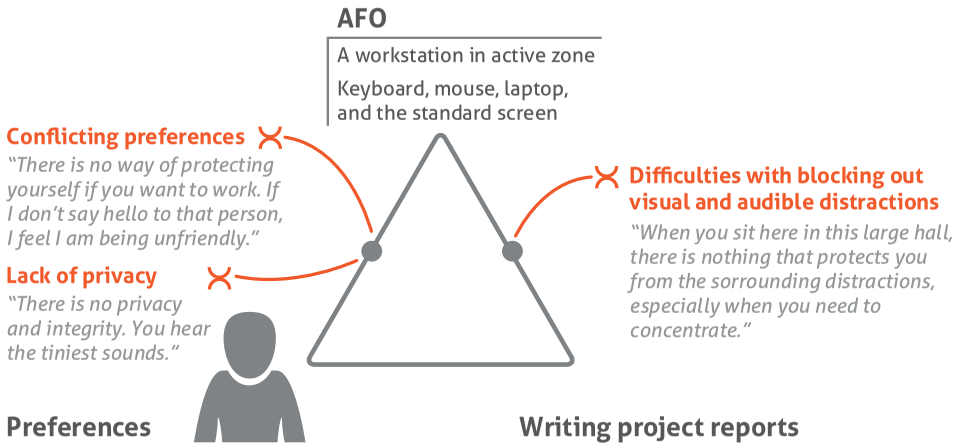


Figure 4.4. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who disregarded the desk-sharing rule.

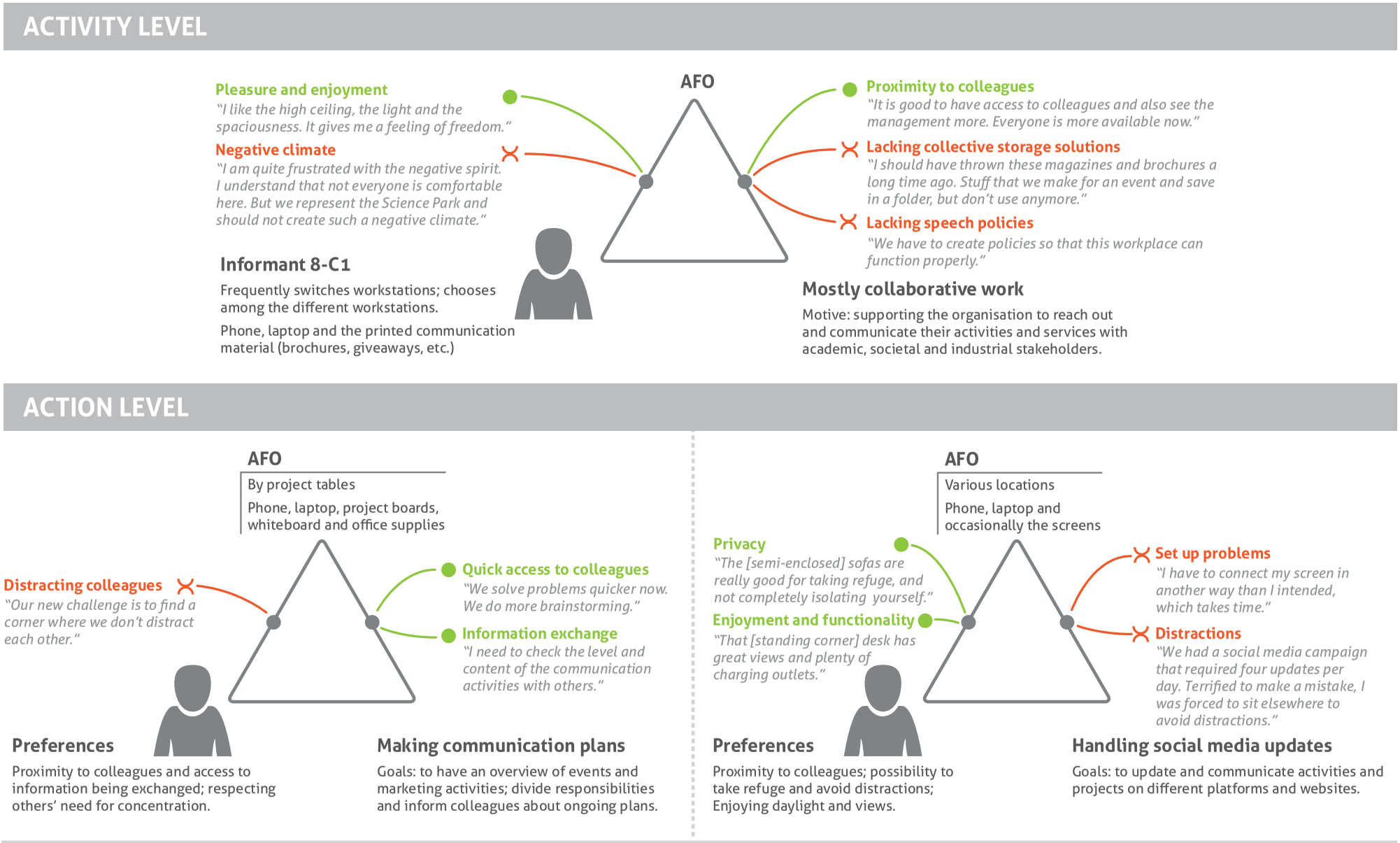


Figure 4.5. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule.

In general, the informants' preferences for workspaces conflicted with their activities. All the informants used the open zones due to a preference for social inclusion when they had work that required concentration, not taking advantage of the walk-in rooms. In addition, all the informants frequently used the meeting spaces in open zones, despite worrying about being overheard or disturbing others. This was due to their preference for access to daylight and views, which was not provided in any of the meeting rooms.

4.1.2. Appropriation of the AFO solution in Case 1

The identified issues and events that characterise different phases of appropriation are summarised in Figure 4.6. The informants' first encounters with the office solution started six months prior to relocation by receiving information about the layout, visiting the new office prior to relocation, and gradually moving their belongings in the first couple of weeks after the relocation. The few weeks post-relocation among those who were dissatisfied involved identifying artefacts that malfunctioned or had not yet been delivered. After initial familiarisation with the AFO solution, the informants started exploring different ways of using the premises: (i) some of the informants decided to follow the desk-sharing policy, (ii) others rejected the policy and used the same workstation, and (iii) a third group shifted between rejecting and adopting the desk-sharing policy. For those who followed the desk-sharing policy, the explorative phase involved identifying a few functioning workstations and finding compromises to minimise set-up time. After having identified preferred workstations, they repeatedly returned to the same workstation (stable phase). However, the set-up time was not eliminated and led to brief periods of *excitement* and work fragmentations in the otherwise stable state of appropriation. In contrast, those who rejected the desk-sharing policy left their belongings at one workstation throughout the fieldwork.

The length of the explorative and stable phase varied between the informants: (i) those who followed the desk-sharing policy had a short period of exploration and a long stable phase, (ii) those who shifted between following and rejecting the policy had a longer exploration phase before they reached a stable phase, and (iii) those who rejected the policy demonstrated limited or no exploration phase and had the longest duration of stability since they avoided the set-up problems. Apart from the adaptations that occurred over time, the informants desired changes in the AFO solution. Their desired adaptations ranged from macro changes, for instance having an enclosed area for the Science Park's main employees with dedicated workstations, to micro ones, such as adding bins.

	FIRST ENCOUNTERS	EXPLORATORY PHASE	STABLE PHASE
ACQUIRED INSIGHTS 	Gaining information regarding the solution six months prior to relocation; Identifying incomplete and missing instruments	Identifying pros/cons of the different workstations; Identifying desired improvements; Realising limitations on making improvements	Identifying problems with the limited workstation choices (due to dwelling)
BEHAVIOUR<AL ADAPTATIONS 	Decision to follow/reject desk-sharing	Re-evaluating the decision to follow desk-sharing; Devising routines for updating/informing/locating colleagues; Eliminating habits that distracted others	Encouraging dwellers to follow desk-sharing
INSTRUMENT ADAPTATIONS 	Dealing with insufficient storage and incompatibility of docking stations	Bringing individual instrument to resolve ergonomic problems associated with the collective instruments; Adding project boards; Reducing the number of personal instruments and printed documents; Dealing with set-up problems	Adding whiteboards and storage; Dealing with set-up problems
RULE-RELATED ADAPTATIONS 		Identifying the need to develop and communicate a quiet speech policy: when to/not to interrupt each other, or move away from the desks to take phone calls	Disregarding the quiet speech policy due to conflicting needs among the informants
PROCEDURAL ADAPTATIONS 		Changing time/day of weekly meetings to accommodate more colleagues; Devising processes to document and communicate progress	
HEDONIC ADAPTATIONS 	Novelty; Appreciation of access to colleagues; Deriving joy from using different workspaces	Negative atmosphere; Frustrations and disempowerment due to limitations on making improvements	Resignation; Acceptance of unlpeasant work environment

Figure 4.6. The appropriation process in case 1.

4.1.3. Planning and adaptation process in Case 1

Prior to relocation, all employees in Case 1 participated in a survey regarding needs and requirements, and a diary study for activity analyses. The choice of office type and its layout, and the business model behind the co-working spaces, was made by the facility owner who was one of the financiers of the organisation. Since multiple companies were going to use the same facilities, the facility management and the designers planned for spaces that could accommodate organisations with different needs. The employees were informed about the office type and the layout of the premises six months before the relocation. In other words, the employees did not have the opportunity to influence the design decisions and customise the solution to match their needs. In addition, the results from the initial surveys and diary studies were not used to inform the design decisions. The relocation, in general, was regarded as beneficial both from the informants' and the leadership's perspectives for the organisation's ability to provide collaboration opportunities for different stakeholders. However, some of the informants were not satisfied with either the physical work environment or the co-working space concept. They believed this was justifiable because they were the only tenants with desk-sharing rules to use

the premises full-time. Moreover, no workshop, training or support services were provided for employees to adopt flexible ways of working. These shortcomings in the planning process led to mismatches between the office solution for the informants' work, lack of ownership and belonging, as well as different use interpretations, and rejection of the concept.

Post-relocation, the premises were incomplete for several weeks, for instance sufficient storage was not provided, making it hard to follow the desk-sharing concept. Furthermore, the desk-sharing rules were not explicitly communicated to the employees and the application for booking workstations was neither introduced nor used. This led to different interpretations of the expted usage behaviour. During the explorative phase of appropriation, the employees documented and requested improvements (Figure 4.7). Furthermore, the results from this case study were presented for the facility management to encourage them to make improvements. Nonetheless, there were limited options for modification and improvement of the spaces. Since different organisations were using the premises, the facility management tried not to customise the solution. A critical improvement that the employees implemented was the introduction of a quiet speech policy to allow for uninterrupted work. However, the policy was discontinued due to conflicting needs and usage preferences among the employees, as well as failure in communicating the rule to other tenants. Lack of options for making improvements in the AFO to better match the informants' needs led to lingering mismatches and prevented symbiosis in the informants' activity systems.

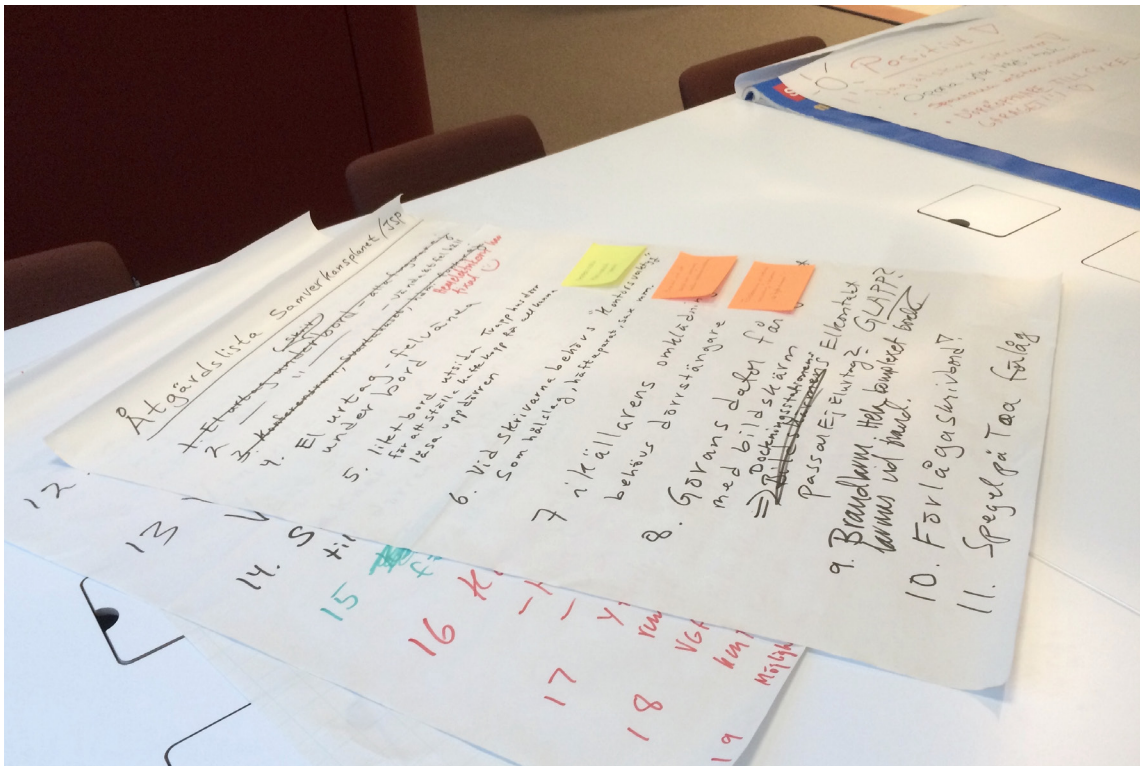


Figure 4.7. The informants documented and requested their desired modifications. These modifications were implemented partially due to limitations on customising the AFO imposed by the facility management.

4.2. Case 2: The Knowledge and Training Provider

The Knowledge and Training Provider (C2) had relocated from an open-plan office to an AFO. Their motive behind relocation to an AFO was to further develop their services as a knowledge and training provider by adding a venue for holding conferences and events, and to improve their work environment.

The organisation's services involved disseminating knowledge about work environment issues, that is to say knowledge related to occupational health and safety, and developing methods to support workplaces in work environment management. Work environment knowledge was disseminated by publishing educational material, books and magazines, and by offering courses and training.

The organisation had a total of 40 employees, 24 of whom volunteered to participate in the interview study. The informants' roles and responsibilities varied: (i) communication and marketing, including creating and editing printed or online content, (ii) project leadership, such as working with development of tools, methods, and knowledge with different stakeholders for work environment management, and (iii) administrative work, for instance providing support for holding courses, conferences and events or providing internal service and administration.

The AFO solution in Case 2 (Figure 4.8) was located on the second floor of a building, divided into two main areas separated by a public corridor: (i) conference venue and office spaces for administration, and (ii) the main office area comprising quiet, semi-quiet and active zones, and enclosed rooms for different activities.

4.2.1. Interdependencies between employee(s), their activities and the AFO solution in Case 2

The identified interdependencies in informants' activity systems are described here by summarising (i) usage preferences with respect to the desk-sharing rule, workspaces, and work instruments, and (ii) matches and mismatches between and the AFO solution and the informants' activities.

Usage preferences – Most informants (18/24) tried to switch desks on a daily basis, and all the informants removed their belongings when leaving. Switching workstations during workdays was only mentioned when the informants had different meetings or when they felt they had to move to the more quiet zones to concentrate on their tasks. Repeated use of the same workstations was observed in the scarce zones (i.e. walk-in rooms and the strictly quiet zone) and the allocated area for administrative staff. The reasons for using the same workstation varied among the informants: *work-related preconditions*, such as administrative responsibilities that required presence at the reception or activities that required dealing with confidential documents or conversations, to *individual preconditions*, for example personal circumstances, physical impairments, or individual preferences. The informants with physical impairments used a dedicated workstation. Nonetheless, they felt they were limited for following the desk-sharing rule and could not benefit from the range of spaces as much as the others did.

Case 2 - The Knowledge and Training Provider

Relocation year: 2016

Time elapsed post-relocation: 2.5 months

No. of interviewees: 24

No. of employees sharing the offices: 40

Workstation/employee ratio: 0.97

Office type before relocation: open-plan

Motives behind relocation: further development of their services as a knowledge and training provider by adding a venue for holding conferences and events, and improvement of their work environment.

Use policies

Employees were instructed to vacate workstations when leaving/by the end of the day.

The different zones for solitary work had pre-determined speech policies: semi-quiet, strictly quiet, and active zones.

Layout specification

Number of workstations and their intended functions	Open zones	Enclosed rooms (no. of rooms)
Solitary and concentrative work	4	3 (3)
Solitary work (some interruptions)	10	0
Solitary work (interruptions allowed)	16	6 (1)*
Collaborative work (2-4p)	8	4 (2)
Collaborative work (5p+)	6	34 (4)
Total no. of workstations	44	47 (10)

*There were additional facilities dedicated for the case organisation: (i) six workstations for employees responsible for administration of courses and events, and (ii) spaces for holding events and conferences.

Collective instruments

Each workstation for solitary work (39) was equipped with a height-adjustable desk, an adjustable office chair, dual screens, and a docking station. All employees had lockers and were provided with a toolbox for carrying belongings.

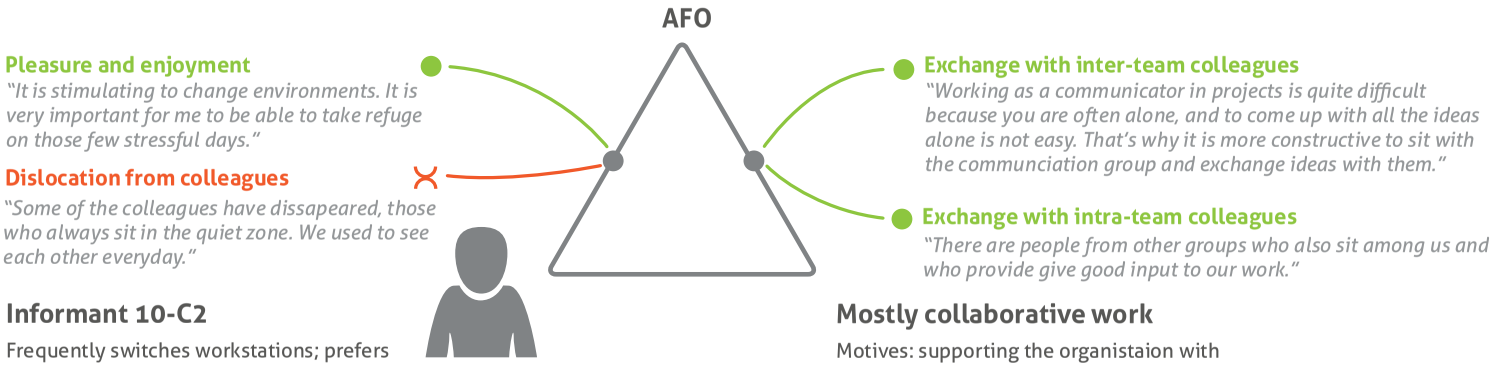
Figure 4.8. An overview of the AFO solution in Case 2: usage policies, specification of layout and the collective instrument included in the AFO solution.

The informants' usage of the AFO solution varied considerably in terms of workspace preferences. The informants working with communication and marketing (11/24) predominantly used the active zone, the publishing room and the stand-up meeting areas. The informants working with project leadership (4/24) mainly used the semi-quiet zone and the walk-in and meeting rooms. The administrative staff (9/24) worked either exclusively in the reception area or chose between the different spaces. All the informants had individual keyboards, computer mouses, and laptops, based on the employees' request during the planning process. Toolboxes were used to facilitate carrying these instruments, printed documents and office supplies. The collective instruments used by the majority of informants were dual screens and the office chairs. Discrepancies from expected usage were also observed: (i) the strictly quiet zone and one of the walk-in rooms were repeatedly used by the same informants and for this reason, the other informants avoided these spaces, (ii) the sofas with high backrests were disregarded, (iii) the workstations in the middle that exposed the informants' screens to passers-by were underused, and (iv) the application for integrating phone and chat functions was rejected by most of the informants since they already had such functions on their phones, thus not needing a new application that was perceived as unnecessary and difficult to learn.

Perceived work support – The majority of informants (19/24) were satisfied with the AFO solution and mentioned positive impacts on their performance. They appreciated the functional and aesthetic qualities of the office environment, and perceived the new office as a comprehensive upgrade in comparison with their previous open-plan offices. The informants satisfied with the AFO solution followed the desk-sharing rule and reported more matches in their activity systems than mismatches. However, the identified matches varied between informants depending on their activities (Figures 4.9 & 4.10).

On activity level, the informants with communication and marketing responsibilities reported on the ability to work side-by-side and exchange information with inter- and intra-team colleagues as the main way that the AFO supported their activities (Figure 4.9). They also mentioned matches related to enjoyment from switching workstations and access to walk-in rooms and quiet spaces. The only mismatch reported on activity level was dislocation from colleagues who did not use the active zone. *On action level,* the informants found the open meeting spaces a major improvement for their editorial meetings. For solitary work, such as editing videos, images or texts, the main matches were finding inspiration and getting immediate support through co-locating with different colleagues in active zones. The main mismatch for solitary actions was physical discomfort due to the insufficiently adjustable chairs.

ACTIVITY LEVEL



ACTION LEVEL

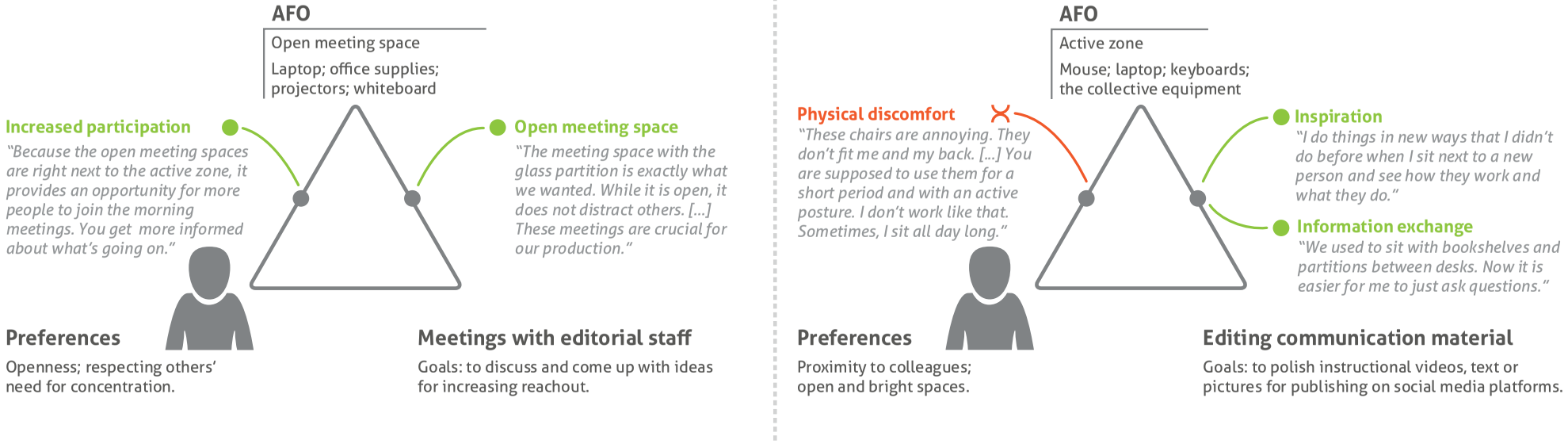
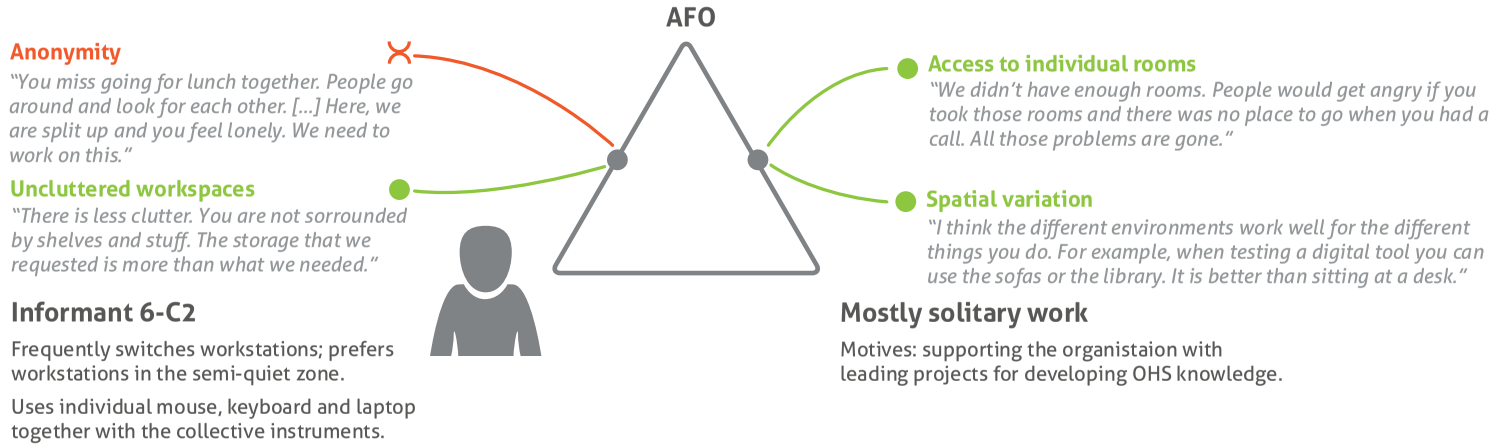


Figure 4.9. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule. (Activity: communiaction/marketing)

ACTIVITY LEVEL



ACTION LEVEL

Figure 4.10. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule. (Activity: knowledge development)

For activities that involved project management, the informants reported on the spatial variation and the access to individual rooms as one of the main ways the AFO supported their activity (Figure 4.10). In addition, decluttered workspaces were aligned with their individual preferences Furthermore, anonymity and dislocation from colleagues were reported misalignments with their preferences, due to use of the semi-quiet zone that discouraged conversations and separated the informants from colleagues in the active zone. *For actions* that involved collaborations with internal and external stakeholders, access to different meeting rooms was regarded as support by reducing misspent time for booking a meeting room. However, redundant applications that made phone contacts difficult to handle was mentioned as a mismatch for collaborations. *For actions* that involved solitary work, blocking out stimuli, appreciation of the freedom to choose a workstation and desirable ambient conditions were reported as matches between the action, the informants' preferences and the AFO (Figure 4.10).

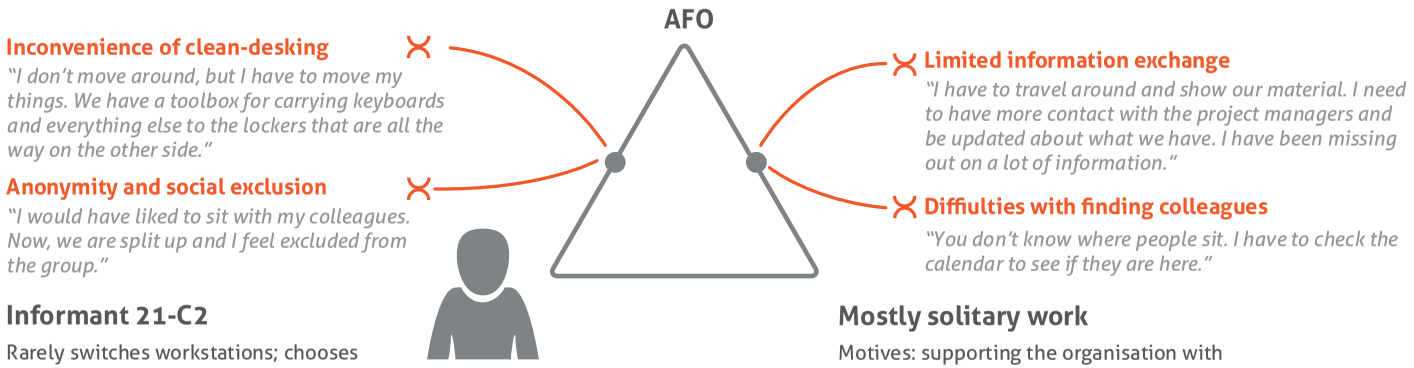
A few informants (5/24) were dissatisfied with the AFO solution and reported negative impacts on their performance. They either belonged to the administrative or the communication and marketing staff. The informants who were dissatisfied with the AFO solution disregarded the desk-sharing policy. They also reported more mismatches in their activity systems than matches (e.g. Figure 4.11). *On activity level*, dislocation from colleagues, anonymity and inconvenience with setting up and clearing out workstations were identified as common matches. *On action level,* recurrent mismatches related to difficulties with adjusting chairs and inflexible lighting, as well as work fragmentation and misspent time due to having to fetch belongings from lockers that were located away from the workstations. The recurrent match between the informants' preferences and the AFO, despite their dissatisfaction, was appreciation of the aesthetics of the work environment.

4.2.2. Appropriation of the AFO solution in Case 2

The first encounters with the AFO solution were through collectively choosing the AFO concept as their future office, involvement during the planning process, receiving information, study visits, workday simulations and preparations such as scanning documents*. Post-relocation, the interviewees started with experiments to identify the pros/cons of different spaces and simplify adjustment and setting up of their workstations. Most of the informants switched workstations. However, they dealt with instrument mismatches as a result of sharing spaces, for instance the screens were calibrated according to different preferences and had to be recalibrated. The majority of the informants reported that they had a slightly more positive attitude towards the AFO concept than before relocation and their worries regarding finding workspaces had been resolved.

* Prior to relocation, the informants sorted their folders and binders, scanned the paper documents that could be stored digitally, and reduced the number of paper documents. This was done to enable flexibility and facilitate adoption of the desk-sharing concept. However, the informants regarded this as a rather 'annoying' task.

ACTIVITY LEVEL



ACTION LEVEL

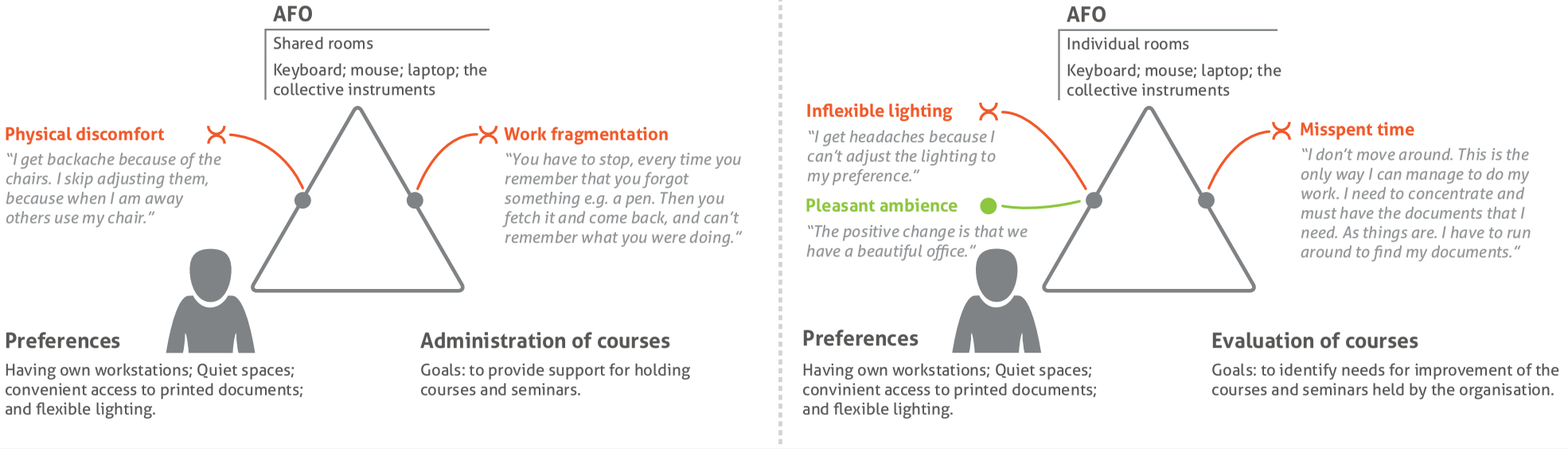


Figure 4.11. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who disregarded the desk-sharing rule.

At the time of data collection, the informants had identified favourite workstations. They had also received instructions on how to adjust the chairs, and had started experimenting with the digital application for locating colleagues. Social adaptations involved exchange with intra-team colleagues and proximity to supervisors. The identified adaptations that had occurred over time are reported in Figure 4.12. Despite the limited time post-relocation, most of the informants had adopted and adapted to the AFO solution, reaching a stable phase with a fruitful symbiosis between their activities, preferences and the AFO solution. However, some of the mismatches persisted in this phase and concerned difficulties with finding colleagues as they had not yet learned their colleagues' workspaces preferences. Other problems at this stage related to the missing instruments that had not yet been delivered, such as paper bins. The informants proactively verbalised suggestions for improving the AFO solution, and the data collection was used as an additional resource for evaluating and informing on ways to improve the AFO solution. The desired adaptations related to having dedicated spaces for those informants who were dissatisfied with the AFO solution, improving the lighting, adding more walk-in rooms, and redistributing the storage areas to avoid having to run around.

	FIRST ENCOUNTERS	EXPLORATORY PHASE	STABLE PHASE
ACQUIRED INSIGHTS 	Gaining information regarding the AFO solution via during the planning process; Identifying pros/cons of the different workstations	Identifying preferred workstations and their availability throughout a workday; Learning about colleagues' workstation preferences; Identifying a need for improving team cohesion	Participating in evaluations and identifying needs for improvement
BEHAVIOURAL ADAPTATIONS 	Decision to follow/reject desk-sharing	Finding routines for checking tasks before choosing workstations; Finding routines for switching workstations depending on daily schedule	
SOCIAL ADAPTATIONS 		Exchange with intra-team colleagues; Increased access to superiors; Disclocation from team members	
INSTRUMENT ADAPTATIONS 	Dealing with problems regarding adjustment of chairs, calibrating screens, digitalising documents	Receiving instructions on how to adjust the chairs; Devising solutions to replace permanent memory cues; Learning to use dual screens; Identifying problems with the new digital application	
PROCEDURAL ADAPTATIONS 		Expressing a need for devising processes to communicate central decisions	Planning improvements in the AFO solution
HEDONIC ADAPTATIONS 	Novelty; Appreciation of access to colleagues; Resolved worries about finding a place	Positive atmosphere; Appreciation of access to colleagues; Deriving joy from using different workspaces	

Figure 4.12. The appropriation process in case 2.

4.2.3. Planning and adaptation process in Case 2

The informants had participated in a survey regarding needs and expectations, and a workshop on how to improve their prior office environment. This had led them to identify problems with their offices and suggest different solutions, one of which was implementation of an AFO. Once the office type was decided, representatives from the different groups were involved in the planning process as a channel between the employees and the process leaders. Moreover, all employees participated in several workshops regarding their activities and needs, facilitated by workplace designers. Prototypes and plan drawings were used to facilitate employee involvement in the planning process and to inform design decisions. Furthermore, all employees were invited to AFO site visits and workshops that involved workday simulations. Moreover, approximately 25% of the employees participated as representatives in a reference group that had meetings every 2-4 weeks for the duration of the planning process (1.5 years). The representatives communicated decisions and concerns between the employees and the reference group. Management also communicated directly with those employees who expressed major concerns in order to address their needs. In addition, risk assessments were conducted. Two explicit rules concerning desk-sharing and speech policies were decided by the reference group who wanted to avoid having many rules for potential problems. To make sure that the rules were communicated to all the employees, several channels were used such as meetings, the intranet and the architectural drawings. Employee feedback on interior design and choice of furniture was sought through the reference group and during the workshops.

Post-relocation, evaluation efforts were initiated to document potential needs for improvement. In addition, ergonomic training for learning to adjust the chairs was held. Instructions were given on how to use the digital application for locating each other. The staff management and the project group realised there was a need for work environment management processes in AFOs and therefore formed a group of representatives to initiate work on improvements and modifications (e.g. Figure 4.13).

Figuer 4.13. Some of the planned adaptations that were later implemented concerned the aesthetics of the AFO and that the informants perceived it to have 'sterile' look. This was addressed by adding wallpapers and colourful details.

4.3. Case 3: The IT group at the Pharmaceutical Company

The IT Group (C_3) was a part of the Pharmaceutical Company that had relocated from open-plan offices to an AFO three months prior to data collection. Their relocation was part of a larger project that involved moving a total of 1100 employees to AFOs over a period of two years. The initial trigger for these relocations was space reduction. However, the motives evolved to ensure a good work environment and improve work processes. This included facilitating internal flexibility since the employees reportedly moved between departments on average 1.5 times/year within the organisation.

The IT group consisted of two divisions with a total of 100 in-house employees and 50 consultants. The group provided support for IT projects and service management of IT systems, and information analysis throughout the organisation. They had relocated to the first and second floors of a building. The second floor was chosen for recruiting informants, since it had no dedicated workstations/areas in contrast to the first floor that had allocated areas for some of the teams and employees. Ten in-house employees from the second floor volunteered to take part in the study. Six of the informants worked with resource allocation and management of IT systems used for research, development and regulatory groups, while the remaining four worked with information analysis, a service that was provided for the research projects at the Pharmaceutical Company.

The AFO solution in Case 3 (Figure 4.14) comprised quiet and active zones, and enclosed rooms for different activities. Apart from the collective instruments at workstations for solitary work, applications for note taking, direction-finding and locating colleagues were provided to facilitate flexible working. In addition, the majority of the walk-in and meeting rooms featured video-conference equipment.

4.3.1. Interdependencies between employee(s), their activities and the AFO solution in Case 3

The identified interdependencies are summarised here by describing the informants' usage preferences and the matches/mismatches in the informants' activity systems.

Usage preferences – All workstations were vacated at the end of the day, or for meetings lasting longer than 1-2 hours. However, the informants preferred to have their own workstations and did not appreciate the desk-sharing concept. Nonetheless, the informants' usage preferences varied considerably. Four informants mentioned that they returned to the same workstations in the quiet zone, and one of the informants had a dedicated workstation in the active zone that was extra-height adjustable. Those who switched workstations chose among workstations in active zones and the walk-in rooms, except one informant who chose between the walk-in rooms. The walk-in rooms were appreciated by all the informants, in particular those rooms that had windows/daylight and curtains that covered the glass walls and allowed for some privacy.

Case 3 - The IT Group at the Pharmaceutical Company

Relocation year: 2017

Time elapsed post-relocation: 3 months

No. of interviewees: 10

No. of employees sharing the offices: 75

Workstation/employee ratio: 0.92

Office type before relocation: open-plan

Motives behind relocation: space reduction, improving work processes and work environment, facilitating internal mobility.

Use policies

Employees were instructed to vacate workstations if they planned to be away longer than an hour. For walk-in rooms, the time limit was 20 minutes. All workstations featured information on desk-sharing and speech policies.

Layout specification

Number of workstations and their intended functions	Open zones	Enclosed rooms (no. of rooms)
Solitary and concentrative work	12	13 (13)
Solitary work (interruptions allowed)	44	0
Collaborative work (2-4p)	20	16 (6)
Collaborative work - bookable (5p+)	8	38 (4)
Total no. of workstations	84	67 (23)

Collective instruments

Each workstation for solitary work (69) was equipped with a height-adjustable desk, dual screens, a docking station, a mouse and a keyboard. In addition, there were various chair types to choose from. Employees had lockers at anchor points - assigned to teams or projects, and were provided with a backpack for carrying belongings.

Figure 4.14. An overview of the AFO solution in Case 3: usage policies, specification of layout and the collective instruments included in the AFO solution.

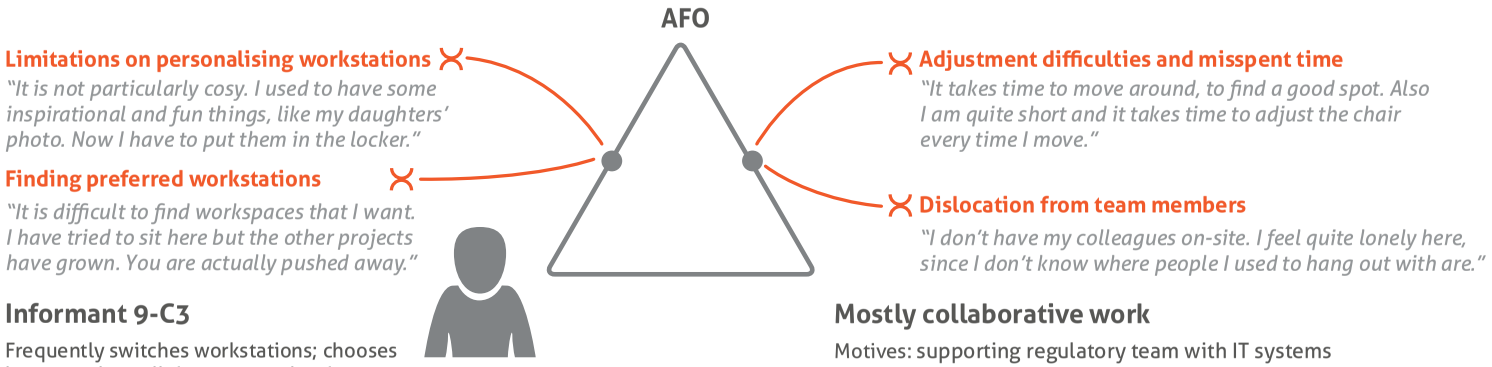
Based on the observations, the walk-in rooms intended for side-by-side work were used by one person, while the walk-in room intended for conversations was underused. Furthermore, most of the workstations in active zones were occupied, except for those that were located along the corridors, as was the open meeting spaces. In addition, the spaces in proximity to the quiet zone remained underused. Six informants used individual instruments, such as roller mouse, chairs, etc. (e.g. Figure 4.15), while others relied on the collective instruments. Among the different chair types that were provided, the informants chose the ones that were easiest to adjust. The screens that showed availability of the rooms were highly appreciated, while the mobile applications were found unnecessary and were disregarded.

Figure 4.15. Examples of the individual instruments that were preferred over the collective ones were mouses and keyboards. The informants who used more individual instruments had to carry these around, and the provided backpacks were too small for this. One informants brought a suitcase to facilitate carrying individual instruments. In addition, the collective instruments were not sufficiently adjustable, for example the screens. Therefore, the informant had to use a book to raise the screen according to her preference.

Perceived work support – A majority of informants (8/10) were dissatisfied with the AFO solution and all the informants perceived a decline in their performance post-relocation. This was due to mismatches in their activity systems: (i) misspent time, work fragmentation and physical discomfort due to a need to set up, sanitise, adjust and pack away belongings when switching workstations; and (ii) dislocation from immediate colleagues, reduced collegial support and limited exchange of relevant information. These mismatches were reported despite the differences in the informants' activities. However, there were some differences in the reported mismatches that concerned the preconditions of the informants' activities and actions. Figure 4.16 illustrates the identified mismatches for an informant who worked with management of IT systems that comprised mostly external collaborations. *On activity level*, the informants with similar work mentioned feelings of alienation and lack of motivation for spending time at the workplace, and had thus started to work from home more often than they had done prior to relocation. This was a result of having anchor points dedicated to teams, and lacking dedicated areas for those who had external collaborations. *For actions* that involved resource allocation, common mismatches were: distractions and high traffic in the active zone; limitations on having confidential conversations; unhygienic collective instruments; conflicts between preferences for using the quiet zone and preconditions of being available for inter-team colleagues and thereby being obliged to use the active zones. *For actions* that required coordination with intra-team colleagues, the common mismatches were difficulties with locating and co-locating with colleagues and finding available walk-in rooms (Figure 4.16). Furthermore, the informants who used more individual instruments reported problems regarding carrying, setting up, and clearing out the instruments, while the informants who used more collective instruments reported difficulties with adjusting workstations, for instance chairs or screen height and angle, leading to physical discomfort.

The two informants who were satisfied with the AFO solution mentioned that it worked better than expected, despite the mismatches that they reported. Figure 4.17 illustrates the identified matches and mismatches for an informant who worked with information analysis that required mostly solitary and concentrative actions, and who mainly used the quiet zone. For actions that required concentration, matches encompassed the ability to work uninterrupted in the quiet zone. For actions that required collaboration and coordination, reported matches were: provision of walk-in rooms in proximity to the quiet zone for taking calls and minimising the exposure to others' calls; and desirable ambient conditions such as light and the views in these rooms. These informants also reported mismatches in their activity systems, such as misspent time for setting up of workstations; dislocation from immediate colleagues imposing limitations on quick exchanges of information; insufficient partitions and visual distractions in the quiet zone; a lack of temporary storage for charging laptops; problems with choosing between chairs; and limitations on having their own whiteboards.

ACTIVITY LEVEL



ACTION LEVEL

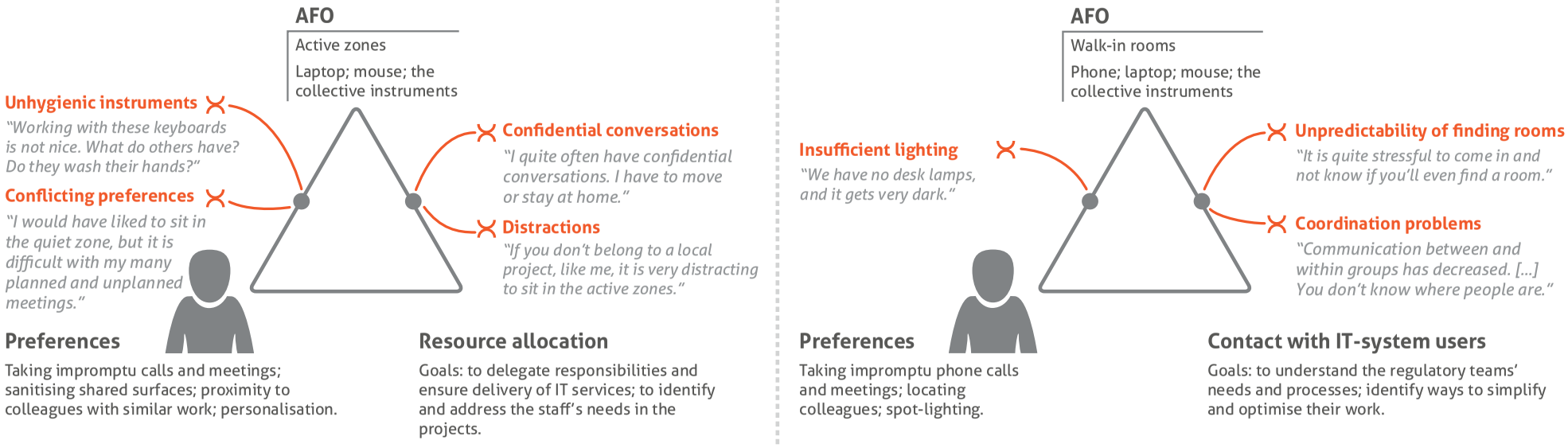
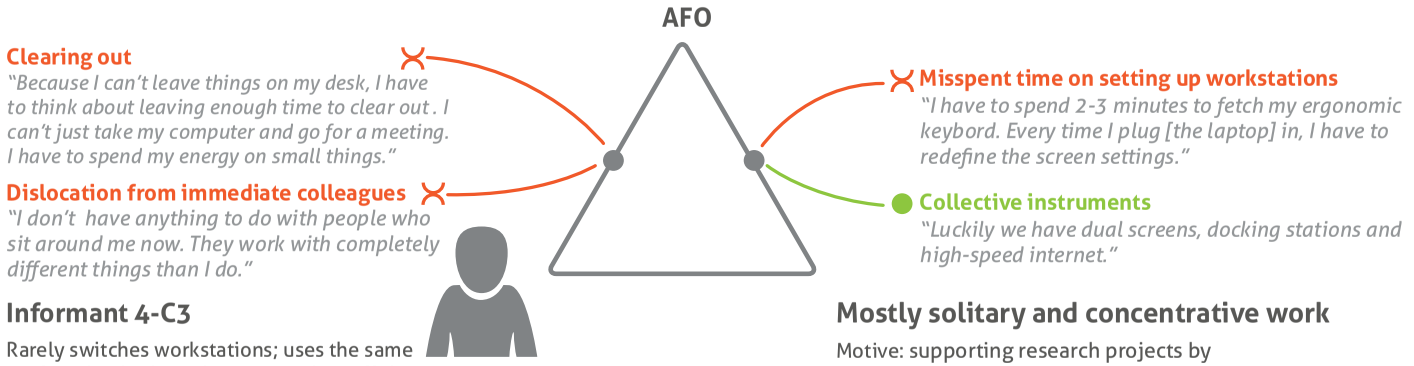
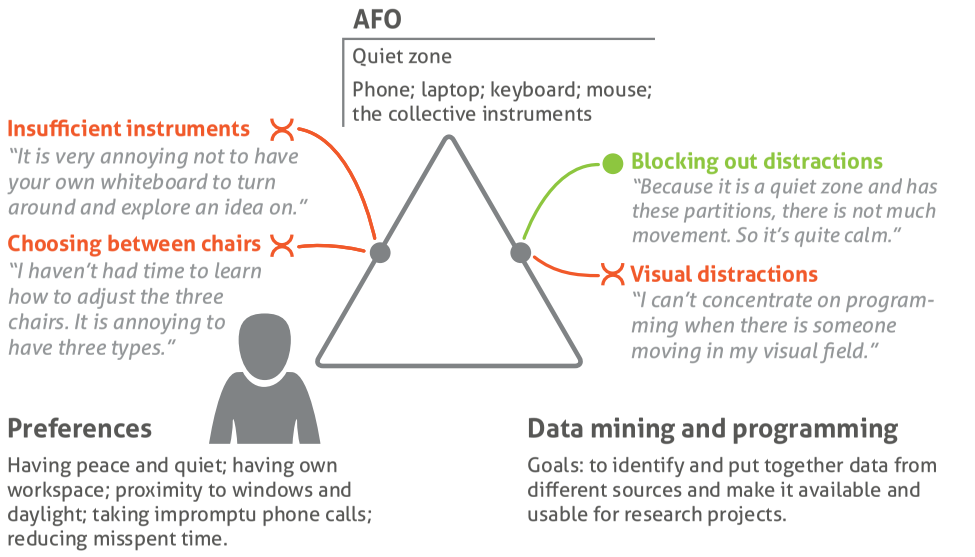


Figure 4.16. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who disregarded the desk-sharing rule.

ACTIVITY LEVEL



ACTION LEVEL



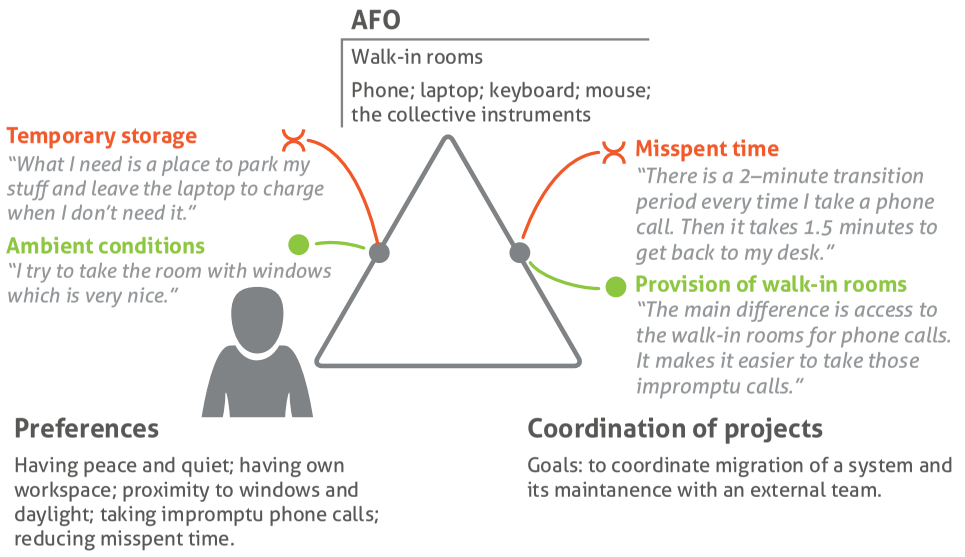


Figure 4.17. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule.

4.3.2. Appropriation of the AFO solution in Case 3

The informants' first encounters with AFO solutions started two years before their relocation, as the other groups at the organisation were being relocated to the same building that they worked in. These first encounters involved visiting the other floors, occasional collaboration with colleagues from other groups, as well as receiving information on the AFO solutions at the organisation and participating in the planning process, and preparations such as scanning documents.

Post-relocation, some informants returned to the same workstations to minimise set-up problems while others switched workstations and reported set-up problems. Half the informants reported that they had a slightly more positive opinion about the AFO concept than before relocation and their worries about finding workspaces had been resolved. Others had either a more negative or an equally negative opinion about the AFO concept. This was due to the initial mismatches that emerged in the informants' activity systems, such as missing instruments at the time of relocation. At the time of this study, the informants were exploring different ways of resolving the mismatches and gaining insights on how to use the AFO solution. For example, some of the informants addressed mismatches by 'quick fixes' (such as installing an additional panel to minimise visual distractions or adding books under the screens to adjust to preferred height). Another example was finding a preferred workspace and returning to it, to minimise mismatches experienced in other spaces. However, the informants had not yet been able to fully explore the concept due to limited time, so the identified mismatches remained unresolved. The identified characteristics of the different phases of appropriation are summarised in Figuer 4.18.

Despite the limited time post-relocation, the informants requested minor as well as major modifications. Apart from requesting the missing instruments that had not yet been delivered (e.g. the desk lamps), the informants suggested building additional walls to block out noise in the quiet zone, adding partitions and curtains in the different spaces, adding charging stations for temporarily leaving computers and phones, as well as replacing the underused and undesirable furniture. The line management had announced that evaluation of the solution and eventual modifications would take place six months after relocation.

4.3.3. Planning and adaptation process in Case 3

The IT group was among the last groups in the project to be relocated to AFO at the Pharmaceutical Company. The design and implementation process consisted of three stages: (i) defining aspirations, visions and guiding principles for developing the AFO solution, (ii) developing concepts for the physical and digital work environment as well as intended usage and behaviour, and (iii) realisation of the concept. Group representatives were involved in the process of identifying and communicating needs and requirements, as well as reporting progress back to the group. The informants were involved in making decisions on and giving input for design of the AFO solution. Prototypes and plan drawings were used to facilitate employee involvement in the planning process. The informants found the planning and implementation process thorough. However, they perceived cost-reduction as the only motive for relocating to the AFO, and found limitations in having own workspaces since this was an

'authority innovation-decision' made by the leadership and the facility management. For this reason, the AFO solution was not appreciated despite the employees' involvement and influence on design of the AFO. In addition, the solution was regarded as incomplete at the time of relocation and lacked some of the instruments such as desk lamps, separating panels, and extra height-adjustable desks. This led to mismatches in employees' activity systems at the time of data collection.

	FIRST ENCOUNTERS	EXPLORATORY PHASE	STABLE PHASE
ACQUIRED INSIGHTS	Visiting and testing AFOs on other floors; Receiving info and involvement in the planning process; Identifying missing instruments	Identifying pros/cons of the different workstations; Identifying desired spatial and instrument improvements; Learning about colleagues' workstation preferences	Planning for evaluations
BEHAVIOURAL ADAPTATIONS	Following desk-sharing policy after relocation vs. finding a preferred workstation to return to	Developing routines for choosing workstations, and setting up and packing away instruments; Incorporating the set-time into planning	
INSTRUMENT ADAPTATIONS	Minimising reliance on printed documents; Difficulties with setting up workstations	Eliminating personal instruments vs. returning to the same workstation to minimise set-up problems; Making quick fixes at workstations to resolve mismatches	Planning for further improvements
SOCIAL ADAPTATIONS	Difficuties with locating colleagues	Dislocation from immediate colleagues; Networking with intra-team colleagues	
PROCEDURAL ADAPTATIONS			Devising routines for making improvements in the AFO and managing OHS issues
HEDONIC ADAPTATIONS	Anonymity and isolation from colleagues	Negative atmosphere; Frustrations due to dislocation from colleagues, lack of group cohesion, and misspent time	

Figure 4.18. The Appropriation Process in Case 3.

Post-relocation, the line management in Case 3 aimed to evaluate the consequences of the AFO after six months. This involved using an internal survey for evaluation, following up on employees' worries and concerns expressed prior to relocation, and forming an AFO group to monitor and address OHS (Occupational Health & Safety) issues. During the member checks, representatives from Case 3 reported a number of modifications that had taken place after data collection. For example, they had resolved some instrument problems: desk lamps and better mouse mats for all workstations were acquired. They had also discussed strategies and insights for encouraging flexible use of workstations among the employees, for instance encouraging employees to use the quiet zones more often for concentrative work to avoid distractions. Additional spatial adaptations were planned such as reconfiguring the underused spaces to allow for having more workstations, provision of more

sound-absorbing panels and the addition of more whiteboards and other requested instruments. Figure 4.19 provides examples of these implemented and planned adaptations. These improvements in the AFO solution were planned to make the AFO better match the informants' needs and resolve the identified mismatches and disturbances in the informants' activity systems.

Figure 4.19. Examples of planned and implemented spatial adaptations. Left: the underused quiet area was planned to be replaced with workstations for solitary work. Right: panels were added to the quiet area for reducing distractions.

4.4. Case 4: The Regulatory Group at the Pharmaceutical Company

The Regulatory Group (C4) belonged to the same biopharmaceutical company and had relocated to the same building, as did Case 3. They had relocated from different types of offices (cell-offices and open-plan offices) to the AFO solution, two years prior to data collection.

The regulatory group consisted of three divisions and 80 in-house employees. Twelve in-house employees from this group volunteered to take part in the study. Their work concerned Regulatory Operations, with the overall motive of ensuring that regulatory and legal obligations and requirements of health authorities were met efficiently and effectively when the company applied for permission to introduce and distribute new pharmaceutical products in different countries. Their work involved reviewing submissions, authored by researchers and developers in the organisation, and matching these reports to the technical requirements that the health authorities in different countries require. Some of the informants worked with resource allocation in this group, while others worked with programs and processes for identification and documentations of the requirements of each health authority and handling of the submissions.

The AFO solution in Case 4 (Figure 4.20) comprised active zones, an enclosed quiet zone and rooms for solitary and collaborative activities. Apart from the collective instruments at workstations for solitary work, applications for note taking, direction-finding and locating colleagues were provided to facilitate flexible working. In addition, the majority of the walk-in and meeting rooms featured video-conference equipment.

4.4.1. Interdependencies between employee(s), their activities and the AFO solution in Case 4

The identified interdependencies in informants' activity systems concerned (i) usage preferences with respect to the desk-sharing rule, workspaces, and work instrument, and (ii) matches and mismatches between and the AFO solution and the informants' activities.

Usage preferences – Half the informants (6/12) mentioned that they frequently switched workstations, while others periodically used the same workstation. Nonetheless, all the workstations were vacated at the end of each workday. The informants used the active zone, and stayed close to their anchor point. The walk-in rooms, especially those with windows and sufficient collective instruments, were appreciated by all the informants, and used frequently for concentrative activities and video conference calls. The informants also appreciated the collaborative spaces. The informants who did not switch workstations used individual instruments such as roller mouse, keyboard and their own chairs, while others relied on collective instruments. Reliance on individual chairs, keyboards and mouses was due to individual preconditions such as back or shoulder pains. These made it difficult for the informants to switch workstations.

Case 4 - The Regulatory Group at the Pharmaceutical Company

Relocation year: 2015

Time elapsed post-relocation: 2 years

No. of interviewees: 12

No. of employees sharing the offices: 80

Workstation/employee ratio: 0.87

Office type before relocation: cell- and open-plan

Motives behind relocation: space reduction, improving work processes and work environment, facilitating internal mobility.

Use policies

Employees were instructed to vacate workstations if they planned to be away longer than an hour. For walk-in rooms, the time limit was 20 minutes. All workstations featured information on the desk-sharing and speech policies.

Layout specification

Number of workstations and their intended functions	Open zones	Enclosed rooms (no. of rooms)
Solitary and concentrative work	4	12 (12)
Solitary work (interruptions allowed)	54	0
Collaborative work (2-4p)	24	20 (6)
Collaborative work - bookable (5p+)	0	14 (2)
Total no. of workstations	86	46 (20)

Collective instruments

Each workstation for solitary work (except 2/70) was equipped with a height-adjustable desk, dual screens, a docking station, a mouse and keyboard. In addition, there were various chair types to choose from. Employees had lockers at anchor points - assigned to teams or projects, and were provided with a backpack for carrying belongings.

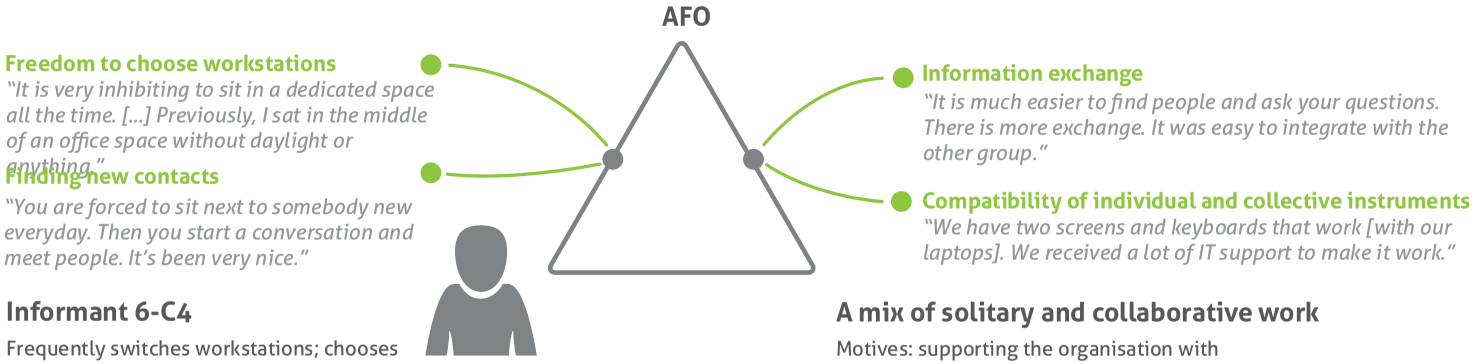
Figure 4.20. An overview of the AFO solution in Case 4: usage policies, specification of layout and the collective instruments included in the AFO solution.

Observed discrepancies from expected usage included: (i) some of the chair types were difficult to adjust and therefore disregarded; (ii) the quiet zone was perceived as dark and unpleasant and therefore remained underused despite the informants' needs for quiet spaces; (iii) the workstations along the corridors with high traffic were avoided; (iv) the furniture and sofas in proximity to the desks were underused; (v) the walk-in rooms for side-by-side work were used by only one person; (vi) the walk-in rooms with low-height furniture and/or without windows were underused; (viii) the collective instruments in the walk-in rooms had disappeared; and (ix) the digital phone application for locating colleagues and available rooms was not adopted by the majority of informants.

Perceived work support – The majority of informants (10/12) in Case 4 were satisfied with the AFO solution and appreciated the physical work environment. They reported matches between the AFO and their activities and preferences (e.g. see Figure 4.21). *On activity level*, the recurrent matches reported by informants were information exchange and increased support from inter- and intra-team colleagues that helped expand their understanding of the organisation and improve their services regarding regulatory operations. Some of the informants mentioned that this had resulted in developing their skills and career development opportunities. The informants appreciated the freedom to choose where to sit, and found the collective instruments to be compatible with their individual instruments. *For actions* that required coordination with colleagues, the reported matches were the ability to work side-by-side and the information exchange within groups. In addition, having uncluttered spaces aligned with the informants' preferences. *For actions* that involved solitary work, the reported matches were: blocking out stimuli, and quick set-up of workstations due to having easily adjustable chairs and compatible collective instruments. Missing collective instruments was the only mismatch reported regarding instruments. Some informants mentioned mismatches with regard to the insufficient number of walk-in and bookable rooms; and the undesirable ambient conditions of the quiet zone. However, these mismatches were seen as temporary and avoidable since the informants switched workstations and did not feel obliged to use the less desirable spaces.

The informants who were dissatisfied (2/12) with the AFO solution reluctantly followed the desk-sharing rule, but periodically used the same workstations (e.g. see Figure 4.22). *On activity level*, the informants reported mismatches due to limitations on leaving belongings at workstations, annoyance with clean-desking, and lack of group cohesion. *On action level*, the informants reported mismatches with regard to distractions in active zones, unpredictability of finding available walk-in rooms, and misspent time as a result of having to clear out workstations. Having individual chairs was important for these informants due to a history of back and shoulder pains. Therefore, they had marked their chairs to prevent others from re-adjusting the chairs when they were elsewhere. However, they reported that these chairs were occasionally re-adjusted. Another mismatch related to maintenance problems and a need to report missing collective instruments. Due to the outlined mismatches, the informants mentioned that they were less motivated in the workplace and tried to work from home more often.

ACTIVITY LEVEL



ACTION LEVEL

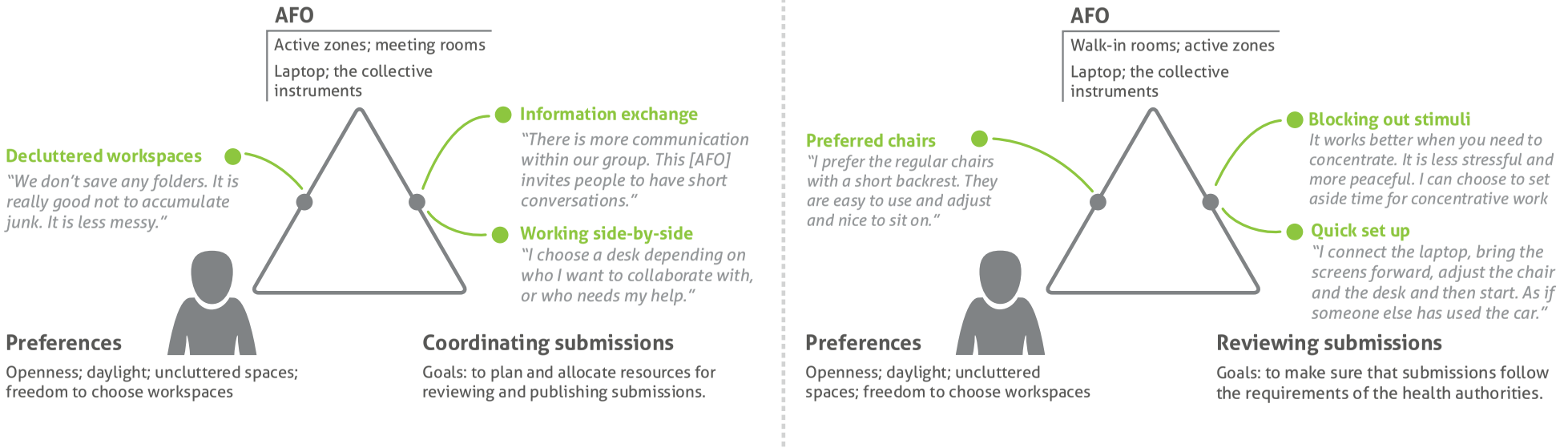
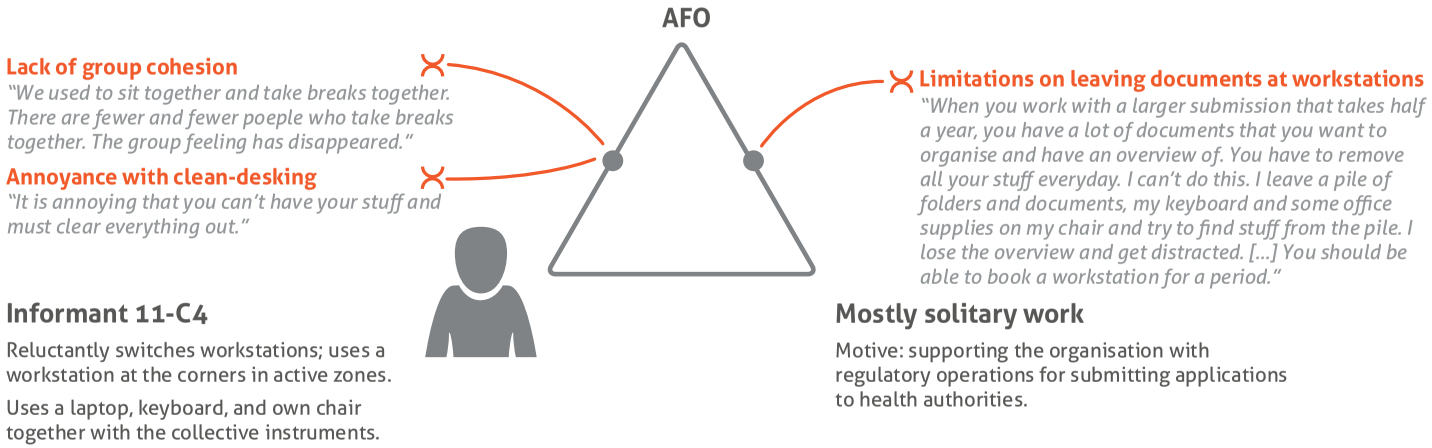


Figure 4.21. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule.

ACTIVITY LEVEL



ACTION LEVEL

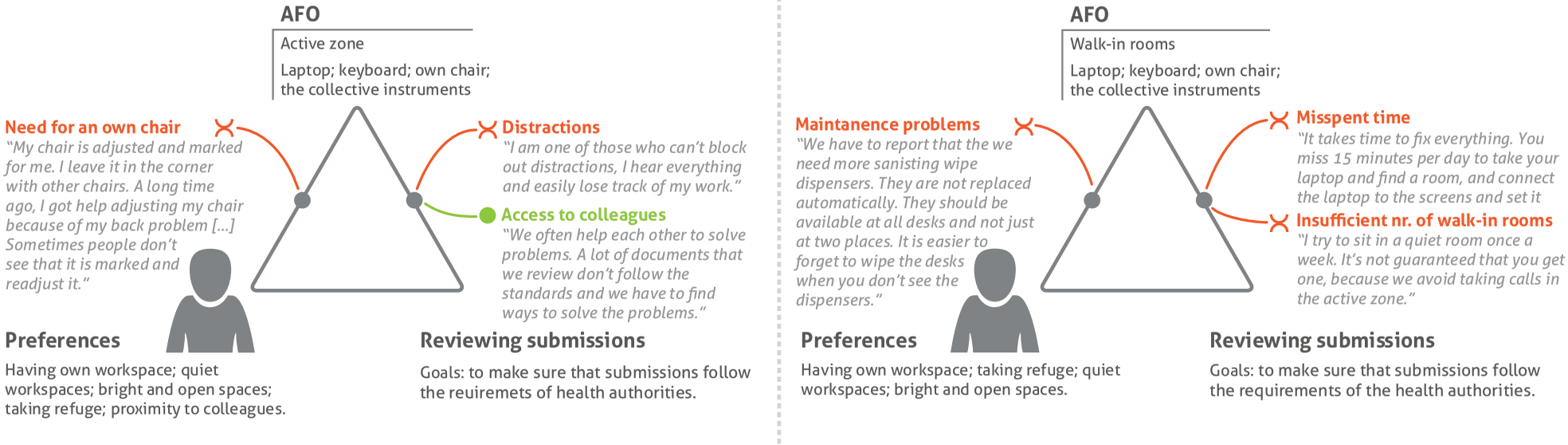


Figure 4.22. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who reluctantly followed the desk-sharing rule.

4.4.2. Appropriation of the AFO solution in Case 4

The informants' first encounters with the AFO solution involved receiving information during the planning process and preparations prior to relocation. Post-relocation, the majority of informants followed the desk-sharing policy and gained insights regarding the different workstations, as well as their colleagues' workstation preferences. They mentioned initial problems such as difficulties in setting up workstations, worry over finding available workstations and difficulties in finding colleagues. In the explorative phase, the informants identified workstations that matched their different activities, gained insights on colleagues' workspace preferences, experimented with allocating spaces to projects or for training new employees for a short period, and identified strategies to minimise set-up time and eliminate set-up problems. In addition, spatial and instrument modifications were made in the AFO solution to make it better match the employees' needs. These adaptations had reduced the initial excitement and mismatches that the informants had experienced during the first encounters, and thereby led to a *fruitful symbiosis* in the informants' activity systems during the stable phases of appropriating the AFO solution. They mentioned that they were more (or equally) satisfied with the AFO solution compared to before relocation and earlier after relocation (Hedonic adaptations). The identified adaptations that characterise the different phases of appropriation are summarised in Figure 4.23.

The only desired adaptation mentioned by the informants was having more walk-in and bookable rooms.

4.4.3. Planning and adaptation process in Case 4

The regulatory group was among the first groups to be relocated to AFO in the Pharmaceutical Company. The design and implementation process consisted of three stages: (i) defining aspirations, visions and guiding principles for developing the AFO solution, (ii) developing concepts for physical and digital work environment as well as the intended usage and behaviour, and (iii) realisation of the concept. The informants found the planning and implementation process to be thorough, especially regarding the consideration given to their needs and the information they received throughout the process. Prototypes and plan drawings were used to facilitate employee involvement in the planning process. Furthermore, the informants' perception of motives and visions for relocating to AFOs was in line with the process teams' intentions. Clear communication, the opportunities given to express their needs, and having taken employees' needs into consideration during the planning process led to creating a workspace solution that matched employee needs and was thereby appreciated.

Post-relocation, the line management from the Regulatory Group and the facility management developed processes for making better use of the AFO solution post-relocation. They initiated and engaged in processes for improving the employees' work environment and addressing OHS (Occupational Health & Safety) issues. This involved creating an AFO forum with the management and employee representatives, devising a suggestion box and holding monthly meetings to go through and address employees' suggestions and work environment issues, as well as appointing a helpdesk for dealing with error reports or missing instruments in the facilities.

	FIRST ENCOUNTERS	EXPLORATORY PHASE	STABLE PHASE
ACQUIRED INSIGHTS 	Receiving information regarding the AFO solution and involvement in the planning process	Identifying pros/cons of the different workstations; Identifying colleagues' workstation preferences	Identifying crowded days/hours at AFO; Identifying workspace availability
BEHAVIOURAL ADAPTATIONS 	Decision to follow the desk-sharing policy	Developing routines for choosing workstations, and setting up and packing away instruments; Incorporating the set up time into planning; Adapting tone of voice in the open zones	
INSTRUMENT ADAPTATIONS 	Minimising reliance on printed documents; Difficulties with setting up workstations	Eliminating personal instruments; Finding tools/applications for remembering tasks/recording information; Identifying chairs that were easy to adjust; Upgrading and improving the collective instruments; Introducing an application for way-finding and locating colleagues	Maintanence issues; Replacing mal-functioning instruments
RULE-RELATED ADAPTATIONS 		Devising local speech rules and communicating them for the open zones	
SPATIAL ADAPTATIONS 	Difficulties with finding colleagues	Removing underused furniture; Adding sound-absorbing panels; Adding more workstations for solitary work; Reconfiguring the collaborative spaces based on observed needs	
SOCIAL ADAPTATIONS 		Getting to know inter-team colleagues; Improved intra-team collaborations and exchange	
PROCEDURAL ADAPTATIONS 		Regroupings for improved intra-team collaboration; Devising suggestion boxes & ceating an AFO forum to identify and resolve OHS issues	Appointing a 'help-desk' for dealing with error reports
HEDONIC ADAPTATIONS 	Novelty; Appreciating the aesthetics and newness of the premises; Frustrations with misspent time	Appreciating the AFO design, views, lightness of premises, and quality of workstations; Appreciating access to inter- and intra-team colleagues	Feeling ownership of the workspace; Appreciation of the AFO solution

Figure 4.23. The Appropriation Process in Case 4.

The implemented modifications ranged from spatial and instrument adaptations (e.g. Figure 4.24) to finding ways to discourage implicit ownership of spaces, to temporarily occupying certain spaces depending on the employees' and the groups' needs or activities. However, some of the mismatches persisted regardless of the identified adaptations and modifications. These included distractions in open zones, a need for more walk-in rooms, and the additional task of sanitising work surfaces. In addition, new mismatches emerged as new employees and groups joined the premises. The ongoing organisational process of addressing and resolving mismatches continued to address the emerging issues. The informants appreciated the ability to modify and customise the AFO solution, and the assistance they had received – in terms of IT support and ergonomic training – and mentioned that they had been able to customise the AFO solution to fulfil their needs.

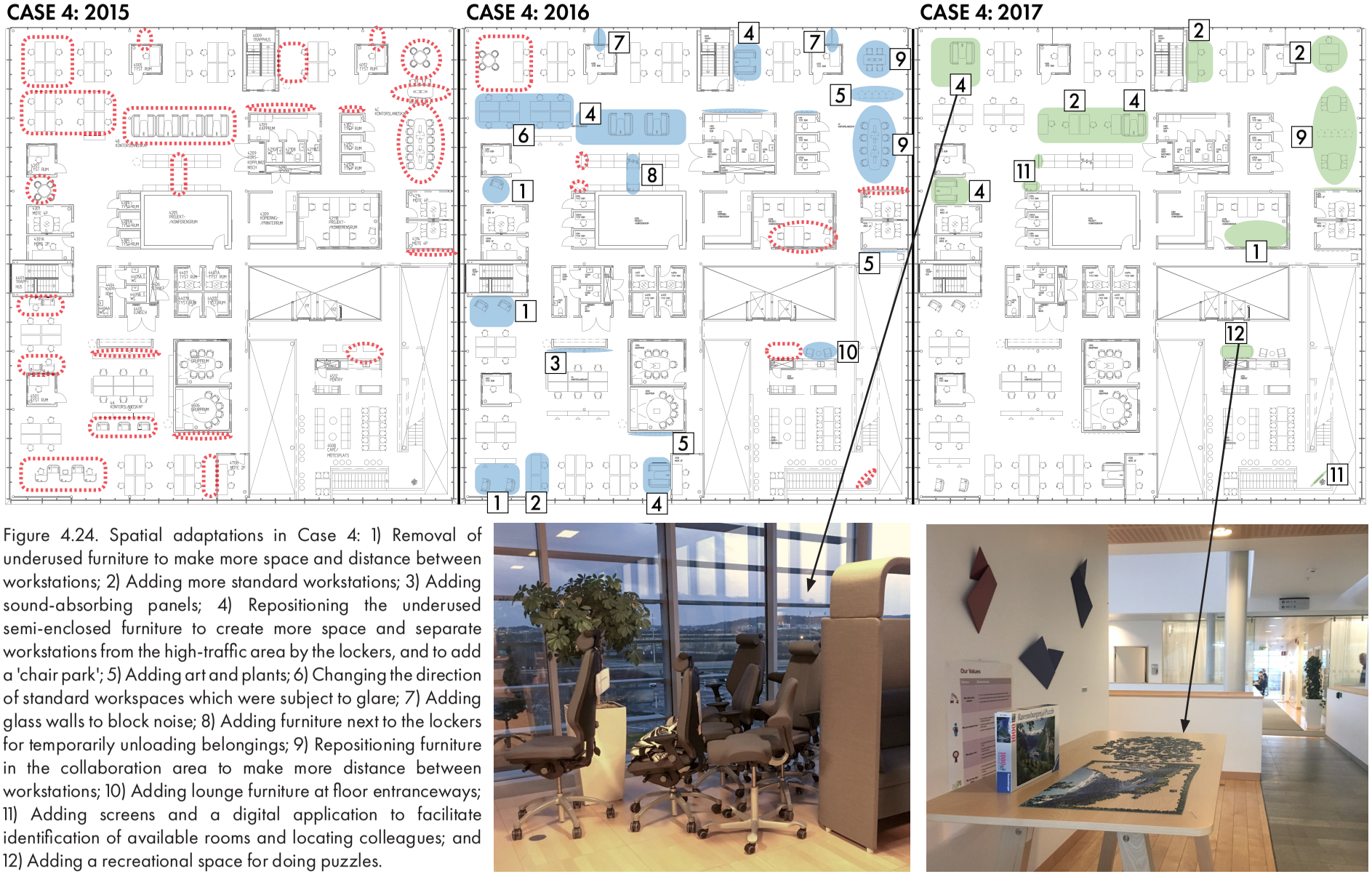


Figure 4.24. Spatial adaptations in Case 4: 1) Removal of underused furniture to make more space and distance between workstations; 2) Adding more standard workstations; 3) Adding sound-absorbing panels; 4) Repositioning the underused semi-enclosed furniture to create more space and separate workstations from the high-traffic area by the lockers, and to add a 'chair park'; 5) Adding art and plants; 6) Changing the direction of standard workspaces which were subject to glare; 7) Adding glass walls to block noise; 8) Adding furniture next to the lockers for temporarily unloading belongings; 9) Repositioning furniture in the collaboration area to make more distance between workstations; 10) Adding lounge furniture at floor entranceways; 11) Adding screens and a digital application to facilitate identification of available rooms and locating colleagues; and 12) Adding a recreational space for doing puzzles.

4.5. Case 5: The Section for Care and Elderly Support

The section for Care and Elderly Support (C5) was a part of a Municipality that had relocated from cell-offices to an AFO, three years prior to data collection. The relocation of the Municipality was triggered by maintenance problems in their former property that was closed down by the Swedish Work Environment Authority. The motives for choosing an AFO solution were to (i) allow for flexibility and mobility, (ii) facilitate collaborative and solitary work, and (iii) promote meetings between employees and the general public. The Municipality's AFO solution consisted of 6 floors, divided into different areas and dedicated for specific groups.

The section had a total of 58 employees, 14 of whom participated in the interview study. Their main responsibilities were planning, providing and evaluating the support and care for individuals with physical and/or psychological functional impairments. Some of the informants (6/14) worked with resource allocation and management and training of personnel for provision of elderly care, personal assistance, rehabilitation support, and public health activities. Others (4/14) worked with improving the processes for resource allocation and staff management; while a few (2/14) evaluated the quality of care provided to care recipients and followed up on cases of reported complaints.

The section had an allocated area on the second floor of the Municipality's AFO premises. Their AFO solution (Figure 4.25) comprised quiet, semi-quiet and active zones, as well as enclosed rooms for solitary or collaborative activities.

4.5.1. Interdependencies between employee(s), their activities and the AFO solution in Case 5

The identified interdependencies in informants' activity systems are described here by summarising (i) usage preferences with respect to the desk-sharing rule, workspaces, and work instruments, and (ii) matches and mismatches between and the AFO solution and the informants' activities (in general and with regard to their actions), thereby identifying features of the AFO solution that support or impede informants' activities.

Use preferences – The informants' use of the AFO varied considerably in terms of following or rejecting the desk-sharing policy, and preferred workspaces and instruments. Some of the informants (6/14) returned to the same workstation on a daily basis, while others (8/14) switched workstations. In the latter group, two informants chose solely among the scarce zones (walk-in rooms), while the others chose between different zones and rooms. The informants who switched workstations expressed worries and stress due to having to compete over finding decent workstations, due to a large number of employees disregarding the desk-sharing rule. The informants who switched workstations avoided workstations frequented by a team or a colleague. Their workstation choices were based on individual preference for respecting others' territories, despite their needs.

Case 5 - The Section for Care and Elderly Support at the Municipality

Relocation year: 2015

Time elapsed post-relocation: 3 years

No. of interviewees: 14

No. of employees at the section: 58

Workstation/employee ratio at the section: 0.87

Office type before relocation: cell-offices

Motives behind relocation: addressing maintenance problems in former offices (that was closed down by the Swedish Work Environment Authorities), allowing for flexibility and mobility, facilitating collaborative and solitary work, and promoting meetings between employees and with the citizens.

Use policies

Employees were instructed to vacate workstations when leaving. Speech policies were communicated through signs in each zone: Quiet zone (no conversations allowed); Semi-quiet zone (short conversations allowed); Active zone (conversations allowed).

Information on use policies were summarised together in a document available on their homepage.

Collective instruments

Each workstation for solitary work (38/51) was equipped with A height-adjustable desk, an adjustable office chair, one screen, docking station, mouse and keyboard. The remaining workstations (13/51) had other solutions for active sitting instead of an adjustable office chair. Four of the workstations for solitary work were equipped with dual screens.

Number of workstations and their intended functions	Open zones	Enclosed rooms (no. of rooms)
Solitary and concentrative work	10	4 (4)
Solitary work (some interruptions)	14	0
Solitary work (interruptions allowed)	23	0
Collaborative work (2-4p)	26	18 (8)
Collaborative work (5p+)	8	18 (3)
Total no. of workstations	79	40 (15)

Figure 4.25. An overview of the AFO solution in Case 4: usage policies, specification of layout and the collective instruments included in the AFO solution.

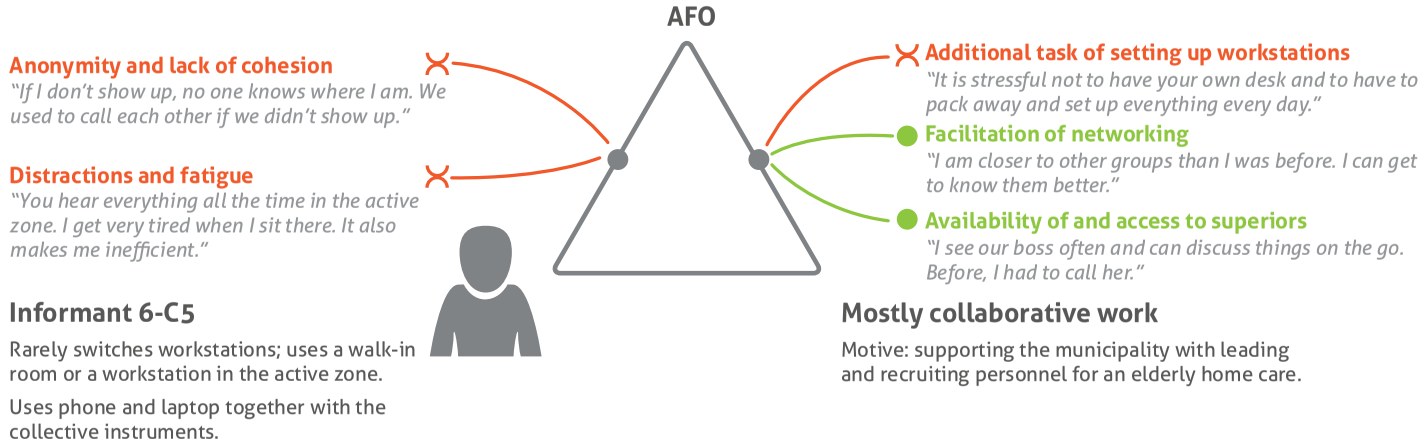
Underused spaces were also identified in Case 5, such as meeting spaces in the active and semi-quiet zones, walk-in rooms without windows and meeting rooms without screens. In addition, the break-out space was considered insufficient and uncomfortable, preventing social inclusion, and was thus disregarded by the informants. The informants' choices of workspace were the result of trade-offs between preferences for ambient conditions (light and views), exposure to noise and visual distractions, protecting the content of their work, proximity to colleagues, availability of relevant instruments, and quick access to belongings in the lockers. Most of the informants (11/14) used the collective instruments provided at the workstations, others used individual mouse and keyboard. All the informants mentioned an insufficient number of adjustable chairs, and competition over finding and securing the preferred office chairs.

Perceived work support – The majority of informants (10/14) were dissatisfied with the AFO solution, and mentioned negative impacts on their performance. Half the informants (7/14) recalled being satisfied with the AFO solution due to its novelty and aesthetic qualities initially after relocation. However, the reported initial satisfaction had faded over time. Some of the informants (3/14) mentioned that they had remained dissatisfied with the AFO solution from the beginning. This had resulted in a resigned feeling towards the AFO solution; some of the informants were considering whether to change jobs or await their retirement.

The informants dissatisfied with the AFO solution either rejected or reluctantly followed the desk-sharing rule. Figure 4.26 illustrates mismatches identified in the activity system of an informant who disregarded the desk-sharing rule and mainly used a walk-in room. The informant's main activity involved staff management, and comprised actions such as recruiting personnel and resource allocation in one of the municipality's care centres. *On activity level*, the identified mismatches were: a feeling of alienation and dislocation from immediate colleagues; fatigue due to distraction; misspent time for setting up workstations; problems with cluttered and unorganised lockers leading to difficulty with gaining an overview of one's belongings; having to remember what to bring from the lockers for their different activities and going to and from lockers to fetch belongings. Despite the reported mismatches, they appreciated increased access to intra-team colleagues, and proximity to inter-team colleagues and their superiors. *For actions* that involved collaborations with internal stakeholders, the identified mismatches were: insufficient number of walk-in rooms; difficulties with locating colleagues; and physical discomfort due to carrying around belongings. *For actions* that involved collaborations with external stakeholders, the identified mismatches encompassed an insufficient number of walk-in and meeting rooms.

The mismatches in activity systems of informants who disregarded the desk-sharing rule were similar to those who reluctantly followed the rule (exemplified in Figures 4.26 & 4.27). However, the latter group reported additional mismatches that related to following the desk-sharing rule (Figure 4.27). *On activity level*, the additional mismatch was difficulties with finding preferred workstations; having to arrive early to secure a workstation; and dedicating time for clearing up workstations to make it to the bus stop when leaving. These mismatches were critical when the individual personal circumstances, for instance having to drop off their children at daycare, limited the informants' ability to arrive early and secure a desirable workstation.

ACTIVITY LEVEL



ACTION LEVEL

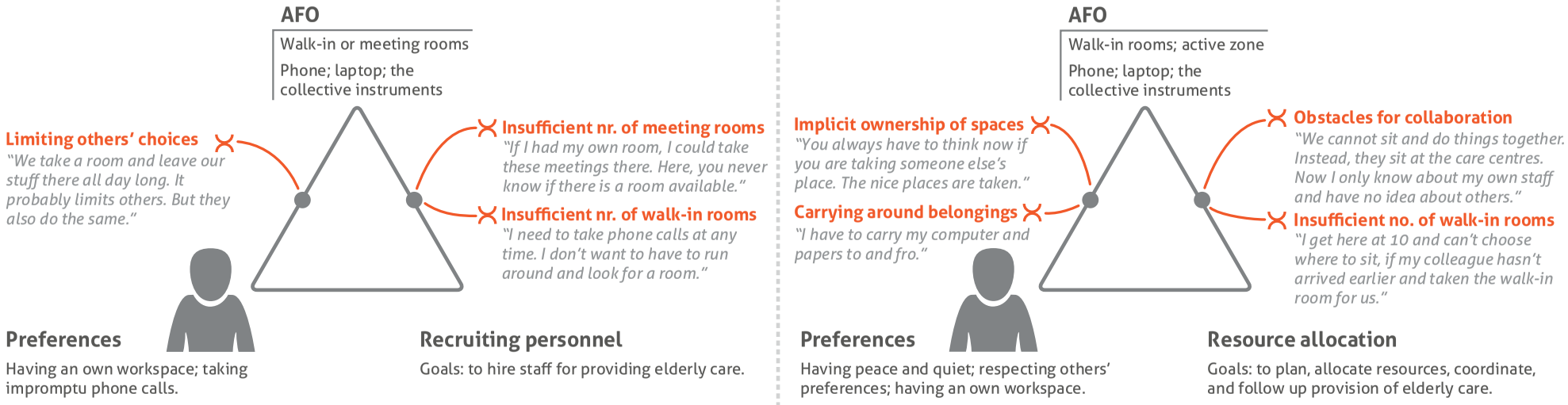
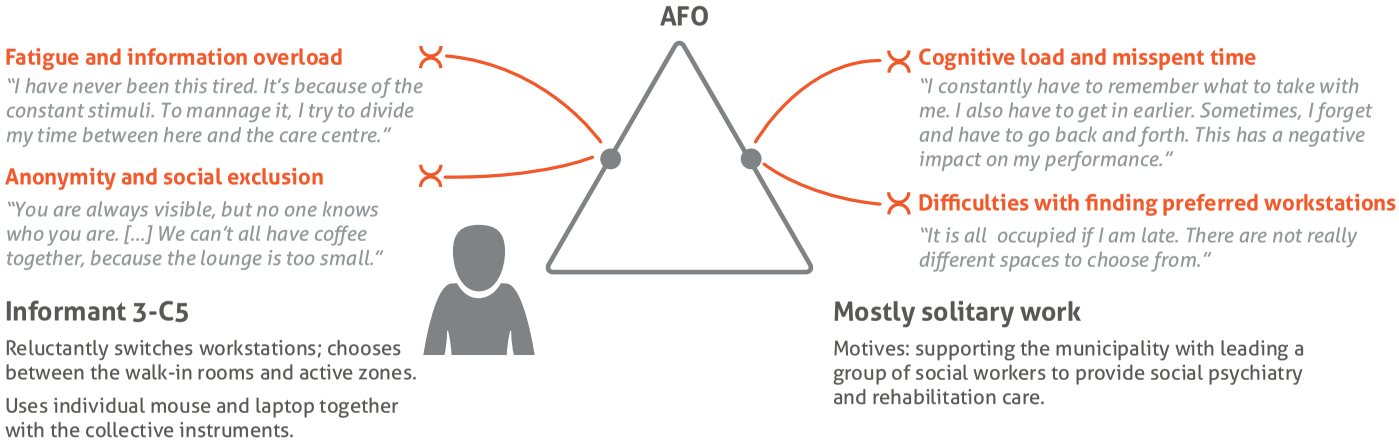
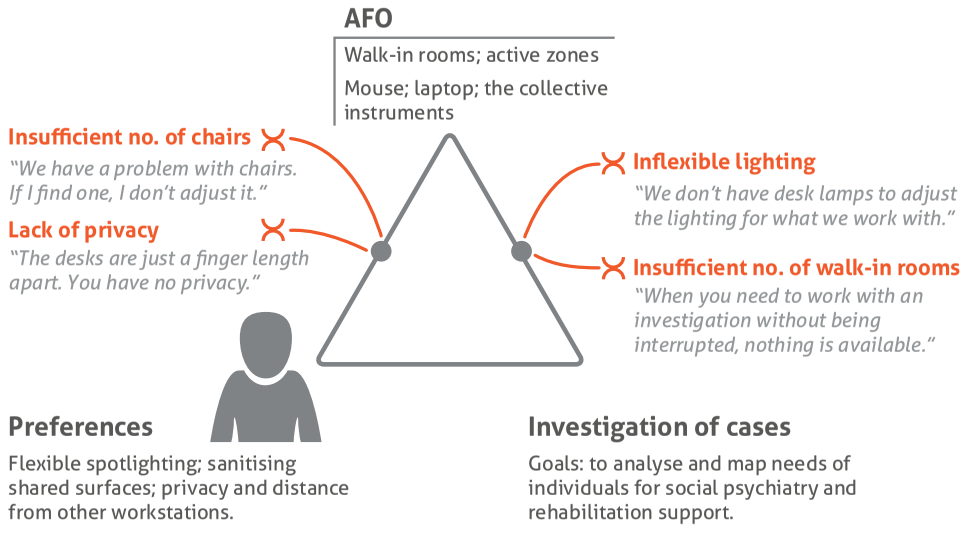


Figure 4.26. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who disregarded the desk-sharing rule.

ACTIVITY LEVEL



ACTION LEVEL



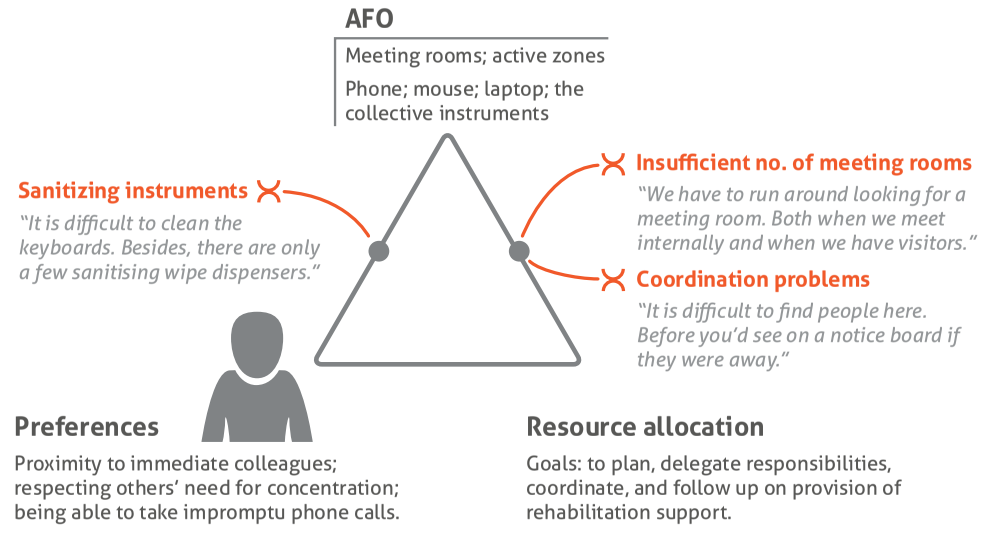


Figure 4.27. Examples of reported mismatches that explain the reasons behind dissatisfaction with the AFO, and that describe how the AFO misaligned with personal preferences and impeded activities and actions of an informant who reluctantly followed the desk-sharing rule.

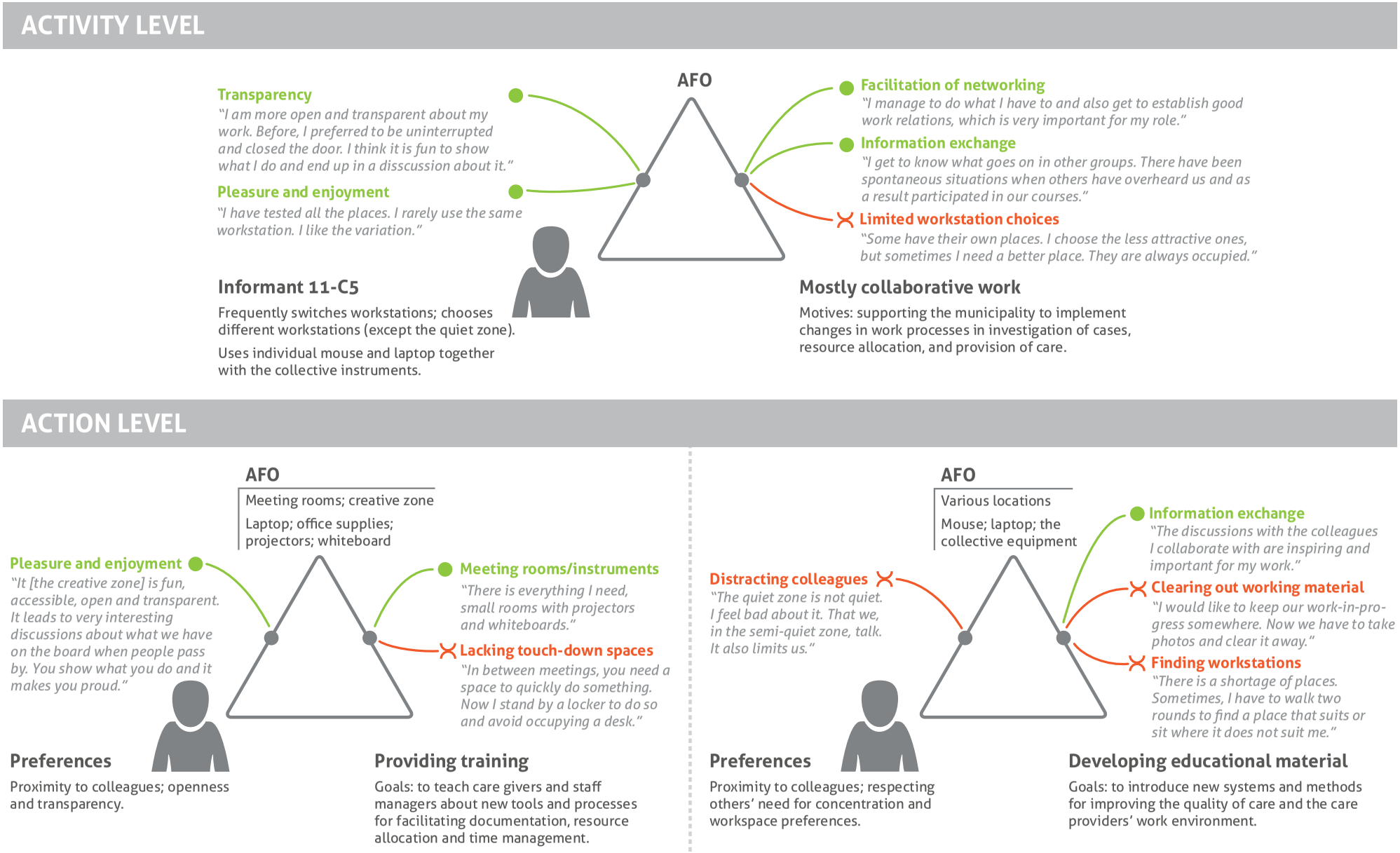


Figure 4.28. Examples of reported matches that explain the reasons behind satisfaction with the AFO, and that describe how the AFO aligned with personal preferences and supported activities and actions of an informant who followed the desk-sharing rule.

For actions that involved solitary work such as case investigation (Figure 4.27), the identified mismatches were: insufficient number of walk-in rooms and office chairs; physical discomfort in shoulders and wrists since the collective keyboards were too wide and could not be angled because they had broken legs; headaches and fatigue that were considered to be due to inflexible lighting in open zones; and a need to sanitise shared surfaces. For actions that involved coordination and resource allocation, the identified mismatches were: coordination problems due to dislocation from colleagues and limited privacy and having to be vigilant for protecting the content of their work, since workstations were placed 'too close' to each other exposed the informants' screens or involved having colleagues walking behind.

Some of the informants (4/14) mentioned that they had become equally or more satisfied with the AFO solution over time despite their initial worries. They believed that the AFO solution supported their activities which were mostly of a collaborative nature. These were informants who followed the desk-sharing rule and who frequently switched workstations. Figure 4.28 illustrates identified matches and mismatches in the activity system of an informant who followed the desk-sharing rule. This informant's activity involved developing and providing instructions for improving work processes of the group. *On activity level*, the identified matches were: appreciation of transparency, that is to say showing her own work and seeing others' work due to having open spaces; deriving pleasure and enjoyment from working in different spaces; and networking and information exchange with inter- and intra-team colleagues. *For actions* that involved providing training and instructions, the identified matches were availability and access to different types of meeting rooms that all had whiteboards and projectors. *For actions* that involved developing the educational material, the identified matches were: the ability to work side-by-side; and having creative spaces that facilitated discussions. Despite her satisfaction with the AFO solution, the informant also mentioned mismatches in her activity system such as: limited choices due to implicit ownership and insufficient number of workstations; lacking touch-down spaces for short-time work in between meetings; worrying about distracting others in the quiet zone in proximity to the semi-quiet ones; and lacking solutions for periodically keeping and showcasing work material and ideas.

All the informants reported limitations in choosing workstation, regardless of whether they returned to the same workstations or not. Having quiet zones that were not quiet in practice was another mismatch in informants' work; both for those who had concentrative work and for those who did not. The different zones were similar visually and in terms of noise, and therefore discouraged the informants to switch workstations, leading to overuse of walk-in rooms and implicit ownership of spaces; hence the 'fight over good places'. Excessive noise also discouraged people from choosing meeting spaces in the open zones. Instead, they preferred meeting rooms, and hence the reported shortage of meeting rooms. The few informants who reported that they enjoyed switching workstations and found the AFO solution satisfactory and supportive of their activities, had to choose the less attractive places that were 'left over'.

4.5.2. Appropriation of the AFO solution in Case 5

The informants' first encounters with the AFO solution involved receiving information during the planning process and preparations prior to relocation. Post-relocation, all the informants followed the desk-sharing policy. The majority of informants (11/14) were initially satisfied during their first encounters with the solution. In the explorative phase, some of the informants (6/14) identified a preferred workstation and repeatedly returned to the same workstation in the stable phase. Other informants (8/14) remained flexible and switched workstations on a daily basis. Due to limitations on making improvements and insufficient storage, the informants made individual improvements for dealing with the insufficient storage (e.g. Figure 4.29). In addition, the Municipality had a 43% increase in staffing after relocation. The differences among the informants in adopting the AFO solution and the increased staffing led to periods of negative *excitement* and *mismatches* in the otherwise stable state of appropriation for the flexible employees, for example limited workstation choices and difficulties in finding available workstations. Some informants (6/14) mentioned working elsewhere (e.g. from home for concentrative work or from the Municipality's care centres for meetings with stakeholders) as frequently as possible to avoid the shortcomings of the AFO solution. The identified issues and events that characterise different phases of appropriation are summarised in Figuer 4.30.

Apart from the adaptations that had occurred over time, the informants desired additional adaptations ranging from macro changes in the AFO solution (e.g. building walls and having dedicated workstations) to micro changes (e.g. adding sanitary wipe dispensers at all workstations). The informants who followed and appreciated the desk-sharing policy desired behavioural adaptations among their colleagues (with respect to disregarding the desk-sharing policy), and procedural adaptations at the organisational level to prevent implicit ownership of workstations. The informants who reluctantly followed the desk-sharing policy desired personal hedonic adaptations, so that they would be at peace with the concept and have a more positive stance towards it.

Figure 4.29. The informants found ways to organise their personal belongings, expand their storage and facilitate carrying the belongings around. Examples were addition of suitcases and file organisers.

	FIRST ENCOUNTERS	EXPLORATORY PHASE	STABLE PHASE
ACQUIRED INSIGHTS 	Receiving information and involvement in the planning process; Identifying difficulties with finding colleagues and co-locating	Identifying pros/cons of the different workstations; Identifying social codes such as workstations that implicitly belonged to colleagues; Identifying colleagues' preferred workstations; Identifying crowded days/hours	Realising the un-predictability of colleagues' presence; Realising the limited workspace choices
BEHAVIOURAL ADAPTATIONS 	Decision to follow/disregard the desk-sharing policy	Returning to the preferred deks; Finding strategies to avoid using the same workstation two days in a row; Having lunch earlier/later to ensure having uninterrupted work hours; Devising solutions to work elsewhere	Devising strategies to ensure co-locating with colleagues; Avoiding the implicitly 'owned' workstations; Blocking days for working from elsewhere
INSTRUMENT ADAPTATIONS 	Minimising reliance on printed documents; Dealing with difficulties with setting up workstations	Reducing personal instruments; Finding tools for remembering tasks and taking notes; Identifying chairs that were easy to adjust	Identifying workstations that were easy to adjust with respect angle of screens and keyboards
RULE-RELATED ADAPTATIONS 		Challenges with adhering to and remembering speech rules for the different zones	Clarification of rules through documentations and signs at each zone
SPATIAL ADAPTATIONS 			Adding sound absorbing panels in the enclosed rooms and for separating the quiet zone
SOCIAL ADAPTATIONS 		Getting to know inter-team colleagues; Increased access to superiors; Intra-team collaborations and exchange	
PROCEDURAL ADAPTATIONS 		Organisational changes and regroupings; Holding workshops to identify and discuss OHS issues and desired improvements	Devising routines for dealing with OHS issues
HEDONIC ADAPTATIONS 	Novelty; Appreciating the aesthetics and newness of the premises; Frustrations with misspent time	Appreciation of access to inter-team colleagues; Continued difficulties with finding intra-team colleagues; Continued OHS ptoblems due to the sub-optimal design of AFO	Resignation; Disempower-ment due to limitations on making improvements; Acceptance of unlpeasant work environment

Figure 4.30. The appropriation Process in Case 5.

4.5.3. Planning and adaptation process in Case 5

During the planning process, work groups from different sections of the Municipality were created to collaborate on analysing and identifying needs and requirements regarding their future premises. This analysis concluded that the new premises should (i) allow for flexibility and mobility, (ii) facilitate collaborative and solitary work, and (iii) promote meetings between employees as well as the general public. The choice of office type was made based on these results. The Municipality's administration was commissioned for procurement. The implementation of the AFO solution was carried out by consultants. Some of the informants (4/14) mentioned that they were involved in the design and implementation process and had been given opportunities to express their needs and influence the solution. According to other informants (6/14), the implementation process was 'top-down', in other words the project group at the Municipality made decisions regarding the choice of AFO and its design, and the informants were generally just informed about the progress rather than being involved in the process. The remaining informants (4/14) were employed after relocation.

The majority of the informants (12/14) mentioned economy and space optimisation as the main reasons behind relocation to the AFO, while a few (4/12) mentioned increased collaboration and modernisation of the Municipality. Limited involvement in the planning process may have led to the identified discrepancies between actual and perceived reasons for choosing the AFO solution, as well as the reported mismatches between employees' activities and the solution.

During the initial phases after relocation, limited support for working in AFO and options for modifications were provided for the employees (according to both informants and the secondary data). One year after relocation, the AFO process team followed up and evaluated the AFO solution and its impact on employees' work environment through workshops with employees and interviews with union representatives. All employees were invited to participate in these workshops. In total, 250 employees participated and 12 workshops were held. The results were compiled in an action plan approved by the steering committee. However, the informants found the evaluation activities insufficient, and further mentioned that they had not received the results of the evaluation and that insufficient changes were made to improve their work environment after the evaluations.

According to the secondary data, some improvements were made: (i) devising processes for dealing with physical and psychosocial work environment issues in the AFO, (ii) clarification and communication of desk-sharing and speech rules, and (iii) improvements in quiet zones to ensure uninterrupted work as shown in Figure 4.31. Nonetheless, there were limited options for modification and improvement of the spaces from the informants' perspectives. They mentioned that the devised processes for dealing with the work environment issues involved long processes for making decisions and therefore their suggestions were not addressed. Lack of options for making improvements in the AFO to better match the informants' needs led to lingering mismatches in the majority (10/14) of informants' activity systems. This led to a *resigned symbiosis* in the activity system: the informants found strategies to carry out their activities despite the disturbances. In contrast, the AFO

solution matched activities of four informants. Their main desired modification was encouraging appropriate usage of the solution to ensure their freedom to choose among the available spaces. Thereby, a *resigned symbiosis* was identified in their activity systems that involved dealing with implicitly owned workstations and limited choices, despite reporting that the AFO solution stimulated, inspired and developed their activities.

Figure 4.31. The main improvement in Case 5 was addition of panels for separating the quiet zone from other zones. Nonetheless, distractions from neighbouring zones were not eliminated in the quiet zone with addition of these panels.


47
48
56

CHAPTER 5
CROSS-CASE FINDINGS

The previous chapter provided findings from each of the case studies. This chapter aims to answer the research questions of the thesis based on the cross-case analysis. The overall stance towards the AFO solutions varied between informants in all the cases. Some informants were satisfied with the AFO solution and sought to work in a flexible manner. Others were dissatisfied with the AFO solution, and either disregarded the desk-sharing rule or followed it reluctantly. While the former group found the AFO solution supportive in their work, the latter group perceived the AFO as an obstacle in their work. There were however considerable differences between the cases (Table 5.1): overall satisfaction with the AFO solution and the perceived work support was higher in C2 and C4, compared to C1, C3 and C5.

Table 5.1. The informants' overall satisfaction with the A-FOs and perceived changes in their performance.

Cases	Satisfaction with the AFO solution	Perceived changes in performance: solitary work	Perceived changes in performance: collaborative work
1	Majority: dissatisfied	Majority: decreased	Mixed results
2	Majority: satisfied	Majority: increased	Majority: increased
3	Majority: dissatisfied	Majority: decreased	Majority: decreased
4	Majority: satisfied	Majority: increased	Majority: increased
5	Majority: dissatisfied	Majority: decreased	Majority: decreased

The cross-case analysis for addressing RQ1 was conducted at an individual level beyond the case boundaries, that is to say between subjects (Section 5.1). The findings outline interdependencies between employee(s), their activities, and AFOs, and explain why some informants were satisfied with the AFO solutions while others were not. These were based on comparisons between (i) how the informants used the AFOs and why they used the AFOs the way they did, and (ii) investigating how AFOs – as used – supported/impeded the informants' activities and actions.

For research questions 2, 3, and 4, the cross-case analysis was on a case level, in other words between cases. Section 5.2 explains the successful and sub-optimal design features that led to matches and mismatches in the informants' activity systems. Section 5.3 describes the informants' processes of appropriating AFO solutions in the different cases. Section 5.4 explains the success factors in planning of AFOs and adaptation processes post-relocation.

5.1. Interdependencies in the Informants' Activity Systems

RQ1. What (if any) are the interdependencies between employee(s), their activities, and AFOs, and how do these interdependencies impact employees' satisfaction with AFOs?

In order to explain the differences in terms of informants' satisfaction with the AFO solutions, an Activity Theoretical perspective was adopted that allowed for understanding the interdependencies between individuals, their activities and the AFO solutions. This section outlines the identified interdependences on an individual level beyond the case boundaries. The identified interdependencies related to usage of AFOs and the matches/mismatches between informants, their activities and the AFO solutions.

Two major differences were identified between informants in terms of using AFOs, and they were conceptualised as: (i) use profiles, that is to say the informants' stance towards the desk-sharing rule, and (ii) composition of the informants' artefact ecologies. These differences were instrumental for explaining the reasons behind dis-/satisfaction with AFOs and are described in Sections 5.1.1 and 5.1.2.

The matches/mismatches between informants, their activities and the AFO solutions were identified based on comparisons between (i) why the informants used the AFOs as they did, and (ii) how the AFOs – as used – supported/impeded the informants' activities and actions. Section 5.1.3 describes the identified types of interdependencies, and 5.1.4 and 5.1.5 outline matches and mismatches identified in activity systems of informants with different types of artefact ecologies.

5.1.1. Use profiles — dwellers, mobile workers, and experimenters

One of the identified interdependencies that can explain individual informants' dis-/satisfaction with the AFOs was the stance towards the desk-sharing policy, in other words whether they followed the desk-sharing rule or not. The informants' preferences for usage with regard to the desk-sharing policy varied considerably (Table 5.2). A larger proportion of informants followed the desk-sharing policy and switched workstations in Cases 2, 3 and 4, than in Case 1 and Case 5. The identified usage profiles were dwellers, mobile workers and experimenters.

Table 5.2. Preferences for usage with regard to the desk-sharing.

Cases	Dwellers	Mobile workers	Experimenters
1	6/12	3/12	3/12
2	4/24	20/24	-
3	5/10	5/10	-
4	-	6/12	6/12
5	6/14	8/14	-
Sum	**19/74**	**44/74**	**9/74**

Dwellers – The informants who did not switch workstations returned to specific workstations. The workstations that the dwellers returned to were generally in open zones and often in a corner without having people walking behind, or with a pleasant view, or in proximity to other colleagues who also did not switch workstations. A few dwellers returned to walk-in rooms and avoided the open zones. As a result, the availability of the desirable workstations became limited for others. A number of work-related and individual preconditions were identified that obstructed desk-sharing among dwellers. *The work-related preconditions* were: (i) solitary actions (e.g. reading, editing, or writing reports) and limited internal collaborations, for which the informants did not benefit from switching workstations, (ii) dealing with confidential documents or conversations, and (iii) the stationary instruments such as desktop computers, project boards, or printed documents required for the informants' activities. *The individual preconditions* were (a) workspace preferences in terms of privacy, need for having a home base and co-locating with close colleagues, (b) earlier experiences of office environments, (c) physical problems and impairments, and (d) personal circumstances in terms of family situation and activities outside office.

Mobile workers – The informants who followed the desk-sharing rule used different workstations and zones (when provided) according to their needs and preferences. While this may explain the general satisfaction with the AFOs in Case 2 and Case 4, it does not apply to Case 3. In the latter case (as well as a few informants in other cases), there were informants who reluctantly switched workstations and they did so despite finding the desk-sharing concept to be an obstacle in their work. The work-related preconditions that facilitated and motivated desk-sharing for mobile workers were: (i) a mix of solitary and collaborative actions, (ii) project collaborations in different group constellations, and (iii) having work instruments that were easy to transport. *The individual preconditions* were (a) preferences for meeting new colleagues and inclusion in different social contexts, (b) earlier experiences of having different office environments, and (c) personal circumstances in terms of family situation and activities outside the office.

Experimenters – Periodically following/disregarding the desk-sharing policy was identified as an alternative strategy (i) to experiment with the desk-sharing rule and benefit from working at different workstations, while periodically benefitting from returning to the same workstation, thereby reducing the time and effort coupled with setting up workstations, or (ii) to support the informants' ongoing activities and meet their needs for collaboration that changed periodically. For analysis, this group was regarded either as mobile workers, when they referred to problems related to switching workstations, or as dwellers, if they referred to problems related to the clean-desk rule or to the specific workstation to which they returned.

In general, the dwellers were dissatisfied with the AFO solutions, while the mobile workers were either satisfied or dissatisfied. The dwellers found the effort involved in desk-sharing to be more costly than the potential gains. The mobile workers found more gains from following the desk-sharing rule (e.g. regulating where and next to whom to sit) than compromises (e.g. having to look for spaces and adjusting instruments). The informants' stances on the desk-sharing policy and choice of workstations and instruments involved making trade-offs between perceived efforts and benefits. The informants' choices and trade-offs with respect to workstations and instruments are described in the next section.

5.1.2. Composition of the informants' artefact ecologies

Differences in the composition of the informants' artefact ecologies can further explain the differences in overall satisfaction with the AFO between cases. All informants had individual artefacts (e.g. laptops) that they used in combination with collective artefacts (e.g. a certain workstation or collective keyboards and mouses) to compose their artefact ecologies. The provided collective instruments varied in different cases: (i) in Case 2, the informants had individual mouses and keyboards, while (ii) in the remaining cases collective mouses and keyboards were provided, enabling a reduction in the number of individual instruments. The informants' choices of artefact ecologies involved making trade-off decisions between efforts and perceived benefits. Two types of artefact ecologies were identified depending on the informants' preferences for using individual or collective instruments (Figure 5.1).

Static artefact ecologies – The informants who did not switch workstations and used individual instruments were observed to have static artefact ecologies. They returned to the same workstation for solitary work. There were some variations regarding the instruments: some used individual chairs, keyboards, and computer mouses while others used the collective instruments provided at the workstation to which they returned. However, most of the informants followed the clean-desk policy and removed their belongings when they left work. Some of the informants returned to the same workstation due to their physical problems such as back pains or functional variations. The choices of workstations and instruments for these informants involved making one trade-off: reducing effort and time for setting up the workstations by returning to the same workstation at the expense of limiting the choice of workstations.

Dynamic artefact ecologies – The artefact ecologies were dynamic for those informants who switched workstations and/or used the collective instruments. The choices of workstations for these informants involved making trade-offs between (i) different ambient conditions, (ii) privacy and communication, and (iii) socialising with inter-team and intra-team colleagues. The informants who frequently switched workstations did not find the disadvantages of a certain space to be a persistent concern since they would use another one. Having a dynamic artefact ecology also involved daily changes in the instruments used by the informants. These informants chose between the collective artefacts and integrated them into their artefact ecologies. The number of individual instruments among the informants with dynamic artefact ecologies varied: for some it was limited to a laptop and a phone, while for others it involved supplementary artefacts (e.g. own keyboards). The more the informants used collective instruments, the fewer items they had to carry. This was a trade-off between using preferred individual instruments at the expense of having to carry them. In terms of office chairs, the informants made trade-off between using the ones that were most comfortable versus the ones that were easiest to adjust (when a variety was provided). Another trade-off concerned use of digital tools for documentation to reduce the set-up time and for locating colleagues, at the expense of having to learn to use digital alternatives.

The informants who periodically followed/disregarded the desk-sharing rule – the experimenters – had dynamic artefact ecologies when they followed the desk-sharing rule and static artefact ecologies when they did not. The experimenters' trade-offs

in choosing workspaces depended on whether or not they were following the desk-sharing rule. When following the rule was perceived to have more disadvantages, they returned to the same workstation. In this way, they reduced the problems and the discomfort associated with switching and setting up workstations, and for a period had a static artefact ecology. In contrast, when returning to the same workstation was unsatisfactory, the started switching workstations. For some of the informants, returning to the same workstation periodically was related to specific projects and the need for co-location with colleagues.

In general, the informants with static artefact ecologies were dissatisfied with the AFO solution, while the informants with dynamic artefact ecologies were either satisfied or dissatisfied with the solution. To explain the reasons behind the informants' dis-/satisfaction with AFO solutions, the next sections describe the identified matches and mismatches in the informants' activity systems.

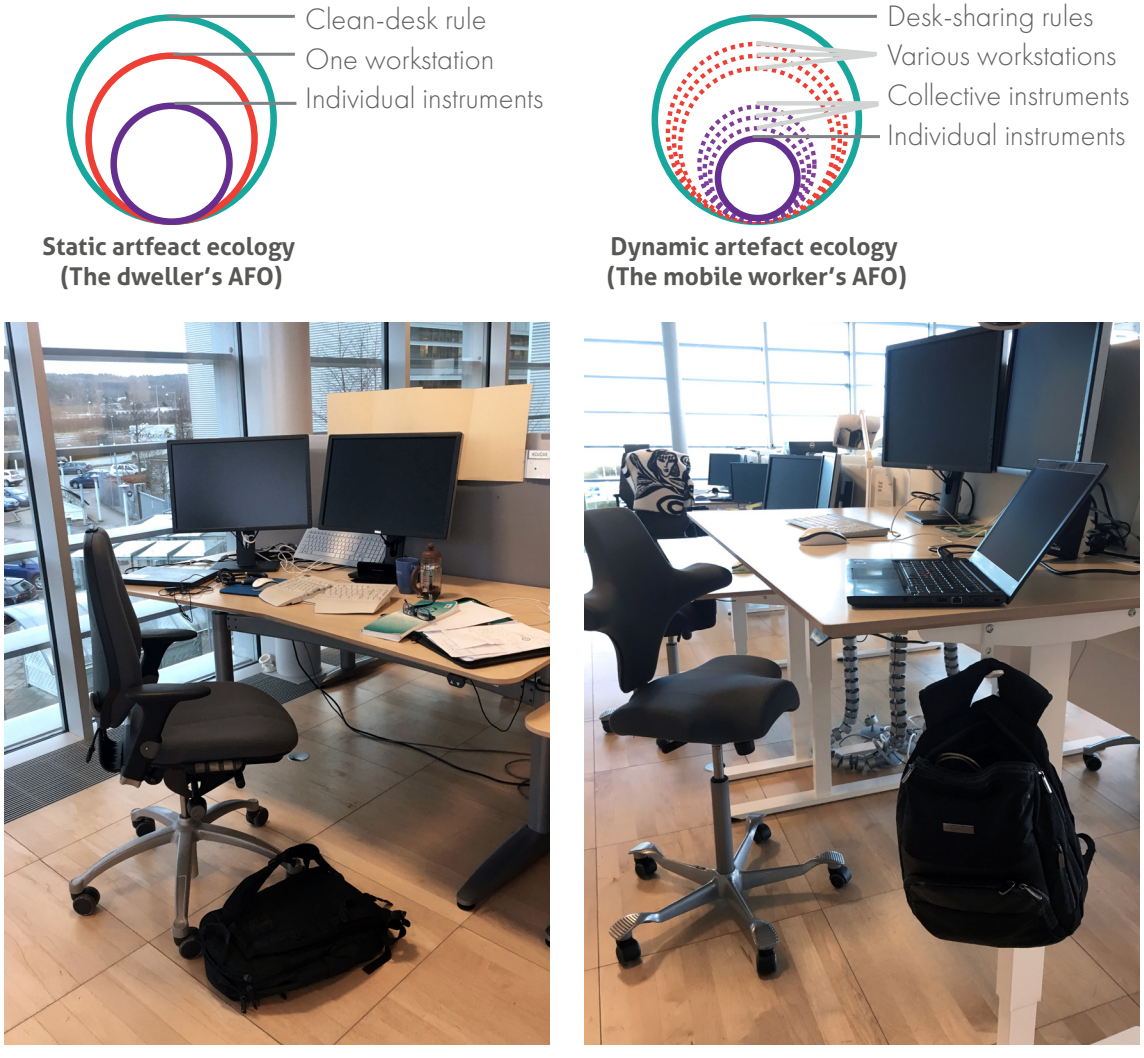


Figure 5.1. Left: dwellers' artefact ecologies were static, i.e. they used individual instruments; returned to the same workstation; but cleared out the workstations when leaving. Right: mobile workers' artefact ecologies were dynamic, i.e. they had few individual instruments (usually a laptop), and used the collective instruments and different workstations.

5.1.3. Matches and mismatches in the informants' activity systems

Three types of matches and mismatches were identified that concerned the interdependencies in informants' activity systems. These were identified on an individual level, beyond the case boundaries.

Informant ↔ AFO: matches and mismatches between informants and the AFOs concerned alignment of AFOs with the informants' preconditions and the fulfilment of the informants' needs, desires or preferences for comfort and wellbeing. Three sub-categories were identified for these types of matches/mismatches.

- Informant ↔ desk-sharing rule
- Informant ↔ workstations
- Informant ↔ instruments

Activities ↔ AFO: matches and mismatches between informants' activities and the AFOs concerned facilitation or obstruction of activities and actions. Three sub-categories were identified for these types of matches/mismatches.

- Activities ↔ desk-sharing rule
- Activities ↔ workstations
- Activities ↔ instruments

Informant ↔ Activities: matches and mismatches between the informants and their activities relate to changes in the motives and the nature of the informants' activities as a result of relocation to AFOs.

In general, the informants who were dissatisfied with AFOs reported more mismatches than matches in their activity systems. The matches and mismatches reported among informants with static artefact ecologies were different from those with dynamic ones, and are addressed separately in the next two sections.

5.1.4. Matches and mismatches in activity systems of informants with static artefact ecologies

The informants with static artefact ecologies were in general dissatisfied with the AFOs. Having static artefact ecologies meant using individual instruments and the same workstation for solitary work. Despite using the same workstation, the informants cleared out the desks when leaving (except in Case 1). Based on the interviews, interdependencies were identified that explain the reasons behind dissatisfaction with AFOs among the informants with static artefact ecologies and these are described in this section.

Clean-desk rule ↔ Informants' activities: clean-desking was considered to impede the informants' activities. Common mismatches were: time misspent for setting up and clearing out individual instruments; unpredictability of colleagues' presence; and dislocation from team members.

Clean-desk rule ↔ Informants' preferences: clean-desking was in conflict with the informants' desires and needs. Recurrent mismatches were: having to re-adjust the instruments at workstations if someone else had used it; feeling excluded from the group due to rotation of colleagues; and for a few informants limitations for personalising and decorating workstations.

Workstations ↔ Informants' activities: the ways in which workstations supported/impeded employees' actions varied in different situations. The informants who used the active zones regarded distractions and limitations on protecting content of work

as the main mismatches in their solitary work. The informants using the quiet zone or quiet rooms found the spaces supportive for their solitary work, provided that the quiet zone was in fact quiet. The main mismatch with respect to the quiet zone or quiet rooms was dislocation from colleagues for quick information exchanges. For collaborative actions, the informants used the meeting spaces, which were generally regarded as supportive, provided they were not in open zones.

Workstations ↔ Informants' preferences: one recurrent mismatch regarding the quiet zone or quiet rooms was social exclusion. With respect to the active zones, a lack of privacy, exposure to irrelevant information and poor ambient conditions such as lighting were regarded as unpleasant. The informants using the quiet zone or walk-in rooms derived satisfaction from privacy. With respect to the active zones, the identified matches were situational, for instance regarding workstations that allowed some privacy such as those located in corners, or that provided pleasant ambient conditions (e.g. proximity to windows and access to daylight).

Instruments ↔ Informants' activities: a common mismatch impeding the informants' activities was the limitation on having permanent memory cues at their workstations (e.g. to-do-lists, calendars, post-it notes). Having individual instruments was critical for some of the informants, for example keyboards to ensure the expected typing speed. However, the provided backpacks did not support the carrying of such individual instruments, in contrast to the toolboxes. Matches regarding the collective instruments were: dual screens (when provided) that allowed for having several windows and programs running simultaneously and spreading their work sheets (e.g. word processors, mailboxes, calendars, Skype).

Instruments ↔ Informants' preferences: common mismatches were physical discomfort and neck and back pain due to having insufficiently adjustable chairs; and lockers that were misplaced, were not moveable and did not allow for organising belongings. The informants who were provided with 'own chairs' reported physical comfort and appreciated the ability to keep their preferred settings.

Informants ↔ Activities: relocating to AFOs led to expansion of the informants' activities, for example through the introduction of new actions for composing artefact ecologies. The composing action involved putting individual instruments such as laptops or keyboards together with collective instruments provided at different workstations. The goal for composing artefact ecologies was most often layered: preparing to start/finish work, reducing loss of time, and increasing comfort. For the informants with static artefact ecologies, composing artefact ecologies was viewed as additional and meaningless work. In addition, they considered overhearing intra-team colleagues as distracting, and dislocation from inter-team colleagues as an impediment in their work. These led to a critical mismatch between the informants and their activities which involved disengagement from their activities, seeking new job opportunities, demanding dedicated 'own spaces' or working elsewhere.

In summary, having *static artefact ecologies* entailed impediments in informants' activities, while it fulfilled the informants' preferences and desires for comfort and having a home base to which to return. Nonetheless, mismatches were reported between the AFOs and informants' preferences with respect to clean-desking, workstations, and the collective instruments. As a result of these mismatches, the informants were dissatisfied with the AFO solution and stopped wanting to engage in their activities.

5.1.5. Matches and mismatches in activity systems of informants with dynamic artefact ecologies

The informants with dynamic artefact ecologies were either satisfied with the studied AFO solutions or dissatisfied. Those who were satisfied reported more matches, in comparison with mismatches) in their activity systems. In contrast, the informants who were dissatisfied reluctantly followed the desk-sharing rule and reported more mismatches (in comparison with matches). This section summarises the different types of matches and mismatches identified in the activity systems of informants with dynamic artefact ecologies.

Desk-sharing rule ↔ Informants' activities: common matches raised by the informants who were satisfied with the AFO solution were the opportunity to choose where to work; co-location with inter-team colleagues; and overhearing the otherwise hard-to-access information, and as a result, increased transparency. Recurrent mismatches that led to dissatisfaction with AFOs were: time misspent in setting up workstations; difficulties with finding suitable workstations due to the low workstation/employee ratio and the implicit ownership of workspaces; and unpredictability of colleagues' presence or location impeding quick information exchanges.

Desk-sharing rule ↔ Informants' preferences: the informants who were satisfied with the AFO solution reported matches between the desk-sharing rule and their preferences, for instance deriving pleasure and enjoyment from having a variety of workspaces and inclusion in different social contexts. Recurrent mismatches predominantly mentioned by those who were dissatisfied with the AFOs and reluctantly followed the desk-sharing rule were: inconvenience of setting up, re-adjusting, and sanitising workstations; having to 'fight' for desirable workspaces due to limited availability; limitations on personalising and decorating workstations; and feeling excluded from the group due to rotation of colleagues.

Workstations ↔ Informants' activities: availability of workspaces in different zones (when provided) was supported the informants' different actions. The reported matches were blocking out distractions in quiet and semi-quiet zones (when functioning); quick access to information; facilitation of side-by-side work in active zones; and provision of walk-in rooms supporting different actions that were either concentrative or involved phone conversations or video-conferences. Recurrent mismatches reported mainly by the informants who were dissatisfied with the AFOs related to distractions in active zones, and difficulties with finding suitable workstations due to malfunctioning or limited availability of walk-in rooms and quiet or semi-quiet zones. Mismatches regarding workstations were seen as temporary, since the informants switched workstations.

Workstations ↔ Informants' preferences: reported matches between workstations and the informants' preferences varied depending on the workstation. These concerned privacy in the walk-in rooms; social inclusion in active zones; fulfilment of preferences for ambient conditions with respect to lighting or proximity to windows; convenience of having workstations in proximity to storage; and cosy break-out spaces. The informants who were dissatisfied with the AFO solutions reported mismatches that concerned: the workstations which were 'too close' to each other or 'too exposed', thus limiting the informants' privacy and leading to a perception of being under surveillance; uncomfortable and ill-fitting furniture;

uncomfortable and insufficient break-out spaces; and workspaces with undesirable ambient conditions such as poor lighting. Mismatches regarding workstations were seen as temporary, since the informants switched workstations. However, the mismatches were not always avoidable (despite the freedom that desk-sharing entails) due to the preconditions of the informants' activities and responsibilities. Internal conflicts were also observed between the informants' preferences, for instance when they wished to avoid distractions while at the same time fearing social exclusion and missing out on information being shared.

Instruments ↔ Informants' activities: reported matches by the informants were who were satisfied with the AFO solutions were quick set-up, easy adjustment and sufficiency of the collective instruments; easy-to-use digital applications that helped reduce the use of printed documents; and digital solutions that facilitated finding location of colleagues and/or available spaces. In contrast, mismatches that explained the informants' dissatisfaction were: difficulties with adjusting the collective instruments; incompatibility between the collective and the individual instruments; inconvenience of carrying or storing belongings between different activities; having to remember what to bring; and having to learn and use new digital applications.

Instruments ↔ Informants' preferences: the informants who were satisfied with the studied AFO solutions reported compatibility and sufficiency of the collective instruments; quick and easy adjustment of instruments; and fulfilment of their preferences for physical comfort, especially when a variety of chairs were provided from which to choose. Mismatches reported by the informants who were dissatisfied concerned: insufficiency of the collective instruments, such as a lack of desk lamps; difficulties with sanitising the shared surfaces; physical discomfort (due to insufficient number of or adjustment of chairs for prolonged sitting, and difficulties with remembering the settings and learning the right adjustments of the chairs); difficulties with organising belongings in the lockers according to individual preferences; unpredictability of available and functioning instruments (as the collective instruments disappeared, were misplaced, or broke in AFOs with a longer time elapsed post-relocation). These mismatches led to adoption of compensatory behaviours that involved making trade-offs between misspent time and comfort, such as skipping the adjustments, or acquiring 'own' chairs or adapters.

Informants ↔ Activities: access to information being exchanged and networking with intra-team colleagues was a way in which the informants' activities had expanded, with the new information and the increased collegial support seen as new tools that mediated the informants' everyday activities. The informants' activities had also expanded by the introduction of new actions for composing artefact ecologies, which was regarded as meaningful among those informants who were satisfied with the AFO solution, as it allowed them to benefit from the AFO solution. As a result, the informants who were satisfied also perceived an improvement in their performance. In contrast, the informants who were dissatisfied found impediments in their activities due to exposure to irrelevant information, dislocation from immediate colleagues, and having to compose their artefact ecologies, which was viewed as additional and meaningless work. As a result, they stopped wanting to engage in their activities, sought new job opportunities or started working elsewhere.

In summary, the informants with *dynamic artefact ecologies* were either satisfied or dissatisfied with the AFO solutions. Those who were satisfied reported more matches than mismatches between the AFO (desk-sharing rule, the workstations and the instruments) and their activities and individual preferences for wellbeing and comfort. As a result, they perceived improvements in their activity systems. In contrast, the informants who were dissatisfied reported more mismatches than matches, and found impediments in their activity systems. While some of the outlined matches and mismatches were related between AFOs as a general concept and the individual and work-related preconditions, others concerned the design of AFOs and how well they aligned with individuals' preconditions and activities. The next section describes the identified design features that influenced the informants' satisfaction with AFOs.

5.2. Success Factors and Suboptimal Features in the Design of AFOs

RQ2. How does the design of AFOs influence employee satisfaction?

The identified matches and mismatches in the previous section were related in part to AFOs as a concept and in part to the design specificities of the studied AFOs. These specificities are summarised as success factors and suboptimal features with respect to specification of the desk-sharing rule, design of the workspace and the collective instruments.

5.2.1. Specification and communication of the desk-sharing rule

In cases with unambiguous and simple rules, it was easier to share the workspaces. The employees were expected to clear out their workstations if they were planning to be elsewhere for more than a specified duration, which varied from one hour to one day. One important aspect was clear specification and communication of the duration of use despite attendance. The longer the informants were able to keep a workstation, the fewer negative consequences were reported (Case 2). Having information at each workstation that communicated these rules was important in facilitating desk-sharing and ensuring that the employees had a shared understanding of the intended usage (Cases 3 & 4).

A sub-optimal feature regarding the desk-sharing rule was ambiguity of the duration of unattended use of workstations in Cases 1 and 5. As a result, different interpretations were identified among informants, leading to implicit ownership of spaces and difficulties in sharing the spaces. Table 5.3 summarises the identified success factors in definition and communication of desk-sharing rules in AFOs.

Table 5.3. Successful features identified in specifications and communication of the desk-sharing rule.

Desk-sharing rule	Case 1	Case 2	Case 3	Case 4	Case 5
Clarity and simplicity of rules	-	Yes	To some extent	To some extent	-
Duration of use despite attendance	Ambiguous	1 day	2 hours: open zones 20 minutes: walk-in rooms		Ambiguous
Communication of rules at workstations	-	-	Yes	Yes	-

5.2.2. Design of the workspaces

The AFO layout encouraged switching workstations and facilitated the informants' work by providing a variety of workspaces, specifically functioning and desirable quiet/semi-quiet zones and walk-in rooms. This was enabled by (i) blocking out the noise from elsewhere, (ii) ensuring that the speech policies were clearly communicated, for instance through instructions and signs at workstations, and (iii) providing walk-in rooms and quiet/semi-quiet zones that had more or less similar ambient conditions to the open zones in terms of windows and access to daylight. As a result, the informants switched workstations due to the added value they gained from using different workspaces based on their needs, preferences and/or activities (Cases 2, 3, & 4). In addition, a higher workstation/employee ratio allowed the informants to choose and share workspaces based on their needs. Another success factor was well-designed break out spaces (at the floor plan) that met the informants' preferences. Table 5.4 summarises the identified success factors in design of workspaces in AFOs.

Deficient zoning and underused spaces and furniture were identified as suboptimal design features and highlighted a limited understanding of users' needs in AFOs. Deficient zoning involved having malfunctioning, insufficient and/or undesirable quiet/semi-quiet zones and walk-in rooms. These (i) were in proximity to the active zones, exposing the informants to the surrounding noise, regardless of the informants respecting or disregarding the speech rules, (ii) were visually similar to the neighbouring active zones, encouraging the informants to behave similarly, (iii) lacked information about expected usage and speech rules, (iv) had undesirable ambient conditions, for instance they lacked windows and daylight, or (v) lacked sufficient collective instruments. As a result, it was not possible to simultaneously support the informants' activities and fulfil their wellbeing preferences. This imposed unnecessary trade-offs when choosing workstations, for example between seeking privacy and avoiding distractions, while at the same time having pleasant ambient conditions. Deficient zoning was an impediment for the informants' activities, and discouraged the informants from switching workstations. As a result of deficient zoning and in combination with lower workstation/employee ratios, the informants' choices of workstations were based on a need to secure a workstation rather than find a workstation that matched their work and preferences. The need to secure a workstation was represented in behaviours such as leaving belongings at workstations or arriving early to secure a workstation.

Table 5.4. Successful features identified in design of workspaces.

Workspace features	Case 1	Case 2	Case 3	Case 4	Case 5
Functioning quiet zones	N/A	Yes	Yes	Yes	-
Desirable quiet zones	N/A	Yes	Yes	-	Yes
Desirable walk-in rooms	-	Yes	Yes	Yes	Yes
Desirable break out spaces	-	Yes	-	Yes	-

Underused spaces were observed in all five cases. These were pinpointed as neither desirable nor with functionality that supported the informants' activities, and included: (i) some of the scarce spaces such as quiet rooms/zones when considered undesirable (no windows/poor lighting) despite their functionality, (ii) meeting spaces located in proximity to workstations for solitary work were found to be undesirable for having conversations as the informants felt that they were both being overheard and distracting their colleagues, and (iii) undesirable break-out spaces. The underused spaces present design opportunities, for instance increasing the number of workstations available per employee, or improving the functionality or attractiveness of the workspace solutions.

5.2.3. Design of the collective instruments

The collective instruments that facilitated shared use (i) were easy to adjust and easily showed the preferred setting, (ii) had a darker colour hiding the ageing of the material or traces of previous users, (iii) could withstand repetitive use and adjustment without breaking, (iv) were easy to sanitise, and (v) easy to move around or transport. Another success factor was to provide different types of instruments since the informants had different preferences, for instance different types of chairs were provided in Cases 3, 4 and 5. In the latter case, however, the chairs provided were not sufficient for the number of employees in the AFO. In addition, to satisfy the informants' preferences for having individual chairs, small spaces were assigned for parking the chairs and thereby facilitating shared use of spaces (in Cases 3 & 4). In Case 2, having individual instruments such as keyboards and mouses was facilitated by provision of toolboxes for carrying these instruments. In Cases 3, 4, and 5, backpacks were provided for carrying individual instruments. However, the backpacks were insufficient for carrying a large number of individual instruments. Furthermore, to facilitate shared used of spaces and rotation of employees, it was deemed necessary to have an overview of available workstations. This was satisfied by provision of digital instruments both as mobile phone applications or screens with layout overviews (in Cases 3 & 4).

Some *easy fixes* were also identified that facilitated desk-sharing, such as a hook under desks for hanging bags or backpacks; surfaces close to the lockers for temporarily placing belongings while handling the lockers; standing desk mats hanging close to the different spaces that could be fetched when needed; easy-to-access office supplies, chargers and adaptors; plenty of wipe dispensers for sanitising shared surfaces; signs for communicating the intended functions; as well as cloakrooms for leaving outerwear on arrival.

One critical aspect was to ensure that the collective instruments were available and functioning. This required a system for maintenance, in other words reporting and dealing with malfunctioning or missing collective instruments (as observed in Cases 3 & 4), as well as ways to discourage the employees from misplacing the collective instruments. Table 5.5 summarises the identified success factors in design of the instruments in AFOs.

The main suboptimal design feature of the collective instruments was that they were not designed for shared use and repetitive adjustments. On the one hand, chairs with various, and occasionally hidden, knobs with no clear indication of their functions

were difficult to adjust and required the informants to remember the suitable position for each use. These were otherwise adjusted once for one user and as a result, the informants used these chairs without adjusting them. On the other hand, chairs designed with simple adjustments were often intended for short-term use. These did not support the informants' prolonged seating and led to physical discomfort. Underused instruments were also identified, such as (a) inappropriate furniture that was perceived as childish, unprofessional or exclusive, and (b) redundant digital applications that were introduced together with the AFO solutions.

Other sub-optimal design features that obstructed desk-sharing were: (i) small and difficult-to-handle backpacks and/or toolboxes for carrying belongings, encouraging the informants to stay close to their lockers instead of exploring other spaces, (ii) small, immobile and difficult-to-organise lockers, (iii) insufficient collective instruments at workstations, such as keyboards, desk lamps, adapters, (iv) missing and/or malfunctioning collective instruments, and (v) insufficient sanitising wipe dispensers. One of the main issues with respect to the instruments was the lack of a maintenance system or routine for identifying and dealing with misplaced, missing or malfunctioning instruments.

In summary, the identified success factors and sub-optimal features highlight the role that design of AFOs can play in facilitating employees' work and fulfilling their preferences and needs. The suboptimal design features highlight a limited understanding of users' needs and preferences during the planning and design process. These related to ambiguous rules, deficient zoning and undesirable workspaces, and instruments that were not intended for shared use. Knowledge of the sub-optimal design features may help stakeholders who are involved in planning and design processes to identify and avoid potential pitfalls when making decisions that relate to the specification of the desk-sharing rule, design of workspaces, and design of the collective and individual instruments.

Table 5.5. Successful features identified in design of the collective instruments.

Instrument features	Case 1	Case 2	Case 3	Case 4	Case 5
Provision of different types of chairs	-	-	Yes	Yes	Limited
Artefacts for carrying individual instruments	-	Toolbox	Backpacks	Backpacks	Backpacks
Digital applications for locating available workstations	-	-	Yes	Yes	-
Dual screens	-	Yes	Yes	Yes	Limited
'Easy fixes'	Limited	Limited	Yes	Yes	Limited
Maintenance of instruments	-	-	Yes	Yes	-

5.3. The Informants' Processes of Appropriating AFOs

RQ3. How do employees appropriate AFO solutions?

The informants' appropriation of AFOs involved three phases: first encounters, explorative and stable phases (Figure 5.2). During these phases the informants' use and experiences evolved, they developed new routines, gained new insights, and made modifications in their artefact ecologies.

The first encounters – This phase involved introduction of changes in the informants' artefact ecologies upon relocation to the AFO. Almost all the informants were introduced to the AFO for the first time and had no prior experience of working in AFOs. Nonetheless, the informants who were satisfied with the AFO solution were more prepared, informed and had a higher level of involvement in the planning process than those who were dissatisfied.

The explorative phase – The informants tried different ways of using the AFOs in this phase. In Cases 2, 3 and 4, worries about finding workspaces were resolved. In Cases 2 and 4, the informants derived joy from switching workstations and not being limited to one. This phase was of different character for informants who followed the desk-sharing policy, mobile workers with dynamic artefact ecologies, and those who disregarded the desk-sharing policy, that is to say dwellers with mostly static artefact ecologies. The difference concerned the type of matches/mismatches identified in the respective groups' activity systems. While the mobile workers dealt with mismatches in their dynamic artefact ecologies, the dwellers dealt with an ever-changing (social) milieu. Despite the informants' stance towards the desk-sharing policy and the character of their artefact ecologies, various adaptations occurred during the explorative phase. The informants who were satisfied with the AFO solution reported more behavioural adaptations, social adaptations (exchange with inter-team colleagues), and instrument adaptations than the informants who were dissatisfied with the AFO solutions. These adaptations helped resolve the mismatches in informants' activity systems, thus leading to general satisfaction with the AFO.

The stable phase – The nature of the stable phase varied among the informants, with differences in their hedonic adaptations. While some of them reported increased satisfaction over time, others were less satisfied than they had been just after relocation to AFOs. Among the informants who were satisfied with the AFO solution, the stable phase did not include mismatches in their activity systems. This stability involved a *fruitful* symbiotic relation between the mobile workers and their artefact ecologies and activities. In contrast, the informants who were dissatisfied with the AFO solution continued to experience discomfort and lack of pleasure, but they could do what they were supposed to; leading to a *resigned* symbiosis in their activity system. They had given up/resigned trying to modify the solution or found ways of escaping the mismatches. This was achieved by compensatory behaviours such as working elsewhere at the expense of dislocation from immediate colleagues or reducing individual instruments and the misspent time for setting up workstations at the expense of physical discomfort.

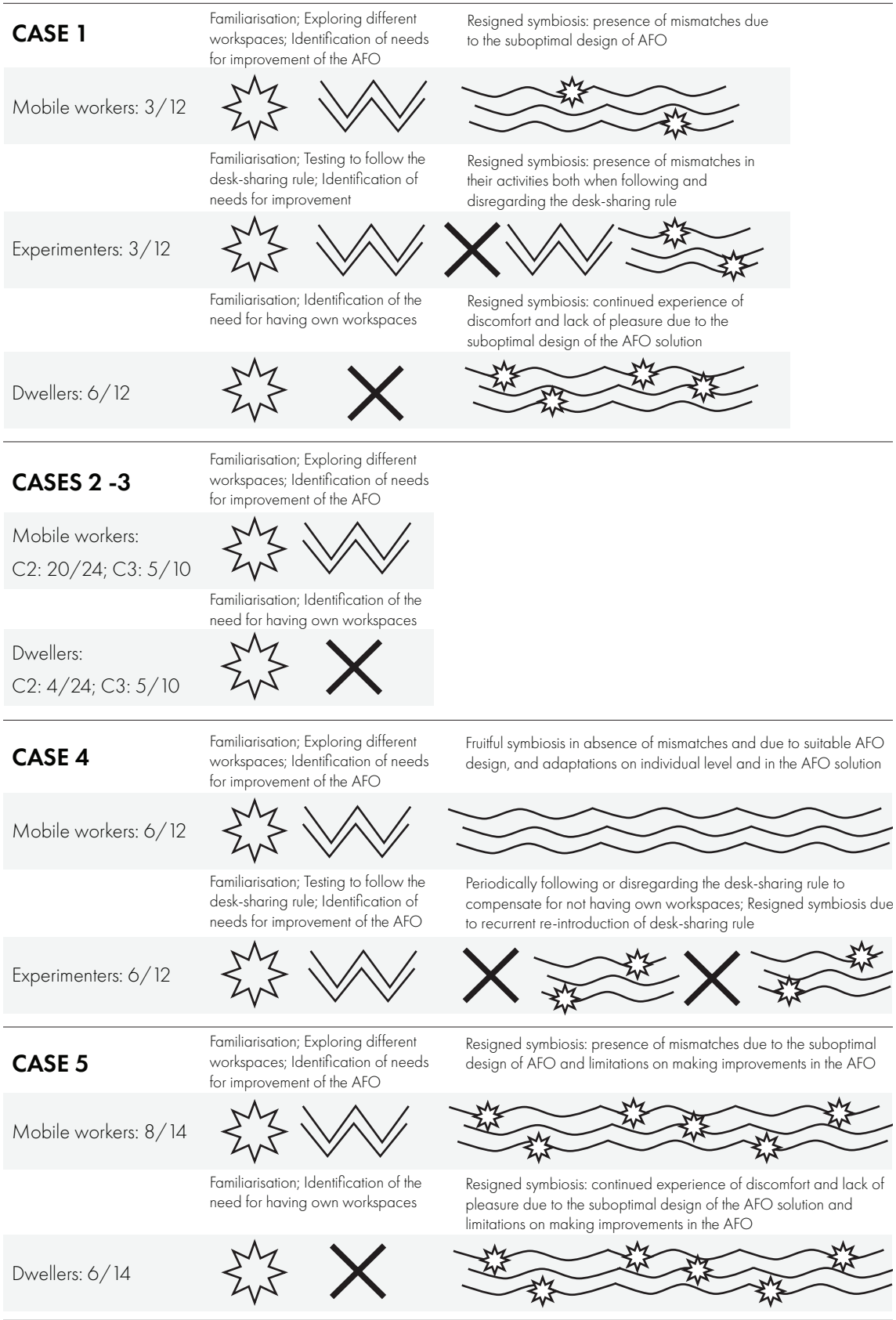


Figure 5.2. Phases of appropriating AFOs among mobile workers and dwellers in different cases.

It is important to highlight that the appropriation phases were studied to different extents for each case. Cases 1-3 revealed more about the first encounters and the explorative phases, while Cases 4 and 5 revealed more about the explorative and the stable phases of appropriation. Nonetheless, the retrospective elaborations on the appropriation process revealed that a fruitful symbiosis in the informants' activity systems was achieved in Case 4, as well as in Case 2 despite the short duration they had spent in the AFO at the time of data collection.

5.4. Success Factors in the Planning and Adaptation Processes

This section summarises success factors in the planning and adaptation process that helped reach a symbiosis in the informants' activity systems.

RQ4. What (if any) process-related aspects influence employees' satisfaction with AFOs?

5.4.1. Success factors in the process of planning AFOs

The processes of planning AFOs varied considerably between cases. The success factors that contributed to the informants' satisfaction with the AFOs were mostly identified in Cases 2 and 4 (Figure 5.3). These factors were related to the different phases of adopting AFOs as an innovation at an organisational level, from emergence of a need for making improvements in office environments to choosing AFO as a concept, planning and relocating to AFOs.

Agenda-setting concerned emergence of a need for innovation and making changes in the office environments. The trigger for adopting an innovation varied between cases. A success factor was observed in cases 2 and 4, where the adoption of AFOs was due to the problems with prior office environments identified by both employees and the organisation. In other cases, the need had emerged on an organisational level and was not anchored in employees' needs.

Matching involved finding an innovation – in this case the AFO concept – to address the employees' or the organisations' needs. Involvement of users in choosing the office type was identified as one of the main success factors in Case 2. The informants in Case 2 mentioned that they were involved in a workshop at the start of the planning process, during which they had formulated their needs and wishes, and where the idea of implementing an AFO emerged. Engagement of informants in choosing and designing the office concept helped create a sense of ownership, and thereby encouraged them to follow the desk-sharing rule. The informants in other cases were not involved in choosing AFO as an office type. Another critical factor was the intent behind choosing AFOs. All the cases shared similar intents and visions for implementing AFOs: to improve the work environment and facilitate collaboration, and to reduce facility costs. However, the informants' perception of these intents varied between cases: the perception of intent in Cases 2 and 4 was in accord with that stated in the documents. In contrast, in Cases 1, 3, and 5, the informants believed that cost-reductions were the only motive behind implementation of AFOs. Therefore, assuming and communicating positive intents for implementing AFOs is critical for realising AFOs with which employees will be satisfied.

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
AGENDA-SETTING: emergence of a need for innovation					
Origins of the need for making changes in the former offices	The organisations' owners; Part of a larger development	The employees and staff managers	The organisation; Part of a larger development	The organisations; Part of a larger development	The organisation; Problems with former offices
MATCHING: finding a innovation to address the need					
Involvement of employees in choosing the office type	None	To some extent	None	None	None
Perception of intent	Mixed	Positive; work environment improvements	Negative; Cost-reductions	Positive; Work environment improvements	Negative; Cost-reductions
REDEFINING: reinventing the innovation to correspond to the organisations' needs					
Understanding of users' activities and needs	Limited	Thorough analyses	Thorough analyses	Thorough analyses	Limited
Extent of employee involvement	Limited	High: directly and via representatives	High: directly and via representatives	High: directly and via representatives	Limited
Trialability	None	Study visits; Workday simulations	Study visits; Prototypes	Lectures; Study visits; Prototypes	Prototypes; Study visits
Communication of process and outcomes	Limited	Continuously and through several channels	Intermittent and through several channels	Intermittent and through several channels	Intermittent and through several channels
CLARIFYING: putting into a widespread use					
Complete 'product' at relocation time	Missing instruments	More or less	Missing instruments	More or less	More or less
Duration of planning	Six months	Two years	Six months	Two years	Three years

Figure 5.3. Success factors identified in organisations' processes of adopting AFOs, from emergence of a need to make changes in office environments to relocation to AFOs.

Redefining involved matching the AFO concept to the organisation's needs, which encompasses all the activities that take place during the design and planning process. The success factors in this phase were: (i) thorough analysis of the employees' activities and needs in Cases 2, 3, and 4, as an input for the interior designers and the project groups, (ii) involvement of employees during the planning process, directly in workshops and indirectly through employee representatives, (iii) trialability of the solution through training, preparations, demonstrations, study visits, simulations and prototypes, to help employees prepare and envision how they would work in the AFOs, and (iv) clear and continuous communication of the process to provide progress updates, and allow employees to express their opinion and feel in control. These success factors were mainly observed in Cases 2, 3 and 4 and provided preconditions for gaining a better understanding of employees' needs during the design processes, thus designing AFO solutions that matched the employees' activities and preferences. In addition, the outlined success made it possible to reach a shared understanding of the AFO and its intended usage among the employees.

Clarifying involved relocating to AFOs and putting the solution into widespread use. One critical success factor in this phase was provision of a more or less 'complete product' at the time of relocation. In cases where the AFO was incomplete at the time of relocation, the informants were disappointed and had to deal with mismatches until the missing instruments and so on were in place. A positive first impression, on the other hand, helped reduce worries that the informants had prior to relocation, particularly in Case 2. Another aspect concerning relocation was the duration of planning. Too short planning duration (less than 6 months) led to provision of an 'incomplete product' at the time of relocation, while too long duration (more than 3 years) involved having to deal with the organisational changes that may occur during planning. More moderate planning periods were observed in Cases 2 and 4 and made it possible to mentally prepare the informants for working in AFOs.

5.4.2. Success factors in adaptation process — Occupational Health and Safety Management practices in AFOs

The last phase for an organisation in adopting an innovation involves routinising, that is to say finding ways to make the innovation into an integrated element in the organisation. Different types of adaptations and OHS (Occupational Health & Safety) management practices emerged post-relocation for resolving the initial work environment problems in AFOs and integrating the AFOs into the organisational processes. These adaptations and OHS management practices varied between cases (Figure 5.4). Most adaptations were identified in Case 4, facilitating informants' processes of appropriating the AFOs, achieving a symbiosis in their activity systems, and inducing a collective sense of ownership due to the post-relocation customisations. In addition, the line managements' role in following up and finding ways to facilitate and benefit from a shared use of spaces was also important for reaching a symbiosis in the activity system of the groups in Case 4. Critical success factors in the adaptation process were thus:

- evaluation efforts and control processes
- openness to making spatial, instrument and rule-related modifications
- established processes for collecting feedback through different channels
- established processes for making modifications and adjustments
- delegation of responsibilities for reporting and resolving faulty items
- continuous user empowerment/involvement in the modification process
- provision of support, e.g. IT support and ergonomic training
- continuous improvements, customisation, and maintenance

In contrast to Case 4, adaptations made in other cases, in particular Cases 1 and 5, were limited. As a result, the informants felt disempowered in terms of making changes to their work environment. The main difference among the remaining Cases (2 & 3) was the delay in evaluation efforts. Case 2 evaluated the AFO's influence on employees' work, 2.5 months post-relocation and was open to making changes accordingly, while the employees were asked to 'wait it out' for six months before evaluating and making further changes. This waiting time was not received positively by the informants.

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
ROUTINISING: making the innovation an integrate element in the organisation					
Time of evaluation efforts post-relocation	1 month	2.5 months	6 months	2.5 months	12 months
Processes for modifications	Limited	Initiating; Forming an office group	Initiating; Forming an office group	Established	Ambiguous
Openness to making modifications	Limited	Yes	Yes	Yes	Limited
Continuous employee involvement	Limited	Yes	Initiating	Yes	Limited
Provision of support	Limited	Ergonomic training IT support	Initiating	Ergonomic training IT support	Limited
Spatial, instrument and rule-related modifications	Limited	Initiating	Initiating	Implemented	Limited

Figure 5.4. Success factors identified in organisations' adaptation processes during the routinising phase of adoption post-relocation.

5.5. Summary of Key Findings

Interdependencies between individuals, their activities and the AFOs concerned usage preferences, and matches/mismatches in individuals' activity systems. The informants' usage of AFOs varied considerably in terms of (i) following/disregarding the desk-sharing policy, and (ii) use and non-use of the different zones and workstations, as well as (iii) use and non-use of individual and collective instruments. Two major use profiles were identified: dwellers who did not switch workstations and had a static artefact ecology, and mobile workers who switched workstations and had dynamic artefact ecologies. The individuals' choices were not always made to benefit isolated actions. The choices were either due to work-related or individual preconditions, and involved making trade-offs to reduce inconvenience and misspent time (and benefit their work as a whole), as well as to increase enjoyment, wellbeing, and pleasure.

The informants with static artefact ecologies were in general dissatisfied with the AFOs, while those with dynamic artefact ecologies were either satisfied or dissatisfied. To explain the reasons behind dis-/satisfaction, three types of matches and mismatches were identified: (i) Informant ↔ AFO, (ii) AFO ↔ Activities, and (iii) Informant ↔ Activities. The informants who were dissatisfied with AFOs reported more mismatches than matches in their activity systems. However, the identified matches and mismatches between the informants with static and dynamic artefact ecologies varied, as summarised in Figures 5.5-5.7.

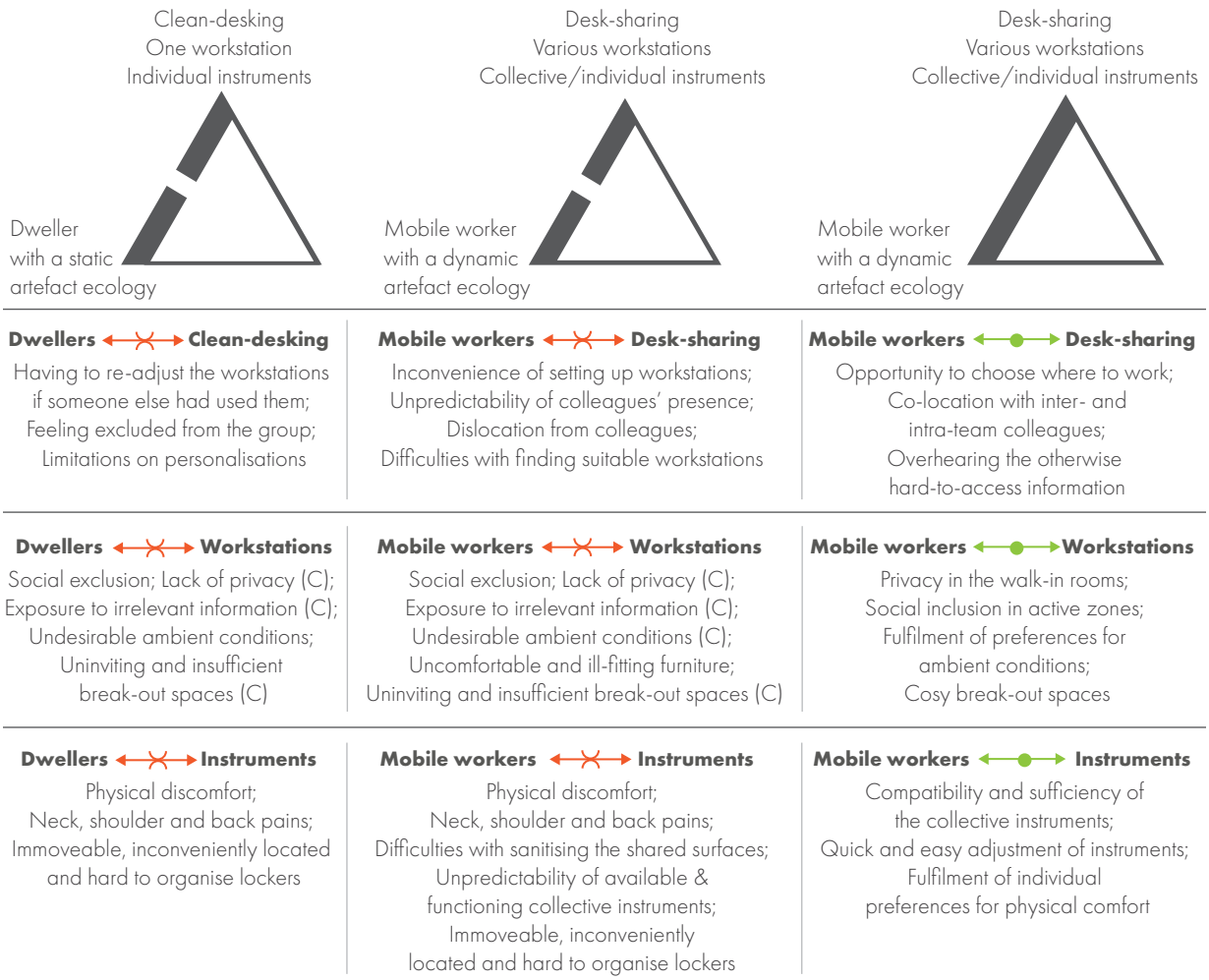
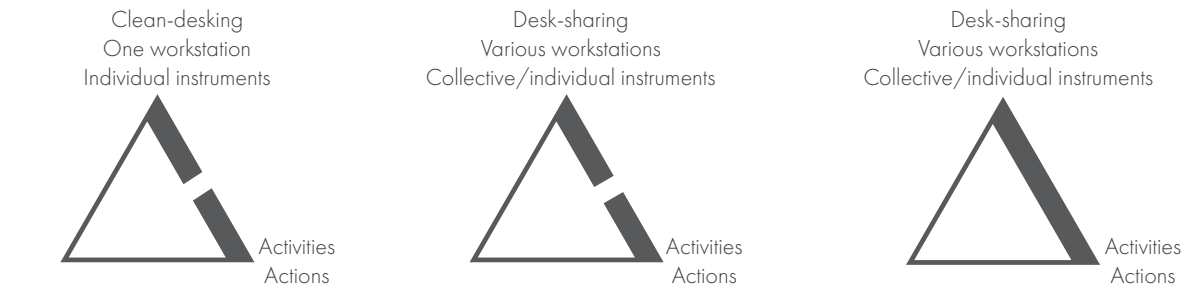


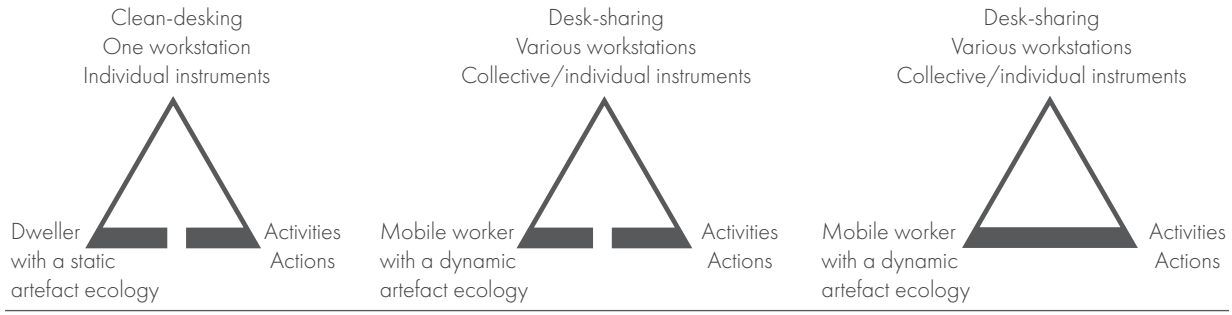
Figure 5.5. Recurrent matches and mismatches in informants' activity systems between the AFOs, that is to say desk-sharing workspaces, and instruments, and the infromants. The colmuns represent from left (i) dwellers, and (ii) mobile workers who were dissatisfied with AFO solutions, as well as (iii) mobile workers who were satisified with the AFOs. (C: case- and design-dependant matches/mismatches)

Success factors and suboptimal features were identified in the design of AFOs. Clearly defined and well-communicated rules were crucial for having a shared understanding of expected behaviour, making the flexible office concepts work, and avoiding uncertainties, conflicting interpretations and disregarding of rules. Sub-optimal design of workspaces involved: malfunctioning quiet and semi-quiet zones due to openness and proximity of the zones; workspaces that were located in the darker areas of the building, lacking desirable ambient features; workspaces that were difficult to interpret due to mixing of the furniture within zones or visual similarities between zones; and undefined and poorly communicated speech rules. The sub-optimal design features of the workspaces led to competition for the desirable workspaces, while undesirable spaces were underused and disregarded. Dysfunctionality of the collective instruments was another sub-optimal design feature. The provided collective instruments were not designed to facilitate shared use and led to mismatches in employees' activity systems.



Activities ✕ Clean-desking	Activities ✕ Desk-sharing	Activities — Desk-sharing
Having to re-adjust the workstations if someone else had used them; Limitations on having work-related personalisation; Feeling excluded from the group	Time misspent in setting up workstations; Inconvenience of carrying or storing belongings; Limitations on having work-related personalisation Feeling excluded from the group; Having to 'fight' for desirable workspaces	Deriving pleasure and enjoyment from having a variety of workspaces; Inclusion in different social contexts
Activities ✕ Workstation	**Activities ✕ Workstations**	**Activities — Workstations**
Distractions and limitations on protecting content of work (C); Dislocation from colleagues (C); Impeding collaborations and concentrative work (C)	Distractions in active zones; Difficulties with finding suitable workstations; Insufficient quiet/semi-quiet zones (C); Insufficient walk-in rooms; Insufficient touch-down workstations (C); Impeding collaborations and concentrative work (C)	Availability of workstations (C); Blocking out distractions in quiet and semi-quiet zones (C); Provision of walk-in rooms supporting different actions (C); Quick information exchange; Facilitating collaborations
Activities ✕ Instruments	**Activities ✕ Instruments**	**Activities — Instruments**
Difficulties with reading due to limitation on having deks lamps	Difficulties with reading due to limitation on having deks lamps; Insufficient no. of dual screens Incompatibility between the collective and the individual instruments	Quick set-up; Dual screens; Sufficiency of the collective instruments; Easy-to-use digital applications to replace printed documents; Digital solutions that facilitated locating colleagues and/or available spaces

Figure 5.6. Recurrent matches and mismatches in informants' activity systems between the AFOs, that is to say desk-sharing workspaces, and instruments, and the informants' activities. The colmuns represent from left (i) dwellers, and (ii) mobile workers who were dissatisfied with AFO solutions, as well as (iii) mobile workers who were satisified with the AFOs. (C: case- and design- dependant matches/mismatches)



Dwellers ✕ Activities	Mobile workers ✕ Activities	Mobile workers — Activities
Introduction of additional and meaningless actions; Disengagement from activities; Seeking work elsewhere	Introduction of additional and meaningless actions; Disengagement from activities	Expansion of individuals' activities as a result of networking with intra-team colleagues; Increased collegial support

Figure 5.7. Recurrent matches and mismatches between the informants and their activiteis as a result of relocation to AFOs. The colmuns represent from left (i) dwellers, and (ii) mobile workers who were dissatisfied with AFO solutions, as well as (iii) mobile workers who were satisified with the AFOs.

The employees' processes of appropriating AFOs involved: first encounters, exploration, and stable phases. The identified differences between the employees' processes of AFO appropriation highlight the fact that it takes time for employees to become familiarised with AFOs and experiment with new ways of working and the new workspaces, before they reach a stable phase. During this period, different types of adaptations occurred on an individual level as well as in the AFO solutions: Acquisition of insights; Behavioural adaptations; Hedonic adaptations; Social adaptations; Instrument adaptations; Spatial adaptations; and Rule-related adaptations. The stable phase in the employees' appropriation process had different characters, depending on the type of symbiosis in their activity systems. A *fruitful symbiosis* were observed when co-adaptation between the individuals and the AFO solution took place, and as a result the AFO supported employees' work and wellbeing, despite initial work environment problems. A resigned symbiosis was observed when the co-adaptations were insufficient, and the employees regarded the AFO as an obstacle in their work, yet managed to carry out their activities despite their dissatisfaction.

The planning and adaptation processes varied considerably between cases. Procedural shortcomings during the planning process led to a limited understanding of users, and thus implementation of sub-optimal AFO solutions that did not match users' needs and activities. Procedural shortcomings during the adaptation process involved limited resources and a lack of knowledge about Occupational Health & Safety (OHS) management in AFOs. This led to lingering mismatches and a resigned symbiosis in employees' activity systems. Figure 5.8 summarises success factors in the planning and adaptation processes of AFOs, from an innovation adoption perspective. Success factors in the planning processes were critical for gaining an in-depth understanding of users and for designing AFO solutions that matched employees' preferences and activities, as well as for reaching a shared understanding of expected behaviour and acceptance of the AFO concept among the employees. Post-relocation adaptations and OHS management processes helped resolve mismatches that appeared in employees' activity systems and achieve a fruitful symbiosis. Furthermore, an inclusive adaptation process allowed for achieving a sense of ownership of the workspace on a macro level by collectively customising the otherwise standardised and non-allocated workspaces in AFOs.

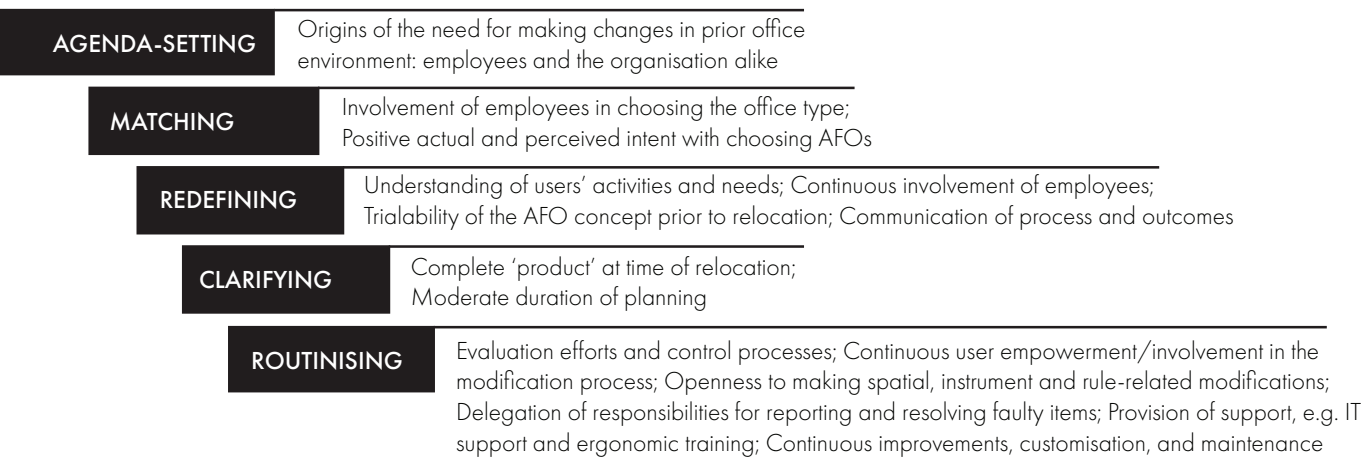


Figure 5.8. Success factors identified in the different phases of adopting AFOs.

CHAPTER 6
DISCUSSIONS

The overarching purpose of this thesis was to develop further knowledge of the consequences of relocating to AFOs in terms of employees' work and work environment, and to explain why some AFOs work while others do not. This was enabled by developing and applying a framework based on Activity Theoretical and Artefact ecological perspectives to understand changes in employees' activity systems as a result of relocating to AFOs and explain the reasons behind employees' dis-/satisfaction with AFOs. The framework focuses on understanding individuals' usage of AFOs, probing into matches and mismatches in employees' activity systems, and enables identification of success factors and sub-optimal features in the design of AFOs. In addition, the empirical findings of this thesis provide an increased understanding of the temporality involved in appropriation of AFOs both from an individual and organisational perspective.

6.1. Why Some Activity-based Flexible Offices Work While Others Do Not

In the introduction to this thesis, the inconsistent research results in terms of employees' satisfaction with AFO solutions was identified as a knowledge gap. For this reason, the overarching purpose of this thesis was twofold: to develop further knowledge about the impacts of relocating to AFOs on employees' work and work environment, and to explain why some AFOs work while others do not. In order to understand the reasons behind differences in outcomes of implementing AFOs, interdependencies in employees' activity systems and design of AFOs were addressed (RQs 1 & 2), based on the assumption that the interactions between employees, their activities and the AFO impacts employees' satisfaction with AFOs.

The identified interdependencies concerned individuals' usage preferences, and matches and mismatches in their activity systems. Three types of matches and mismatches were identified: (i) Informant ↔ AFO, (ii) AFO ↔ Activities, and (iii) Informant ↔ Activities. The identified matches and mismatches varied depending on the individuals' usage preferences. Nonetheless, individuals who were dissatisfied with AFOs reported more mismatches than matches in their activity systems. A lack or abundance of mismatches in activity systems of a majority of employees' in an AFO is here argued to explain why some AFOs work while others do not.

6.1.1. Usage preferences and individual preconditions

The individuals' usage preferences varied considerably: from following to disregarding desk-sharing; use and non-use of different artefacts such as workstations and collective instruments. Confirming other studies, discrepancies were identified between intended and actual usage of the AFOs in terms of desk-sharing (cf. Appel-Meulenbroek et al., 2011; Elsbach, 2003; Hirst, 2011; Hoendervanger et al., 2016; Tagliaro & Ciaramella, 2016). However, usage preferences and non-preferences regarding workstations and instruments have not previously been addressed in the literature. This was enabled by the theoretical framework adopted in this thesis that emphasises the usage context (cf. Activity Theoretical perspective in Hiort, 2010; Karlsson, 1999) and pays attention to non-use in combination with use of multiple artefacts (cf. artfefact ecology perspective Forlizzi, 2008). One consequence of implementing AFOs is that individuals have to compose their artefact ecologies by puzzling their personal instruments together with collective ones. Therefore, addressing use and non-use of artefacts helped in identifying successful design features in AFOs (discussed in Paper 3), as well as in understanding the individuals' preconditions for following the desk-sharing rule.

Individuals' choices of workstations and instruments involved making trade-offs between the perceived efforts and benefits associated with the artefacts. In terms of workspace choices, the trade-offs were between (i) privacy and communication, (ii) inter- and intra-team proximity, and (iii) activities and preferences for ambient conditions. While the latter two trade-offs are specific to AFOs, the privacy-communication trade-off relates to open-plan offices in general (cf. Kim & de Dear, 2013), which is more evident in AFO solutions where the majority of spaces are open. The outlined trade-offs with respect to workstations and instruments sometimes favoured the individuals' activities over their wellbeing preferences, while at other times they fulfilled wellbeing preferences despite the individuals' activities. When workstations and collective instruments with successful design features were provided, the individuals' activities were supported at the same time as their preferences for wellbeing were fulfilled.

Another finding was that individuals' preconditions for working in a flexible way vary considerably. Whether or not one follows the desk-sharing rule depends on individuals' personal circumstances, prior experiences, preferences, and impairments, as well as their work-related preconditions. Studies that address individuals' personal circumstances in office environments, specifically in AFOs, are scarce (exceptions are Seddigh, 2015; Seddigh et al., 2014). These studies generally operationalise the office environment as office types, and investigate how well different office types fit with parameters such as concentration demands on experimental tasks or individuals in terms of personality. While these findings generate insights, for example on concentration problems in open-plan offices, they have a reductionist approach and do not provide contextual insights regarding for instance the design of office environments and whether they support individuals' actual activities or align with their preconditions beyond personality traits. To address individuals' preconditions and preferences and how well AFOs match them, in-depth and contextualised approaches are required since AFOs, by definition, require employees to choose between collective artefacts, as opposed to having individual ones.

The identified variations in the usage of AFOs entailed differences in individuals' work environment. Those who did not switch workstations were generally dissatisfied with the AFO solutions, while others who switched workstations were either satisfied or dissatisfied. A positive correlation has earlier been identified between switching frequency and satisfaction with AFOs (Hoendervanger et al., 2016), regarding switching workstations for different activities throughout a workday or a week. However, the switching frequency as measured in surveys is ambiguous, as it can be interpreted as how often employees switch from a specific workstation to a meeting room, and back. The in-depth insights from the work presented in this thesis show that individuals who reluctantly switch workstations, specifically for solitary work, were dissatisfied with AFOs. Thus, switching workstations did not necessarily imply satisfaction with the AFOs. Furthermore, reasons behind dis-/satisfaction are not confined to the desk-sharing rule; AFOs are physical work environments in which individuals' artefact ecologies vary considerably depending on their usage preferences. The next section discusses findings regarding how well AFOs, as a whole, match individuals' preconditions, preferences and activities.

6.1.2. Matches and mismatches in individuals' activity systems

The concept of mismatch in individuals' activity systems was used in this thesis to explain the reasons behind dis-/satisfaction with AFOs. This was based on the assumption that satisfaction arises in the absence of mismatches in individuals' everyday activities in the context of AFOs.

Mismatches impeding individuals' activities that concerned the desk-sharing rule were misspent time and difficulties with locating immediate colleagues (Activity↔Desk-sharing mismatch). In addition, the main mismatch between individuals and the desk-sharing rule was not having own workstations and isolation from the group (Informant↔Desk-sharing mismatch). The identified mismatches are in line with previous studies, on a general level (Kim et al., 2016), and specifically in terms of dislocation from colleagues and the negative consequences for interpersonal relationships in AFOs (Morrison & Macky, 2017). However, no distinctions are made between individuals' usage preferences in these studies, which may be due to the unavoidable reductive nature of surveys (cf. Kvale, 1996). To address this shortcoming, the findings of this thesis demonstrated that dislocation from colleagues was dependent on the workstation choices of individuals, in other words whether they isolated themselves in walk-in rooms, or whether a majority of employees worked elsewhere.

The findings of this thesis also showed that misspent time in setting up workstations concerned fetching and removing belongings among individuals with static artefact ecologies, while it involved more steps for those with dynamic artefact ecologies, including having to look for workstations, adjust the collective and individual instruments, and sanitise the shared surfaces. In other words, having static artefact ecologies fulfilled the individuals' preferences and desire for comfort and for having a home base to which to return, and involved fewer mismatches than did the AFO among informants who reluctantly followed the desk-sharing rule and had dynamic artefact ecologies. These differences have not previously been identified in the literature.

Mismatches that concerned the workstations and the layout of the office environment were distractions (Activity↔Workstation mismatch) and lack of privacy (Employee↔Workstation mismatch). The identified mismatches confirm previous studies on AFOs regarding distractions (Appel-Meulenbroek et al., 2011; Brunia et al., 2016; De Been et al., 2015; Kim et al., 2016; Seddigh et al., 2014) and negative effects on privacy (Brunia et al., 2016; De Been et al., 2015; Gorgievski et al., 2010). These findings are also consistent with studies on consequences of relocation to open-plan offices from cell-offices (Brennan et al., 2002; Kaarlela-Tuomaala et al., 2009; Oldham & Brass, 1979). Nonetheless, investigation of individual differences in this thesis (rather than performing the analysis at group levels as in previous studies) highlights that these mismatches were generally reported when individuals used the active zones, and specifically when the AFOs did not provide quiet and enclosed spaces. In addition, individuals who switched workstations reported additional mismatches regarding the workstations: a shortage of desirable and suitable alternatives due to implicit ownership of spaces and insufficient design of workstations, particularly in terms of insufficient quiet zones and walk-in rooms. These results are in line with previous studies by Rolfö (2018a) who argue that AFOs turn into open-plan offices when they lack spatial diversity and involve disregarding of the desk-sharing rule.

Common mismatches regarding the instruments were the limitations on personalisation and the lack of individual adjustments according to individuals' preferences for wellbeing and comfort (Employee↔Instrument mismatch), as well as limitations on work-related personalisation impeding individuals' work (Activity↔Instrument mismatch). While limitations on personalisation and individual adjustments have been identified in earlier research (cf. Kim et al., 2016), a previously uncharted topic is the role that the collective instruments play in AFOs, as some of the recurrent mismatches were due to having malfunctioning collective instruments that were not intended for collective use and therefore did not satisfy individuals' preferences for wellbeing and comfort.

Individuals who were satisfied with the AFO solutions reported more matches in their activity systems than mismatches. Recurrent matches regarding the desk-sharing rule related to the freedom to choose where to sit, which would enable fulfilment of individual needs for wellbeing and comfort, facilitation of side-by-side work in different group constellations and information exchange between different groups. In general, the workspaces were perceived to facilitate different types of actions from solitary and concentrative work to different types of collaboration, and to match the preferences for comfort and ambience. These matches are reported in successful examples of AFO implementations (cf. Brunia et al., 2016; van der Voordt, 2004; Rolfö, 2018b) and have been identified despite methodological variations between different studies. Apart from confirming previous research on consequences of desk-sharing and workspace in AFOs, the findings of this thesis highlight the importance of (i) having collective instruments that require minimal time to adjust, and are comfortable and easy to adjust (Employee↔Instrument match), and (ii) providing sufficient collective instruments that facilitate digitalising work material and therefore also following of the desk-sharing rule (Activity↔Instrument match). Consequently, the empirical data demonstrated that in the absence of mismatches

attributable to the collective instruments, composing artefact ecologies turns into routinised operations and this is argued to lead to satisfaction with AFOs.

Thus, individuals' dis-/satisfaction with AFOs seem to be partly dependent on the design of AFOs and usage preferences which were dictated by personal circumstances and work-related preconditions. It is important to highlight that individuals' preconditions for working in a flexible way vary and not every individual has personal circumstances, preferences and work-related preconditions for following the desk-sharing rule. The combination of these preconditions and the design of AFOs led to matches and mismatches in individuals' activity systems. In the presence of abundant mismatches, individuals were not only dissatisfied; they also stopped wanting to engage in their activities, and sought other jobs or other spaces from which to work (Informant↔Activity mismatch). Some of the goals of AFO implementation are to attract and retain employees (De Been et al., 2015; Nijp et al., 2016), increased efficiency and performance (Appel-Meulenbroek et al., 2015; De Been & Beijer, 2014) and to make work more enjoyable for employees (van Koetsveld & Kamperman, 2011). Contradicting the goals associated with implementation of AFOs, the findings of this thesis showed that some individuals were willing to change jobs or placement due to their dissatisfaction with AFOs and the mismatches in their activity systems. In contrast, other individuals were not only satisfied with the AFOs in the absence of mismatches; they also considered their activities to be supported and developed as a result of working in AFOs. The next section discusses the role that design can play in meeting individuals' needs and requirements and supporting their activities.

6.1.3. Successful and sub-optimal design features of AFOs

Several features were identified that were crucial for ensuring a positive impact of AFOs on employee satisfaction, facilitating the individuals' activities, and providing preconditions for sharing workspaces. These related to clear specification and communication of the desk-sharing rule (discussed in Paper 2); functioning and desirable workspaces, specifically the quiet and semi-quiet workspaces and walk-in rooms (discussed in Paper 3); as well as provision of sufficient collective instruments that were easy to use and share among employees. In contrast, when these design features were suboptimal, they were seen as obstacles not only for sharing workspaces, but also for individuals' activities, leading to general dissatisfaction with AFOs.

Deficient zoning was identified as one of the main reasons behind mismatches in employees' activity systems. In addition to the quiet and semi-quiet zones that were malfunctioning due to openness and proximity of the zones, something that has been pointed out in earlier research (Brunia et al., 2016; Ekstrand & Damman, 2016; Rolfö, 2018), the sub-optimal design features of workspaces were: (i) quiet and semi-quiet zones and walk-in rooms located in dark areas of the building, lacking desirable ambient features; (ii) quiet zones that were difficult to interpret due to mixing of the furniture that encouraged having conversations; (iii) zones for different purposes that were visually similar, making it difficult for the users to interpret the intended use; (iv) undefined speech rules and as a result conflicting interpretations over expected behaviour (iv) insufficient signs to communicate the intended speech rules for employees and visitors. These sub-optimal design features

could further could explain the inconsistent research results regarding the ability to concentrate in different AFOs (Brunia et al., 2016; Engelen et al., 2019; van der Voordt, 2004). In addition, deficient zoning discouraged individuals from switching workstations, imposed unnecessary and avoidable trade-offs for choosing workspaces, and led to underused spaces. These contextualised findings may also explain the reasons behind low switching frequencies among a large proportion of employees in previous studies (Hoendervanger et al., 2016).

A low workstation-employee ratio was another sub-optimal feature in two of the cases in the thesis. This led to competition for the 'good' spots and difficulties with finding preferred workstations. In line with findings from other studies, this competition for good spots was negatively impacted by nesting tendencies and implicit ownership of workspaces (cf. Hirst, 2011). One of the good spots was the walk-in rooms since they were the versatile 'Swiss Army knife' of the workstations, supporting different types of solitary work; and more of them were desired despite the ratio of walk-in rooms provided per employee. At the same time the undesirable workspaces were disregarded despite their usefulness in terms of providing quiet workspaces, for example. It is important to note that having underused spaces contradicts with one of the common motives for implementing AFOs: cost reductions (according to Appel-Meulenbroek et al., 2015; Bodin Danielsson, 2014; Brunia et al., 2016; Donatella et al., 2013; Elsbach, 2003; Hirst, 2011). However, the underused spaces present design opportunities, as having fewer undesirable and underused workspaces can mitigate the negative impacts of AFOs, and reduce crowding in and competition for the 'good' spots in AFOs. Therefore, space usage evaluations post-relocation are recommended for identifying design opportunities for making improvements in AFOs. Paying attention to identified sub-optimal design features may help in avoiding common pitfalls in designing AFOs, which can be facilitated by developing methods for investigating usage scenarios before relocation.

Regarding the collective instruments, the main sub-optimal design features were insufficient provision of instruments at workstations for facilitating desk-sharing, and that the provided instruments were not designed for shared use in AFOs. In fact, the collective instruments in AFOs were the same ones used in traditional offices, which were adjusted once for one user, as for example the office chairs. As a result, the individuals either skipped adjustments, or through repetitive use the knobs and adjustments tended to break. In addition, when the provided chairs were designed for collective use, they were intended for short-term use and thus did not support the informants' prolonged seating due to limited adjustability and led to physical discomfort in the lower back. Requirements for the design of instruments intended for shared use differ from those intended for one end-user (cf. Selvefors et al., 2019). Therefore, it is important not to identify and acquire instruments that fulfil requirements for shared use when designing AFOs.

Other sub-optimal design features of collective instruments were labelled as 'easy fixes' and involved for example (i) small and difficult to handle backpacks and/or toolboxes for carrying belongings, (ii) small, immobile and difficult to organise lockers, (iii) wide keyboards that imposed ulnar deviation, or (iv) insufficient sanitising wipe dispensers. Even though resolving the dysfunctionalities of these everyday instruments can considerably change preconditions for sharing

workspaces, the role of collective instruments in facilitating desk-sharing and employees' work has received little attention in the literature on AFOs. In general, studies of musculoskeletal disorders with respect to office workstations address hand ergonomics, visual demands and prolonged sitting (see literature reviews by Brand, 2008; Wahlström, 2005). However, these studies have been conducted in traditional office environments where employees have their own workstations, and studies on physical ergonomics in AFOs are scarce. Therefore, future studies are recommended to explore how well-designed collective instruments can facilitate sharing workstations and mitigate physical ergonomics problems in AFOs.

Thus, the outlined sub-optimal design features highlight a limited understanding of users' needs and requirements during the planning process, in particular with respect to the collective instruments. In order to secure employees' satisfaction with AFOs, it is important to pay attention to the identified success factors and avoid sub-optimal features in AFOs with respect to the specification of rules, and the design of workstations and instruments during the planning process.

6.2. Temporality and Process Factors

One unexplored research theme outlined in the introduction of this thesis was the individuals' and organisations' processes of appropriating AFOs (RQs 3 & 4). Taking temporality into account, a theory of adoption of innovations was used to understand individuals' and organisations' processes of appropriating AFOs and identify process factors that influence employees' satisfaction in AFOs.

6.2.1. Employees' processes of appropriating AFOs

The individuals' processes for appropriating AFOs were divided into First encounters, Explorative phase, and a Stable phase – with fruitful or resigned symbiosis in the activity system. The results showed that the participants' initial period of becoming familiarised with the AFOs involved identifying matches and mismatches of the different workspaces and workstations.

The Explorative phase involved various types of adaptations: (i) on the individual level: acquired insights, and behavioural, social and hedonic adaptations, as well as (ii) in the AFO solutions: rule-related, spatial and instrument adaptations. These adaptations can be seen as a way of dealing with the mismatches that individuals experienced over time. Nonetheless, individuals who were satisfied with the AFO solution reported increased satisfaction and perceived work support over time (Ekstrand & Hansen, 2016; Meijer et al., 2009), while those who were dissatisfied either remained dissatisfied or reported a reverse trend (Gerdenitsch et al., 2017; Mosselman et al., 2010). Gradual improvements in employee satisfaction with AFOs are associated with habituation (Meijer et al., 2009), while the reverse trend is argued to be associated with fading novelty effects (Gerdenitsch et al., 2017). The identified adaptations expand on earlier research, providing nuances to what habituation may involve, and indicate that modifications occur on an individual and group level as well as in the AFO solutions. For making adjustments in the AFO solution, organisational adaptations were also identified (discussed in 6.2.2.).

In cases where various adaptations occurred both on an individual level and in the AFO solution, the mismatches in users' activities had over time been resolved, and a state of fruitful symbiosis was achieved. Conversely, in cases without multi-dimensional adaptations, a resigned symbiosis was identified where the informants were able to work despite the persistent mismatches and their dissatisfaction with AFOs. Thus, the nature of the Stable phase varied between individual employees. Nonetheless, the stable phase for all the individuals involved accepting having to spend time to set up workstations. Among individuals who were satisfied with the AFO solution, setting up workstations was considered to be seamless and short, and had, over time, transformed from a goal-directed action into a routinised operation. Among individuals who were dissatisfied with the AFO solution, setting up workstations involved brief periods of negative excitement in the otherwise stable state of appropriation.

6.2.2. Success factors in planning and adaptation processes

Significant procedural differences were identified between cases regarding their processes of adopting AFOs as an innovation. Taking Rogers's theory of adoption in organisations (1995), the success factors in adoption processes were divided into 5 stages. The planning process involved: (i) Agenda-setting, (ii) Matching, and (iii) Redefining. This was followed by relocation to AFOs which involved: (iv) Clarifying; and (v) Routinising. The identified success factors in the different stages are discussed in this section.

The first two stages, *Agenda-setting* and *Matching* involve emergence of a need and finding an innovation to address the need (Rogers, 1995). The main success factor with respect to agenda-setting was that the need for innovation was based on both the individuals' need for improvements in their work environment and the organisation's need. In the matching stage, the main success factors were involvement of employees in deciding the office type and assuming and communicating positive intents with choice of AFOs. Process descriptions of implementing AFOs refer to these two phases as 'ambition', that is to say defining the goals of implementing AFOs (cf. van Koetsveld & Kamperman, 2011). In line with previous studies, assuming and communicating positive intents for implementing AFOs, for example work environment improvements, had a positive impact on employees' satisfaction with AFOs (Rolfö, 2018b), while cost-reduction intents led to employees' dissatisfaction (Lahtinen et al., 2015). However, the emergence of the need to implement AFOs is not addressed in the literature on planning processes of AFOs. To understand the reactions of different stakeholders to an organisational change, here implementation of AFOs, it is important to identify who defined the problems and who decided on what should be done when initiating changes (Nielsen & Randall, 2013). The empirical findings of this thesis demonstrated the importance of taking these aspects into consideration, since employees who were satisfied with the AFO solutions perceived that the choice of AFO was based on their needs for improved work environment and increased flexibility.

The third stage, *Redefining*, concerns revising the innovation to meet the local needs of the organisation, and this varied considerably between cases in terms of the extent of employee involvement, analyses of employees' needs and activities,

providing demonstrations of the concept as a whole or in detail, and communication during this phase. First, in line with previous studies, employee participation in the planning process was positively related to the employees' satisfaction with the AFO (cf. Rolfö, 2018b), and had a positive effect on acceptance of the new work system (cf. van Koetsveld & Kamperman, 2011) and decreased misuse of the workplaces (cf. Appel-Meulenbroek et al., 2011). In contrast, restricted employee participation was associated with dissatisfaction with the AFO solution (cf. De Been et al. 2015). In general, acceptance of work environment interventions is influenced by employee participation during the planning of the intervention (Nielsen & Abildgaard, 2013; Nielsen & Randall, 2013; Nielsen et al., 2010). Furthermore, involving employees in the planning process in combination with thorough analyses of their work made it possible to gain insights on users' needs and requirements. Second, thorough analyses of employees' activities and needs led to designing workspaces that matched the employees' needs and activities, and consequently employees' satisfaction with AFOs. This was consistent with previous studies on AFO implementations (Berthelsen et al., 2017; Brunia et al., 2016; Rolfö, 2018b; Ruohomäki et al., 2015; Toivanen, 2015). Third, the provision of demonstrations, AFO-related training, prototypes, and samples of workstations facilitated the redefining stage by making the innovation triable. This trialability allowed for shared learning experiences both among employees and the AFO project groups and helped employees to understand, envision, and test the office concept, and give input for specifying rules, design of workspaces and choices of instruments before relocation. Having shared learning experiences was found to be a predictor of successful organisational intervention and effective innovation implementation (Klein & Knight, 2005), and according to Rogers (1995), trialability of an innovation is positively related to acceptance of the innovation. However, studies on processes of implementing AFOs have not captured these factors, despite their relevance for increasing employee participation. Participation of employees in implementing organisational changes, here an AFO solution, is considered to ensure ownership of the solution, help match the solution with the needs of different stakeholders, and empower employees (Nielsen & Abildgaard, 2013; Nielsen & Randall, 2013). Fourth, clear communication of the progress and the motives behind different decisions in the process was associated with employees' satisfaction with AFOs, consistent with previous studies on implementation of AFOs (Brunia et al., 2016; Rolfö, 2018b). The extent and content of communication is considered critical for achieving positive outcomes of an organisational intervention (Nielsen & Abildgaard, 2013; Nielsen & Randall, 2013), and according to the empirical findings in the thesis, helped employees prepare for working in the AFO, removed ambiguities and enabled them to engage in the process.

The fourth stage, *Clarifying,* involves putting the innovation into widespread use (cf. Rogers, 1995), which in the context of the thesis concerned relocation to AFOs. This is when individuals' appropriation processes begin. While the success factors during the redefining stage, outlined above, may provide opportunities for previewing during the '*first encounters*', the individuals put the AFO solution into actual use at the clarification stage of the organisation's adoption process. At the time of relocation, it was critical that the workspaces were more or less complete. Missing workstations and late delivery of instruments post-relocation left a negative first impression, caused disturbances in employees' work and were associated with

general dissatisfaction with AFOs. In addition, too-rapid or too-slow implementation of AFOs was also related to employees' dissatisfaction. The clarification phase has not been previously studied in the literature on AFOs but taking an innovation adoption perspective enabled understanding of the factors that play an important role at the time of relocation. Future studies are recommended to explore how the clarification phase and the experience of relocation may be improved.

Finally, *Routinising* involved finding ways to make the innovation an integrated element in the organisation, and varied between cases in terms of adaptations and management of OHS (Occupational Health & Safety) issues. While process evaluations of AFO focus on the early phases of adoption (Berthelsen et al., 2017; Brunia et al., 2016; Rolfö, 2018b; Toivanen, 2015), little attention is paid to post-relocation processes. This is of critical importance since the routinising stage overlaps with employees' explorative and stable phases of appropriating AFOs. The key success factors during the routinising stage were evaluation efforts and devising processes for making modifications and resolving the mismatches in employees' activity systems. The identified adaptations and procedural differences between the cases are argued to explain why some AFOs work over time while others do not. The ability to improve the AFO solution and resolve the initial mismatches led to increased satisfaction over time, while restrictions on making changes in the AFO solutions led to having persistent mismatches, developing compensatory behaviours and a resigned feeling among individuals. OHS legislation holds employers liable for solving problems in the work community, preventing ill health and promoting a good work environment (AFS, 2018; ISO 45001, 2001). In line with Swedish OHS legislation, a supportive work environment was achieved when OHS management practices were included in the daily activities, with clear procedures, systematic documentation, allocation of work environment tasks and cooperation and employee engagement. The findings show that organisations implementing AFOs are not necessarily equipped with systematic OHS practices to reduce initial issues caused by relocating to AFOs and ensuring a supportive work environment. In line with a recent study by Pettersson-Strömbäck and colleagues (2018), the responsibility of OHS management in AFOs was ambiguous in some of the cases. Generally, OHS management is considered to be abstract and time-consuming, but methods are developed for time-effective, structured and inclusive OHS management (e.g. Svartengren & Hellman, 2018). Future research is recommended to explore applications of systematic OHS practices for ensuring employee satisfaction in AFOs.

The establishment of continuous, proactive and inclusive processes for collaborative customisation of AFOs was identified as a successful strategy for OHS management, and led to identifying and resolving the mismatches in employees' activity systems. In cases that involved continuous dialogues between employees, work environment representatives, line managers, and the facility managers, a collective sense of ownership was achieved due to customisations on a macro level; this prompted appreciation of the solution and increased perception of work support despite initial disruptions to the employees' work. Conversely, when OHS management involved limited employee participation and long decisions chains, the employees felt disempowered, the novelty effect wore off and were replaced by lingering mismatches in employees' activity systems. Hence, the findings of the thesis highlight that the problems associated with limited personalisation in

AFOs (cf. Brunia & Hartjes-Gosselink, 2009) can be mitigated by the macro-level customisation. This also confirms the findings from laboratory studies, that the ability to manage and design one's work environment improves employee work conditions, job satisfaction and productivity (Knight & Haslam, 2010). The importance of employee participation and involvement in systematic work environment management is generally emphasised by work environment authorities and researchers (Hasle & Sørensen, 2013; ISO 45001, 2018; Nielsen et al., 2010; AFS, 2001) and specifically in regard to flexible workplaces (Donatella et al., 2013; Ekstrand & Damman, 2017). Another contribution of this thesis is to exemplify systematic participative approaches for OHS management in AFOs, in which employees were able to suggest improvements or highlight work environment issues which the organisation then gradually addressed. This allowed for achieving the so-called 'IKEA effect', that is to say the increased valuation that people have for self-made things (cf. Norton et al., 2012). In traditional offices, this is achieved by personalisation of individual workstations, while in AFOs, it is not achievable on a micro level. A sense of ownership of the workspace in AFOs emerges on a macro level by collectively customising the otherwise standardised and non-allocated workspaces in AFOs.

Support and training were another success factor in the routinising stage. Provision of IT support helped employees adopt new digital tools, reduce the use of paper documents and thereby remove some of the set-up problems. Provided ergonomics training included formal and informal workshops and training sessions that helped the employees learn ergonomic use of flexible workplaces, thereby reducing work-related fatigue and physical discomfort. This is consistent with a previous study by Robertson and colleagues (2008) that found reduced physical discomfort among a group of employees who received ergonomics training compared with a group that did not. Thus, provision of relevant support and training facilitated working in AFOs, and helped resolve some of the mismatches in employees' activity systems.

Another success factor in the routinising stage was devising the processes required for maintenance of collective instruments. This involved defining roles and responsibilities within the organisations for identifying and replacing malfunctioning or missing instruments. While some of the participating organisations succeeded in devising maintenance processes over time, others did not. This limited the number of functioning workspaces and caused new mismatches in employees' activity systems that involved keeping track of malfunctioning workspaces to be avoided, or having to work in sub-optimal situations. According to the findings of this thesis, the planning and design process focuses on delivering a finished product – the AFO solution – while little attention is paid to devising processes for adaptations, maintenance, and customisation post-relocation despite the opportunities it presents for making work environment improvements. Finally, devising processes for making adaptations is critical in organisations where employees and groups rotate frequently, as was in one of the cases. Having such processes makes it possible to cater for the needs of new groups and the dynamic nature of individuals' activities.

In summary, the outlined success factors in the *agenda-setting, matching,* and *redefining* stages of adopting AFOs in organisations enabled the creation of workspaces that matched employees' activities and preferences, and helped them reach a shared understanding of intended usage of the workspaces among employees

(as discussed in Paper 2). The employees' processes of appropriating AFOs, that is to say first encounters, and the explorative and stable phases, discussed in Paper 1, began with *clarifying* the adoption of AFOs in organisations and involved various types of adaptations. The success factors in the *clarifying* and *routinising* stages of adopting AFOs were (i) provision of a more or less complete product at the time of relocation; (ii) identifying and resolving the mismatches in employees' activity systems through inclusive, proactive and continuous OHS management processes; and (iii) achieving a joint sense of ownership of the workspace on a macro level by collectively customising the otherwise standardised and non-allocated workspaces in AFOs, and (iv) defining roles and responsibilities and devising maintenance processes for identifying and replacing the malfunctioning or missing instruments. These factors are further discussed in Papers 4 & 5. The success factors helped improve the AFO solution to better support employees' work, resulting in a fruitful symbiosis in the activity system.

6.3. Reflections on the Research Approach

This section aims to discuss the theoretical perspectives and the methodological approach adopted to address the research questions posed in this thesis.

Activity Theory in combination with the artefact ecology perspective has a central role in this thesis. Its application helped in understanding individuals' personal circumstances, work-related preconditions, usage preferences, the matches and mismatches in their activity systems, as well as successful and sub-optimal design features in AFOs. The identified matches and mismatches concerned desk-sharing rules, workspaces and specifically the collective instruments in AFOs, which complements earlier studies that either focus on the desk-sharing rule (e.g. Hirst, 2011; Millward et al., 2007) or a combination of layout design and desk-sharing (e.g. Brunia et al., 2016). The concept of matches/mismatches in Activity Theory can be compared with the theory of Person-Environment Fit to clarify their differences in terms of the constructs they spotlight.

The Person-Environment (P-E) fit theory refers to the match between individuals and their work environment (Caplan, 1987; Edwards et al., 2006). Studies suggest that when the work environment fits the characteristics of individuals, positive outcomes such as satisfaction, performance, and wellbeing can be expected, while poor fit can result in negative outcomes (Ostroff & Judge, 2012). P-E fit has been central in the realm of organisational psychology where various person and environment constructs are examined, such as employee needs and work-related rewards, personal and organisational values, employees' abilities and demands of the job, and the personality of the employee and other members of the organisation (ibid.). These constructs barely address the physical work environment (except in studies by Seddigh, 2015; Seddigh et al., 2014). However, the mentioned studies have a reductionist approach, where the the physical environment is operationalised as office types, and personality traits and the ability to cope with concentration demands of the job are considered as individual factors. With respect to AFOs, the application of the person-environment fit theory was identified in a study by Gerdenitsch and colleagues (2017). They used a modified version of P-E fit theory (need-supply fit) as a moderator that indicates individuals' appropriate usage of AFOs, to examine

distractions, interactions and satisfaction. While the study provided valuable insights on differences in usage and consequences of relocating to AFOs, the individuals and their needs were reduced to an evaluative judgement of the fit between the workspace and their activities. However, as shown in the thesis the individuals' needs are related not only to their activities, but also to their personal circumstances, prior experiences, values, and preferences for enjoyment and wellbeing.

In summary, there are several shortcomings with use of P-E theory that motivate taking an Activity Theory perspective for understanding compatibility of the environment, and individuals and their work: (i) both organisational and physical aspects are encompassed in the 'environment' in P-E fit theory, making it difficult to differentiate between these conceptually separate constructs, (ii) a duality between the person and the environment is imposed, rather than considering the triad of individuals, the physical environment and the conditions of their activities in the organisation; (iii) applications of P-E fit theory are conducted by reductive approaches such as surveys, while contextual enquiries are recommended from an Activity Theory perspective. In combination with the Artefact ecology perspective, application of Activity Theory in the thesis allowed for examination of the interrelations between AFOs ↔ Individuals, AFOs ↔ Activities, as well as the resulting changes in the nature of interrelations between Activities ↔ Individuals. In this view, AFOs are regarded as 'instruments' that mediate the activities of employees and the changes in the instruments, as a result of relocating to AFOs, and have consequences for employees' activities. In addition, a theory of adoption of technological innovations on individual and organisational levels was used for examining the role of temporality and process-related factors in implementation of AFOs, and this has not been explored in research on AFOs.

The main methodology applied in the studies was contextual inquiries by means of semi-structured interviews together with supplementary data collection methods (observations, shadowing, process inquiries). The investigations in the thesis involved triangulating with different data sources. Investigating individuals' usage preferences and design features of AFOs, and matches/mismatches in individuals' activity systems, relied on both interviews and observations. Process inquiries relied both on process documentations and interviews with employees and AFO project leaders. Triangulation between cases and data collection methods was adopted to ensure reliability and transferability of the results. However, the interviews with employees played a more central role in the thesis, as one of the implications of taking an Activity Theoretical perspective. Dialogue between the researcher and participants is suggested as a means of understanding people and their activities, as dialogues trigger individuals' reflections and allow for surfacing of the concerns of individuals as subjects of their activities (Miettinen, 2006a). Future work may benefit from focusing on the activities of AFO project groups and OHS service providers, to build further on the lessons learnt from the thesis, identify best practices, and understand the challenges they face during and after implementation of AFOs.

One limitation of the studies concerns the retrospective nature of process inquiries, both regarding individuals' and the organisations' processes for appropriating AFOs. Retrospective process inquiries involve recall effects. Using in-situ process inquiries and recurrent interviews would have removed the recall effects. However, this was not feasible in the scope of this work, as such approaches demand a long period

of time and the process of AFO implementation and employees' appropriation of AFOs exceeded the time limits of this study. Nonetheless, measures were taken to reduce the recall effects: (i) inclusion of different stakeholders (i.e. different employees and AFO project leaders) that allowed for capturing more content than one person may provide, and (ii) analysing process documentation – when available – that enabled capturing the events and activities that were documented. Future studies with recurrent interviews and in-situ approaches are suggested to avoid recall effects. In addition, investigations with a longer post-relocation time lapse can help in understanding whether the positive and negative consequences of AFOs remain over a longer period than two years.

A strength and a limitation of this research is that it represents different organisational contexts and types of work. The studies provide in-depth insights from the different cases and organisations (in response to previous calls for contextualised studies by Brunia et al., 2016; Hoendervanger et al., 2016). However, it is more difficult to compare the results from different cases. Future studies may benefit from comparing organisations and groups with similar work, to identify what solutions function best for a specific type of work. Nonetheless, the findings in this thesis confirm a previous study that compared successful and unsuccessful implementations of AFOs (Brunia et al., 2016). It is also important to note that the identified reasons behind satisfaction or dissatisfaction with AFOs were not limited to one case or a unique observation; rather, they were observed in two or more contexts despite the case differences. Therefore, the findings are considered generalisable and can be seen as mapping of matches and mismatches, likely to be observed in activity systems of employees in other AFO cases.

Some improvements in the methodological approach are worth mentioning to be considered for future studies. First, all the interviews were located in the AFOs that were being studied, and plan drawings and (in three cases) walking tours were used in connection with the interviews to facilitate reflection on the AFOs. This facilitation process can be improved by including more structured walking tours, or sensitising the interviewees through preparation prior to the (by using methods such as photo journals or diaries, see different applications in e.g. Pettersson, 2018; Renström, 2016). Second, the observations and interviews in this study were conducted in parallel due to time limitations. As a result, the focus of the interviews was mostly individuals' usage of AFOs. A sequential design is recommended in future studies, to incorporate the results from observations and process inquiries in the interviews with employees. This may help with (i) triggering discussions and reflections on the collective use of AFOs, (ii) reducing potential errors with self-reported use of AFOs, and (ii) remembering events and activities during the appropriation processes and reducing the recall effects. Third, investigating use and non-use could have been improved by using smart technologies. However, this was not feasible in the studies, with the exception of the occupancy sensors that were used in walk-in rooms in one of the organisations. The potential for using smart technologies has also been explored in other studies; for instance a recent study explored the impact of relocating to open-plan offices on face-to-face interactions (Bernstein & Turban, 2018). While these applications may provide relevant insights into studies of office environments, they are reductive in nature and do not capture contextual factors. Therefore, future

studies are recommended to explore use of smart technologies for investigating the work environments in offices in combination with contextual inquiries.

Lastly, the studies in this thesis were summative evaluations of AFOs and their adoption processes. This work can be also seen as 'research for design', that is to say producing conceptual frameworks and design implications with the intention of being applied in practice (Forlizzi et al., 2009). While the findings suggested improvements and were communicated to the project groups, follow-ups were limited for capturing eventual improvements and their impacts. Nonetheless, the findings from the different case studies included in this thesis provide in-depth insights into the consequences of relocating to AFOs, and can be used by different practitioners involved in the processes of planning AFOs or those responsible for OHS management in AFOs post-relocation. Future investigations are recommended for applying the framework of the thesis to formative purposes during the planning processes so as to guide the design of AFOs. Future work also involves dissemination of the findings in various platforms such as development of practitioner summaries, as well as presentations of the results for different stakeholders.

CHAPTER 7
CONCLUSIONS

The overarching purpose of this thesis was to develop further knowledge of consequences of relocating to AFOs in terms of employees' work and work environment, and to explain why some AFOs work while others do not. This was enabled by developing and applying a framework based on the Activity Theoretical and artefact ecological perspectives to understand the reasons behind employees' dis-/satisfaction with AFOs. The framework focuses on understanding individuals' usage of AFOs and probing into matches and mismatches in employees' activity systems, based on the components of AFOs: desk-sharing rules, workspaces, and instruments. The lack or abundance of mismatches in activity systems of a majority of employees' in an AFO explains why some AFOs work while others do not. In addition, the thesis provides an increased understanding of the temporality involved in adoption of AFOs, from planning process, to employees' appropriation of AFOs to the organisations' adaptations and Occupational Health & Safety management processes. Procedural differences were identified between the cases that further explain why some AFOs work over time while others do not.

In summary, AFOs work provided that (i) they match individuals' personal circumstances and work-related preconditions; (ii) they support individuals' work, fulfil individuals' preferences for wellbeing and enjoyment, and facilitate flexibility and the shared use of spaces through well-designed rules, spaces and instruments; (iii) individuals' appropriation processes reach a stable phase where mismatches are resolved and a fruitful symbiosis is achieved in individuals' activity systems; and (iv) the organisations' process of adopting AFOs as an innovation is successful both during the planning process and during the routinising stage post-relocation. The following sections summarise the contributions of this thesis with respect to the research questions.

7.1. Untangling Interdependencies

RQ1. What (if any) are the interdependencies between employee(s), their activities, and AFOs, and how do these interdependencies impact employees' satisfaction with AFOs?

Individuals' usage of AFOs varies considerably in terms of (i) following/disregarding the desk-sharing policy, and (ii) use and non-use of the different zones and workstations, as well as (iii) use and non-use of individual and collective instruments. As a result, two types of artefact ecologies were identified that explain the main differences in employees' use of AFOs. The employees who followed the desk-sharing rule, switched workstations and used more of the collective instruments had *dynamic* artefact ecologies, while those who did not switch workstations and mainly used individual instruments had *static* artefact ecologies. The choices between following/disregarding the desk-sharing rules, different workspaces, and different instruments involved making trade-offs. These trade-offs were not always made to benefit isolated actions, rather they were made to reduce inconvenience and misspent time (and benefit their work as a whole), as well as to increase enjoyment, wellbeing, and pleasure.

It is important to note that individuals' preconditions for sharing workspaces vary depending on their activities and personal circumstances such as preferences, physical impairments, and prior experiences. Not everyone had the preconditions for following the desk-sharing policy, nor did everyone derive joy from sharing workstations. In addition, some of the activities had material and temporal preconditions that did not benefit from and discouraged desk-sharing. In short, having static artefact ecologies was associated with dissatisfaction with AFOs, while dynamic artefact ecologies entailed either satisfaction or dissatisfaction with AFOs.

Three types of matches/mismatches were identified in employees' activity systems that explained the reasons behind dis-/satisfaction with AFO solutions: *Employee* ↔ *AFO, Activity* ↔ *AFO,* and *Employee* ↔ *Activity*. The typical mismatches were: not having own spaces; limitations on work-related personalisation; having to set up and clear out; distractions and dislocation from immediate colleagues. Additional mismatches were reported by individuals with dynamic artefact ecologies: physical discomfort; inconvenient adjustment and setup of workstations; malfunctioning instruments; misspent time; unavoidable distractions; shortage of desirable workstations; and dislocation from immediate colleagues. Conversely, individuals who were satisfied with AFOs reported matches in their activity systems: quick setup of workstations; access to quiet spaces; and co-location with inter- and intra-team colleagues. The interrelations between *Employee* ↔ *AFO* and *Activity* ↔ *AFO,* generated matches/mismatches between *Employee* ↔ *Activity,* which involved either an improvement or a disengagement in individuals' activities. In general, the abundance or lack of mismatches in individuals' activity systems explained why some individuals were satisfied with AFOs while others were dissatisfied.

7.2. The Devil is in the Details

RQ2. How does the design of AFOs influence employee satisfaction?

Investigating the individuals' usage preferences and non-preferences, and the outlined matches/mismatches, highlighted success factors and sub-optimal features that relate to specification of desk-sharing rules, and design of workspaces and instruments.

Clearly defined and well-communicated rules were crucial for having a shared understanding of expected behaviour, making the flexible office concepts work, and avoiding uncertainties, conflicting interpretations and disregarding of rules.

Employees' preferences and non-preferences highlighted unnecessary and avoidable trade-offs that were imposed by sub-optimal design features. These were due to deficient design of workspaces that failed to simultaneously support the employees' activities and fulfil their wellbeing needs. Deficient zoning involved: malfunctioning quiet and semi-quiet zones due to openness and proximity of the zones; workspaces that were located in the darker areas of the building, lacking desirable ambient features; workspaces that were difficult to interpret due to mixing of the furniture within zones or visual similarities between zones; and undefined and poorly communicated speech rules.

The sub-optimal design features of the workspaces led to competition for the desirable workspaces, while undesirable spaces were underused and disregarded. The reasons behind non-use were: (a) undesirable ambient features, (b) exposure to stimuli, (c) difficult-to-interpret spaces, (d) insufficient collective instruments; and (d) mismatches with the organisations' identity or the employees' work and preferences. These highlight that the AFOs are not used to their full potential and do not necessarily entail efficient use of spaces. Analysing preferences and non-preferences can therefore help in identifying design opportunities to increase workstation-employee ratio and provide more usable and desirable workspaces. This approach can be used both during the design process and post-relocation, for identifying and replacing the undesirable workstations with desirable ones, and mitigating the stress of finding a suitable workstation in AFOs.

Dysfunctionality of the collective instruments was another sub-optimal design feature. The provided collective instruments were not always designed for shared use and repetitive adjustments. In addition, various dysfunctionalities were highlighted in everyday artefacts that obstructed desk-sharing and led to mismatches in employees' activity systems.

7.3. Things Take Time!

RQ3. How do employees appropriate AFO solutions?

The employees' processes of appropriating AFOs involved: first encounters, exploration, and stable phases. The identified differences between the employees' processes of appropriation of AFOs highlight that it takes time for employees to become familiarised with AFOs and experiment with new ways of working and the new workspaces, before they reach a stable phase. During this period, different adaptations occur: (i) on an individual level: Acquisition of insights, Behavioural adaptations, Hedonic adaptations, and Social adaptation; and (ii) in the AFO solutions: Instrument adaptations, Spatial adaptations, and Rule-related adaptations.

The stable phase in employees' appropriation processes had different characters, depending on the type of symbiosis in the employees' activity systems. A *fruitful symbiosis* was observed when co-adaptation between the individuals and the AFO solution took place, and as a result the AFO supported employees' work and wellbeing, despite initial work environment problems. A resigned symbiosis was observed when the co-adaptations were insufficient, and the employees' found the AFO to be an obstacle in their work, yet managed to carry out their activities despite their dissatisfaction.

7.4. Adoption Process Instead of an AFO Project

RQ4. What (if any) process-related aspects influence employees' satisfaction with AFOs?

The adoption processes varied considerably between cases. Procedural shortcomings during the planning process led to a limited understanding of users, and thereby, implementing sub-optimal AFO solutions that did not match users' needs and activities. Procedural shortcomings in the routinising stage involved limited resources and a lack of knowledge about OHS (Occupational Health & Safety) management in AFOs. This led to lingering mismatches and a resigned symbiosis in employees' activity systems.

Success factors in the planning processes consisted of assuming and communicating positive intent, demonstrations that arouse users' curiosity, allowed trialability and clarified ambiguities, analyses of activities and needs, employee participation, change-related training and preparations, clear communication of the process, and providing a more or less complete product at the time of relocation. Success factors in the planning processes were critical for gaining an in-depth understanding of users and designing AFO solutions that matched employees' preferences and activities, as well as reaching a shared understanding of expected behaviour and acceptance of the AFO concept among the employees.

Success factors in the routinising stage related to adaptations and organisational processes for OHS management and included evaluation efforts and control processes; provision of support and training; a continuous dialogue between

employees, work environment representatives, line managers and facility managers to identify mismatches to be resolved; as well as defining roles and responsibilities for continuous improvements, customisation, and maintenance of spaces and the collective instruments. The routinising stage was critical since the nature of individuals' activities is dynamic and, despite thought-through design processes, the outcomes may be used in a different way than intended. Therefore, making adaptations helps resolve mismatches that appear in employees' activity systems post-relocation and achieves a fruitful symbiosis. Furthermore, an inclusive adaptation process allowed for achieving the so-called 'IKEA effect' in AFOs, that is to say a sense of joint ownership of the workspace on a macro level by collectively customising the otherwise standardised and non-allocated workspaces in AFOs.

REFERENCES

AFS. (2001). Systematic work environment management (in swedish: Arbetsmiljöverkets föreskrifter om systematiskt arbetsmiljöarbete),The Swedish Work Environment Authority. AFS 2001:1.

Appel-Meulenbroek, R., Clippard, M., & Pfnür, A. (2018). The effectiveness of physical office environments for employee outcomes: An interdisciplinary perspective of research efforts. *Journal of Corporate Real Estate, 20*(1), 56-80. doi:doi:10.1108/JCRE-04-2017-0012

Appel-Meulenbroek, R., Groenen, P., & Janssen, I. (2011). An end-user's perspective on activity-based office concepts. *Journal of Corporate Real Estate, 13*(2), 122-135. doi:10.1108/14630011111136830

Appel-Meulenbroek, R., Kemperman, A., Kleijn, M., & Hendriks, E. (2015). To use or not to use: Which type of property should you choose? Predicting the use of activity based offices. *Journal of Property Investment & Finance, 33*(4), 320-336.

Arbetsmiljöverket. (2016). *The work environment 2015*. Retrieved from https://www.av.se/globalassets/filer/publikationer/foreskrifter/engelska/systematic-work-environment-management-provisions-afs2001-1.pdf

Arbetsmiljöverket. (2018). *The work environment 2017*. Retrieved from https://www.av.se/globalassets/filer/publikationer/foreskrifter/engelska/systematic-work-environment-management-provisions-afs2001-1.pdf

Bernstein, E. S., & Turban, S. (2018). The impact of the 'open'workspace on human collaboration. *Philosophical Transactions of the Royal Society B: Biological Sciences, 373*(1753), 20170239.

Berthelsen, H., Muhonen, T., & Toivanen, S. (2017). Vad händer med arbetsmiljön när man inför aktivitetsbaserade kontor inom akademin? *Arbetsmarknad & Arbetsliv, 23*(3), 9-23.

Bjerrum, E., & Bødker, S. (2003). *Learning and living in the 'new office'.* Paper presented at the ECSCW.

Bodin Danielsson, C. (2014). Vad är ett bra kontor? *Olika perspektiv på Sveriges vanligaste arbetsplats. Svensk*.

Bodin Danielsson, C., & Bodin, L. (2008). Office type in relation to health, well-being, and job satisfaction among employees. *Environment and Behavior, 40*(5), 636-668. doi:10.1177/0013916507307459

Bodin Danielsson, C., & Theorell, T. (2018). Office employees' perception of workspace contribution: A gender and office design perspective. *Environment and Behavior*, 0013916518759146. doi:10.1177/0013916518759146

Bødker, S., & Andersen, P. B. (2005). Complex mediation. *Human–computer interaction, 20*(4), 353-402. doi:10.1207/s15327051hci2004_1

Bødker, S., & Klokmose, C. N. (2011). The human–artifact model: An activity theoretical approach to artifact ecologies. *Human–Computer Interaction, 26*(4), 315-371. doi:10.1080/07370024.2011.626709

Bødker, S., & Klokmose, C. N. (2012). *Dynamics in artifact ecologies.* Paper presented at the Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design.

Boutellier, R., Ullman, F., Schreiber, J., & Naef, R. (2008). Impact of office layout on communication in a science-driven business. *R&d Management, 38*(4), 372-391. doi:10.1111/j.1467-9310.2008.00524.x

Brand, J. L. (2008). Office ergonomics: A review of pertinent research and recent developments. *Reviews of human factors and ergonomics, 4*(1), 245-282.

Brennan, A., Chugh, J. S., & Kline, T. (2002). Traditional versus open office design: A longitudinal field study. *Environment and Behavior, 34*(3), 279-299. doi:10.1177/0013916502034003001

Brunia, S., De Been, I., & van der Voordt, T. J. (2016). Accommodating new ways of working: Lessons from best practices and worst cases. *Journal of Corporate Real Estate, 18*(1), 30-47. doi:10.1108/JCRE-10-2015-0028

Brunia, S., & Hartjes-Gosselink, A. (2009). Personalization in non-territorial offices: A study of a human need. *Journal of Corporate Real Estate, 11*(3), 169-182. doi:10.1108/14630010910985922

Caplan, R. D. (1987). Person-environment fit theory and organizations: Commensurate dimensions, time perspectives, and mechanisms. *Journal of Vocational behavior, 31*(3), 248-267.

Carroll, J., Howard, S., Vetere, F., Peck, J., & Murphy, J. (2002). *Just what do the youth of today want? Technology appropriation by young people.* Paper presented at the System Sciences, 2002. HICSS. Proceedings of the 35th Annual Hawaii International Conference on.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*: SAGE Publications.

Creswell, J. W., & Clark, V. L. P. (2011). *Designing and conducting mixed methods research*: SAGE Publications.

Czarniawska, B. (2007). *Shadowing: And other techniques for doing fieldwork in modern societies*: Liber.

Czarniawska, B. (2014). *Social science research: From field to desk*: SAGE Publications.

De Been, I., & Beijer, M. (2014). The influence of office type on satisfaction and perceived productivity support. *Journal of Facilities Management, 12*(2), 142-157. doi:10.1108/JFM-02-2013-0011

De Been, I., Beijer, M., & Den Hollander, D. (2015). *How to cope with dilemmas in activity based work environments–results from user-centred research.* Paper presented at the Conference paper 14th EuroFM Research Symposium. EuroFM research papers.

De Croon, E., Sluiter, J., Kuijer, P. P., & Frings-Dresen, M. (2005). The effect of office concepts on worker health and performance: A systematic review of the literature. *Ergonomics, 48*(2), 119-134. doi:10.1080/00140130512331319409

Donatella, D. P., Kirsten, A., & Siri, H. B. (2013). Creating business value with open space flexible offices. *Journal of Corporate Real Estate, 15*(3/4), 181-193. doi:10.1108/JCRE-11-2012-0028

Edwards, J. R., Cable, D. M., Williamson, I. O., Lambert, L. S., & Shipp, A. J. (2006). The phenomenology of fit: Linking the person and environment to the subjective experience of person-environment fit. *Journal of Applied Psychology, 91*(4), 802-827. doi:10.1037/0021-9010.91.4.802

Ekstrand, M., & Damman, S. (2016). Front and backstage in the workplace: An explorative case study on activity based working and employee perceptions of control over work-related demands. *Journal of Facilities Management, 14*(2), 188-202.

Ekstrand, M., & Damman, S. (2017). Management of integrated workplace concepts at multiple locations. *Facilities, 35*(3/4), 188-201. doi:10.1108/F-12-2015-0086

Ekstrand, M., & Hansen, G. K. (2016). Make it work! Creating an integrated workplace concept. *Journal of Corporate Real Estate, 18*(1), 17-29. doi:10.1108/JCRE-10-2015-0031

Elsbach, K. D. (2003). Relating physical environment to self-categorizations: Identity threat and affirmation in a non-territorial office space. *Administrative Science Quarterly, 48*(4), 622-654. doi:10.2307/3556639

Engelbrektsson, P. (2004). *Enabling the user – exploring methodological effects on user requirements elicitation.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Engelen, L., Chau, J., Young, S., Mackey, M., Jeyapalan, D., & Bauman, A. (2019). Is activity-based working impacting health, work performance and perceptions? A systematic review. *Building research & information, 47*(4), 468-479.

Engeström, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics, 43*(7), 960-974. doi:10.1080/001401300409143

Engeström, Y., Miettinen, R., Theory, I. C. R. A., & Punamäki, R. L. (1999). *Perspectives on activity theory*: Cambridge University Press.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry, 12*(2), 219-245.

Forlizzi, J. (2008). The product ecology: Understanding social product use and supporting design culture. *International Journal of design, 2*(1).

Forlizzi, J., Zimmerman, J., & Stolterman, E. (2009). *From design research to theory: Evidence of a maturing field.* Paper presented at the International Assoc. of Societies of Design Research Conference.

Gerdenitsch, C., Korunka, C., & Hertel, G. (2017). Need–supply fit in an activity-based flexible office: A longitudinal study during relocation. *Environment and Behavior, 50*(3), 273-297. doi:10.1177/0013916517697766

Gorgievski, M. J., van der Voordt, T. J., van Herpen, S. G., & van Akkeren, S. (2010). After the fire: New ways of working in an academic setting. *Facilities, 28*(3/4), 206-224.

Hasle, P., & Sørensen, O. H. (2013). Employees as individually and collectively acting subjects-key contributions from nordic working life research. *Nordic Journal of Working Life Studies, 3*(3), 9.

Hiort, V. (2010). *The significance of things: Affective user–artefact relations.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Hirst, A. (2011). Settlers, vagrants and mutual indifference: Unintended consequences of hot-desking. *Journal of Organizational Change Management, 24*(6), 767-788. doi:10.1108/09534811111175742

Hoendervanger, J. G., De Been, I., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2016). Flexibility in use: Switching behaviour and satisfaction in activity-based work environments. *Journal of Corporate Real Estate, 18*(1), 48-62. doi:10.1108/JCRE-10-2015-0033

ISO 45001. (2018). Occupational health and safety management systems - requirements with guidance for use (Vol. ISO 45001:2018): ISO (International Organization for Standardization).

Jung, H., Stolterman, E., Ryan, W., Thompson, T., & Siegel, M. (2008). *Toward a framework for ecologies of artifacts: How are digital artifacts interconnected within a personal life?* Paper presented at the Proceedings of the 5th Nordic conference on Human-computer interaction: building bridges.

Kaarlela-Tuomaala, A., Helenius, R., Keskinen, E., & Hongisto, V. (2009). Effects of acoustic environment on work in private office rooms and open-plan offices–longitudinal study during relocation. *Ergonomics, 52*(11), 1423-1444.

Kaptelinin, V., & Nardi, B. A. (2006). *Acting with technology: Activity theory and interaction design*: MIT Press.

Karlsson, M. (1996). *User requirements elicitation – a framework for the study of the relation between user and artefact.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Karlsson, M. (1999). A framework for the study of the relation between user and artefact. *Engineering psychology and cognitive ergonomics, 4*, 379-386.

Kim, J., Candido, C., Thomas, L., & de Dear, R. (2016). Desk ownership in the workplace: The effect of non-territorial working on employee workplace satisfaction, perceived productivity and health. *Building and Environment, 103*, 203-214. doi:10.1016/j.buildenv.2016.04.015

Kim, J., & de Dear, R. (2013). Workspace satisfaction: The privacy-communication trade-off in open-plan offices. *Journal of Environmental Psychology, 36*(0), 18-26. doi:10.1016/j.jenvp.2013.06.007

Klein, K. J., & Knight, A. P. (2005). Innovation implementation: Overcoming the challenge. *Current directions in psychological science, 14*(5), 243-246. doi:10.1111/j.0963-7214.2005.00373.x

Knight, C., & Haslam, S. A. (2010). The relative merits of lean, enriched, and empowered offices: An experimental examination of the impact of workspace management strategies on well-being and productivity. *Journal of Experimental Psychology: Applied, 16*(2), 158. doi:10.1037/a0019292

Kuutti, K. (1996). Activity theory as a potential framewrok for human computer interaction research. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction*: MIT Press.

Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*: SAGE Publications.

Lahtinen, M., Ruohomäki, V., Haapakangas, A., & Reijula, K. (2015). Developmental needs of workplace design practices. *Intelligent Buildings International, 7*(4), 198-214. doi:10.1080/17508975.2014.1001315

Lawson, B., & Dorst, K. (2009). *Design expertise*: Taylor & Francis Group.

Meijer, E. M., Frings-Dresen, M. H., & Sluiter, J. K. (2009). Effects of office innovation on office workers' health and performance. *Ergonomics, 52*(9), 1027-1038.

Merriam, S. B. (2009). *Qualitative research : A guide to design and implementation (3)*. Somerset, US: Jossey-Bass.

Miettinen, R. (2006a). Epistemology of transformative material activity: John dewey's pragmatism and cultural-historical activity theory. *Journal for the Theory of Social Behaviour, 36*(4), 389-408.

Miettinen, R. (2006b). Pragmatism and activity theory: Is dewey's philosophy a philosophy of cultural retooling? *Outlines. Critical Practice Studies, 8*(2), 3-19.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*: SAGE Publications.

Millward, L. J., Haslam, S. A., & Postmes, T. (2007). Putting employees in their place: The impact of hot desking on organizational and team identification. *Organization Science, 18*(4), 547-559. doi:10.1287/orsc.1070.0265

Morrison, R. L., & Macky, K. A. (2017). The demands and resources arising from shared office spaces. *Applied ergonomics, 60*, 103-115. doi:10.1016/j.apergo.2016.11.007

Mosselman, N., Gosselink, A., & Beijer, M. (2010). Long-term effects of activity based working. *EuroFM Insight, 2010 (15)*.

Nardi, B. A. (1996). *Context and consciousness: Activity theory and human-computer interaction*: MIT Press.

Nielsen, K., & Abildgaard, J. S. (2013). Organizational interventions: A research-based framework for the evaluation of both process and effects. *Work & Stress, 27*(3), 278-297.

Nielsen, K., & Randall, R. (2013). Opening the black box: Presenting a model for evaluating organizational-level interventions. *European Journal of Work and Organizational Psychology, 22*(5), 601-617. doi:10.1080/1359432X.2012.690556

Nielsen, K., Randall, R., Holten, A.-L., & González, E. R. (2010). Conducting organizational-level occupational health interventions: What works? *Work & Stress, 24*(3), 234-259.

Nijp, H. H., Beckers, D. G., van de Voorde, K., Geurts, S. A., & Kompier, M. A. (2016). Effects of new ways of working on work hours and work location, health and job-related outcomes. *Chronobiology international, 33*(6), 604-618.

Norton, M. I., Mochon, D., & Ariely, D. (2012). The ikea effect: When labor leads to love. *Journal of Consumer Psychology, 22*(3), 453-460. doi:10.1016/j.jcps.2011.08.002

Oldham, G. R., & Brass, D. J. (1979). Employee reactions to an open-plan office: A naturally occurring quasi-experiment. *Administrative Science Quarterly*, 267-284.

Ostroff, C., & Judge, T. A. (2012). *Perspectives on organizational fit*: Taylor & Francis.

Pettersson, I. (2018). *Eliciting user experience information in early design phases. The care approach to in-vehicle ux.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Pettersson-Strömbäck, A., Bodin Danielsson, C., Nordin, M., Öhrn, M., Harder, M., Olsson, T., Wahlström, V., & Slunga-Järvholm, L. (2018). *Slutrapport från aktikon-projektet i örnsköldsviks kommun : Arbetsmiljö, fysisk aktivitet, hälsa och produktivitet i aktivitetsbaserad kontorsmiljö – en kontrollerad studie i örnsköldsviks kommun* (16547314 (ISSN)). Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-148549

Renström, S. (2016). *Inviting interaction: Explorations of the district heating for people.* (Licentiate of Engineering), Chalmers University of Technology, Göteborg, Sweden.

Rexfelt, O. (2008). *User-centred design and technology-mediated services: Identifying and addressing challenges by analysing activities.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Robertson, M. M., Huang, Y.-H., O'Neill, M. J., & Schleifer, L. M. (2008). Flexible workspace design and ergonomics training: Impacts on the psychosocial work environment, musculoskeletal health, and work effectiveness among knowledge workers. *Applied ergonomics, 39*(4), 482-494.

Rogers, E. M. (1995). *Diffusion of innovations, 4th edition*: Free Press.

Rolfö, L., Eklund, J., & Jahncke, H. (2018). Perceptions of performance and satisfaction after relocation to an activity-based office. *Ergonomics, 61*(5), 644-657. doi:10.1080/00140139.2017.1398844

Rolfö, L. V. (2018a). Activity-based flexible office work environments : Design and implementation processes and outcomes. (Doctor of Philosophy). KTH Royal Institute of Technology, Stockholm, Sweden.

Rolfö, L. V. (2018b). Relocation to an activity-based flexible office – design processes and outcomes. *Applied ergonomics, 73*, 141-150. doi:10.1016/j.apergo.2018.05.017

Rossitto, C., Bogdan, C., & Severinson-Eklundh, K. (2014). Understanding constellations of technologies in use in a collaborative nomadic setting. *Computer Supported Cooperative Work (CSCW), 23*(2), 137-161. doi:10.1007/s10606-013-9196-4

Ruohomäki, V., Lahtinen, M., & Reijula, K. (2015). Salutogenic and user-centred approach for workplace design. *Intelligent Buildings International, 7*(4), 184-197.

Sambasivan, N., Ventä, L., Mäntyjärvi, J., Isomursu, M., & Häkkilä, J. (2009). *Rhythms of non-use of device ensembles.* Paper presented at the CHI'09 Extended Abstracts on Human Factors in Computing Systems.

Seddigh, A. (2015). *Office type, performance and well-being: A study of how personality and work tasks interact with contemporary office environments and ways of working.* (PhD thesis), Stockholm University.

Seddigh, A., Berntson, E., Danielson, C., & Westerlund, H. (2014). Concentration requirements modify the effect of office type on indicators of health and performance. *Journal of Environmental Psychology, 38*, 167-174. doi:10.1016/j.jenvp.2014.01.009

Seim, R., & Broberg, O. (2010). Participatory workspace design: A new approach for ergonomists? *International Journal of Industrial Ergonomics, 40*(1), 25-33.

Selvefors, A. (2015). *Design beyond interventions – supporting less energy-reliant activities in the everyday.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Selvefors, A., Rexfelt, O., Renström, S., & Strömberg, H. (2019). Use to use – a user perspective on product circularity. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2019.03.117

Simon, H. A. (1988). The science of design: Creating the artificial. *Design Issues*, 67-82.

Strömberg, H. (2015). *Creating space for action – supporting behaviour change by making sustainable transport opportunities available in the world and in the mind.* (Doctor of Philosophy), Chalmers University of Technology, Göteborg, Sweden.

Svartengren, M., & Hellman, T. (2018). Study protocol of an effect and process evaluation of the stamina model; a structured and time-effective approach through methods for an inclusive and active working life. *Bmc Public Health, 18*(1), 1070.

Tagliaro, C., & Ciaramella, A. (2016). Experiencing smart working: A case study on workplace change management in italy. *Journal of Corporate Real Estate, 18*(3), 194-208. doi:10.1108/JCRE-10-2015-0034

Toivanen, S. (2015). Framtidens arbetsplatser. *Att utveckla hållbara och friska kontor.*

van der Voordt, T. J. (2004). Productivity and employee satisfaction in flexible workplaces. *Journal of Corporate Real Estate, 6*(2), 133-148. doi:10.1108/14630010410812306

van Koetsveld, R., & Kamperman, L. (2011). How flexible workplace strategies can be made successful at the operational level. *Corporate Real Estate Journal, 1*(4), 303-319.

Voigt, P., & Von dem Bussche, A. (2017). The EU general data protection regulation (GDPR). *A Practical Guide, 1st Ed., Cham: Springer International Publishing.*

Vos, P., & van der Voordt, T. (2002). Tomorrow's offices through today's eyes: Effects of innovation in the working environment. *Journal of Corporate Real Estate, 4*(1), 48-65. doi:10.1108/14630010210811778

Wahlström, J. (2005). Ergonomics, musculoskeletal disorders and computer work. *Occupational Medicine, 55*(3), 168-176.

Wohlers, C., & Hertel, G. (2016). Choosing where to work at work – towards a theoretical model of benefits and risks of activity-based flexible offices. *Ergonomics*, 1-20. doi:10.1080/00140139.2016.1188220

Yin, R. K. (2018). *Case study research and applications: Design and methods*: SAGE Publications.

APPENDIX A

Interview questions that were used in all the studies.

Themes	Questions included in Wave 1	Additional questions included in Wave 2
General	Tell me about your roles and responsibilities! What are the most common activities and tasks involved in a typical week? Do you work in a team? (If so, with how many people?) How much of your work is solitary – collaborative, and concentrative? How long have you worked in this position and at the organisation?	
Workspace preferences	Where do you sit when carrying out these activities? Why? (Mark on the drawings) How often do you switch workstations? How do you choose a workstation when you arrive or when you switch workstations? Are there activities that you choose not to do at the office? Why? How often?	Have your preferences changed over time? How? Why? Has your switching frequency changed over time? Why?
Rules	Are there any rules that you have to follow? What are they? How well are they followed?	Has anything changed in the rules or the extent to which they are followed?
Instruments	What are the central tools that you use? How do you set up and adjust your workstation?	Have there been changes in the tools you use and the way you adjust your workstation? Why? Have you started/stopped using any tools, furniture or spaces? Why?
Functionality	How well does the AFO/ABW work for you? What are the strengths and weaknesses of the AFO/ABW solution? How does the desk-sharing concept support/impede your work? How do the layout and different workspaces support/impede your work? How do the available tools support/impede your work?	Do you remember how well the AFO/ABW worked in the beginning? Have there been any problems that were resolved? What are they? Have there been any changes in the AFO/ABW solution over time? Give examples. Who initiated these changes? Do you find the changes positive or negative?
Satisfaction	Are you satisfied with the AFO/ABW solution? Why? What are the most positive/negative changes?	Were you equally satisfied (or dissatisfied) with the solution in the beginning? Why?
Perceived performance	Has relocation to AFO/ABW influenced your performance? (Your ability to carry out your activities) How? To what extent?	
Interactions	Has group cohesion changed post-relocation? Why? How do you find your colleagues? Are there any difficulties? Have there been changes in your interactions with colleagues/new relations? Why? Have there been changes in your collaborations? Why?	
Planning and adaptations	Were you involved in choosing to go with an AFO/ABW solution? Did you have a positive or negative opinion about this choice? Why? Did you participate in designing the AFO/ABW during the planning process? How? To what extent? Were you able to influence the solution? Give examples. To what extent were your needs taken into consideration during the planning? Give examples.	
	Are you satisfied with the planning process? Have there been annoyances or conflicts? Give examples. What was the biggest annoyance? Why? Is there something missing or that you would like to change?	Why do you think ABW/AFO was implemented? Are you satisfied with the possibilities to make improvements in the environment? How would you go about making such improvements?

APPENDIX B

Criteria for evaluating the quality of conclusions in qualitative research and tactics used for testing and confirming findings in the 5 appended papers (based on Miles & Huberman, p. 262-280).

Criteria	Definition	Quality checks used in the different papers	1	2	3	4	5
Credibility Authenticity Internal validity	Findings reflect informants' understandings	Joint analysis: involving multiple researchers in the analytical process to have the opportunity for discussion and further development of coding and analysis		Y			Y
		Discussions on analysis and interpretation with supervisors	Y	Y	Y	Y	Y
		Member checks/Respondent validation: integrated as part of the interpretation and the analytical process to check accuracy of findings	Y		Y	Y	Y
		Testing the findings by using unpatterns (extreme cases), checking outliers, and following up surprises	Y	Y	Y	Y	Y
Dependability Reliability Auditability	The logic leading from data to interpretation are made explicit	Case-to-case transfer: selection of multiple cases with different AFO solutions, organisational contexts, times, and respondents, to check the boundaries of the findings		Y	Y	Y	Y
		Providing a detailed description of the research context in all the studies, and by highlighting the limitations and strengths of each study	Y	Y	Y	Y	Y
Transferability Fittingness External validity	The contexts in which the findings are likely to hold are clear	Peer review: feedback was collected on analysis and interpretation from colleagues, peers, and supervisors	Y	Y	Y	Y	Y
		Inter-rater agreement: involving multiple researchers in joint analysis and reaching adequate agreement		Y			Y
		Detailed and clear description of case organisations, informants' activities, and the AFO solutions to allow for comparison with other contexts	Y		Y	Y	Y
		Checking congruency of findings with prior studies	Y	Y	Y	Y	Y
		Using multiple cases and contexts to strengthen transferability of the findings		Y	Y	Y	Y
Confirmability Objectivity	The conclusions depend on subjects and conditions of the study rather than the researcher	Explicit and detailed description of data collection and analysis procedures allowing for linking the data to conclusions	Y	Y	Y	Y	Y
		Checking out rival explanations regarding time and habituation process in AFOs			Y	Y	
Utilisation Application Action orientation	Contributions for different stakeholders	Making the finding accessible for potential users by presenting results at department level	Y	Y	Y	Y	Y
		Providing guidance for future action or for solving problems	Y	Y	Y	Y	Y
		Employee empowerment: making sure the informants' experiences and desires were communicated to senior staff for future action	Y	Y	Y	Y	Y
		Ethical considerations: verbal consent was gathered for data collection, and anonymity guaranteed in communication of results (in studies prior to introduction of GDPRs)	Y	Y	Y	Y	Y
		Ethical considerations: written consent was gathered prior to data collection, and anonymity guaranteed in communication of results in compliance with GDPRs			Y		Y