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# **Spaces of Working in Modern Software Organisations**

**A Thesis Submitted in Part-fulfilment of the Requirements for the Degree of  
Doctor of Philosophy of The University of Warwick**

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## LIST OF ABBREVIATIONS

AP	Asia-Pacific Region
API	Application Programming Interface
CSCW	Computer-Supported Cooperative Work
EMEA	Europe, Middle East & Africa
GBS	Global Business Services
HCI	Human-Computer Interaction
ICT	Information and Communications Technology
IoT	Internet of Things
IS	Information Systems
iX	IBM Interactive Experience (a subsidiary of GBS)
LGTM	Looks Good to Me!
MVP	Minimum Viable Product
PO	Product Owner
SCM	Supply Chain Management
SBU	Strategic Business Unit
SPOC	Single Point of Contact
SDK	Software Development Kit
ST	Sametime Messenger
UI	User Interface

UX	User Experience
VP	Vice President
WYSIWYG	What You See Is What You Get

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Kamaran Sheikh

## **DECLARATION**

This is to certify that the work I am submitting is my own. None of the material contained in the thesis has been previously published or submitted for a degree at another university.

All external references and sources are clearly acknowledged and identified within the contents. I am aware of the University of Warwick regulation concerning plagiarism and collusion.



## ABSTRACT

*The growing use of digital media in the workplace is shifting work to digital platforms, whilst digital working is often seen to be replacing office-based work practices. This study captures the opposite. It explores the appropriation of features of both physical and digital environments by collocated software development teams in a multinational IT company. These environments are designed in isolation, yet they become integrated in practice by employees.*

*This study is positioned within the information systems literature as a step to address the gap on digital work and understand the essential role played by the physical environment in the usage and appropriation of digital tools in modern organisations. It posits a view of space as constantly in the making through sociospatial practices. It empirically demonstrates that the physical environment is not only integral to work practices and deeply entangled with digital interactions and activities, but space emerges as a result of a mutual shaping, where physical and digital coexist in tightly woven symbiotic form.*

*In this manner, this study extends existing knowledge through four novel concepts including a combined theorisation to understand how work is performed in modern digital organisations: (a) **spatial work practices** extend the concept of spatial practices (de Certeau 1984) as they are intrinsically attached to work activities. They are responsible for the creation and the dismantling of (b) **physical-digital assemblages**, which conceptualise and explain how actors combine and configure elements from the physical environment and digital technologies to create (c) **spatialities**, as planned spatial effects to influence the way in which work activities are performed. These concepts are integrated through the emergent framework of (d) **crafted workspaces**, which enables the theorisation of new types of organisational space that transcend traditional dichotomous notions of physical or digital.*

*This research thus responds to recent calls for a ‘spatial turn’ in organisational studies and information systems literature, enabling modern working practices to be understood and effectively integrated into modern organisations, whilst in turn calling for greater attention to space as a performative and constitutive element of digital work in information systems research.*

**Keywords:** agile software development, code/space, crafted workspace, digital, digital work, modern work, physical-digital assemblages, physical, space, sociospatial, spatialities, spatial work practice, transduced workspace, work practices.



## CHAPTER 1: INTRODUCTION

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The increasing adoption of digital media within the workplace is shifting work activities and interactions to digital tools and collaborative platforms in organisations (Leonardi et al. 2013). Work activities are now increasingly embedded in digital platforms (Yoo et al. 2010), which has led organisations to re-evaluate the role of the physical office environment in supporting work. Many organisations responded to this by adopting flexible or virtual working policies (Kingma 2018; Steinfield et al. 2001). However, several technology organisations including Apple (2017), Microsoft (2018) and IBM (2014), have done the opposite by reconfiguring their physical office environments to support these new ways of working in attempt to better integrate them in the dynamics of collaborative activity and interactions of modern workplaces. Further, several of these organisations which once pioneered remote work including Yahoo! (Miller and Rampell 2013), Hewlett Packard Enterprise (Nichols 2017) and IBM (Simons 2017), have been calling workers back to the office.

These combined factors have led to new work environments where employees are now both digitally and physically proximate and constantly connected (Kolb et al. 2012; Wajcman and Rose 2011), facilitated by the ubiquity of mobile technology (MacCormick et al. 2012; Mazmanian et al. 2013). This is redefining our sense of distance and spaces of work and interaction (Woolgar 2002). These modern office environments combine advanced technologies such as sensors and automation with a reconfigurable physical architecture such as movable furniture, versatile settings and drawing and projecting walls which enhance work, improve employee engagement and experience (Bjerrum et al. 2003; Waber et al. 2014) ultimately with the aim to accelerate the pace of work (Simons, 2017). This has shifted the role and design of the physical office to be more aligned with the features of digital platforms, which together act as signalling devices for aspired organisational behaviours supporting greater collaboration, engagement and innovation.

Work in modern organisations is therefore characterized by ongoing flows of interactions across physical and digital environments (Davis et al. 2011; Orlikowski 2007). Tasks traditionally performed in physical workspaces in the office are increasingly embedded in digital platforms, whilst interactions such as face-to-face meetings can now be enhanced and extended by virtual interactions (Baptista and Huang 2013). This suggests an increase in the blurring of face-to-face and digital interactions (Weeks and Fayard 2011), where physical interactions are augmented through digital communications which support and extend physical meetings (Dixon and Panteli 2010). Yet significantly digital communications are not seen as a substitute for face-to-face encounters, as the collocation of employees does not make virtual communications any less relevant. This blurring across physical and digital creates a new challenge for organisations whom need to think creatively about how to

integrate the physical and virtual so that the myriad interactions that take place within them become more than the sum of their parts (Flecker 2016; Weeks and Fayard 2011).

This has led to rethinking the role and purpose of modern office environments, which are not merely passive containers for work activities happening within them, rather they shape and contribute positively toward organisational capacities (Kornberger and Clegg 2004; De Vaujany and Vaast 2013). They enable workplaces which consist of physical environments, digital technologies and collaborative work practices which are deeply intertwined. This study focuses precisely on examining these modern hybrid physical and digital environments and exploring how work is performed within them.

### **1.1 Research Motivation and Knowledge Gap**

The importance of the physical environment in the organisation of work has been acknowledged since Ford's production line and has resurfaced through recent calls for a 'spatial turn' in organisational studies (Clegg and Kornberger 2006; Dale and Burrell 2008; Kornberger and Clegg 2004; Taylor and Spicer 2007). This has followed a progressive shift in the understanding of space, from origins as a static and inert background until the 1970s, when a relational conceptualisation of space based on the work of Lefebvre (1991) marked a significant shift in the thinking about space as instead being socially produced through mutually constitutive relations between the social and material. More recently, a performative view of space has emerged wherein "*space achieves its form, function, and meaning through practice; space emerges as a process of ontogenesis*" (Kitchin and Dodge 2014a, p. 68). This distinct 'ontogenetic' conceptualisation of space is significant because it sees space as a dynamic concept which is not given, instead it is continuously performed wherein it is remodelled, reaffirmed and changed by sociospatial practices which shape how space is beckoned and assembled into existence.

This theoretical shift is evocative to the performative approach adopted in science and technology studies (Latour 2005; Pickering 1995) and in more recent scholarship on sociomateriality (De Albuquerque and Christ 2015; Leonardi 2015; Orlikowski 2007) which has advanced our understanding of the materiality of technology and specific digital artefacts (Leonardi 2011; Orlikowski and Scott 2008), but has not explored the constitutive role of physical environments in the use and adoption of digital technologies in the modern workplace (de Vaujany and Mitev 2013).

Most research in IS marginalises the role of space within studies of technology in the workplace (Mazmanian et al. 2013) and virtual work (Townsend et al. 1998). Space has

generally been considered as an alternative or complement to face-to-face interaction (Dixon and Panteli 2010; Gaver 1992; Leonardi 2011, 2013; Vaast and Kaganer 2013) instead of capturing the mutual constitution between physical and digital. This marginalisation of the role of space as co-constituted and performative is particularly limiting in studying digital work practices in information systems research.

In response to recent calls to bring space back into organisational theory (Fayard 2012a; Kornberger and Clegg 2004), this research seeks to demonstrate that the absence of space within the information systems research is a major limitation in understanding new forms of workplace settings and working practices, thus it responds to increasing calls for studies that combine research from the fields of organisational studies and information systems (Fayard 2012b; Fayard and Weeks 2011). It draws on theories on the relationship between space, technology and social practice which adopt a performative view of space based on the work of the philosopher de Certeau (1984; 1985) and on scholarship on human geography by Kitchin and Dodge (2014). It aims to better understand and conceptualise the increasing integration and mutual constitution of digital and physical spaces of work. In particular it conceptualises the flow of activities and interactions between physical and digital spaces of work and captures the emergence of hybrid environments inscribed across physical workspaces and digital platforms.

Capturing activities which integrate both physical and digital spaces provides a novel way to study the role of the physical environment in organisations. It also provides a differentiation between the 'place' where the organisation is located (typically an office building) and the 'space' that emerges from practices that appropriate features of both physical and digital environments to support the performing of work within organisations. It thus contributes with a novel analytical framework which conceptualises space within organisations as emerging from the combination of people, work practices, physical and digital in performance.

## **1.2 Research Question**

Work activities in modern workplace settings require new forms of theorising that address the gap in the information systems literature. Theory needs to digest modern working practices to redefine the notion of workspace as a continuum across physical and digital, emerging from interactions between people, work practices, technology and physical environments. This study seeks to conceptualise the flow of activities and interactions between physical and digital environments of software development teams and the emergence of integrated workspaces inscribed across physical work environments and digital platforms. It finds that unique spatial effects emerge when organisational actors observe and combine properties of both the

physical environment and the digital tools used to support their individual and teamwork activities. For example, if there are comfortable and attractive physical areas available for team collaboration, employees will adjust their digital collaborative practices to include activities in these areas. The research question therefore emerges from the gap within the literature review as: *What is the role of physical environment and digital tools in the constitution of workspaces in modern software organisations?*

To address this question, this research conducts an interpretive case study within a recent purpose-built software design studio in a large multinational IT company in London, UK. It focuses on colocated software development teams, as an extreme example of intense collaboration within an agile software development environment. The case captures the practices of these teams as they combine face-to-face work activities across both the physical environment and digital platforms of the purpose-built environment of this IT company. This case is potentially extreme because these teams of software developers are naturally digital savvy and work in a physical environment dedicated to agile work, which means that both environments have been created to support their needs. However, this type of work is not unique, and by studying these teams, it enables a consideration of conceptual method to capture developments in the crafting of workspaces in other sectors and types of organisations where colocated digital work happens.

The study employs in-depth qualitative research data collection methods including detailed participant observation, semi structured interviews and time-lapse video recording with the advantage of insider access for richness in data. The findings show how the software development process takes place in emergent workspaces that transcend traditional divisions between physical and digital. It analyses the practices of team members that configure and appropriate features of both physical environments and digital tools whilst observing that their practices are also mutually shaped through this process. This captures the process and the crafting of different types of workspaces to enact the various needs, temporalities and modulations of collaborative work practices.

### **1.3 Structure of the Thesis**

Chapter 2 presents the literature review beginning with an exploration of the evolving conceptualisations on the ontology of space within social science research. This is followed with a review of the literature on physical space and digital space respectively and how they are being combined through new ways of working in practice. It then analyses how this phenomenon has been digested within the information systems, computer-supported cooperative work and sociomateriality literature. This process identifies a gap in the extant

literature to position the study.

Chapter 3 presents the theoretical framework which commences with theoretical underpinnings that explore the performative view of space with consideration to human agency including physical situatedness, embodiment and relational context. It establishes the inextricable links between space and time and then proceeds to theoretical development. Here the framework extends the work of scholars to craft a new perspective and vocabulary to conceptualise changing work practices and activities which are becoming increasingly integrated between physical and digital within organisational settings to create the spaces of the modern office. This includes most significantly, the development of *spatial work practices*, a concept which is developed by extending the work of the philosopher Michel de Certeau (1984).

Chapter 4 presents the methodology which begins with a justification for the qualitative study approach. This provides details of the unit of analysis and the empirical setting selected to capture work activities across physical and digital spaces of work. The author's perspective as an insider researcher is explained, including how this provides unique access through extended access and profound knowledge of the setting, to provide insights which traditional outsider approaches maybe not be able to uncover. The data collection methods are detailed, leading to an explanation of the data capture and coding process which is used as a basis to structure the subsequent chapters.

Chapter 5 provides the results of the data collection which took place over an eighteen-month period from January 2017 to June 2018. The findings commence with a detailed overview of the empirical setting at the IBM London Studio including a detailed examination of the underlying strategies of the design of physical and digital spaces of work. They reveal how physical and digital environments become integrated conceptually and through practice by employees whom are aware of the integrated environment in which they operate. To elaborate this, the study traces the lifecycle of project work activities through a crafted research instrument which are presented as four discrete vignettes. These vignettes illustrate how the teams deliberately combine their physical and digital environments to support desired work outcomes through spatial effects. They findings highlight how the physical and digital environments in which they operate were designed in isolation and the workplace issues that arise as they are integrated in practice.

Chapter 6 includes the analysis and discussion. This empirically demonstrates that modern work practices can only be properly understood by looking simultaneously at the interactions happening through digital tools in conjunction with the context and relational understanding of

physical interactions happening in the workplace. It arrives at a novel understanding of modern workspaces as integrated physical and digital environments within technology organisations. Building on the concept of code/space (Kitchin and Dodge 2014a) to address spaces emerging from *spatial work practices* that are intrinsically co-constituted through software-mediated practices. It demonstrates how digital tools modulate the use of the physical environment and also extends this concept by capturing situations where physical features and interactions modulate the usage and configuration of digital tools. *Spatial work practices* are used by the software development teams to engender different workspaces by configuring assemblages of physical and digital elements termed *physical-digital assemblages*. These are as a response to their various needs with intended spatial effects termed *spatialities*. Collectively, these concepts arrive at the emergent framework of *crafted workspaces* which enables a new theorisation of organisational space that emerges from the performance of organisational actors, work practices, and the combined technology and physical environment.

Chapter 7 presents the project conclusion which begins with an assessment of the project limitations and recommendations for further research. It then provides a detailed exploration of the theoretical contributions and practical implications of the study where it is posited that physical interactions are not only integral to work practices and deeply entangled with digital interactions and activities, but space in fact emerges as a result of a mutual shaping, where physical and digital coexist in symbiotic form. From a practical perspective, the use of the concepts presented through the conceptual tool enable modern workspaces to be understood and captured; therefore, designed and integrated into the office to support modern work. This study is positioned within the existing gap of information systems research on digital work given the essential role played by the physical environment in the usage and appropriation of digital tools in modern organisations.

This study provides both a theoretical and practical contribution. The conceptual and methodological approaches are suggested to offer an invaluable resource to IS researchers that are interested in achieving more nuanced understandings of how digital work is performed in modern organisations.



## **CHAPTER 2: LITERATURE REVIEW**

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Space is an essential and integral element of organisational life both in terms of the physical environments such as buildings, walls and furniture (Dale and Burrell 2008), as well as the growing digital platforms that support interactions and work activities. Yet the literature capturing the effects and dynamics of physical space and specifically workspace design and its impact to organisational performance has not fully captured the shift in modern workplaces to digital working practices. Whilst there is a significant body of literature on virtual mobility underpinned by information and communication technology, little research has been performed on the relationship between organisational space and ICT.

To enable a deeper understanding of how modern workspaces emerge from the interplay of physical environments, digital technologies and organisational practices, this chapter begins with an exploration of the evolving conceptualisations on the ontology of organisational space in social science research. This provides a foundation for the subsequent review of the literature in the distinct domains of physical and digital spaces as a pathway toward more recent literature, which begins to explore how digital and physical spaces are being combined in practice.

## **2.1 Evolving Conceptualisations of Space**

The study and relevance of space has recently attracted increasing attention from researchers. Whereas space had traditionally been taken for granted in organisational studies and management literatures, commentators now suggest we are amidst a 'spatial turn' within the social sciences. This is not to say that the role of space had been completely ignored in the past. It has been present, however resigned to a sterile and static role where researchers were more interested in descriptive writing of space, rather than an exploration of the nature of the space itself. Space was natural and essential, whilst spatial processes were teleological and predictable (Kitchin and Dodge 2014a). This is in opposition to the notion of time, which has been seen as fertile and full of life (Foucault 1980; Mukherjee 2017).

The "genealogy of space" as traced by the geographers Kitchin and Dodge (2014) identifies three dominant ways of thinking about space within social sciences. The first conceptualisation, which occurred in the late 1950s and 60s, posits space as a static and inert background within which social life unfolds. In this notion of 'spatial science' space was articulated as having an absolute ontology where it was defined and understood primarily through a Euclidean geometry (Kitchin and Dodge 2014a). This absolute notion of space as a fixed 'container' to social life was critiqued from the 1970s onwards, especially following from the work of the Marxist human geographer Henri Lefebvre, who put forward a new relational concept of space in his work "the production of space" (Lefebvre 1991). From this viewpoint,

space is not neutral or an absolute geometric grid, but it is instead constitutive of social relations and material social practices (Massey 1994). Lefebvre argues that all space is socially produced. Through this conceptualisation he provides the tools for a subtle understanding of the social and material interplay within an active, social production of space. He also argues for the mutually constitutive relations between the social and material, where *“space is produced by social relations that it also reproduces, mediates and transforms”* (Dale and Burrell 2008; Natter and Jones III 1997, p. 149).

Lefebvre attempts to bring together understandings of space from disparate areas of thought as a ‘unitary theory’ (Lefebvre 1991, p. 11), making a distinction between space as perceived, conceived and lived, relating these to three overlapping concepts of social space: spatial practice, representations of space, and representational space (Dale and Burrell 2008). The first aspect ‘spatial practice’ is described as both the production, reproduction and particular locations and spatial sets characteristic of each social formation. These can be interpreted to mean spaces that we are familiar with and experience regularly, including our home, work and daily commute. These routines become internalised through our bodies as knowing the spatial relations within a particular place (Bourdieu 1990; Merleau-ponty 1973) and how they are constructed spatially to produce meaning (Dale and Burrell 2008). The second element of Lefebvre’s representations of space is conceived spaces. These are spaces as planned and executed by planners, designers, architects, engineers as deliberate constructions and arrangements of space to achieve certain objectives. Recently there has been a much more deliberate design of workplaces in order to embody certain organisational values and achieve organisational goals through the manipulation of space. This goes beyond ergonomics and efficiency gains as an integral element of manufacturing organisational culture and employee identity (Dale and Burrell 2008). The final element is representational space which is characterised by Lefebvre as ‘lived space’. This overlays experienced space with imaginary spaces, thus the material and cultural become interwoven as organisational design; use of specific furniture, images and symbols become material.

This relational view recognised that spaces do not simply exist as prefabricated and awaiting to be imbued with meaning. Instead they are made, shaped and given meaning by people and discursive practices which actively shape social relations. In these terms, a space like an airport can be seen through both its physical form which is managed by multiple organisations for commercial purposes as well as given meaning through the daily labour of staff, the organisation of aircraft and machinery, and the rituals and behaviours of travellers and their hosts. The use of the airport is therefore shaped both by its material form and the immaterial values associated with it (Hubbard et al. 2002). This relational perspective of space

led to an evolution in conceiving how space is produced and managed within contextual and relational ways to affect sociospatial relations (Kitchin and Dodge 2014a) and also to analyse organisational space as constituted through social practice (Clegg and Kornberger 2006; Taylor and Spicer 2007).

In the past few years, a third stream of theoretical work has emerged that challenges both absolute and relational conceptualisations of space, seeking to develop a new understanding by proposing a performative view where “*space achieves its form, function, and meaning through practice; space emerges as a process of ontogenesis*” (Kitchin and Dodge 2014a, p. 68). This 'ontogenetic' conceptualisation of space is able to capture the fact that space is continuously remodelled, reaffirmed or changed by sociospatial practices. For instance, an office workplace is brought into being as a space for performing work through a series of coordinated practices and material exchanges through workplace actors, e.g. every day employees come in and leave at certain times, tables and other furniture are arranged (and rearranged), employees swap places, a printer breaks down and is replaced, rooms are reorganised, stationary supplies are replenished and subsequently depleted etc.

The ontogenetic view of space reflects a view that space is constantly in the making and established through practice, which suggests a different way of thinking about the relation between place and space. The philosopher de Certeau (1984, p.117) defines place (*lieu*) as “an instantaneous configuration of positions”, which implies an indication of stability. In this way when we refer to a place (e.g. a room, an office, a city), we usually think of a set of relatively positioned elements or a snapshot of dynamic relations. In contrast, “*space is composed of intersections of mobile elements, from which we can infer space is a practiced place*” (de Certeau 1984), alternatively in the words of Tuan (1977, p. 179) “*Space is movement; place is rest*”. This conceptualisation of space is therefore performative and changes “*the central question of inquiry (Tuan 1977) from ‘what space is’ to ‘how space becomes’*” (Kitchin and Dodge 2014a). Space and its production are brought into being through performativity and the unfolding actions of people. This allows for a nuanced analysis that appreciates differences across time, place and context with the complexity of sociospatial relations amongst actors (Rose 1999). Yet these spaces are not easily captured because they are often unreflective and habitual, performed without cognitive and rational thought (Thrft 2008). Wherein spaces are constantly brought into being as an intended solutions to ongoing relational problems (Kitchin and Dodge 2014a; Mackenzie 2003; Simondon 1992).

The work of Giddens (1984) introduced spatial scales with consideration toward the individual and everyday life. Giddens emphasised that routinised patterns of behaviour through which social reproduction and change occur (mostly unintentionally) are always

structured temporally and spatially. This theory of structuration enabled social theory to view spaces as contingently produced entities, which are continually in a state of becoming via the actions of human subjects. Thus spaces do not arise from passive locales, rather they are active milieu that influence, and are in turn influenced by, the interactions of actors in a mutual constitution (Hubbard and Kitchin 2010).

This theoretical shift in approaching the study of space is analogous to the performative approach which has been adopted in science and technology studies by Pickering (1995), Latour (1986) and others (Beyes and Steyaert 2012; Quattrone et al. 2004). This shift has also been taken up by recent scholarship on sociomateriality in IS and organisation studies (De Albuquerque and Christ 2015; Leonardi 2013; Orlikowski and Scott 2008). The sociomaterial turn drew attention to how digital technologies are embedded within local practices and conditions where neither the material features within the technology or their impacts are predetermined, instead they emerge through a performative and emergent process (Gaskin et al. 2014; Kallinikos 2010). The dominant approach here emphasises a reshaping or mutual constitution between actors and technologies through their idiosyncratic appropriation across contexts (Leonardi 2011; Pentland and Feldman 2008). Yet such studies of technologies in practice have mostly focused on the relationship between actors, organisational routines and technologies in pursuit of organisational output, where space hitherto has been given a marginal role (De Vaujany and Vaast 2013).

Where sociomateriality has considered space, it has treated the social and the material aspects of space as mutually entangled through practices that develop affordances, constraints, and appropriations (Fayard 2012a, 2012b; Van Marrewijk and Yanow 2010). For example, Fayard and Weeks (2007) demonstrated how the balance between privacy, propinquity and permission in organisational settings afforded or constrained informal interactions in photocopier rooms. Whilst, Hislop and Axtell (2009) revealed how consultants with ostensible workplace flexibility were actually constrained by the affordances of mobility and the necessity to create flexible, temporary workspaces. Other literature has examined the manipulation of physical objects using digital technologies within surgery practice (Beane 2019), space science (Mazmanian et al. 2014) and how the materiality of mechanical and digital innovations becomes entangled within work practices (Barrett et al. 2012). Sergeeva *et al.* (2017) analysed the physical setting and the presence of onlookers to examine the effects on the technology usage of actors. Whilst recent scholarship in the social sciences has applied a performative view of space within a case study examining the impact of a new physical workplace design with consideration of digital technologies used within the setting (Sivunen and Putnam 2019).

This narrow corpus of literature recent has demonstrated that both physical and digital materiality play a role in understanding modern working practices. A common thread between them is their commentary on the neglect of physical materiality (Faulkner and Runde 2013; Østerlie et al. 2012) and calls for greater attention to consider the physical environment and the embodied character of technology use in practice (Cecez-Kecmanovic et al. 2014; Sergeeva et al. 2017). Outside of this narrow, studies that investigate workspaces (Clegg and Kornberger 2006; Dale and Burrell 2008; Kornberger and Clegg 2004) still conceptualise space as a fairly stable construction that provides limits for social interaction (Hiikkinen and Kivinen 2013). Therefore, they fall short of the ontogenetic perspective as reviewed previously based on the work of human geographers and social science scholars. This marginalisation prevents information systems studies from capturing the co-constitutive, generative role of the materialities of physical environments, digital technology and social processes which create space within the modern office workplace.

In order to further position the study and research how physical and digital environments are being combined in practice within the modern office, we begin by defining space and place using established conventions with the literature. We then build on this by following the dichotomous bodies of physical and digital space literature with an objective to conceptualise these two spaces independently and their gradual alignment within modern workplace settings.

## **2.2 Defining Space and Place**

The term 'space' is often arbitrarily used without a clear definition of its meaning (Lefebvre 1974), making research into organisational space difficult to aggregate. This is partly due to the significant vocabulary used to describe this object of analysis. Terms amongst others include: space, place, building, workspace, office, environment (Taylor and Spicer 2007). In particular, there is controversy around the distinction between the concepts of space and place (Casey 1993). Therefore, developing a better understanding of physical and virtual space within the context of organisational studies is an essential foundational point.

Fayard (2012) argues that physical space is constantly socially constructed and emerges from the relationships and practices of people living, working and interacting in that space as an entanglement (Flecker 2016; Orlikowski 2007) of physical materials and social practices and narratives. This concept of space is important for understanding materiality due to its frequent association with space within the IS literature. As a concept, space is the location where objects, buildings and people are situated within material boundaries of locations and structures. As a construct, space is defined as a material constraint which acts as a barrier to

interaction due to physical distance (Davis 1984). Space is measurable and objective with fixed representation, whereas time is associated with life and activity. These tensions between time and space which we return to shortly, are central to the narrative of many concepts of space (Fayard 2012a; Massey 2005).

The IS literature has evolved from treating space and place as synonymous terms, which previously influenced the view and conceptual treatment of these concepts (Sahay 1997; Schultze and Boland 2000). Place and space now hold distinctive meanings and identifications of people to locations across physical and digital domains (Sarker and Sahay 2004). In most social sciences and geography literature, and in common usage, a place can be considered like a home or personal (physical or digital) workspace, laden with socially constructed experience and meanings that helps to create a sense of attachment, familiarity stability, and security. In contrast, a space can be considered like a house, office, digital device or virtual world, without the same emotional and existential attachment. Spaces serve as containers for places whose meanings are constructed by what one does within them (Curry 1999), whilst places represent psychologically meaningful domains and a personalised concept (Godkin 1980). Whilst digital space may be conceived as a different kind of space to physical, it conceptually shares many of the same properties of physical space including how material entanglements, social practices and narratives create spaces (Fayard 2012b, 2012a).

### **2.3 Space within Organisation Studies**

Space is an essential and integral element of organisational life both in terms of the physical environments such as buildings, walls and furniture, as well as the growing digital platforms that support interactions and work activities. Yet the literature capturing the effects and dynamics of physical space and specifically workspace design and its impact to organisational performance has not yet fully captured the shift in modern workplaces to digital working practices and can be characterised by the absence of a unifying theoretical approach. A thinly spread array of theories has originated from diverse disciplines including social relations, geography, history, psychology and information systems including computer-supported cooperative work (CSCW) literature.

In support of post-industrial management and working practices, collaborative systems use information technology to facilitate communications to help organisations organise, work and learn. This research on the impact of the physical environment to intellectual work outcomes includes a substantial literature on the design, ethnography and technology of the workplace. This CSCW literature generally falls into the two categories of work environment and classroom space research respectively. This literature itself draws upon the fields of

environmental psychology, interior design and ergonomics to analyse spatial organisation for control and communication and the effects of the ambient properties of space (such as light, noise, seating density and temperature) with a view to finding linkages to worker productivity and satisfaction (Sundstrom 1987; Wineman 1982).

Collectively or in isolation, these theoretical approaches still lack empirical support (Clegg and Kornberger 2006; Van Marrewijk and Yanow 2010) making it difficult to determine their respective efficacy (Davis et al. 2011). This gap may also be explained by the complexity of the office and its constituent parts, or perhaps the lack of consistent role-responsibility for ownership of workspace within the boardroom (Vischer 1995).

Clearly space matters to organisations; and therefore, space should matter in the study of organisations (Kornberger and Clegg 2004; Kreiner 2010; Taylor and Spicer 2007; De Vaujany and Vaast 2013). Such studies of space are featured in management and organisation studies from classic studies such as Taylor's Scientific Management (Taylor 1911), Henry Ford's spatial redesign to socially reorganise space for competitive advantage, to the work on the Hawthorne studies which demonstrated the impact of social (rather than interior) design on organisational behaviour. Foucault's important study (1976) of panoptical space demonstrated how the layout of a physical environment has impact on power and control dynamics in a social setting by creating a powerful construct for workers to self-discipline themselves (due to ever-present potential for surveillance). More recently Gagliardi's (1990) work on the aesthetics of space in organisational settings has created opportunities for other contributors in both physical and Information systems fields (Ciborra and Lanzara 1990; Hatch 1990; Rosen et al. 1990). Kornberger & Clegg (2004) argue that 'generative buildings' have the architectural capability to combine order and chaos through flows of communication, knowledge and movement to facilitate flexibility, design and creative problem solving through the sharing of normally separated ideas and concepts. In the words of Hillier and Hanson "*The ordering of space in buildings is really about the ordering of relations between people*" (1984, p. 2). Space may be thought of as it has been filled in the past and present with meaning and presence or denied it by decided absence (Althusser 1971). A room may have fixed features and properties including four walls a floor and a ceiling, however that provides us very little information unless we know what meanings it imbues and evokes (Forster 1947). Space therefore, defines the medium, outcome and possibilities of the social construction within it (Rosen et al. 1990).

An illuminating work in recognising and shaping the organisational systems and the mutually constitutive nature of organisational space can be found in 'The Interface: IBM and the Transformation of Corporate Design, 1945-1976' (Harwood 2011). It tells the story of the

IBM Design Program, where in 1956, the president of the IBM, Thomas Watson Jr., hired the industrial designer and architect Eliot F. Noyes to entirely reinvent IBM's corporate image, in parallel with Watson's decision to reorganise IBM's pyramidal managerial hierarchy into a more "horizontal", efficient structure. Noyes thus embarked to redesign the entire environment of IBM both socially and materially as a harmonious system: from stationery and curtains, to products such as typewriters and computers, to laboratory and administration buildings, IBM was literally to become "simply the best in modern design".

This design program was to serve as a unifying control function seeking to establish a material regime by, for, and of the logic of organisation. IBM was not simply a maker of business machines, rather it was in the business of controlling, organising, and redistributing information in space. This Noyes recognised as a matter of environmental control as he would emphasise repeatedly throughout his career, the process of management was one of controlling space (Harwood 2011). To quote Marx (1972), an organisation can be described as "*a relationship between people mediated by things*", and these people, things, and mediated relations can be described (Harwood 2011). Such studies of physical space have demonstrated the instrumental role of office space in shaping organisational life by influencing and shaping human interaction (De Vaujany and Vaast 2013).

Perhaps the largest and most commonly explored body of research on organisational space focuses on workspace layout (Hafermalz and Riemer 2015; Taylor and Spicer 2007) and how office space influences human interactions and its symbolic functions. Hatch (1997) examines aspects of organisations such as the relationship between furniture, objects and workplace actors (Brookes and Kaplan 1972; Duffy and Powell 1997; Hatch 1987; Sundstrom and Sundstrom 1986). The origins of modern working practices can be traced back to the widespread introduction of open-plan office space, which began again with IBM in the 1970s and still has a profound impact on the way organisations use physical space today (Brookes and Kaplan 1972). This workspace focused literature covers related aspects such as effects of open-plan design on inter and intra-team communication (Lee and Brand 2005), and in reducing overheads (Vischer 1995) by increasing employee density (Elsbach and Pratt 2007), to enable more open and collaborative working practices which integrate business functions and reduce hierarchy (Brennan et al. 2002).

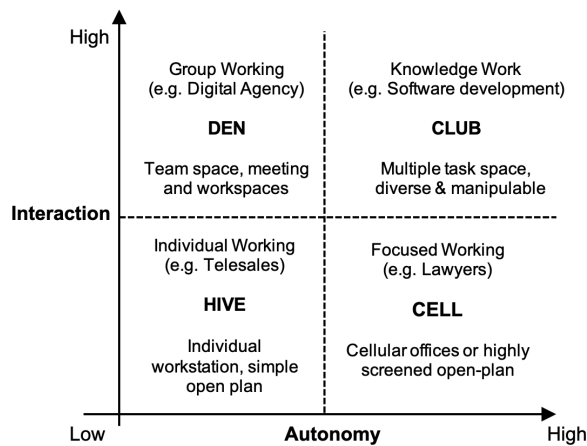
Figure 1 below categorises the types of physical workspace into four common workspace typologies within organisations, measured by varying degrees of employee interaction and autonomy which we now briefly explore. The Cell setting is suited to highly autonomous working employees where high levels of concentration or privacy may be required with minimal group interaction. The Hive setting provides employees open-plan working space where both



low autonomy and interaction are required. The Den setting facilitates work centred around team collaboration with little individual autonomy, whilst the Club setting provides a configurable space which can be tailored to employee requirements.

### Figure 1: Physical Workspace Typologies

*Adapted from Duffy & Powell, 1997*



In practice most organisations typically only provide one of these workspace types, which may suit core activities, but does not support the full range of activities which employees may be engaged in (Duffy and Powell 1997; Sailer et al. 2015). Increased employee propinquity has been seen to lead to workplace efficiency, employee satisfaction, firm competitiveness and innovation (Taylor and Spicer 2007). It is also associated with knowledge spill-over, impact on inter-personal relationships (Almeida and Kogut 1999; Kono et al. 1998) and in determining employee performance (Worthington et al. 2001). However, as many of these espoused benefits were realised, they also gave rise to new issues related for example related to employee privacy (Kupritz 1998; Sundstrom et al. 1980), and unwanted noise and distractions, leading to cognitive overload or perceptual over-stimulation (Atchley 2010). Employees thus inhabit an environment where communication technologies are ubiquitous, presenting simultaneous, multiple and ever-present calls on their attention (Wajcman and Rose 2011). Studies have also captured these unintended or adverse workspace satisfaction results and the resulting poor employee job satisfaction (Veitch et al. 2007).

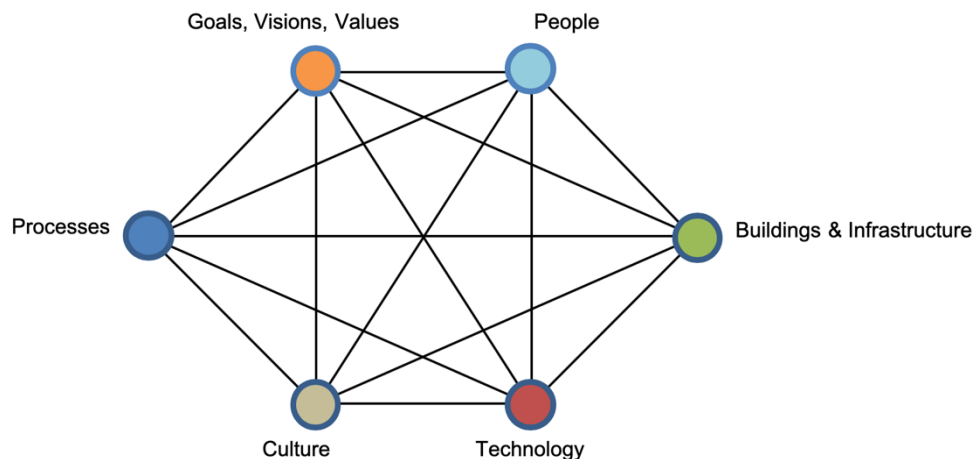
In modern organisations, employees no longer inhabit dichotomised face-to-face or remote virtual environments as characterised by much of the early information systems literature (Gibson and Gibbs 2006; Huang et al. 2002; Kiesler and Cummings 2002); instead their work activities are characterised as a combination of both physical environments and digital technologies (Zhang and Venkatesh 2013). Digital space now integrates with physical space

to enable, enhance and extend work activities, allowing organisations to be more flexible with the properties of their physical work environments (Castells 1996). Physical and digital spaces operate closely (Van Binsbergen 1998) and are intertwined (Panteli et al. 2007), contributing to a more shared understanding of how to operate and function in the organisation (Fayard 2012a; Husted and Plesner 2016; Schultze and Orlikowski 2001). As the topic of space re-emerges within information systems and organisational studies literature (Fayard and Weeks 2007; Kornberger and Clegg 2004; Leonardi 2011; Taylor and Spicer 2007), scholars in these fields have begun to construct a vocabulary around mutually constituted attributes of space (De Vaujany and Vaast 2013) in order to understand how modern work practices are becoming increasingly integrated between physical and digital environments within modern organisations (Orlikowski and Scott 2008; Weeks and Fayard 2011).

Work environments involve tensions in design across various competing elements and what is most desirable for workers against what can be achieved within organisational financial and technical constraints. Figure 2 illustrates this interconnectedness of the organisation across the physical (buildings and infrastructure), digital (technology) and social (process, culture, values, people) domains. This has led to authors from various disciplines arguing that the work environment should be considered as part of the overall organisational system (Allen and Henn 2013; Haynes 2007; Lawson 2004). They encourage the collaboration of architects, engineers, psychologists and ICT specialists alongside staff and management (Allen and Henn 2013; Elsbach and Pratt 2007) to establish a balance between the interconnected and competing nature of an organisational system (Clegg and Shepherd 2007; Jamieson et al. 2000; Nadin et al. 2001).

### Figure 2: Interconnected Organisation

*Adapted from Challenger et al., 2010; Davis et al., 2011*



Thus, space is a social interaction system conditioned by its physical and contextual settings. Changing employee behaviours and attitudes involves the modification of the interaction and technological systems (Clegg and Kornberger 2006). These elements are relevant considerations when conceptualising the interplay between physical and digital workspace design and the design of information systems technology (Jamieson et al. 2000).

## **2.4 Digital Spaces of Work**

Technology has reconfigured buildings and the office in the past, but it has seldom done away with them. This pattern is familiar in architecture, if you consider how the high-rise building was made possible by elevators and telephones to connect separated employees across floors and even factories and headquarters. Electrification, in particular has reshaped domestic and professional life. Lighting, for instance has reversed the relation between indoors and outdoors at night. It also reverses the architectural modulation of historic facades by lighting them from below, rather than from the sunlight, for which they may have been designed. Technology is also incremental and additive to existing technologies. Lighting made it possible to build subways, which in turn influenced daily lives to become organised around train schedules, creating a remarkable interplay between space and time (Mumford 1936). The office has endured reconfiguration through combinations of technical change where software and mobile technologies take apart many of the spatial linkages we have come to expect and reassembles them into new forms, allowing work to be carried out where it is most convenient (Mitchell 1996).

In contrast to physical space, studies of digital space have focused on how a collection of technologies and platforms can be configured to support information management, processing, sharing and communication between individuals in organisations (Gressgård 2011), and ultimately mediate knowledge based work process (Forman et al. 2014). The technologies that form digital workspaces range from simple email and telephone communication to video-conferencing, collaborative social software applications including social media platforms and internet/intranet technologies which form an informational infrastructure of virtual spaces (Bjelland and Wood 2008; DiMicco et al. 2008; Townsend et al. 1998). Here, digital working arrangements are associated with productivity gains achieved through the digitisation of work processes and an ability to connect employees and information distributed across time and space (Cascio 2000; Raghuram et al. 2010).

Technology has broadened our understanding and exploration of physical space and indeed the notion of space itself. Whilst physical space has its limitations as human beings can only be present at a single site at a single point in time, digital space frees us from such

boundaries and constraints. Digital space is dynamic, it changes each time we connect. It is not out there for us to find, rather it is constructed by technology and social practices in action (Flecker 2016; Kivinen 2006). It has enabled international migration flows, global nomads and social networks that link distributed individuals through digital media and platforms (Go and Fenema 2006) which enable new affordances such as persistence, visibility and editability (Treem and Leonardi 2012).

Until recently, workplace technologies still focused on supporting standard work routines such as spreadsheet calculations, word processing, or accessing documents on an intranet. However, a whole new set of digital capabilities has evolved during the last five years. Specifically, mobile and social media technologies for the enterprise, copying the concepts of social tools as Facebook, adding new possibilities for employees to connect and share information (Schallenmueller 2016). This new generation of employees bring with them new behaviours and expectations of modern organisations, *“Never has a generation entered the workplace using technologies so far ahead of those adopted by its employer”* (Meister and Willyerd 2010, p. 17).

Digital tools and platforms in modern day represent a collection of technologies to support information management, processing, sharing and communication between individuals in organisations (Gressgård 2011), and ultimately mediate knowledge-based work process (Forman et al. 2014). These include social media and messaging platforms (e.g. Slack) which afford alternative environments for new forms of employee engagement and behaviours which can promote psychological bonding without requiring a great deal of in-person communication (Wilson et al. 2008). These tools and platforms represent the most transformative impacts of the digital workplace within a business setting, both within and beyond organisational boundaries (Aral et al. 2012; Lamb and Davidson 2005; O’Flaherty and Whalley 2004), creating malleable organic platforms built to support dynamic and emergent communication. They have enabled significant advancements to organisations including global improvements in the speed and cost of communications, vastly expanded connectivity and pervasive computing. The impact is increased reach and flexibility for individuals, organisations, communities, and societies (Fulk and DeSanctis 1995), with productivity gains achieved through the digitisation of work (Raghuram et al. 2010).

The concept of virtual work and the digital workplace is now used by employees within global virtual teams (Bartlett and Ghoshal 1987; Jarvenpaa and Leidner 1999), flexible working (Cascio 2000; Leonardi 2011) and distributed working arrangements across modern organisations. The driving force behind this increasing popularity ranges from productivity gains, which can be achieved from digitisation of work processes, to an ability to connect

employees and information which is distributed across time and space (Raghuram et al. 2010). Digital space coexists, overlaps or even replaces physical space which allows organisations to be free from physical constraints (Castells 1996). This allows digitally connected organisational members to mitigate the time and space divide amongst distributed members using modern internet enabled technologies (Jarvenpaa and Leidner 1999).

The considerable literature analysing these technologies and the effectiveness of virtual work (Townsend et al. 1998) has analysed how actors and teams interact across distances to accomplish common goals (Cramton 2003; Hinds and Bailey 2004; O'Leary and Mortensen 2010; Wilson et al. 2012). These studies have framed virtual work as an alternative or complementary to face-to-face interaction (Dixon and Panteli 2010; Gaver 1992; Leonardi 2011; Leonardi et al. 2013; Vaast and Kaganer 2013). They have found that distance directly affects individual and group behaviours whilst influencing other features that alter group processes (e.g. the adoption of digital platforms). These factors are relevant and must be considered with changes in work processes and environment which are being influenced by new ways of working.

## **2.5 New Ways of Working**

Implementing new ways of working that focus on providing flexible activity-based workplaces which integrate physical and digital, means that offices are redesigned to support a variety of working practices. Organisations often drive the adoption of such new working practices with a simultaneous opening of a new office building or the redesign of their existing office space. Without these corresponding changes of the office and work environment, the concepts of new working practices are harder to implement. Offices therefore need to adapt to create a new sense and experience of work (Kingma 2018; de Kok 2016). For example, the creation of new modern offices have been used by companies like Google, IBM, and the Virgin Group as a way to inspire employees and increase creativity (Groves and Knight 2010).

Clegg and Kornberger (2006) argue that each organisation's culture feeds its identity, spatial configuration and aesthetics, which collectively participate to create the symbolic universe of the organisation (Gagliardi 1990). It is therefore given that the spatial forms, architecture, and aesthetics of organisations are full of meaning and contribute to their symbolic representation. Their space and use of it are an emblem which produces the organisation's identity (Lefebvre 1991; Taylor and Spicer 2007).

Yet work and organisation is no longer contained solely within building or the corporate office workplace (Felstead et al. 2005). It is rapidly moving through trains, cafes, shopping

malls and throughout homes (Massey 2005). Indeed 'workspace' as a distinctive bounded place has become a problematic concept. With the rise of knowledge work and digital technologies, workspaces are not bounded by the traditional separation of production lines, instead they are overlaid on other sorts of spaces used to form specific sub-spaces through organisation (Dale and Burrell 2008).

With the commencement of the digital age, predictions about the decreasing relevance of physical space for human interaction and organisations were abound. Advanced information communication technologies (ICTs) providing high-speed internet access along with powerful mobile technologies would spell the end for the traditional office space (Townsend et al. 1998). However these predictions have fallen short of capturing the complex interplay between physical space, digital technologies and human interaction (Felstead et al. 2005; Weeks and Fayard 2011). With that said, there is little disputing that recent developments in digital technologies represent a major leap in the capacity to store, process and share data which have enabled broad spatial transformations of global society (Castells 1996).

Ironically when work has become less physically bounded and defined, the spaces and places of the organisation have been drawn into a battle for hearts and minds in more explicitly planned and conscious ways (Dale and Burrell 2008). The increases in speed, digital transactions and international business have not reduced the need for face-to-face relations. Conversely, there is a greater move toward the establishment of embodied networks and physical meetings as part of a greater need for employee commitment and identification with the organisation (Thrift 1996).

What is novel about these changes is how the combination of technology and organisational design are being integrated and presented in a systematic way, thus furthering new kinds of social workspaces. These innovative designs are believed to improve organisational efficiency and effectiveness to better align with the requirements of modern organisations in the information age (Castells 2001). These new ways of working may therefore be regarded as part of what Lefebvre called the 'abstract space of capitalism' – i.e. an instrumental space in which *"the world of commodities is deployed, along with all that it entails: accumulation and growth, calculation, planning, programming"* (1991, p. 307). These abstract spaces offer a coherent and impressive but often transparent insight into production spaces. Within management textbooks, these new ways of working are often presented as contributing to a wide array of business benefits including networking within and between organisations, cost savings, productivity, quality, creativity, collaboration, communication, empowerment, transparency and trust – which reportedly culminate in greater overall employee and customer satisfaction (Kingma 2018).

### **2.5.1 Collocated Work**

Employee collocation enables face-to-face communication, close proximity, informal social interaction, and so is considered the gold standard of work environments (Kiesler et al. 1984; Olson et al. 2002). Studies of collocated work document the higher productivity of these teams through interactive, continuous communication, making coordination, learning and sharing of information and artefacts easier (Olson et al. 2002). They also show the kinds of flexible interaction that collocation can offer, such as sharing common spaces and enabling opportunities for touching, eating and drinking together which allows strong social ties and shared territory to be established (Kiesler and Cummings 2002; Nardi and Whittaker 2002).

The proximity of work locations and employees have their highest impact on group functioning through the effect and opportunities for informal, spontaneous communication (Brockner and Swap 1976; Ebbesen et al. 1976; Kraut and Streeter 2002). People who work in proximate settings meet and interact serendipitously at water cooler, photocopier and the cafeteria (Fayard and Weeks 2007). These planned and unplanned encounters increase the convenience of communication and enable multipurpose interactions (Nardi and Whittaker 2002) enabling work to progress more seamlessly through regular and spontaneous communications (Kiesler and Cummings 2002).

Studies of group dynamics since the 1950's and before the recent emergence of distributed virtual work, were typically collocated. From the seating arrangements of management teams (Howells and Becker 1962) to those driven by production frameworks (Thompson 1967), where the proximity of workers was typically defined and dictated by work flow, task interdependence, and coordination needs (Kmetz 1984). Organisational theorists have since embraced the idea that work groups can be strategically designed and distributed to take advantage of changing resources and opportunities, including social network relationships and global labour talent pools. Today employee proximity might be defined by the number of floors or buildings separating work group members, the number of different locations in which people work over time, the distance of members or sites from corporate headquarters (Finholt et al. 2002).

The research shows that face-to-face discussion has a strong impact on cooperation through its effects on bonds, social contracts and group identity acting as a powerful tool to develop and maintain group culture, authority, and tacit norms (Hinds and Kiesler 2002; Levitt and March 1988). People tend to be most comfortable when they are a few feet from colleagues, although this distance varies according to cultural norms, relationships and tasks (Sommer 1969). Once people are no longer collocated, face-to-face conversation and direct

observation becomes difficult posing challenges for groups trying to work together. As employees are distributed further apart, they communicate less frequently (Allen 1977; Zipf 1949) which drastically reduces the likelihood of voluntary work collaboration (Kraut et al. 2002).

Group processes have been established as subtle and delicate, physical teams can support these by sharing artefacts of various kinds, such as whiteboards, flipcharts, post-it notes and drawings as critical elements of work (Olson et al. 2002). In contrast, virtual work groups effectively adapt their interactions to make use of modern communication technologies. These enable the exchange of work information without face-to-face communication and for spontaneous communication using digital mediums to mediate remote collaboration: email, social media platforms, instant messaging, videoconferencing and others. However, due to the lack of real and perceived presence of others and shared physical social setting, these technologies do not necessarily encourage communication. Further, the style of communication used in virtual work groups is likely to be less mutually attentive, less companionable, less frequent, and more effortful than when colleagues are in close proximity and available for face-to-face interaction.

Even in the age of communication and digital technologies across the internet, physical proximity increases the likelihood of both physical and digital collaboration. Physical collaboration stimulates collaboration amongst employees who may not otherwise work together. Research shows that two people in the same department are 66% more likely to collaborate if based on the same corridor, as opposed to the same floor (Kraut et al. 2002). Physical space helps people engage in conversation because when they encounter each other, they are reminded of each other's existence, assess each other's availability for communication, and have multiple channels to signal intent and carry out communication.

Even with proximity between employees, collaborative projects are complex endeavours. In order to be successful, they require potential collaborators to identify and form connections to others whom they believe are relevant and competent to support their work efforts. This often requires moving from vague ideas to proposals and execution of supporting plans. These processes are not linear and can consist of subtasks alongside active and passive coordination and sharing of information. There are many important ways that physical proximity combined with the availability of digital tools may facilitate collaboration, communication and coordination. It is therefore unsurprising to see a growing trend of technology organisations including Yahoo! (Miller and Rampell 2013), Hewlett Packard Enterprise (Nichols 2017) and IBM (Simons 2017) calling workers to return back to the office to work in collocated software development teams, to create intense collaboration across



physical and digital spaces of work.

The features and affordances of these combined environments affect interpersonal interaction and awareness in collaborative work. When people are collocated, it takes relatively little effort for them to initiate communications. This proximity puts team members who have prerequisites for conversation in each other's presence (Monge et al. 2008). This increases the likelihood of chance encounters and shared community, and affects the frequency of communication (Allen 1977; Kraut et al. 1988). This communication is essential to share information, make decisions, monitor work and perform joint activities. Clark and Brennan (1990) argue that different methods of communication offer different resources and affordances that shape communications. These affect the interactive process by which communicators exchange information and their understanding over interactions as they accrue common grounding (Clark and Wilkes-Gibbs 1986). Different mediums of communication therefore incur different grounding costs which impact the spectrum of conversations from initiating conversation, to formulating responses, receiving and understanding, turn-taking, timing of cues and interjection, displaying and referring to something or repairing misunderstandings (Kraut et al. 2002).

Whilst physical proximity does not prevent team members from interacting digitally, the affordances of face-to-face conversation make communication particularly efficient by facilitating grounding in environment, local customs and culture. Thus, not only do collocated teams pick up information implicitly, they also share a context that helps them accurately interpret this information.

In contrast, digital technologies may be preferential where persistence, editability and extended visibility are required (Treem and Leonardi 2012). However, they may also be preferred to reduce the cognitive demands of spontaneous conversation. In face-to-face conversation, speakers need to both plan and execute utterances simultaneously. This necessitates the need to formulate a conversational strategy, design the substance and syntax of sentences, to effectively communicate. In effect, speakers in a conversation may begin speaking whilst they are still planning (Levelt 1989). This process needs to be performed both rapidly and consistently with planned intentions, whilst monitoring feedback from the listener and adjusting speech accordingly. With such cognitive demands, it is unsurprising that spoken conversation is littered with sentence fragments, pauses, filler sounds such as um and imprecise word choices. These conversations are also ephemeral, unlike digital messages in a messaging platform or a written email. The listener cannot pause or reread the message when they have failed to comprehend, whilst they are also unlikely to ask for clarification in the presence of others (Kraut et al. 2002). Therefore, digital communications may also be

preferred to ensure successful transmission in group settings.

The use of digital technologies for communication can enable efficient, productive, and satisfying conversations, but how they accomplish this varies across media. The principle of least collaborative effort suggests that people try to ground their conversations with as little combined effort as possible to compensate for the costs of the medium (Clark and Wilkes-Gibbs 1986). For example, the use of additional verbal signals in telephone conversations, quoting previous message text within digital message exchanges or the use of emoticons. Modern technologies also provide a passive awareness of availability through status indicators which signal and provide colleagues with notifications of states such as online and available, 'Do Not Disturb' or other variations. However, digital technologies that introduce even small delays between participants make this grounding substantially more difficult to accomplish. Research suggests that these types of conversations are less successful because participants feel the conversations are less natural or successful, despite being more effortful, and therefore withdraw from them sooner (O'Conaill et al. 1993).

Although digital technology allows co-workers to exchange an ever-increasing variety of information, it remains unclear how well these technologies support ongoing work that requires close collaboration (Kiesler and Cummings 2002) and how employees choose to communicate when they are afforded opportunities to select and combine both physical and digital mediums. Exploring and unpacking this complex relationship between digital space and organisational space has significant implications for information systems research given how critical space is to organising.

## **2.6 Integrating Physical and Digital Environments**

The use of information technology enables the creation of virtual work environments and untethered knowledge workers that can perform tasks anywhere at any time (Lee 2016). Whilst the argument that organisations have become 'boundaryless' (Ashkenas et al. 1995; Newell et al. 2001) and that digital space annihilates distance (Fayard 2012a) have led to increasing homework and virtual organisations, the reality is such arrangements remain unpopular with managers due to the associated difficulties with managing and organising activities (Cascio 2000; Taylor and Spicer 2007) where distance and propinquity remain essential to working practices (Fayard and Weeks 2007) for knowledge spill over, professional relations (Almeida and Kogut 1999; Kono et al. 1998; Newell et al. 2001) and in determining performance (Worthington et al. 2001). These factors also have a direct relationship with workplace efficiency, health and safety, employee satisfaction, firm competitiveness and innovation (Taylor and Spicer 2007). It is therefore unsurprising that many organisations still

operate with physical offices.

It has long been established that proximity boosts communication; we are four times as likely to communicate with someone sitting six feet away from us, as with someone sixty feet away and almost never communicate with colleagues on separate floors or in separate buildings (Allen 1977). Even collocated workers communicate virtually with each other much more regularly than with colleagues in different locations, leading to 32% faster project completion times (Waber et al. 2014). It is also important to recognize that when tasks are extremely interdependent, additional communication, collaboration, and control are necessary along with richer communication (both physical and digital) for successful collaboration (Lee 2016). It is therefore no surprise that the literature shows that teams with denser, more frequent and more diverse interaction patterns are considered to be more productive (Reagans and Zuckerman 2001). Thus even though work has become mobile and distributed, physical interactions and work environments remain important (Lee 2016).

Today's digitally enabled workers do not exclusively inhabit face-to-face or virtual environments as characterised by much of the early IS literature (Gibson and Gibbs 2006; Huang et al. 2002; Kiesler and Cummings 2002), instead they combine face-to-face communication with digital technologies (Zhang and Venkatesh 2013) within hybrid teams, whose members do not work in a fixed space and time, but at various points on the space time continuum (Kirkman and Mathieu 2005; Robert et al. 2008). The advancement of technology has led to the emergence of virtual communities which are purported to have an enormous impact on how we now work, communicate and share knowledge (Panteli and Chiasson 2008). Digital space now integrates with physical space to enable, enhance and extend work activities. Physical and digital spaces operate more closely (Van Binsbergen 1998) and are intertwined (Panteli et al. 2007), contributing to a more shared understanding of how to operate and function in the organisation (Fayard 2012a; Husted and Plesner 2016; Schultze and Orlikowski 2001).

Dixon and Panteli (2010) argue that ICT mediated interactions actually complement rather than substitute physical interaction. They propose the concept of virtuality combines these distinct forms and improves our understanding of the dynamics between online and offline interactions which reflect the nature of modern hybrid digital organisations. This virtuality consists of activities that can take place anywhere, at any time with no physical constraints as a fluid and flexible social and conceptual network, connecting people and things that share the same interest and conceptual space (Zigurs and Qureshi 2001). Even though digital technologies are an important facilitator of virtuality, they do not dictate its existence (Panteli and Chiasson 2008).

As workers create and maintain interpersonal relationships within the digital workplace, these digital networks become as important 'spaces' as offices. Modern organisations operate in intricate networks that are intertwined such that they cannot be conceived independently of their digital ecosystem which can extend to alliances, multisided business models, partnerships, and competitors (D'Adderio 2001; Klein 2009; Saraf et al. 2007). Yet, there are gaps within the extant literature as to how contemporary physical and digital workspace designs are mutually shaped.

As Orlikowski (2000, p.412) argues, actors "*have the option, at any moment and within existing conditions and materials, to 'choose to do otherwise' with the technology at hand.*" Knowledge workers can exercise their discretion to shape the effects those technologies have on their work (Azad and King 2008; Boudreau and Robey 2005; Vaast and Walsham 2005). A good deal of research within the field of information systems has shown new technologies to be customisable and adaptable to the needs of developers and users (Leonardi 2011; Majchrzak et al. 2000). In addition to these opportunities to reconfigure technologies with which they work; workers in modern organisations may choose to substitute or complement digital and physical interactions. However, the extant research has not analysed these phenomena empirically.

Belanger et al. (2001) argue that optimal digital workplace design contingent on employee context is important, as it significantly impacts employee productivity and performance, satisfaction and ability to innovate (Ahuja and Thatcher 2005) both individually and collectively. Therefore, organisations need to evaluate their digital workplaces not only from a functionality standpoint, but also from the perspective of the contextualisation of the individual and collective members of teams (Majchrzak et al. 2005) within their respective physical environments.

To find optimal levels of productivity, organisations need to understand how individuals and teams work across integrated space to help them combine technology with access to correct level of multitasking and heterogeneous information (Aral et al. 2012; Wu 2013). The limited research in this area has found that physical space is used to provide conditions for innovation and idea generation, whilst digital space trails this process for reaching outcome through affirmation and consensus (Husted and Plesner 2016). However, broader considerations of context and the way these new environments are appropriated and mutually constituted has not been fully explored.

## 2.7 Research Gap

The recent research on global organisations identifies significant problems attributable to place and time separation (Carmel 2002; Sarker and Sahay 2004). Whilst modern digital work practices are meant to be flexible, untied to the desk or the clock or the calendar or the country (Dale and Burrell 2008). The dynamics of technology use within organisations remains a moving target and are constantly redefining boundaries to organise around what can be done with digital information (Zammuto et al. 2007). This interdependence between technology, physical and temporal proximity and organisational activity has caused major shifts in the structure, power and hierarchy of organisations. Yet despite this growing relevance of physical space in modern digital work, the information systems literature has rarely integrated physical considerations when studying the use of information systems within modern organisations (Fayard 2012a).

The literature posits that power manifests through buildings in the ways that people interact; through the location of persons and objects; through the control of their paths of movement and visual, digital and communicative paths (Markus 1993). The research has separately looked at technology usage within organisations and put forward theories about the usage and adoption of these digital tools without always seeing them in the context of the physical environment within which they are used. Such studies are usually bounded by technology and behaviour without attention to the physical environments wherein the digital work actually happens (Vischer 1995). Further, whilst digital space and virtuality has been strongly linked to globalisation through the death of distance (Woolgar 2002), others argue that globalisation is not only about the reduction of time and space, but the emergence of new spatial and temporal connections that were previously inconceivable (Van Binsbergen 1998).

The information systems research still has a paucity of studies which consider space, even in spite of calls to bring the subject back into organisational theory (Cecez-Kecmanovic et al. 2014; Fayard 2012a; Kornberger and Clegg 2004). The small body of literature which has recognised the influence of space has demonstrated that materiality is not a single artefact, but rather it arises from multiple objects, bodies, locales, and durations of movement that choreograph space into being (Beyes and Steyaert 2012; Vásquez 2016). Physical and digital are interdependent variables, as the affordances of digital tools are only relevant based on their physical context and therefore have to be contextualised to the physical environments within which they are to be used. As Nicolini (2009, 2012) argues, it is necessary to zoom-out to discern the dynamic and emergent relationships between the social and material, since local practice is always affected by other contextual elements in space and time (Latour 2005).

This provides a foundation to address the literature gap by examining and theorising the mutual constitution between the physical environment, digital technology and social processes (Fayard and Weeks 2007) which collectively enable and constrain interactions that support new forms of communication, collaboration and coordination (Baptista and Huang 2013; Bjerrum et al. 2003) contributing to the generativity of performative spaces within the modern office. This will be addressed through the previously established research question: *What is the role of physical environment and digital tools in the constitution of workspaces in modern software organisations?*

## 2.8 Chapter Summary

We often take the physical environment for granted in our daily activities, where it fades into the background unless it is foregrounded as a topic of conversation: such as when planning an international visit or planning a redesign of office layout. Yet physical space is not passive, it shapes our movements (de Certeau 1984; Lefebvre 1991). In an urban context, infrastructure including roads, buildings and transport direct our movement across and within cities, shaping our movements in both space and time by design (Lefebvre 1974). These pendulumlike movements (Tuan 1977) define the movement and daily routine for knowledge workers in modern organisations. Wherein these routines and habitual movements (Thrift 2008) become internalised (Bourdieu 1990) and enacted in accordance with, or deliberately against their planned and intended design (de Certeau 1985).

The use of space has been viewed in a variety of ways across a wide range of disciplines including architecture, mathematics, philosophy, sociology and information systems. Humans construe and organise themselves within space based on physical and social experiences (Tuan 1977). Being able to move and interact in a range of ways is therefore a central concept in each individual's conceptual system of space, which enables us to examine how and why individuals manipulate objects and their environments (Saunders et al. 2011).

These concepts extend to organisations, where office layout and workspace design are intended to shape employee interactions in pursuit of organisational goals. Space is an essential element of organisational life both in terms of physical environments such as buildings, or geographical locations and digital spaces which are constantly evolving through technology and social practices in action (Flecker 2016; Kivinen 2006). These spaces are not merely passive containers for actions happening within them, rather they shape and contribute positively toward organisational capabilities (de Certeau 1984; Kornberger and Clegg 2004; Lefebvre 1991). This performative view reflects that space is established in practice through technologies that themselves have the capability to automatically produce space through

software (Kitchin and Dodge 2014a; Thrift and French 2002) to modulate spatial and temporal conditions (Kitchin and Dodge 2014a; Mackenzie 2003; Simondon 1992).

The spaces in which modern organisations operate are not fixed and bounded. Modern conceived workspaces are built upon evolving identities which are shaped by the dynamic nature of social relations as mobile and liquid. They are flexible by design, unchained from the desk, clock, the calendar or country. This liquidity is central to the formation of organisational identities and the blurring between public and private selves (Dale and Burrell 2008). As work becomes more fluid, faster and unbounded, it does not, contrary to common practice, lessen the need for face-to-face relations. In fact the opposite is true, as there is a greater move toward the establishment of collocated working. This is driven by needs for greater commitment from employees, improved collaboration and identification with the organisational goals and culture (Thrift 1996).

An impressive body of research demonstrates that face-to-face communication which is enabled through shared social settings remains the richest communication medium (Daft and Lengel 1984; Doherty-Sneddon et al. 1997; O'Conaill et al. 1993). This holds true in spite of modern advanced communication technologies. Face-to-face communications remain firmly established as the most effective way to nurture human and business relationships. These relationships are grounded in social bonding and symbolic expressions of commitment. This is contrasted with social aspects of communication concerned with information transfer, repairing misunderstandings and referring to shared objects in the environment. Within such settings human perceptual and cognitive capabilities enable an easy flow of interactions (Hutchins 1995a, 1995b) across physical and digital mediums. Participants working face-to-face rarely feel disoriented or without context (Olson and Olson 2000), which is key to successful conduct of tightly coupled physical and digital working.

Our focus is not what people communicate about per se, but how they create a social environment in which they can communicate at all. Social linkages between people are a precondition of information exchange (Nardi and Whittaker 2002). Information exchange is a key goal of communication, yet by focusing our theories exclusively on information, we overlook the social processes and context that scaffold information exchange.

Digitally collocated workers combine face-to-face communication with digital technologies (Zhang and Venkatesh 2013) within hybrid teams, whose members interact at various points on the space time continuum (Kirkman and Mathieu 2005; Robert et al. 2008). Yet the literature analysing the use of digital technologies in the workplace (Mazmanian 2013) and the effectiveness of virtual work (Townsend et al. 1998) has missed this important exploration of

the mutual constitution of the physical environment and information technology in the workplace. This limits information systems studies from understanding how work is performed within organisational practice. In particular, it imposes a serious constraint for investigating work practices in today's software development organisations, many of which are currently emphasising the importance of flexible workspaces within collocated workplace settings.





## **CHAPTER 3: THEORETICAL FRAMEWORK**

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This chapter develops the theoretical framework through a two-stage process. Crucially, it begins by establishing theoretical underpinnings which builds the foundation and path toward new theoretical development. These underpinnings explore the performative view of space with consideration to human agency which includes physical matter, situatedness, embodiment and relational context. From here we establish inextricable links between space and time.

The theoretical development section builds on the established underpinnings to provide novel concepts to perform the analysis and address the research question. This extends the work of scholars to craft a new perspective and vocabulary which conceptualises changing work practices and activities which are becoming increasingly integrated between physical and digital organisational settings to create the spaces of the modern office. This development enables a theorisation of where work happens in modern organisations and conceptualises organisational spaces which accurately reflect for the embeddedness of technology whilst considering the relevance of the physical environment in shaping digital work.

The theoretical framework marks a shift from privileging and focusing on either the features of the digital tools or the features of physical places as independent determinants of the activities performed in the workplace (Zhang and Venkatesh 2013). Whilst physical aspects of the work environment tend to be covered within the organisational studies literature, digital practices in the workplace are generally covered in the information systems literature. The lens draws upon both literature streams to capture the integrated experience of work across digital and physical spaces of work.

This chapter therefore enables an understanding to theorise how the fluid (Dale and Burrell 2008) and mutually constitutive relationship between physical and digital environments become integrated through the performative nature of practice (Cecez-Kecmanovic et al. 2014; Slife 2004).

### **3.1 Theoretical Underpinnings**

To develop the theoretical framework, we begin by establishing the theoretical underpinnings which provide a deeper conceptualisation of space through a performative perspective, i.e. spaces emerge out of the enactment of places. This leads us to the important point of grounding and that no matter how we perceive we create 'space', the physical embeddedness of digital technologies combined with our own physical embodiment reminds us that space remains inherently physical. We then explore how technology has enabled us

to exist in a multiplicity of spaces, yet the creation and appropriation of these spaces is conditioned by their physical context. Finally, we explore the concepts of space and time and how they are inseparably linked and relevant as 'space-time'.

### **3.1.1 The Production and Performance of Space**

In the social sciences, many thoughts around the production of space have now converged around one metaphor, the metaphor of performance. This metaphor has evolved from the notion of 'life is like theatre' to a notion that 'life is like performance'. This metaphor refers to, and operates through, the enactment of events with what resources are available in creative, imaginative ways which lay hold of and produce the moment; events are performed (Gil 1998). Some authors have argued that the metaphor of performance is a key to thinking about new embodiments and context which ground and scaffold our understanding of this performativity (Thrift 2008). As infrastructure and the space it creates has to be performative (Burkitt 2004; Lefebvre 1991; Thrift 2004). In practice, all space is anthropological, all space is practised and contextualised (Thrift 1996).

In this performative view, physical space is tightly integrated alongside social relations and digital media as an active agent. Evidence of this is omnipresent in organisational settings where knowledge work is performed within particular workspaces with significant diversity. For example, compare a university, parliament and a software development studio. In each, the use of space is planned and deliberate, constitutive and productive, the 'where' actively shapes the 'what' and 'how' that unfolds (Kitchin and Dodge 2014a). A university lecture theatre orientates furniture and in-turn students in unison toward a lecturer, whose stage is designed to project and amplify content on a digital screen for students to download and take notes on their laptops and tablets. Consider by contrast the library, where physical books and computers containing digital resources surround singular cubicles designed to isolate students to provide focus and eliminate distractions through insular work or study. Within the British parliament, opposing political houses sit alongside their colleagues on benches to face their opposition in the chamber designed for debate and conflict on issues pertaining to the governing of the country. The distance between the government and the oppositions benches is 13ft which is equivalent to two swords length even though weapons have been banned in the chamber for hundreds of years (Bowden 2018). This arrangement facilitates the adversarial atmosphere which is representative of the British parliamentary approach.

The lived experience of everyday life is multi-dimensional. It is composed of various social fields of practice that are articulated, codified and normalized. Moving through these fields, we

pass through different zones of time and space as heterogenous forms, each combining time and space in a unique way. Organisations deliberately attempt to fix social practices in time and space, by containing them in specific geographical sites and codifying processes which serve their objectives. This includes the use of information and communication technologies which compress space and time to enable employees to communicate instantaneously across the world and share digital media in seconds.

Yet all space is not only produced and performed by humans. Technology itself is also becoming increasingly connective and the purpose of digital devices is increasingly to communicate not just with the human agent, but with other devices. Thus, computing becomes a communication system in which more and more of the communication will be inter-device leading to the automatic creation of digital space becoming a part of how position is actually constructed. In this way, software enables a new and complex form of automated spatiality and the automatic production of space. This has important consequences for what we regard as the world's phenomenality, new landscapes of code that are now beginning to make their own emergent ways and conditions our existence. Increasingly, spaces like cities are being run by mechanical writing, which are being beckoned into existence by code (Thrift and French 2002). Kitchin and Dodge (2014a) propose the term *code/space* to address spaces emerging from spatial practices that are intrinsically co-constituted through software-mediated practices, wherein the software is essential to the form, function, and meaning of space. Examples of *code/space* are prevalent in modern day urbanised spaces; software essentially transforms a large waiting room into an airport, whilst cafes are transformed into networked offices by laptops and wireless access. This geography of software development is ubiquitous within the modern economy that is built on software (Thrift and French 2002).

Thrift and French (2002) argue that we can understand software as a practical extension of human spaces, consisting of three different processes. The first is a simple extension of textuality. For example, modern cities are effectively intertextual – from the myriad forms issued by bureaucracies, through the book, newspaper and the web page, the e-mail and the text message. By extension, modern organisations which are situated within and across these cities are also quite literally written, and software is the latest expression of this cursive passion. Secondly, software is a part of the paraphernalia of everyday urban life, through mobile technologies it has become crucial to the bonding of urban time and space. The smartphone and tablet have become synonymous with the pencil and the notepad, which in their very ubiquity go largely unnoticed. Thirdly, we can see software as a means of transport, as an intermediary passing information from one place to another so efficiently that the journey

appears effortless, movement without friction (Latour 1997).

Kitchin and Dodge (2014) argue that the profound impact that software has had in the world has been achieved because of its ability to modulate spatial and temporal conditions through a process of ontogenetic modulation known as transduction (Mackenzie 2003). This transduction of space emerges through collaborative practices that can be infinitely scaled. In this way, software creates new open-ended possibilities to enable, enhance and extend spatial formation (Kitchin and Dodge 2014a; Thrift 2008). Yet the transduction of space is never fixed, it is contingent, relational and context dependent, shifting and evolving with place, time and social conditions. Therefore studies which explore digital space must consider the physical environment that software is used within as a conceptual and analytical tool for providing context (Kitchin and Dodge 2014a).

In modern organisations, human practices are complemented by digital media and technologies that have the capability to automatically produce space and transduce space through software (Kitchin and Dodge 2014a; Thrift and French 2002). Digital space is thus a routine datum of organisational life, alongside the more local aspects of employee relations, activities, and communications that were its traditional basis. Space as well as time is now expansive, multiple and discontinuous (Burkitt 2004). This enables individuals to make flexible transitions between different places to make space as they perform their daily work.

### **3.1.2 Physical Matters**

Whilst it may be a common perception that modern technologies negate geometry (Mitchell 1995) and logical location may be considered more important than physical, it is important to remember that digital tools and technologies all begin and actually remain bounded within physical matter. IP addresses are bound to the hardware MAC addresses of connecting devices, which are managed by their physical location. Data is stored as electromagnetic bits and bytes in physical disks on our personal devices or in the cloud across large global server farms. We are connected by physical infrastructure including electrified cables for power and wireless radio waves for connectivity. Our digital displays respond to an electrical current allowing different wavelengths of light to charge specific pixels which create shapes, colours and images. We rely on global positioning systems which track our positions continuously and provide us with context rich information such as local news, weather and traffic reports.

These factors indicate the need for spatial awareness within digitally mediated action. In contrast to the assumptions of formless dematerialisation, the combination of digitally and

physically connected employees restores an emphasis on geometry.

No matter how we perceive we create 'space', the physical embeddedness of digital technologies combined with our own physical embodiment reminds us that all digital space remains inherently physical. For example, a video-conference with a colleague on the other side of the world is still a physical connection of two embodied individuals which are connected through physical infrastructure carrying electricity through cables into transistors and processors which process bits of binary code and display as images and audio – connection is at most basic level remains physical to physical. Digital space is therefore created from the activation of physical place and from the infrastructure which through digital technologies creates a transduction of space between connected individuals.

Whether intentional through design or by default, technology has enabled a shift from attachment to a single place toward a connection with a multiplicity of places. More than ever, these places influence most lives, as even those who do not move around can be digital nomads. These digital technologies provide not only mobility, but a new multiplicity of ways to connect. Modern organisations reflect a profound shift from using technology to overcome environmental limitations toward using it to understand and connect more effectively within them. This requires an understanding of how actors move around, assimilate themselves and interact (McCullough 2005).

### **3.1.3 Embodiment**

Interaction between humans and machines has been the object of numerous studies in the Human-computer Interaction (HCI) and CSCW literatures. These show that there is no simple observable exchange between discrete purified entities as 'human' and 'machine', but rather a skillful series of conversations which demonstrate that software is not a simple intermediary, but rather a Latourian 'mediary' (Latour 2005) with its own powers (Thomas 1995; Thrift and French 2002).

A growing consensus among cognitive scientists contends that mental activity is just as much a biological process as, say, breathing. This view has the implication that no thoughts are dematerialised. As George Lakoff and Mark Johnson (1999, p.14) declare in the introduction of their book *"The mind is inherently embodied. Thought is mostly unconscious. Abstract concepts are largely metaphorical. These are the three major findings of cognitive science. More than two millennia of a priori philosophical speculation about these aspects of reason are over"*. Their work provides a complete theory of background cognition as bodies

share conceptual structure; environmental experience grounds metaphor. This leads to an understanding *“that the environment is not a collection of things that we encounter. It is part of our being as a locus of existence and identity. We cannot and do not exist apart from it. It is through emphatic projection that we come to know our environment, understand how we are a part of it, and how it is a part of us.”* (Lakoff and Johnson 1999, p. 566). Humans assimilate their surroundings by means of mentally constructed representations of spatial relationships through both direct engagement and peripheral awareness (McCullough 2005).

We form extraordinarily rich conceptual structures and reason them in many ways that are necessary for our everyday functioning. All of these conceptual structures exist as neural structures in our brains. That makes them embodied in the sense that any construct is realised through neural connections. An embodied concept is a neural structure that makes use of the sensorimotor system of our brains (Lakoff and Johnson 1999).

Technology has enabled these capabilities of the human body to be extended in numerous ways. This is not just concerned with increased mobility or the extension of the human through digital services, it concerns a new era of speed and light which allows the body to virtually travel without moving (Thrift 1996). The conception of embodiment, delineates time and space in which actors are reconfigured in the light of the possibilities that flow from them (Radley 1996). These embodied beings whom by virtue of their physical presence, can portray transmutations of the ‘here and now’ in the digital world which delineate the immediate as a different, or new, totality of meaning. This underlines Merleau-Ponty’s (2013) argument that this immediate movement is transcended, or achieves significance, not in spite of our physical form, but because of it (Radley 1996). As encounters in which ‘other’ things are a part of the interruption are increasing in importance and frequency. So, the ‘ecology of mind’ (Bateson 1973) becomes ever richer through such intermediaries and mediators. Thus the human migrates on to many more planes and is mixed with other ‘subjects’ in increasingly polymorphous combinations (Thrift 2008) leading to *“the body being nourished by technology in the same way that it is nourished by chemical products”* (Marks 1998, p. 48).

Thrift (2004) argues that our conventions of address rely on knowledges of position and juxtaposition. These are sometimes tacit, but increasingly systematised. When practice is established and routine, conventions of address sit quietly in the background. *“Everything - objects, settings, routes, people seems to be real, that is the way things properly are, provided with a sort of existential fixedness and ontological correctness”* (Lanzara and Patriotta 2001, p. 965). Because thought has increasingly been rendered more and more ‘thing-like’, we now seem to live in *“an indeterminate ontology where things seem slightly human and humans*



*seem slightly thing-like*" (Brown 2003, p. 13).

Ingold (2001, p.265) also puts forward a grounded notion of the environment: *"The environment of persons is no more reducible than is their organic existence to pure molecular substance. It is not merely physical, and it is certainly not blank. For example, the ground I walk on is surely a part of my environment, but in a physicalist description the ground, as such, does not exist; there are only packed molecules of carbon, nitrogen, silicon and so on."* Ingold continues: *"It is the earth on which we walk, and the soil in which we plant, that is relevant for us as perceiving and acting creatures; not the molecules discovered by scientists"* (Ingold 1994, p. 111).

Developments in software are producing a new kind of embodied phenomenality of position and juxtaposition. This phenomenality is *"made continuous with the properties admitted by the natural sciences"* (Petitot et al. 1999, p. 23), based on a background sense of highly adaptive complex systems simulating life through communication, logistics and collaboration as experienced in video games such as *Zelda: Ocarina of Time*; which not only create space as entire worlds. Such embodiment produces both spatiality and temporality (Giddens 1984). As Merleau-Ponty (2013, pp.239–240) wrote, *"In every focussing moment, my body unites present, past and future. ... My body takes possession of time; it brings into existence a past and a future for a present, it is not a thing but creates time instead of submitting to it."*

Humans possess an innate ability to make and remake their environments so that they can ask different questions and solve different kinds of problems. Whilst it might be thought that these things cannot qualify as sentient beings even if they are understood as environments, such things enact themselves as effects amidst the system of the world. These objects are mutually referential: behind each tool are legions of other tightly interlaced tools. These tools do not function as individual objects, but as distributed networks in manifold contexts (Harman 2002). Digital tools have an even greater capacity to influence the comings and goings of bodies than in the past because of the distributed networks and ability to configure, combine and automate them (Thrift 2008).

Social configuration and territories of belonging and identification depend on learned spatial cues. Put a group of people in a room and they will quickly organise themselves with consideration to social distance, presentation of self and territoriality, providing a tacit set of social cues and cultural norms. Such spatial relations may deepen the sense of connectedness, orientation and the sense of belonging to the organisation. Qualifying the value of the environment provides a pathway toward better design and practice of appropriate

technology. Embodiment is a property of interaction; latent embodied abilities exist and therefore it is necessary to understand how interactive technology is used by actors embodied within their environment (McCullough 2005).

Our environment is not the same as the physical world as it exists. It takes on meaning in relation to the beings that inhabit it (Gibson 1986). Because what we know and how we know is situated and rooted in embodiment, it follows that a practical or situated way of knowing is contextual (Thrift 1996). Its formation therefore needs to be understood in the same way that we understand objects and persons, as properties of dynamic self-organisation of contextual fields (Thrift 2004). To run our attention from in-person embodiment to the modern office, we see that 'context' is not the setting itself, but the engagement of actors with it, along with the bias that setting gives to the possibility for interactions that occur within it. The 'environment' is the combination of all the present contexts across physical and digital realms. According to the principles explicated, this environment does not exist as an other, or an empty container, but it shapes the perception of persistent possibilities for action (McCullough 2005).

#### **3.1.4 Context**

Spatial relations are at the heart of our conceptual system. They are what make sense of space for us and thus characterise spatial form. Yet these spatial relations do not exist as entities in the external world and we do not see them in the same way that we see physical objects. We do not see nearness and farness. We see objects where they are, and attribute to them nearness and farness based on some relative position (Lakoff and Johnson 1999).

The relations in front of us and those behind us are imposed by us on space in a complex way. When you go in the front of a building, you find yourself in the back of it. Spatial-relations concepts are not simple or straightforward, and to make things more complex, they can vary from language to language. We use these spatial relation concepts unconsciously and impose them via our perceptual and conceptual systems. We can automatically and unconsciously perceive spatial relations. However, such perception depends on an enormous amount of unconscious cognition. For example, to visualise a meeting in the office, we have to conceptualise the boundaries of the room where the meeting takes place as a three-dimensional container with furniture and the relative positioning of objects including ourselves and others within it (Lakoff and Johnson 1999).

In their search for conceptualisation and reductionism, previous scholarship on findings on environment and behaviour have overlooked this vital concern of context. Although context

does not induce action directly, it shapes perceptual selectivity, provides background cues and the application of institutional and tacit knowledge. As the body is our general medium for existence in the world, sometimes its actions are restricted by the actions necessary for life preservation; at other times, elaborating on these primary actions and moving from their literal to a figurative meaning (Merleau-Ponty 2013). Sometimes, the meaning cannot be achieved through the body's natural means, it must then build itself an instrument which it projects through the digital world.

Human interaction is inherently based on proximity to increase social impact and familiarity and to enhance the degree of authenticity and realism of one's experiences (Sarker and Sahay 2004). Given the temporary nature of project work and global dispersion of team members, it is difficult to disregard physical context from the interacting individuals, and to transform virtual spaces into meaningful places for team-members (Schultze and Orlikowski 2001). Individuals remain embedded in their familiar surroundings, while digitally interacting with others, and thus need to simultaneously negotiate the meanings and norms associated with their physical location as well as those emerging virtually (Hine 2000). Here, actors create unique interaction patterns and reciprocal knowledge using their own protocols, symbols and common knowledge. This enables them to improvise around uncertain situations using established social norms (Go and Fenema 2006).

Our primary interaction with objects comes through using them, through simply counting on them within the context of our environment. For the most part, objects are implements taken for granted, a vast environmental backdrop supporting our explicit activities. Indeed, human interaction finds itself embedded amidst countless items of supporting equipment: the most passionate debates in a boardroom stand at the mercy of a silent foundation of floorboards, office furniture, gravity and atmospheric oxygen. We normally do not deal with such entities as aggregates of natural physical mass, but rather from a utilitarian perspective as a range of functions that we rely upon (Thrift 2008).

Place begins with embodiment. Body is place, and it shapes perceptions. Embodiment is therefore not just a state of being, but an emergent quality of interactions (Dourish 2004). From this we must recognise the importance of cognitive background as the "*cumulative perceptions of enduring structures that fundamentally shape human abilities*" (McCullough 2005, p. 27). In order to know more about space and place, the principles of embodiment are essential and relevant to the design of information technology. These theoretical principles provide a useful foundation to understand technological developments with appropriate contextual awareness.

My ontological approach is thus consistent with the strong relational view of sociomateriality (Orlikowski 2007, 2010; Orlikowski and Scott 2008), yet supplements the IS literature with scholarship from other disciplines (Thrift 1996) which approach the problems of ontology, epistemology, the subject and subject-object relations as radically contextual. Shotter (1985, p. 449) describes this context as: *'A performative social situation, a plural event which is more or less spatially extensive and more or less temporally specific. It is, in other words, a parcel of socially constructed time-space which is more or less 'elongated' (and in which socially constructed 'notions' of time-space must play their part; 'rather than living "in" space and time, we account for time and space practically, relative to our form of living'.*

The strong fully relational view of sociomateriality enables a performative and mutually constitutive lens across material (physical, digital and actors) and social through a 'mangle' of practice (Pickering 1995). Practices are embodied and materially mediated arrays of human activity (Jones 2014) and entities exist in relation to other entities, they are performed and continuously brought into being through relations (Latour 2005; Orlikowski 2010) so that organising is always in a state of becoming (Cecez-Kecmanovic et al. 2014). In the words of Slife (2004, p. 159) *"Each thing, including each person, is first and always a nexus of relations...all things, including all practices, have a shared being and a mutual constitution"*.

The performativity of practice is further elaborated by the notion of agential intra-action introduced by Barad (2003). It is through intra-action that material-discursive practices reconfigure relations and thus delineate entities and enact their particular properties. When such intra-activity produces local determinations and makes specific identities of human or social actors, of objects and technologies, they become enacted as such and can then be perceived as having given boundaries and properties. In Barad's vocabulary it is the agential cut performed by practice that makes all entities what they are in a particular situation. While people, environments and technologies are never fixed as they are enacted and re-enacted in practice through iterative intra-action, they may be stabilised for specific purposes by agential cuts (Cecez-Kecmanovic et al. 2014). This view of performativity does not privilege human actors, instead recognising composite assemblages of humans, environments and technologies as ontologically inseparable components. This allows Barad (2003) to reformulate the notion of agency to transcend human versus physical environments or technological agency. Barad conceives of agency as the *"enactment of iterative changes to particular practices through the dynamics of intra-activity"* (p. 827). Intra-action can thus be understood as the *"mutual constitution of entangled agencies"* (Barad 2007, p. 33). In other words, intra-action suggests that these entities cannot exist in isolation, as they shape and

inform one another. We shape the material world and the material world shapes us.

The practice lens highlights the emergent character of patterns of technology use as they are shaped by ongoing action. This shifts analytical attention from the properties influencing designers, to the regularised interactions of users with technology within the context of their physical environment in the course of everyday activities. This approach enables a recognition that the same technology can be taken up in radically different ways in different contexts, which is helpful for revealing the emergence of unexpected patterns of use (Azad and King 2008; Boudreau and Robey 2005; Sergeeva et al. 2017). Such an approach responds to calls to identify the performative role of the physical environment alongside technologies (Cecez-Kecmanovic et al. 2014). It is crucially also practically relevant as it can *“enable practitioners to better understand, engage, and, above all, improve their own practice”* (Sandberg and Tsoukas 2011, p. 354).

This exploration of embodied interactions provides contextual awareness and conditions that we may otherwise take for granted. Whilst they may appear familiar, it is still necessary to study them. For example, consider the management consultant. A role which typically requires frequent travel and interaction and exchange of information with other parties. During the course of a client visit, the consultant may commute by car and later on rail to deliver a scheduled presentation. Along this journey, the consultant receives a call from her manager suggesting she should prepare some additional information on the client before arrival. For this consultant, the intent is clear, yet their embodiment is a clear determinant in how she proceeds. If driving, the consultant may request news on the client through her smartphone embedded voice assistant. Alternatively, if seated with a tablet on a Wi-Fi enabled train, the consultant could use a web browser to scan search engine results in more detail and contemplate how to embed relevant topics into the meeting. If already at the client office, the consultant could connect to the guest Wi-Fi to peruse the clients' extranet from her laptop and embed relevant news content directly into her presentation.

These phenomenological arguments challenge notions of mind-body dualism and afford intuition to subjective intent. In other words, repeated encounters with objects in contexts increase our awareness of them and what we can do with them. Heidegger argues that we understand the world in terms of what we can do with what we find of it (Dourish 2004). The psychologist James Gibson (1986) extended these undertakings to focus on interaction with environment through the concept of *affordances* where seeing and knowing combines vision, embodiment and environment. Epistemically, contexts are full of props and cues which serve as learning resources for patterns of usage. These cues serve as opportunities and constraints

toward an active intent (Ingold 1987). This intent is engaged but not necessarily reflective. Rather, it is as much a product of the ability and intent of the subject as of the perceived properties of the object. Accordingly, the use of available tools transforms the perception of the environment.

We are therefore concerned with process, people, environment and technologies as composite and shifting assemblages, continuously performed in a web of relations with the congealing of agency in the enfolding nexus of relations. In these parcels of time and space, 'subjects' and 'objects' are aligned in particular ways which provide particular orientations to action or affordances (Gibson 1986; Hutchby 2001) and particular resources for action. To constitute a region as an interaction structure, requires a notion of interaction that is mediated by institutional correlations with social structure which is made up of a number of different but connected settings for interaction (Thrift 1996). This framing ensures that the design of information systems expands its subject from digital artefacts to consider their contexts (Krippendorff 1989). Through such contextual awareness, the design of the office and technology become a natural support for modern working practices.

### **3.1.5 Space-Time**

In addition to physical and digital spaces, the information systems literature also posits time as a fundamental category to create temporal order within organisational life (Dubinskas 1988). Whilst space has been typified by measurable, geometrical space which can be located, time is associated with life, activity and movement which comes to oppose the fixed representation of space. This tension between space and time underpins many concepts of space (Malpas 1999; Massey 2005). Whilst it is accepted that technology affects temporal aspects of contemporary society, the complex relationship between technology and time remains poorly understood (Lee and Whitley 2002). This relationship tends to be described primarily with respect to the technical capabilities of technologies that enable the speeding up of production and coordination. Such a perspective overlooks the broader questions related to the underlying mechanisms and how different social groups deal with the challenges arising from the resulting intensification of work (Sarker and Sahay 2004).

Organisations routinely determine the success or failure of their projects based on time and the effective coordination of work (Sarker and Sahay 2004). Consequently, the aspects of time subject to cultural differences, multiplicity of social norms, time-zone differences, and varying work patterns have been increasingly examined (Barley 1988; Carmel 2002) and been found to be deeply embedded at individual, organisational, and societal levels (Dixon and Panteli

2010). This concept of time provides an organising frame of reference for work groups through the synchronisation and temporal nature of activities. The study and dominance of clock time is particularly evident in the literature pertaining to virtual and globally distributed teams. However, research which has studied collocated teams have found they operate with their own temporal rhythms (Maznevski and Chudoba 2000) which impact both how technologies are used, and how through the use of these technologies, the temporal orders for these teams are subsequently redefined (Barley 1988).

As shown in the previous sections, a key characteristic of the human subject's understanding of the world are its situatedness through context. So, abstracting human subjectivity from time and space is always an impossibility. Massey has demonstrated how the cemented divide between time and space is problematic in its flawed association of change with the temporal, and stasis with the spatial (Hubbard and Kitchin 2010; Massey 2005). Building on this, Thrift (1996) argues that there is little sense to be had from making distinctions between time and space. There is only space-time in which space and time are inseparable. Social structure cannot be disentangled from spatial and temporal structure. The two have to be theorised conjointly, rather than as the impact of one upon the other. Temporally, practices are always open and uncertain, they are largely dependent upon the immediate context including the resources available at the particular moment they show up in time and space. Thus, each action is lived and deeply embedded within time and space, and part of what each action becomes is a judgement on its appropriateness within the particular time and space.

Consider that mobility requires both space and time, which is an often overlooked or ill-understood elementary insights of time-geography (Deleuze 1988; Game 1991; Marx 1972; Thrift 1996). Giddens (1984) structuration theory places a large emphasis on the recursive and continual, routinised reproduction of practices across varying space-time contexts. Recursivity can be considered the means of regularising and stabilising space and time, whilst tradition should be understood as a mode of routinisation where practices are ordered across space and time (Thrift 1996).

Finally, human agency must be seen as a continuous flow of conduct in space and time. Such a view of human agency is necessarily contextual. According to Bourdieu (1977, p.9): *"practices are defined by the fact that their temporal structure, direction and rhythm are constitutive of their meaning"*. Human action therefore occurs as a continual space and time budgeting process as an irreversible sequence of actions. Practice is always situated in time and space. Thrift (1996) notes the link to structure for the structurationists, as the places at which activity is situated are the result of institutions which themselves reflect structure, for

example work or school. He considers these institutions as nodes in space and time around which human activity is concentrated.

These theoretical underpinnings provide an essential practice-based foundation for capturing and theorising how works happens in modern organisations that combine new digital technologies and spatial arrangements within the workplace. Such practices constitute the horizon within which all discursive and material actions are made possible and acquire meaning; that practices are inherently contingent, materially mediated, and that practice cannot be understood without reference to a specific place, time, and concrete context (Engeström 2000; Latour 2005; Nicolini 2009; Schatzki 2005).

## 3.2 Theoretical Development

The development of the theoretical framework is composed of two central constructs to approach the research question and understand current combined physical and digital workspaces: (a) *spatial work practices*, which extend the concept of spatial practices (de Certeau 1984) as they intrinsically are attached to work activities. These are responsible for the creation and the dismantling of the (b) *spaces of the modern office*; which conceptualise and explain how human agency is involved in producing and combining space in practice based on the relative position of actors, the physical environment and digital technologies.

### 3.2.1 Spatial Practices

To capture the role of modern workspaces in organisational practice, the theoretical framework follows on the theorisations of space that were identified within the literature review as ontogenetic, drawing particularly on the work of de Certeau (1984).

Ontogenetic conceptualisations change the way we usually think about the relationship between place and space. As stated in the literature review, de Certeau (1984, p. 117) defines place as “*an instantaneous configuration of positions*”, which implies an indication of stability. In this way, when we refer to a place (e.g. a workspace, a room, an office), we usually think of a set of relatively positioned elements, or a snapshot of dynamic relations. In contrast, “*space is composed of intersections of mobile elements... In short, space is a practiced place*”. Therefore, instead of considering space as an inert and absolute container that is detached from social relationships, our conceptualisation corresponds to what de Certeau labels “*experienced space*”, in that it reflects the fact that “*spatial usage creates the determining conditions of social life*”. It is important to note that this inverts the familiar and usual



geographical usage where space is associated with the abstract form of space and place with the more lived and experiential as previously defined. This partly stems from an issue of translation of the French words *lieu* as 'place', and *espace* as 'space' (Hubbard and Kitchin 2010).

In applying these concepts de Certeau uses a central metaphor, the act of walking in the city as a spatial practice. He contrasts this with the static view given by the traces of a map. De Certeau looks to the control of space within the city as a matter of designed and orchestrated strategy implemented through deliberate construction. In contrast, through appropriation of the space, we also become aware of tactics – the arts of making do or improvising through practical knowledge of the city which transforms and crosses spaces, creates new links, as people walk through and walk by these given places. In other words, strategy claims territory and defines place; tactics use and subvert those places. The strategic vision of power and theory can thus be transformed by small-scale tactics. Strategy, he sees, as the imposition of power through the disciplining and organisation of space – by zoning and prescribing activities. Tactics can be considered as the manoeuvres that take this predisposition of the city and make it over or appropriate it to the purposes of inhabitants (Hubbard and Kitchin 2010).

De Certeau is concerned with 'stories' as epistemologies of inhabitants actually getting by in cities; and, in spatial terms, sees walking as a form of practical narration. That is, he sees practices as spatialising places. The city is known by walking rather than looking down at a static plan. His work which has the English title of *The Practice of Everyday Life* is *L'art de faire* in native French, which can also be translated as 'ways of making do'. It looks at the use of objects and places in their environment, rather than their ownership and production. So he focuses attention as to how tactics appropriate what has been created by hegemonic systems (Hubbard and Kitchin 2010).

De Certeau's determination to create a sense of place as actively constructed has been developed in theoretical accounts, especially taking his notions of the transformation of space through the conjunction of context, meaning its affordance change and it too is changed (Crang and Travlou 2001). Space occurs as the effect produced by the practices that orient it, situate it, and make it function in a polyvalent unity of contextual proximities. Space emerges through collaborative manufacture (Crang 1994) as a collective, heterogeneous series of transductions, the outcome of multiple complementary, competing and sometimes contradictory practices enacted by many actants. In relation to place, space is like the word when it is spoken, when it is caught in the ambiguity of an actualisation, transformed into a

term deeply embedded and contextual upon convention, situated and embodied as the act of a present, and modified by the transformations caused by successive contexts. ...in essence, the street geometrically defined by urban planning is beckoned into space by walkers (de Certeau 1984).

For de Certeau practices are always spatial-symbolic which can be discovered via spatial-symbolic metaphors like walking, pathways and the city or analogously to how speech relates to grammatical structures in language. Through the movements of the body and the powers of speech, actors create possibilities to convert one spatial signifier into another. Space intervenes in another way too, in the production of narrative structures as spatial syntaxes. De Certeau posits that narrative structures regulate ways of proceeding and constraints in space in the form of places put in linear or interrelated series. When they are represented in descriptions or acted out by actors these places are linked together more or less tightly or easily by 'modalities' that specify the kind of passage leading from the one to the other. Thus every story becomes a spatial practice (Thrift 1996).

*Spatial practices* thus fulfil a threefold function:

1. They *appropriate* a topographic system;
2. They perform a *spatial realisation* of the site;
3. They *establish relationships between different positions* (de Certeau 1984, p. 108).

The sanctioned and official perspective of *strategies* try to establish a structure, an order and define other elements of the environment in relation to them. These are put in contrast with the *tactical* character of practices of appropriation, which are considered as ways of operating within those structures in everyday practices. This distinction between strategy and tactics is of great significance for the application of these concepts to organisational space. It allows us to distinguish between places as official versions and their disciplining strategies (e.g. planned office layouts of the physical environment, intended managerial usages of rooms and digital tools), and the tactical everyday appropriation of these places that "*bring to light the clandestine forms taken by the dispersed, tactical, and makeshift creativity of groups or individuals already caught in the nets of 'discipline'*" (de Certeau 1984, p. xiv).

### 3.2.2 Spatial Work Practices

To capture the new phenomena in modern organisational settings which integrates both physical and digital environments, it is necessary to extend known concepts beyond previous adaptations of de Certeau's theoretical framework which have focused on the physical world such as cityscapes (Thrift 2008) or pure physical workspace (Best and Hindmarsh 2019).

This work extends de Certeau's (1984) framework of 'walking in the city' to 'working in the modern office', which is applied within an organisational setting which integrates both physical and digital. It posits *spatial work practices* as performed by organisational actors appropriating the relational and contextual elements of their integrated physical and digital environment as spaces of work. This construct of *spatial work practices* provides a way of conceiving and constructing space for work to happen from the perspective of actors (not the organisation) at an individual or group level. These *spatial work practices* may be shaped by agreed social norms, organisational process, management methodologies or simply by preference. In this fashion, they can be considered strategically prescriptive or tactically emergent trajectories. These may be routinised through schedule or ad-hoc and emergent. As these actors pursue their work activities, their paths intertwine through these *spatial work practices* to give shape to space for action to happen.

Whilst modern software organisations provide a canvas through office layout and the availability of digital tools, the art of painting within this canvas is shaped by employee *spatial work practices* as a performative aspect. At the same time as actors appropriate organisational work structures they also create spaces for organisational action to happen. *Spatial work practices* therefore provide a unit of analysis to follow empirical phenomena and identify work happening through the actualisations of physical and digital space in order to perform work activities. These *spatial work practices* depend on goal-oriented action to be triggered by goal-oriented actors appropriating and configuring the materiality of spatial surroundings to support work activities within capitalist or neoliberal structures.

Users of office environments gradually develop specific 'ways of operating' them, which is also analogous to the "enunciation" of physical places proposed by de Certeau (1984). To understand what kind of space and spatial relations emerge from the use of digital tools in organisations, this research will trace and reconstitute the 'walks' of team members through the physical and digital environments, i.e. the *spatial work practices* of appropriating both physical and digital features of workplaces. Development of this concept enables us to understand the spaces that are constituted in practice. In contrast to earlier studies of

information systems, this theoretical framework looks at researching integrated physical and digital environments built for work to happen. Indeed, the way in which environments shape an organisation's activities is relevant because information systems, like architecture have become social infrastructure. This extends previous works of place making by taking advantage of physical contexts as frames and cues for combined physical and digital work activities.

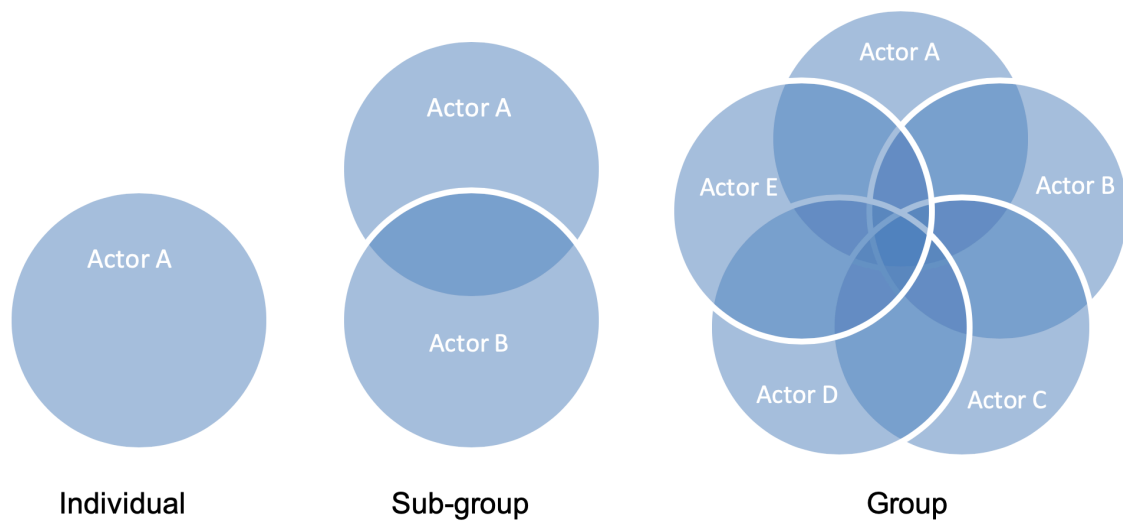
The modern work environment exists as a physical and digital manifestation of the organisational routine that enable and constrain actors. The most obvious examples are those that deliberately attempt to capture or prescribe a routine, such as digital work processes which are embedded into software workflow. More subtle examples include the physical layout of office space. Pentland and Feldman (2005) use the example of an office 'reception' area which facilitates the routine intake of visitors, but does not directly prescribe which visitor should be seen first. Whilst it may seem intuitive to think that the rules and design of an environment may shape and prescribe the patterns of action that make up the performative aspect of a routine, the practical effect and appropriation is often quite remote from its original design or intention. Organisations may provide rules and methodologies as resources for action, and environments as resources for actors (Giddens 1984). However, because contexts vary, they do not determine performances (Garfinkel 1967; Taylor 1993) and there are always contextual considerations that remain open for the routine to be carried out (Victor et al. 2000).

A crucial element in the development of capitalism is the active use of space to boost innovation and collaboration. New space-time arrangements are being designed to act as traps for innovation and invention. They are attempts to mould and extend the environment in which ideas circulate by facilitating the creation of spaces that can continuously generate and transmit ideas. But, crucially, these spaces are not sealed, rather they are insertions within already present flows (Kwinter 2001; Thrift 2008). They are designed to allow continuous interaction boundaries by maximising human gathering (Storper and Venables 2004) in a dynamic, fluid and porous nature within and across physical and digital boundaries. Systems of discipline designed to routinise a set of practices are of commonplace study in the social sciences, especially since the work of Foucault (1976). And, as Foucault and other scholars have shown, the use of physical space is a powerful determinant of their effectiveness. Such systems use specific spatial-temporal environments to draw people, texts and devices together in routine ways. These arenas constitute the nodes of more or less spatially distributed networks, which subsequently require people, process and devices to maintain (Law 1994).

### 3.2.3 Spaces of the Modern Office

Space allows motion, it is a means and not a setting. It is produced as a form of external experience, which can be distinguished from the things which are encountered that experience (McCullough 2005). In 1974, the critical theorist Lefebvre wrote of 'producing space' to supplant previous notions of pre-existing space with emergent phenomena (Lefebvre 1974). From this we can theorise that wherever people or electronic communications flow, spaces form around them. This has been particularly significant for disembodied digital channels as "the space of flows" which changes relations between physical places more than it does away with them. As Castells (1989, p. 169) explains, "*The spaces of organizations in the informational economy is increasing a space of flows... However, this does not imply that organizations are placeless. On the contrary, we have seen that decision-making continues to be dependent upon the milieu of which metropolitan dominance is based; that service delivery must follow dispersed, segmented, segregated markets... Thus each component of the information-processing structure is place-oriented.*" We have established the theoretical underpinnings of space as produced and performed within the physical and digital realms. In order to truly understand the space of the modern office, we need to consider how this takes form and is combined with human agency from actors working individually and within groups across both the physical and digital domains. Whilst space can be beckoned into existence at an individual level, this research concerns itself with the overlapping multiplicity of spaces across both individuals and teams in which work now happens.

Actors collaborate at a 'place' to create shared 'space', this perception of place is ever expansive. For example, within the physical domain, two actors collaborate at a shared desk, they do this whilst situated within their wider team area, which in turn sits on the departmental floor of the second building within the corporate campus and so forth. In order to provide a necessary focus to explain the role of the physical environment and digital tools in the constitution of workspaces, it is necessary to conceptualise both the individual and collective spaces that are created by actors for work to happen as *spatial work practices*. As illustrated in Figure 3, at an individual level these spaces remain relatively simple, occupied by actors and their environment. However, in collective form the complexity increases exponentially through the production of a multitude of spaces through practice (de Certeau 1984; Massey 2005; Rose 1999; Thrift and French 2002), which exist as both individual and collective intersections of space where collaboration can happen between actors in sub-groups and across the entire group. These spaces represent human actors and their creation and intersections are entirely contingent on their relative positions and proximity to one another.

**Figure 3: Individual and Group Spaces of Work**

Within the digital domain, technology modulates spatial and temporal conditions through a process of ontogenetic modulation known as transduction (Mackenzie 2003). This process of transduction creates space between connected actors through a digital interface underpinned by physical infrastructure. Whether these actors are physically collocated or geographically separated, space exists as the transduced connection between them. Unlike the physical domain, where we remain singular, situated and embodied (albeit in increasing scales) technology affords us to create a multiplicity of digital spaces. For example, consider the act of sending a text message to one colleague whilst simultaneously engaged in a video-conference with another. We in effect create an additional transduced space with each simultaneous interaction. Instead of a single space and time, we generate as many spaces and times as there are types of relations. Thus, working in isolation at one's desk will not produce the same space as attending a digitally interactive town-hall meeting alongside hundreds of other employees. The difference comes from the number of others one has to take into account. These multiple spaces then are complex, active, and only partially related with one another; through embodied actors or as interconnected nodes connected through software. They are distributed, not in geometrically regular patterns, but as archipelagos in a turbulent, disordered sea (Thrift 2008).

The human subject must therefore be thought of as both inside digital space and simultaneously outside it within physical space. Scholars have argued the need for a new constitution which recognises the power of objects and the environment as carriers of meaning to a positive and instrumental materialism (Thrift 1996). This makes the simple

acknowledgement of the extent to which this context is intertwined with the subject. Latour (1988) reminds us that all practitioners work with the tools of their trade. Everything we do, from learning to engineering, is a trade with its own tools. We know and interact with the world through these tools, and this situation has become more rather than less the case as the human body and physical environment have been significantly augmented by advancements in digital and mobile technologies.

By grouping these understandings and extending the concepts of Kitchin and Dodge (2014a), we can establish that the modern office workspace therefore emerges through collaborative manufacture, as a collective, heterogeneous series of transductions. It exists as the outcome of multiple practices enacted by many actants. This means spaces emerge in a polyvalent manner, bought into being simultaneously by many actants, who do not contribute to the manufacture or experience the space in the same way or in equal degree. Rather, they experience the resultant space from different perspectives and in diverse ways. Indeed, an executive and an intern both contribute to the spatiality of the office in varying ways and the physical and digital architecture of the office shapes their respective unfolding sociospatial relations differently. Space is transduced as more than the sum of its parts.

What these developments enable is a considerable change in conceptualising the changing nature of space in modern organisations. Thrift (2003) called for such changes as he predicted that spaces of the future will be loaded with information and contextual awareness as they are increasingly connected at scale and speed. These spaces are interactive and performative, enabling users to develop new affordances and practical skill sets that incorporate expectations of how space turns up. Thrift's insights help us understand, but they still need further elaboration to grasp the empirical reality of modern workspaces pervaded by digital technology.

Humans enter into the relations of everyday work and life and bring into existence the totality of the real. We produce social time and space and thus we produce the very basis of humanity. In this way, the production of daily reality occurs both as somewhere beyond our reach as strategic and imposed upon us, but also tactically as the sum total of all our relations - built on the ground, in daily activities and transactions. This happens in our working relations but also beyond, wherever we need to communicate and to play. The question of what constitutes everyday life and by extension, everyday work, must then be centrally concerned with how these relational fields of human experience are produced in space and time (Burkitt 2004).

### 3.3 Chapter Summary

Human life is interactive life, where life is performed, and architecture sets the stage. The layout of the city and the office are both examples of where space emerges through the enactment of places. Digital systems embedded into physical situations can fundamentally affect how actors interact by enabling the creation of a multiplicity of transduced spaces. Information system scholars, psychologists, ethnographers, architects and cultural geographers have not yet understood the consequences of this mediation within work relations. Notions of what digital technologies are have not adequately considered how and where these technologies are applied. As social and local context for organisational life, embeddedness has become part of the architecture. Whereas previous paradigms of digital technologies claimed to dematerialise the architecture of physical space, integrated physical and digital spaces of work invite their defence.

Information systems research needs to understand and respond to recent developments in modern working practices to be able to appropriately design information systems. This includes a need to fill in background knowledge about the office and the role it plays in how and where work happens. Further, those in the related disciplines of the physical environment such as architects and urbanists also need better awareness of the challenges and opportunities raised by the integration of digital technologies within their domains of expertise.

A significant point is that information systems literature and recent scholarship on sociomateriality has marginalised the role of context. Humanity has evolved over thousands of years where it has built languages, conventions and physical architecture. Whilst digital technology has undoubtedly transformed these elements, it has seldom done away with them. As information systems designers study how people work, operate and assimilate technology, they must also study how technology mediation influences what people are doing. It is necessary that they concern themselves with the particular mechanisms of product adoption and usability in terms of work practices, social organisations and the physical environment – in other words, context (Cecez-Kecmanovic et al. 2014; McCullough 2005).

Spaces therefore emerge as crossovers between physical and digital environments and infrastructures. Electronic communication has intensified, not undermined, the hubs of activity in the organisation workplace. This intensification is reflected in the current practices of office design. As modern technology organisations move to merge the dichotomy of physical and digital environments, these organisations are rediscovering how flows of people and information are most valuable where they are most closely intermingled through software



which challenges our assumptions of the world. Through new forms of technological practices and ways of animating space that we are only just beginning to comprehend (Barry 2001). They should not be allowed to take us unaware. One of the more pressing contemporary tasks must therefore be to comprehend these 'information ecologies' (Nardi and O'Day 1999) which allow us to understand and shape overlapping spatial and temporal mosaics (Thrift and French 2002).

Building on these theoretical underpinnings, the theoretical framework understands modern working practices as a continuum of spaces that transcend physical and digital, emerging from interactions between people, work practices, technology and physical environments to redefine the notion of workspace. It establishes and develops the central constructs of *spatial work practices*, which extend the concept of spatial practices (de Certeau 1984) into an organisational context and provides lens for conceiving space where work happens across conventional physical and dynamic digital spaces. *Spatial work practices* are intrinsically attached to work activities through an appropriation of the topographic system of the office. They are responsible for the *spaces of the modern office*; which conceptualise and explain how human agency is involved in spatial realisation of the site based on the relative position of actors, the physical environment and digital technologies.

The theoretical underpinning and two new constructs together form the theoretical framework for this study which enables an understanding of the role of physical environment and digital tools in the constitution of workspaces. It enables us to approach a conceptual understanding of the continuum of ontogenetic configurations which occur in modern organisations. This framework enables us to proceed to answer the research question by exploring the empirical case of the role of workspaces in the collaborative practices of software development teams in a large global IT company.

## **CHAPTER 4: METHODOLOGY**

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A recent turn in organisation and information studies had led to many theorists becoming interested in collected data and theorising work in practice (Gibbs 2009; Leonardi 2015; Treem 2012). These interests follow trends in the organisation and information studies that focus on how knowledge workers coordinate (Carlile 2004), collaborate (Nicolini et al. 2012) and create shared use of technology (Orlikowski 2000) from the practices of their everyday work.

This chapter begins with an overview of the qualitative in-depth case study approach, explaining the unit of analysis that will be used for data collection and the capture of where work happens, leading to an overview of the empirical setting. In order to capture the spatial practices of work activities across both digital and physical environments of work, it is necessary to observe workers in practice over long periods and thus the use of a qualitative approach with methods including participant observation, semi-structured interviews, document analysis and time-lapse video recording is elaborated and justified. As an insider researcher, the author is able to get long-term access to thick data, enabling the research to uncover complex and dynamic interactions among organisational actors and their environments and set the foundation for conceptualisation and theory building (Mintzberg 1979; Weber 2004) which would not have otherwise been possible.

The data collection and subsequent data coding process procedures are explained in depth and supported with a data structure which depicts the progression from raw data to terms and themes used in conducting the analysis to ensure rigor in the qualitative approach (Pratt, 2008; Tracy, 2010) and explicate how data was processed from methodology to theory. The study thus follows a systematic inductive approach to concept development and the strong social scientific tradition of using qualitative data to inductively develop theory through deep and rich descriptions of the contexts within which organisational phenomena occurs.

#### **4.1 Qualitative Methods**

In order to capture the spatial practices of work activities across both digital and physical environments of work this research employs a qualitative in-depth case study utilising multiple data collection methods for triangulation of data (Yin 2009). This approach is consistent with recent studies of technology use in the workplace (Leonardi 2015; Wajcman and Rose 2011), which also employ interpretive and qualitative methods for thick descriptions and richness of data (Easterby-Smith et al. 2012).

The work of scholars has highlighted the performative and improvisatory nature of performing organisational routines (Feldman 2000; Hutchins 1991; Orlikowski 2000; Suchman 1983; Weick and Roberts 1993). They involve a need for actors to understand their

environment, whilst attending to the actions taken by relevant others and the contextual details of their situation. Examining and comparing these performances is an important way of understanding the relationship between context and action (Pentland and Feldman 2005).

Leonardi (2015) argues that work practices are materially bound (Pickering 1995), recurrently enacted over time through patterns of organising (Vaast and Walsham 2005) and technology usage (Orlikowski 1992, 1996, 2000), temporally emergent (Orlikowski 1996) and goal oriented (Pickering 1995). These practices play three roles in the process of organising: Firstly, an instrumental role as a means to accomplish work. Secondly, a communicative role to share information including the type of work that should be done and how. As working in certain ways becomes the basis of organisational culture through social production of meaning amongst individuals. Finally, a constitutive role through micro-activities which are the building blocks upon which organisations are constructed (Barley and Kunda 2001).

It is therefore unsurprising that researchers have argued that the situated and contextual nature of such work practices can only be understood through rich qualitative methods which observe and “*get inside*” (Leonardi 2015, p. 255) the space of work practices. Effective theory building requires rich description to capture the phenomena. By using thick data derived from field methods, the research is better able to uncover complex and dynamic interactions among organisational actors and their environments and set the foundation for conceptualisation and theory building (Mintzberg 1979; Weber 2004).

## 4.2 Unit of Analysis

The study focuses on tracing the organisational routine of agile team-based activities as the unit of analysis. The work activities are sequenced through the agile methodology and deadline driven. Within the agile methodology these recurring patterns of action (Pentland and Feldman 2005) are commonly known as ‘stories’.

The data collection traces and explores the interactions which occurred in these team-based stories, looking at the performances of the actors within the collocated software development teams that operate across digital and physical environments. These performances are considered as the specific actions taken individually or collectively by specific actors at specific times when they are seeking ‘effortful accomplishments’ which are constructed from a repertoire of possibilities (Pentland and Rueter 1994). The performances of such organisational routines are considered work practices as Bourdieu (1977; 1990), Lave (1988) and other scholars have created for that term. They require an appropriation of the topographic system of the physical environment and digital tools against a background of rules

and expectations, where practices may be established (strategic) or inherently improvisatory (tactical) as consistent with the concept of *spatial work practices* presented in the theoretical framework chapter.

### 4.3 Empirical Setting

The empirical setting for the study was the IBM Studio based in London, UK which opened in 2015 as part of a \$100M global investment by IBM into modernising its workspaces (IBM 2014) and changing ways of working. Figure 4 below shows an overview of the design features and ethos of the London Studio, hereinafter referred to as the Studio.

**Figure 4: IBM London Studio**

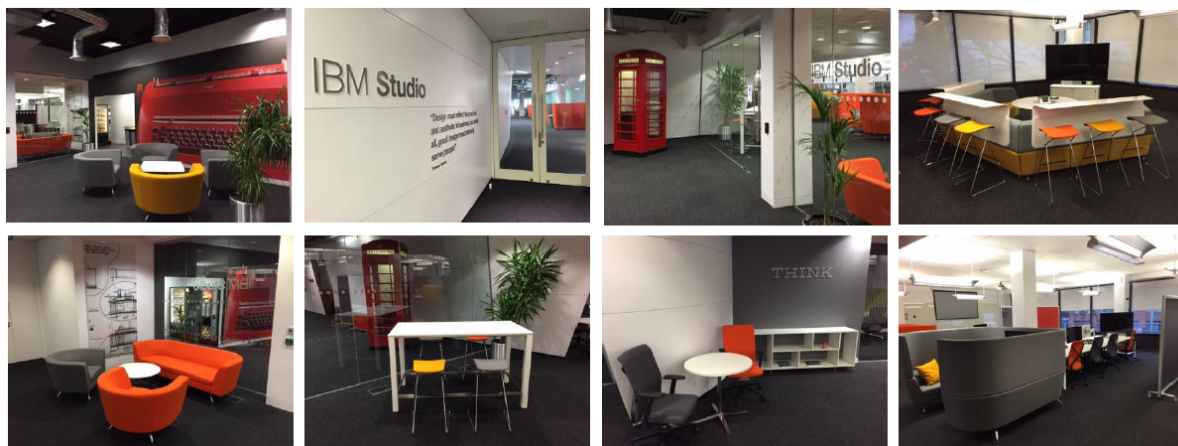


The studio had been designed to facilitate collocated team-based software development using IBM Design Thinking and Agile project management methodologies, which are intended to improve collaboration and accelerate work activities to deliver rapid business value to IBM and its clients (Simons 2017). The Werkbund slogan (Gropius 1975) “*Good Design Is Good*

*Business*” had recently been reinvigorated by IBM. Building on the underlying belief that design is effective in promoting culture and can have a certain reformative impact on the functioning of a corporation (Harwood 2011).

In addition to facilitating new ways of working, the Studio was also used to showcase the ‘transformation’ of IBM to clients, business partners and external media. The colourful and contemporary Studio workspace design as shown in Figure 5, was in contrast to the workspaces in the other areas within the IBM building.

**Figure 5: Colourful and Contemporary Workspace**



This setting provided a unique view to study the phenomena, as the Studio hosts software development teams using Agile methodologies and modern software development technologies which engenders an environment of individuals and teams with constant physical and digital interaction. Therefore, the use of combined physical and digital environments is both necessary and of particular significance within this empirical setting.

This study also benefits from unique insider access to the empirical setting which provided the author with long-term privileged access for data collection as a researcher. This level of access was necessary for this study to be performed and it would have not been possible to complete the study without the author’s position internal to the organisation.

#### 4.4 Insider Research

During the period of the study, the author was an IBM employee within the office of the CIO division, based in the Studio. The author was not directly a member of any of the teams involved in data collection or directly involved within the work activities which were being traced across physical and digital spaces of work. The insider perspective, which is increasingly a common practice in research (Bonner and Tolhurst 2002) provided the author

with unrestricted, permanent and in-depth access to the Studio environment to capture micro and macro level changes of physical and digital use by teams. These changes were captured over an eighteen-month period between January 2017 to June 2018.

Having overcome the challenge of negotiating research access within an organisation, which is often a major challenge within PhD research (Coghlan and Brannick 2014), another key feature of the insider approach was the author's existing knowledge of the organisation. This reduced the time required to understand and learn the context of the environment. Insider-researchers can overcome complex language, methods and organisational settings (Bonner and Tolhurst 2002) resulting in more accurate and representative observations and subsequently richer findings. Further, taking advantage of established familiarity with participants and the empirical setting provides the research with greater confidence of data validity and reliability (Bonner and Tolhurst 2002) as participants are more likely to present a truthful undistorted image to insiders (Mercer 2007; Zinn 1979).

Coghlan and Brannick (2014) argue that not only is the insider research approach valid and useful, it also provides important knowledge about what organisations are really like through a deeper and more profound knowledge of the setting, which traditional outsider approaches maybe not be able to uncover. They argue that insider researchers, through a process of reflexive awareness are able to articulate tacit knowledge that has become deeply institutionally embedded due to socialisation and reframe it as theoretical knowledge. Reflexivity is a central concept within the social sciences to explore and deal with relations between the researcher and the object of research. Insider researchers are already members of their organisation and therefore have primary access and awareness of jargon, cultures, legitimate and taboo subjects and how to explore the organisational network for required data without drawing attention or creating suspicion.

In order to present an objective and unbiased perspective, data collection adopted the terminology of informants to help understand their experiences and follow the informants wherever they led the investigation of the guiding research question (Gioia et al. 2013). The author abstained from expressing personal opinion to ensure the research remained unbiased from preconceived notions, including those derived from theory. The methodological approach and research were completed by working closely with the academic supervisors to constantly refine the approach and findings and relate them to theory and conceptual material through an outsider perspective (Van Maanen 1979). This also supported the elimination of preconceptions, and mitigated the possibility of the author being too native to the setting (Krim 1988). The approach ensured issues were adequately explored to provide rich research data (Saunders et al. 2008). As a result, the research design viewpoint was focused on observation

and analysis from sufficient distance and perspective, rather than an adopting an ethnographical introspection or confessional approach (Alvesson 2017).

To manage the practical constraints of time management, the author was given permission from senior IBM leadership for data collection with IBM participants. IBM senior management were aware of the research and kindly provided the author with the time and flexibility to complete the research (Robson 1993) without role detachment occurring (Adler and Adler 1987). No financial sponsorship pertaining to the research was in place between the author and IBM.

#### **4.5 Data Collection**

Data collection began in April 2016 with a two-week pilot study which provided an initial understanding of the context of software development activity across combined physical and digital environments. The study explored the dimensions of time and space using themes of collaboration, creativity and distractions (Nardi and Whittaker 2002; Wajcman and Rose 2011). This highlighted some of the costs of proximity in particular privacy and distractions, which shaped individual and team behaviours and are explored more fully by this study. The preliminary findings from this pilot study were subsequently used to refine the research approach and inform the latter stages of data collection.

The second stage commenced in January 2017, informants included 40 employees selected using a purposeful sampling approach (Maxwell 2009; Patton 1990) for representativeness of the setting. Four forms of data collection were used within this second stage which extended over an eighteen-month period from January 2017 to June 2018:

- 1. Participant observation** over 150 hours of tracing agile work activities (stories) being performed within project teams. This direct technique permitted observations from the inside (Alvesson 2017; Saunders et al. 2008) allowing for extreme detail in access to follow and trace the crafting and assemblage of physical and digitally integrated workspaces. This was particularly suited to empirical settings facing a period of transformation and disruptive organisational changes (Alvesson 2017) as IBM has invoked through the Studio to disrupt previously established ways of working.

Real-time data was continuously captured including screenshots, notes, sounds, pictures and video. Data collected include the nature, location and duration of activities. This method provided a rich and detailed thick description of events within



a natural and meaningful context (Fetterman 2010). These were supported through supplementary questioning and informal interviews (Coghlan and Brannick 2014) for probing events within ongoing cycles of data collection and analysis with added context and insight (Boeije 2009).

The work activities were captured as vignettes using a crafted research instrument. This method enabled discrete units of analysis for tracing physical-digital interactions with consideration of their temporal and ontogenetic nature. Supplementary questioning and interviews then enabled rich discussions to understand informant *spatial work practices* and particular selection of physical and digital assemblages.

2. **Semi-structured interviews** with 22 participants as detailed in the following sections, to augment and provide context to the participant observation.

Within a qualitative framework, Yin (2009) argues that one of the most important sources of case study information are interviews as they provide essential sources of information which enable focus directly on the case study topics. The interview is a flexible and adaptable way of finding things out. Whilst observing behaviour is clearly a useful enquiry technique, asking people directly about what is going on is an obvious short cut in seeking answers to the research questions (Robson 1993). This research method involved individual and group questioning around *spatial work practices* and observed work practices within the defined social unit of project teams (King 1994).

3. **Document analysis** as an insider researcher, the author had access to IBM internal documentation including email, presentations, process and policy. This included information about the strategy of the empirical setting which supported data collection by providing detailed information and a rich organisational context.
4. **Time-lapse video recording** using a mounted mobile phone to capture the use of the office environments over long periods of time. This functionality is now native to modern smartphones. It works by grabbing an image on a regular timed basis and then collates all the images as an animated video.

Video-based research is well equipped to bring space to the analytical fore both because of its visual quality and its focus on setting (Iedema et al. 2009; Mengis et al. 2018). The typical duration of each time-lapse recording was 60 minutes, which allowed the capture of practices within a fixed physical setting over time. This

innovative approach to data collection provided unique insights for this study around the combined usage of physical and digital space. Although it is not feasible to display the results of this method within this thesis, analysis of the footage was effective in the findings for identifying the entangled nature of physical and digital environments, which could not have been captured as clearly through static methods.

A laptop computer, smartphone, voice recorder and field diary were used to record details of the activities including screenshots, notes, sounds, pictures and video footage. To help the reader gain an appreciation of the qualitative issues, selected quotes and media from the data collection are presented within the findings. This multi-method approach enabled data triangulation (Collis and Hussey 2009; Yin 2009) and corroborating of facts (Yin 2009) through collation of data at different times and from different sources.

#### **4.5.1 Participant Recruitment and Consent**

A participant consent form detailing information about the research and how data would be collected and used (see Appendix A: Participant Consent Form) was prepared inviting employees to participate voluntarily in the study. To ensure the data collection process was valid and reliable, the consent form was distributed to a representative pool of participants across the Studio project teams using a purposeful sampling approach (Maxwell 2009; Patton 1990). These candidates were identified and selected as relevant individuals working on software development stories as per the unit of analysis. Participants comprised of team members from the software development project teams and studio leadership including:

- Agile Coaches
- Business Analysts
- Designers
- Developers
- Iteration Managers (also known as Scrum Masters)
- Management

To supplement this and provide a broader supporting context, interviews were also performed with participants in the IBM corporate real estate and IT strategy departments. All participants were thanked for their participation and advised they would be eligible to receive a digital copy of the thesis or supporting report upon completion. No incentives of monetary rewards were offered in return for participation.

In addition to the routine informal interviews and questioning which supported the participant observation phase, twenty-two formal semi-structured interviews were conducted between January 2017–June 2018 as listed in chronological order in Table 1. These involved participants representing four studio software development teams, two corporate functions and ten job roles.

**Table 1: Participating Interviewees**

#	Date	Team	Job Title	Length (HH:MM:ss)
1	09 January 2017	A	Business Analyst	00:58:33
2	12 January 2017	A	Developer	00:48:44
3	16 January 2017	A	Manager and User Experience Designer	01:01:53
4	21 January 2017	A	Developer	00:42:00
5	01 February 2017	B	Business Analyst	00:24:22
6	02 February 2017	A	Developer	00:27:21
7	02 February 2017	A	Agile Coach	00:20:30
8	02 February 2017	-	Senior Real Estate Space Planner	00:22:38
9	03 February 2017	-	Real Estate Consultant	00:34:13
10	05 April 2017	C	Senior Visual Designer	00:44:16
11	05 April 2017	C	Associate Creative Director	00:35:43
12	07 April 2017	C	User Experience Designer	00:43:19
13	10 April 2017	B	Visual Designer	00:43:05
14	11 April 2017	B	Developer	00:19:23
15	11 April 2017	B	User Experience Designer	00:31:38
16	13 April 2017	-	IT Executive	00:37:50
17	21 April 2017	B	Iteration Manager	00:41:41
18	16th April 2018	A	Developer	00:45:00
19	16th April 2018	A	Developer	01:00:00
20	31st May 2018	D	Designer	00:22:18
21	31st May 2018	D	Business Analyst	00:18:36
22	18th June 2018	D	Iteration Manager	00:50:41

Where quotations are presented in the following sections, the ensuing notation will consist of parentheses containing the respective interviewee's Table 1 # and job title, for example:

*“Quote from Interview Eleven.” (11, Associate creative director).*

## 4.5.2 Interview Guides

A draft interview guide was initially developed for the pilot study using the seven stages framework (Kvale 1996) and suitable interview preparation guidelines (Collis and Hussey 2009; Robson 1993) driven by the research question, theoretical framework and underlying philosophy.

From the findings of the pilot study, three further interview guides were generated for the second stage. This covered the Studio project team members, corporate IT and real estate

respectively (see Appendices B-D). The guides included open-ended exploratory questions built upon the literature review, research question and further reading of interview preparation guidelines (Collis and Hussey, 2009; Robson, 1993; Snow and Thomas, 1994; Wheeler, 2010; Yin, 2009). The content in each was adapted to reflect the intended data collection from the participant group, although the questions were generally divided into sections covering:

1. Introduction (including role and working location)
2. Physical work and interaction
3. Digital work and interaction
4. Where and how work happens
5. Understanding of space
6. Changing patterns of work
7. Closing and Summary

Test interviews were performed with a number of volunteers (excluded from the final study) where amendments were made to the questions to ensure unambiguity, clarity and construct validity for the concepts being studied (Yin 2009).

#### **4.5.3 Interview Process**

Having agreed to participate in the study, interview participants were sent a one-hour meeting invitation by email containing the respective interview guide (see Appendices B-D) a minimum of 24 hours prior to the agreed time. Within the invitation, all interviewees were invited to read the interview guide and prepare in advance to improve recall. Where interviews could not be conducted face-to-face due to participants being geographically remote from the author, video-conferencing or telephone interviews were used.

On beginning their respective interview, all interviewees were reminded of the purpose and background to the study and informed how information shared would be used. Interviewees were also given an opportunity to ask questions. Permission was then requested to record the interview for accurate data capture and transcription.

The interviews lasted between 20 minutes to 1 hour. This was considered the appropriate time to capture the required data and optimise the numbers of persons willing to participate in interviews without placing unreasonable demands on busy interviewees and leading to participation bias (Robson 1993). To provide stimulus equivalence and minimise interview bias (Collis and Hussey 2009), questions were posed using consistent tone and sequence. However the author also applied an adaptive and reflexive approach by interjecting

supplementary probing questions when appropriate (Yin 2009) and adapting questions with the progression of the research (Gioia et al. 2013). Responses to the posed questions were documented in writing during the respective interviews; all interviews were subsequently digitally transcribed and coded for data analysis.

## 4.6 Data Coding

The strong social scientific tradition of using qualitative data to develop theory provides deep and rich descriptions of the contexts within which organisational phenomena occurs. To discover and develop relevant theory that capture the phenomena in terms that are both adequately meaningful to organisational actors that experience it; and adequate at the level of scientific theorising about that experience, the study followed a systematic inductive approach to concept development. By not imposing prior constructs or theories on the informants as a priori explanation for understanding or explaining their experience, data collection made efforts to give voice to the informants from the early stages of data gathering and analysis to represent their voices prominently in the reporting of the research and thus create rich opportunities for the discovery of new concepts (Gioia et al. 2013).

To establish a starting point from which to develop the coding and analysis, the study began where social life happens by examining “*the intersection of one or more actors engaging in one or more activities at a particular time in a specific place*” (Lofland et al. 2006, p. 121). By adapting their categorisation of major units of social organisation to the empirical setting, the following broad categories were derived:

1. Working practices (routines, activities, autonomy, behaviours, methodologies)
2. Groups (project teams, practitioners, organisational initiatives)
3. Roles (e.g. Designer, Developer, Manager)
4. Encounters (rituals, patterns, interactions: meetings, working practices)
5. Settings (physical and digital locations, time, place, duration, frequency)

Data was carefully organised through the coding processes to create a tight framework for qualitative analysis. Key data was identified, highlighted and collated through aggregation of data sources using Microsoft Excel. The use of detailed data capture, digital transcription of interviews, memo writing combined with continued access to informants, enabled effective handling and precision in interpretation and subsequent presentation of the data.

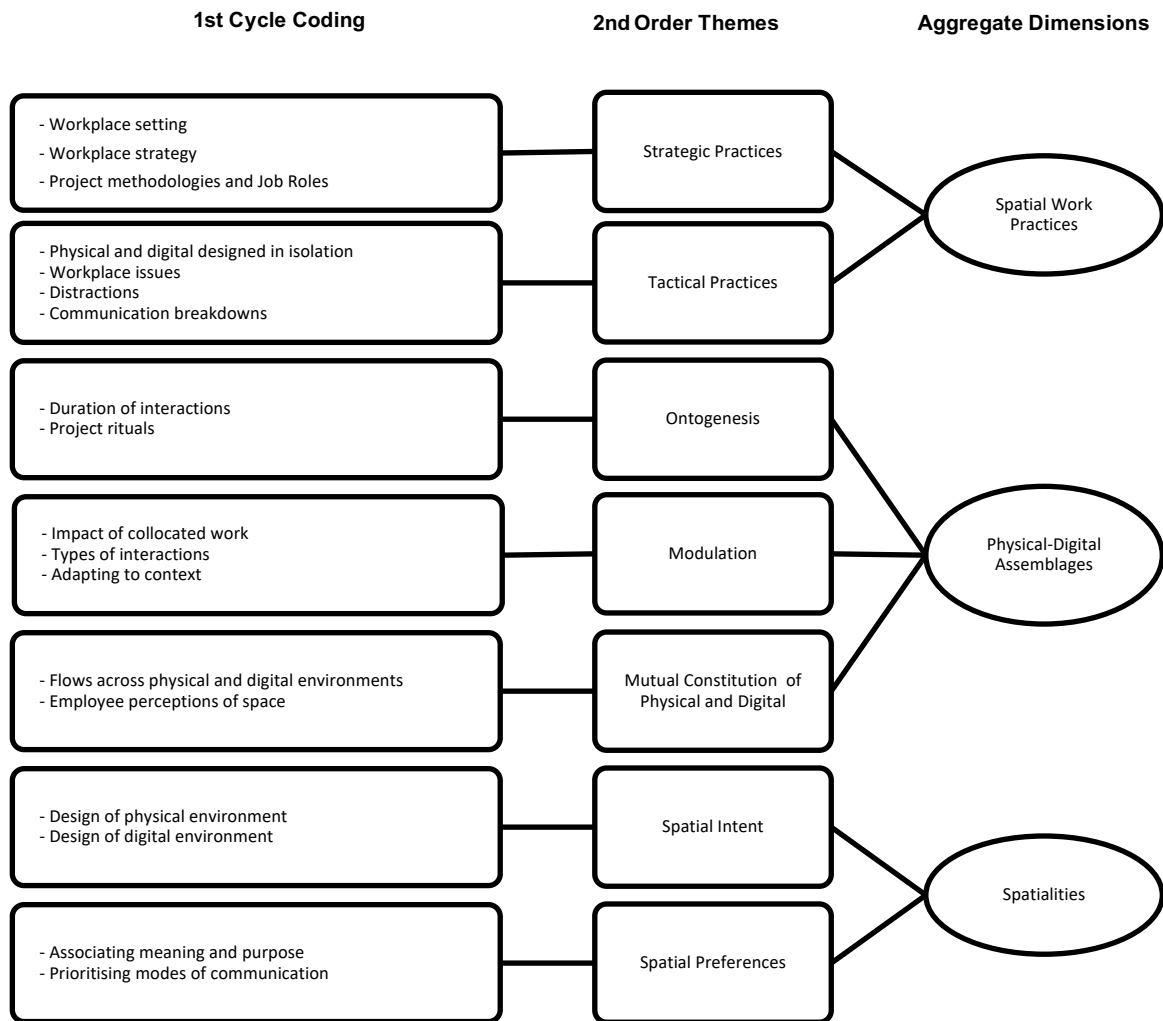
As data was collected it was inductively analysed (Corley and Gioia 2004). A reflexive approach was employed to support 1<sup>st</sup> cycle cyclical attribute coding and recoding to refine

these initial categories and arrive at 'relevant text' across all forms of data collection (Auerbach and Silverstein 2003). Attribute coding was used given its appropriateness for virtually all qualitative studies, but particularly for those with multiple participants and studies with a wide variety of data forms. Attribute coding supports good qualitative data management and provides essential participant information and contexts for analysis and interpretation (Mason 1994). Data was both manually and digitally coded to enable more control and ownership of the work (Saldana 2015).

As an outcome of cyclical coding, categorisation and analytic reflection, the process was able to establish 2<sup>nd</sup> order themes as more general, higher-level, abstract concepts to establish the critical link between data collection and their explanation of meaning (Saldana 2015) through the theoretical lens. These themes help describe and identify what a unit of data is about and/or what it means in order to support interpretation of aspects of the phenomenon of spaces of work. They therefore started to bring meaning and identity to recurrent experiences which captures the understanding of the nature (Auerbach and Silverstein 2003; DeSantis and Ugarriza 2000) of spaces of work within the empirical setting.

To support theoretical development, the methodology focused attention on nascent concepts that linked to the research question and addressed the gaps in the existing literature until reaching theoretical saturation (Glaser and Strauss 1967). This foundational work led to the development of higher-level theoretical aggregate dimensions where similar 2<sup>nd</sup> order themes were clustered together to show how the themes systematically interrelate and lead toward the development of theory (Gioia et al. 2013). These aggregate dimensions include the extension of existing theoretical concepts such as *spatial work practices*. They also highlight emergent concepts that are new including *physical-digital assemblages* and the *spatialities* of workspaces that make up the basis of the emergent framework.

Having established 1<sup>st</sup> cycle coding and 2<sup>nd</sup> order themes and aggregate dimensions, we have the basis for building the supporting data structure as illustrated in Figure 6. This coding data structure provides as a visual representation of the progression from raw data to terms and themes in conducting the analyses, which is a key component of demonstrating rigor in qualitative research (Pratt 2008; Tracy 2010). In this way, the data structure enables processing of the data both methodologically and theoretically (Gioia et al. 2013) and summarises the 2<sup>nd</sup> order themes on which the *crafted workspaces* framework was built.

**Figure 6: Data Coding Structure**

This approach combined with the subsequent chapters enables the coordination and integration of four data displays:

1. Figure 6 above shows the progressive data coding structure.
2. The findings narrative through the results chapter.
3. Table 2, page 121, which provides additional supporting data with the results.
4. Figure 24, page 154, which shows the emergent model within the analysis & discussion chapter.

Collectively these four data displays enable the reader to discern and “quadrangulate” (Corley and Gioia 2004) the evidence for this research.

## 4.7 Chapter Summary

The research employs a qualitative in-depth case study approach for richness in data and to capture previously unexplored spatial practices of work activities across physical and digital environments of work. This systematic and inductive approach is consistent with recent studies of technology use in the workplace (Leonardi 2015; Wajcman and Rose 2011) and is suited to the empirical setting of the IBM Studio for the tracing of agile work activities through the software development lifecycle as these work activities integrate both physical and digital spaces of work.

The author's perspective as an insider researcher provides unique access to trace this phenomenon through long-term access with a profound knowledge of the setting, which traditional outsider approaches maybe not be able to uncover. This is supported through rich data capture using multiple methods which augment and provide supporting context.

The processing of the data focuses on highlighting emergent concepts that are new and extending existing concepts such as *spatial work practices* to provide new insights which integrate digital space into the domain. This presentational tactic foreshadows the central issues which will be addressed through the results, and analysis & discussion chapters respectively.





## CHAPTER 5: RESULTS

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This chapter commences with a detailed overview of the empirical setting within the IBM Studio. It describes the workplace strategy, the design of the physical environment and the separately designed digital tools used by the Studio teams.

The empirical data demonstrates how the physical and digital environments are intertwined and perceived by the Studio team members as an integrated workspace. Employees within the Studio have a contextual and relational view of their environment wherein factors such as collocation and differences in the modes of available communication impact the way they choose to work and interact.

The study traces the lifecycle of project work activities through a crafted research instrument with supporting narrative presented as four distinct vignettes. These vignettes capture and explore the interactions which occurred in team-based stories, looking at the performances of the actors within the colocated studio teams that operate across combined physical and digital environments. They provide a chronological capture of spatial and temporal events with detailed descriptions including the actors, environment and work practices that were performed as spaces of work. They illustrate how the Studio teams understand and deliberately combine their physical and digital environments, whilst relying on the integration of elements of both to support their work activities.

The data highlights an organisational gap in designing combined physical and digital places of work, which were conceived in isolation but are integrated in practice. The data also illustrates workplace issues which arise when employees are in both physical and digital proximity with high degrees of autonomy within an open-plan setting.

## 5.1 Workplace Setting

Located on the banks of the River Thames, the Studio opened in early 2015 as the refurbished first floor northern wing of the IBM building, a landmark site in central London which acts as the head office of IBM UK. The Studio was launched as 'The hub of IBM Design in London' (IBM 2015) hosting teams from three IBM business units:

- **Interactive Experience (iX):** the largest digital agency in the world.
- **Marketing Innovation Group:** which enables IBM digital marketing to build new marketing engagement models.
- **The Office of the CIO:** which provides design-led technology expertise across IBM corporate strategic initiatives.

IBM's (2015) press release announced:

*"IBM Studio London represents the new world of work and a model environment for co-located, creative cross-functional teams. [It] will be a space for clients in industries...to work side-by-side with IBM consultants, researchers, digital marketing and experience design experts to analyse business challenges and integrate next-generation technologies.*

*IBM Design applies the principles of IBM Design Thinking, which takes a rapid prototyping approach to user-centric product development, as well as IBM Design Language, a framework to inspire bold and engaging experiences."*

The Studio formed part of a global \$100m investment (IBM 2014) into modern physical and digital workspaces and new ways of working. It formed part of a global network of twenty other new IBM Studios in locations including: Atlanta, Austin, Boston, Chicago, Dallas, Ehningen, Groningen, Hursley, Melbourne, Mexico City, New York, Toronto and La Gaude (IBM 2015). This Studio network supplemented IBM's rich and longstanding design heritage (Harwood 2011) combined with over a century of experience in developing technology capabilities.

### **5.1.1 Project Methodologies and Job Roles**

The IBM Studios were designed to facilitate collocated team-based software development using both IBM Design Thinking and Agile project management methodologies. These methodologies which were being introduced within the company were intended to improve collaboration and accelerate work activities to deliver rapid business value to IBM and its clients (Simons 2017).

The core Studio employee job roles included:

- Agile Iteration Managers
- Business Analysts
- Designers: Graphic, Industrial, User Interface, User Experience, Visual
- Managers
- Product Owners
- Software Developers: Desktop, Mobile, Web

The decision to locate the studios in major cities had been taken deliberately to attract workers with the required skills, as explained by a senior member of the UK real estate team:

*“I think the location and building being central in London is a main attraction for millennials, rather than being in a village somewhere and out of the main city. I think technology and design of the workplace is a main selling point to encourage, attract and retain staff including millennials.” (8, Senior real estate space planner).*

During commencement of the data collection stage in April 2016, the purpose of the Studio was stated specifically to “Develop design-led software solutions for clients and business partners” whilst working alongside client organisations to support digital transformation projects. Examples of these software development projects included managing the web presence of Audi UK, Selfridges studio, Unilever and major oil companies. This meant that the Studio needed to be different and operate more like a start-up to attract and retain employees that were typically interested in joining more dynamic, agile and modern organisations.

### **5.1.2 Workplace Strategy**

The choice of location, layout and design of the Studio had been deliberately conceived to pioneer new ways of working within IBM and also to compete with other newer technology organisations that had made significant investments in their physical workspaces as explained by a real estate consultant:

*“People coming to us to say: ‘Why can’t we have something like Google, Apple, etc.’ I think they’re saying that partly because of image quality, look and feel, investment in the employee, the happiness of the employee to be coming to this great place to work, versus the comparative world of 20 to 30 year old IBM office space... It’s an unfortunate consequence of where we’re at, but we’re [IBM] still here after 100 years and carrying on. So, that’s why there is a global recognition that our workplace needs to step-change into something more responsive, not least for next generation IBMers that IBM needs to attract and retain. So, the workplace is a key factor as part of answering that point”. (9, Real estate consultant).*

The layout and features of the Studio thus intended to attract employees away from remote working and back to the office (Simons 2017) to support increased collaboration and social interaction using collocated team working:

*“Because of technological advances most people can work at home, and there are times when it does suit individuals, but then also people can become separated*

*from the workplace, slightly out of touch. So, the workplace is becoming more of a place to meet and socialise, so you're seeing more lounge furniture, collaborative spaces for informal meetings as well as desking."* (8, Senior real estate space planner).

IBM more generally was shifting towards collocation and the Studio was conceived internally to be a pioneering model to be adopted more widely. This meant that the teams would be the first to experience a new social interaction system which combined new organisation goals and values with a new office, technology, employees, working practices and methodologies. This necessitated a workspace typology to support activity-based working which can be configured and reconfigured to support employee needs and rituals used within agile methodologies as described by the following quote:

*"We are following corporate strategy for workplace design which, to be honest, is in the same direction as the commercial world - activity-based working [using] a mix of work points, some of which are more mobile and malleable than others. It is a mix of functional spaces based on openness through to enclosedness... I guess in summary it's a multi-functional physical layout to allow people to conduct the type of work that they need to do in the right type of space, and that would range from full-on team sticky-note collaboration through to down-time or quiet reading in a private area."* (9, Real estate consultant).

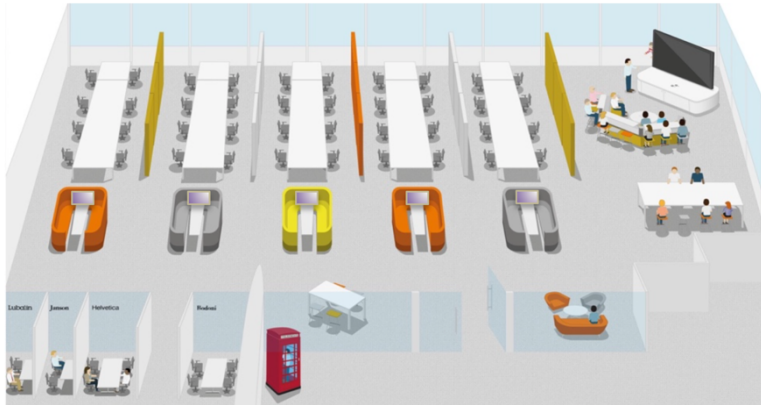
The real estate team recognised that work activities were constantly evolving and often spontaneous and emergent in their nature. This required the environment to be flexible, so it could be reconfigured and appropriated as needed. This informed the layout of the Studio to result in fewer fixed structures such as meeting rooms, in favour of more mobile and modular furniture as explained by the Studio space planner:

*"I think approximately 30% of meetings are ad-hoc and spontaneous and so not pre-planned. Having spaces like meeting booths are a good and efficient solution, they are a flexible solution, they're a piece of furniture, they can be moved and also they're an asset and not a built meeting room with partitions and glazing which need to be removed if we left the building for instance. Providing flexibility, we're seeing more write on wall space and mobile whiteboards, so people can be more spontaneous and creative in sharing ideas... trying to future-proof as far as we are able to try and reduce the number of fixed partitions and fixed rooms, and to enable more flexible space."* (8, Senior real estate space planner).

### 5.1.3 Design of Physical Environment

The Studio as illustrated in Figure 7 was designed and presented as a new office model within the building with distinct features to support the new ways of working.

**Figure 7: IBM London Studio Layout**



The Studio was built as an enclosed glass area that featured IBM's design-themed branding which projected its distinctive identity through colourful imagery and furniture on the Studio approach within the building. This conceived space deliberately contrasted with the remainder of the IBM building to signal the new ways of working and culture in operation:

*"The furniture is new and evolves to provide an aesthetically improved space. So, you see colour, textures and fabrics in the workspace, I think to attract and retain staff. The workspace is becoming a showcase to encourage people to come in to the office." (8, Senior real estate space planner).*

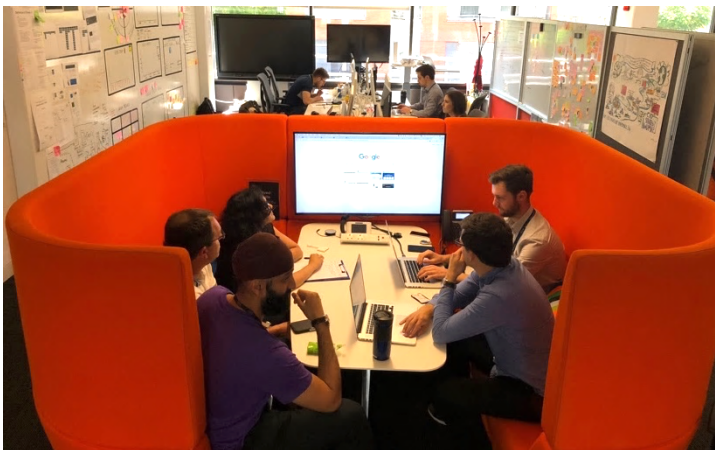
The physical layout within the Studio itself had been designed to reflect changes in working practices away from static individual working to dynamic team-based working as explained further by a real estate consultant:

*"I think we've engaged more creatively because we're now working with a broader, more abstract palette than days of old where 'you're a professional, you get a desk and a pedestal; or you're a manager, you get an office.' It was easy then. Now it's not about entitlement, it's functionally driven and there's need for more engagement because the kit of parts is much more varied." (9, Real estate consultant).*

The layout was split into five team-based areas. Each team was based around a large monolithic desk designed to accommodate between 8-12 members whom operated as complete multi-disciplined team. Each team area designation was a deliberate ordering of employee relations with no physical barriers between the respective team members. These teams operated semi-independently with their own project and structures. Separation from other teams was demarcated with moveable whiteboards which provided visual and acoustic segregation. This physical setup was a clear departure from the remainder of the IBM building which generally featured low partitioned cubicles grouped by department with a considerably more conservative design.

Each Studio workplace typically comprised a laptop and secondary display monitor, whilst the desk also included communal access to USB sockets and power points. Studio based employees would typically occupy the same team desk for the duration of a project, but adjustments were often made to seating location and configuration. Due to the physical proximity and high employee density of team members, headphones (sometimes noise-cancelling) were often used for concentration. Alternatively, employees would exclude themselves to work in more private and protected places for individual work. Alongside their desk, each team also had access to a large and colourful soft-furnished high-backed booth which comprised a fixed digital display and a potential seating for up to 6 team members as shown in Figure 8.

**Figure 8: Team Booth**



These booths provided a degree of physical separation and sound proofing from others and were regular locations for work activities that required discussion and brainstorming. Beyond the team desk and booth, the Studio also featured several other communal areas including:



- Leisure area adjacent to the entrance with table tennis and table football.
- Four glass meeting rooms designed for meetings with increased privacy.
- Two small break-out areas for sharing of ideas and group-based discussion, one featured an arrangement of sofas, whilst the second was based around a high-top table and 4 stools.
- A large high-top table with 10 stools ('Titanic table') with mounted smart board touch display.
- An auditorium style seating area ('Mediascape') which could accommodate 18 people in an auditorium layout facing toward a large cinematic style display.

The five team-based areas were segregated by rolling whiteboards or walls which the teams used to display information relevant for their respective project. These whiteboards were typically for writing or status tracking with marker pens or an arrangement of sticky notes to create their 'wall of work' (see Figure 9) as a visual dashboard which was clearly visible to the entire team. The information displayed as drawings and comments based on templates that replicated the information within some of the digital tools which were also used.

**Figure 9: Wall of Work**



The employee density had been designed to be higher in the Studio space with 120 sq. ft allocated per employee, compared to 160 sq. ft per employee in the remainder of the building. This 33% increase in density was designed to encourage increase interaction and collaboration through physical proximity of employees as further explained by a real estate space planner:

*"In the existing workspace we've got large desks of 1800mm wide, which are*

*hereditary from approximately 11-12 years ago when the desks were installed. We are moving towards a smaller desk size in the London studio, they have bench desking which is 1400mm wide...The increased flexibility with reducing the desk size is certainly a main component moving forward. To create more collaborative agile spaces and not just focussing on a large desk per person.” (8, Senior real estate space planner).*

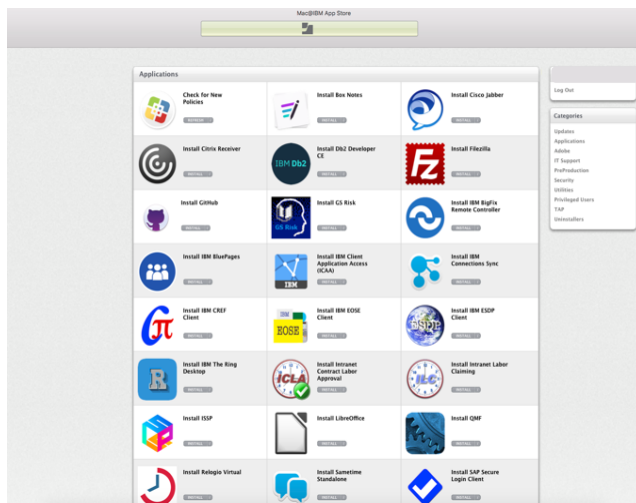
The profile of employees within the Studio was also noticeably different to the remainder of the building. The employees within the Studio were typically of younger age and featured a higher ratio of new employees including recent graduates and external professional hires with previous experience of working using design thinking and agile methods. This was intended to be a way to capture and infuse methods and tools used in other leading technology organisations. Studio employees also dressed more casually, wearing jeans and casual footwear was generally commonplace. This was in contrast to the more formal business attire adorned by the IBM employees throughout the remainder of the building.

This real estate strategy and approach to workspace design had generally proved effective. The Studio was seen as a popular working place to attract and retain staff, particularly in relation to alternative workspaces within the building as explained by a senior visual designer:

*“People from upstairs tell me how much they envy me for working here [in the Studio]. ‘Oh you’re a designer, you work in the Studio!’, they’re impressed...It feels like everybody wants that, but they are in an environment that’s completely different... Everybody that I’ve talked to, and [that] has worked here [in the Studio] and then moves upstairs wants to come back here. This shows people want better working places. For me it would be a deal breaker. If I had everything lined up, a perfect project, but the environment was outside [of the Studio], it would be a deal breaker. That’s how important it is to me.” (10, Senior visual designer).*

#### **5.1.4 Design of Digital Environment**

Whilst the layout of the physical environment was largely preconfigured and generally remained fixed, the teams were given the opportunity to select, configure and integrate a wide range of digital team collaboration and software development tools. This included IBM’s own software products, open source and 3<sup>rd</sup> party licensed software which were available to install through an IBM App Store as illustrated by Figure 10.

**Figure 10: IBM App Store**

The decision to initially provision a wide range of tool choices including many applications which ostensibly served a similar purpose was experimental for IBM as explained by the IT executive with responsibility for IBM employee digital tooling across the company:

*“We did not perform a thorough analysis to select the early tools.... a lot of it was initially just talking to people who we thought were better than us in terms of their practices and their outcomes and finding ways that we could copy and adopt those practices...Then after about a year or so we had some experience with things that worked and things that didn’t work and we created a slightly more formal set of selection criteria. Sort of a balance scorecard approach capability, operational quality, financial sustainability that we used to just bring a little bit more discipline to the selection. But it all starts with are these tools already being used by people who are working the way we aspire to work, and the I guess the second really important thing is, do the people we consider the top practitioners within IBM approve of these tools?” (16, IT Executive).*

The IT executive continued to explain the criteria for tools to be added to the IBM app store. This included their ability to facilitate and support collaboration within teams:

*“One of the key criteria in selecting the tools is will they foster for collaboration, and that’s why we chose tools like Slack because it’s really easy to have channels where you have designers and developers talking about what they’re working on in a very high bandwidth way. Inter-disciplinary collaboration, that’s really a key thing.” (16, IT Executive).*

It was also particularly important that the digital tools could be both configured and integrated to communicate with each other:

*“Tools like Slack and Github and Travis CI, they make it pretty much dead simple to integrate with them between their API’s, their SDKs, open source that kind of grows up around the documentation, even support... They make it very easy to integrate with, and because it’s very easy to integrate with, it became an increasingly popular tool - they just got a bunch of integrations. Once you’ve got all the integrations, it becomes trivially easy for user to add one of those. Somebody had to do the work to integrate, let’s say pager duty in Slack, once they did that for one of my team members to actually realise that integration can link their pager duty instance to Slack, it’s like five or ten minutes work and not very technical work and so the barriers to integration are really lower.” (16, IT Executive).*

The integration capability meant that collaboration platforms such as Slack carried a wider purpose for both inter-personal and inter-digital communication:

*“The mindset becomes that Slack is not just a chat client that it’s really a cockpit for collaborating with both humans but also other tools.” (16, IT Executive).*

This approach was conceived to help IBM modernise its working practices and improve its competitive position:

*“I got really interested in Slack because [another company] used it at the time, they’ve adopted Slack as this sort of cockpit for their continuous delivery. I was amazed at how they could trigger deployment, they could see monitoring information right out of their RTC channel and it was really powerful. When I saw the demo I thought my gosh, this is how everybody’s going to be working five years from now. I felt there was an opportunity that if we can bring in Slack, then we could get ahead of the curve.” (16, IT Executive).*

This flexibility in selecting tools was recognised and captured in the following quote by a business analyst within the Studio:

*“There’s a suite of digital tools available to us and we have a degree of freedom to choose the ones which are most suited to the job.” (1, Business analyst).*

The selection of tools used by the Studio teams was refined based on their needs, familiarity

and industry adoption. The way these tools were appropriated and configured was entirely the choice of the teams based on their needs and preferences. The shared digital tools which then achieved high level of adoption over time by the Studio teams included:

- **Box:** Online file sharing, storage and collaboration service.
- **GitHub:** A software version control service.
- **Jira:** An Agile project and issue management tool.
- **Slack:** a collaboration and communication platform.
- **Webex:** A video-conferencing service.

Teams also used other IBM products and some specialised applications available through the IBM App Store. This particular selection or grouping of tools was again not mandated by IBM, with multiple options often available for a required purpose. For example, Jira, Rational Team Concert and Trello were all available as options for project management tracking tools.

## 5.2 Flows Across Physical and Digital Environments

Whilst the physical and digital environments were individually created with potential use cases in mind, the actual appropriation of the combined elements of these environments was emergent with a high degree of integration and adaptability. This flexibility was an inherent part of the Studio culture and was extended to the way the environment was appropriated and configured by the teams. Whilst the layout of the physical environment remained generally stable due to constraints in moving furniture, the teams would instead reconfigure themselves around the furniture when needed to support work activities. Their culture supported an experimental approach which meant that the environment could be reconfigured if they needed to reorganise themselves or it helped the teams work better by taking advantage of employee collocation.

This high degree of flexibility in the adoption and use of both digital tools and physical environment increased the integration between these two work environments. Most of their work was software development using a wide range of digital tools and services which teams selected, configured and integrated. This meant that certain assemblages integrating features of both the physical and digital environment emerged. This was visible for example in the way that Slack channels were configured to reflect arrangements in the layout of the Studio. These #channels on Slack played an important role and tightly connected to both activities and communication within the Studio. Teams relied on communication through dedicated #channels within Slack to create open or private spaces and used them similarly to physical

break-out areas and private meeting rooms in the Studio. This integration seemed to occur naturally, as per the following example quote from a business analyst:

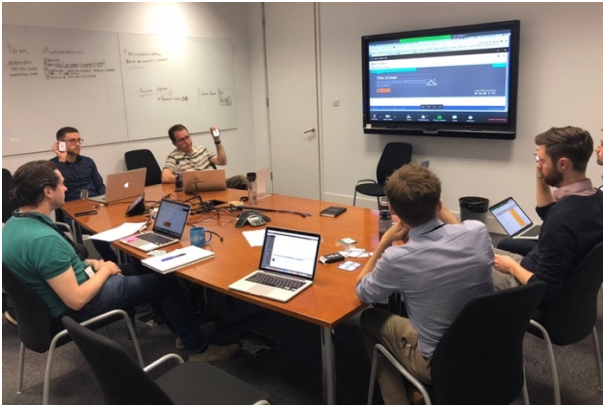
*“The digital tools tie together the physical spaces because you have more opportunities to interact.” (5, Business analyst).*

Whilst the following quote from an Agile Iteration Manager highlights the integration and intertwining between physical and digital environments of work:

*“Work happens in the space we are physically present, but also through writing code, delivering stories and in conversations. Work happens over email, slack, video. Work also happens through the wall of work, it’s very fluid.” (22, Iteration manager).*

This was also evident through the way the team organised their sprint planning event which took place at the beginning of every sprint as shown in Figure 11 and is further explained below in the quote from the iteration manager. Here the physical environment was again tightly integrated with the digital tools to support a workflow which integrated elements of both as essential to the work activity:

*“Everyone has to be in the same space, we are making a commitment for the work we will be delivering over the next two weeks... We usually all go into a bigger meeting room... The product owner dials in via Webex video conference remotely, and we all face toward a big screen with a JIRA board and the product owner. A dedicated meeting room stops us getting distracted by the other teams or our regular work. We keep going until we can’t take on any more work for the sprint and then we click the button on the JIRA board to officially start sprint.” (22, Iteration manager).*

**Figure 11: Sprint Planning Ritual**

### 5.2.1 Impact of Collocated Work

The collocation of staff and availability of physical locations to facilitate increased physical communication and collaboration was a deliberate IBM strategy. This provided employees with additional options to communicate, which in turn influenced employee behaviours and practices based on emergent preferences. This move toward collocated working was recognised and perceived positively by Studio members compared to previous organisational models of remote working as described by a business analyst:

*"I think there's actually a move toward physical space...despite what was previously thought about the advantages of remote work. It's actually very beneficial to have people who are working together in the same area. I think companies are realising that, and rather than reaping the cost benefits of having [remote] digital interactions, they're now reaping the quality benefits of having people sat together in you know, in spaces that are conducive to teamwork and communication and collaboration." (5, Business analyst).*

The physical environment available to the teams supported interactive, continuous communication. The proximity of team members enabled impromptu communication and allowed team members to engage actively and passively in conversations. As the teams worked together over time, they found it easier to build social ties and common ground. This sentiment was supported by others as creating a more effective work environment compared to IBM's previous distributed and virtual remote ways of working as stated by a business analyst:

*"In my previous team I was working in a distributed agile team, we had similar practices, but it was distributed across four cities where I was collocated with just*



*one [other] person. I really missed out on face to face, one to one, human interaction. It's very inefficient as well.” (21, Business analyst).*

As well as a senior visual designer:

*“It’s always easier when the other person is physically next to you. I work with different time zones, I work with teams all over the place. It’s always better having the teams physically in the same space.” (10, Senior visual designer).*

Studio members were acutely aware of their roles as ambassadors of new ways of working within IBM. Particularly as IBM was an organisation which had previously advocated the use of remote working and global virtual teams. This led to the formation of strong opinions to rationalise the studio approach as demonstrated by a business analyst:

*“In IBM, there was a big movement towards having people work from home because they could work digitally as technology is great...One of the lessons we’ve learnt is that it does impact collaboration, communication and coordination so much in the Agile culture that is being adopted across IBM. I think people are starting to believe again that you need to have people sat next to each other to do good work.” (21, Business analyst).*

### **5.2.2 Prioritising Modes of Communication**

The teams within the collocated Studio environment adopted multiple modes of communication across physical and digital. These modes were not considered equal and teams adjusted their activities to associate particular modes for specific purposes. For example, the perceived benefits from using face-to-face interactions when there was a need for richness in communication was explained by a developer:

*“If it’s something that needs a lot more time for understanding, explanation or justification...then we will use physical interaction. Most of the time we will use physical, which will usually be talking something through at the desk or in the booth. Being able to just physically talk across the table to someone you are working with is so much better than sending an email and having to wait...I’m getting a query answered immediately rather than waiting for a response.” (18, Developer).*

This view was also consistently supported by others Studio members:



*"We use face-to-face when the subject of communication is complex and requires detailed explanation, or a live example. Like showing how to replicate a bug, or explaining how code works to a colleague." (4, Developer).*

*"I think it [the physical space] definitely helps, for example in the daily stand-up space which is a daily 15-minute coordination... When I've done similar things digitally it is never the same as face to face because you lose the nuances in the interactions between people." (20, Developer).*

Face-to-face communication was typically used whenever work interactions were important, complex, or affected and required a detailed exchange of feedback from multiple people. This view was supported throughout the organisation as exemplified by an IT executive:

*"I think if you're for instance trying to have a design discussion in a digital medium, it's just too low bandwidth. That's actually the sort of thing I thought about a lot. One of the real key concepts behind all of this is the bandwidth of the discussion and I think when people say or sometimes people joke that if you've been working with somebody distributed for a long time, the first time you spend two days with them and go out for dinner their IQ seems to raise ten points. I think the reason behind that is because the bandwidth of impersonal conversation with the body language give and take, shows much higher bandwidth than for instance an email conversation. I've seen so many email conversations that go off the rails just because it's so low bandwidth like a sentence trying to explain a complex nuance." (16, IT Executive).*

Within the Studio the physical environment was also used to create and display artefacts such as the team wall of work as deliberate and symbolic actions to highlight key performance measures in salient locations which enveloped each team. In this way, the team members lived amongst their physical artefacts, producing a large number of charts on their wall of work. As the groups worked, they referred to these lists and diagrams often, occasionally modifying the artefacts based on discussions and mutual agreements. Their spatial arrangement was based on importance and frequency of access. Team members knew where to look for artefacts and they were used in various meetings where team members could read visual cues to see if other team members were paying attention.

One example was the creation of a 'wall of faces' by a business analyst (see Figure 12) to visibly display feedback from their system key users. Here a photograph of each user was

surrounded by traffic-light coded sticky notes which conveyed supporting comments and sentiment. The large number of red (negative) and orange (neutral) sticky notes in contrast to green (positive) was a reminder to the team that their nascent software solution still had significant room for improvement.

**Figure 12: Wall of Faces**



This practice of using physical walls of work, as opposed to tracking items digitally was supported by the following quote from the business analyst:

*"It's easier to lose things in digital tools, if they are displayed physically its always there, you can see the big picture and also everyone can see it easily as a reminder". (21, Business analyst).*

This justification and selection of physical media choice was further justified when the business analyst was asked if the use of digital alternatives had been considered:

*"I would use a digital tool like Mural.ly with digital sticky notes for distributed teams to reach a broader audience, otherwise with my collocated team I would always use physical alternatives like a meeting room, a whiteboard, real sticky notes and pens." (21, Business analyst).*

### 5.2.3 Adapting to Context

Collocation generally resulted in regular interactions between team members which were spontaneous and unplanned. Studio members could see each other's visual cues and signals, even if communicating digitally. They could see if someone was free or deep in thought and therefore whether they should be disturbed. They were able to use this contextual information to assess situations and adapt their behaviours.

*“If everyone is in the same location then most of the time, we will use physical interaction, which will usually be talking something through at the desk or in the booth. It will move to digital if people are not collocated or someone is deep in thought and we do not want to disrupt them.” (18, Developer).*

This ability to adapt behaviours enabled mutually-constitutive conversations to flow across both physical and digital mediums as explained by an agile coach:

*“What I’ve had typically in the past is you message someone on Slack to ask them a question and they may be sitting next to you or just opposite you in the same space, then they reply and then you reply and then they reply. You think ‘Oh, it’s easier to go to the booth or just talk to them across the table’” So if it’s more than two or three responses each way via Slack or another digital form, and they are free, then that invites the opportunity to move to a face-to-face interaction.” (7, Agile coach).*

#### **5.2.4 Employee Perceptions of Space**

The integration between these physical and digital environments in the Studio was deliberate and aligned to the Studio strategy of collocating its employees for enhanced collaboration and innovation as highlighted in the quote below:

*“I see where I work as both physical and digital space...I think that has changed due to a large move toward co-location, so it will be lots of teams working digitally together in close physical proximity.” (18, Developer).*

This tight integration was enabled and contingent on the close physical and digital proximity of the team members as the developer continued to explain:

*“If I had a project where half the team is in another time zone, it is definitely across the digital space. Here [in the Studio] everyone is collocated, that’s the main thing about how I perceive it to be - it depends on how distributed the team is. It is more of a combination of physical and digital environments as teams come together.” (18, Developer).*

The Studio environment therefore enabled employees to conceive a notion of workspace where physical and digital were interwoven and became both integrated and mirrored as explained by a business analyst:

*“My understanding of where work happens is that the physical space is integrated with the technology and is creating a new type of workplace. So you have the physical space, and you also have next to that or in parallel a digital space, and by having the two together there’s a lot less barriers to communication and collaboration, because there is more options.” (5, Business analyst).*

The business analyst continued to explain the perceived affordances and efficiency benefits of this new type of workspace with an example of ongoing conversations flowing across both physical and digital mediums:

*“Well I think it’s speeding things up definitely, ... If I had a meeting with somebody and we both agree that we covered everything that we wanted to, we [would] adjourn the meeting and they go off. If they then decide that there’s something they need to ask me again, and we needed a personal interaction to do that (before the digital interactions were available), you’d have to wait maybe a week to see that person again; whereas now we can have that conversation immediately ... so the speed at which things can be addressed and ultimately the time to value because of that is going to be improved”. (5, Business analyst).*

### **5.3 Tracing of Work Activities**

To follow and understand work in action within the teams, the use of participant observation from the inside allowed for detailed tracing of the creation and assemblage of combined physical and digital spaces of work. Real-time data was continuously captured with context and insight added by probing events through ongoing cycles of data collection and analysis. The completion of the work activities known as stories were captured as vignettes using a crafted research instrument. This created discrete units of analysis for tracing physical-digital interactions through the lifecycle of software development activities with due consideration and capture of their temporal nature. Four such vignettes which each trace a respective story are presented in the following sections. They follow a Studio team which have recently developed and launched an “what you see is what you get” (WYSIWYG) web content editor platform.

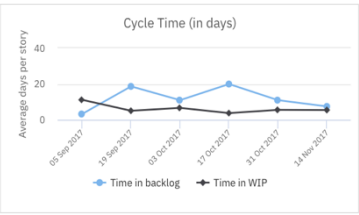
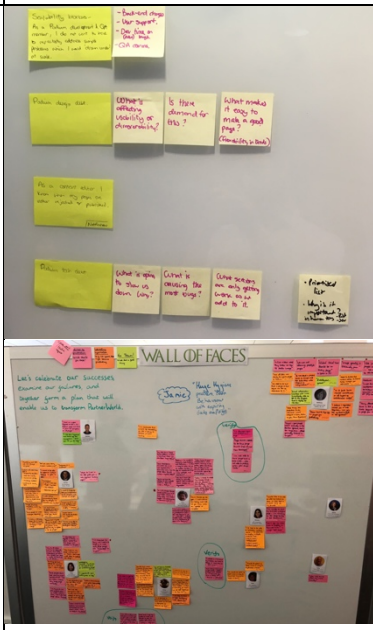
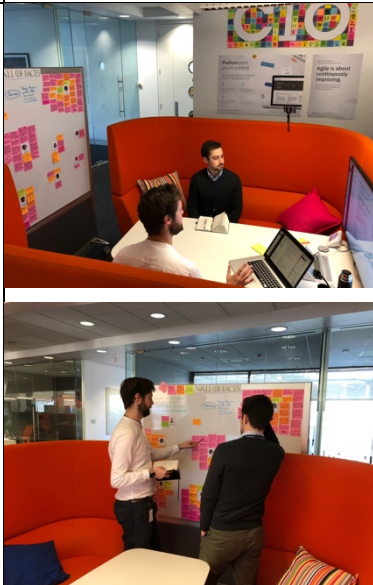
### 5.3.1 Vignette 1: User Feedback Prioritisation

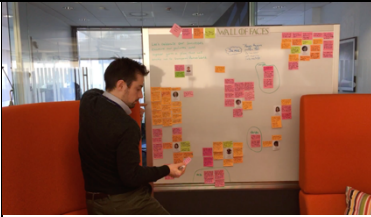
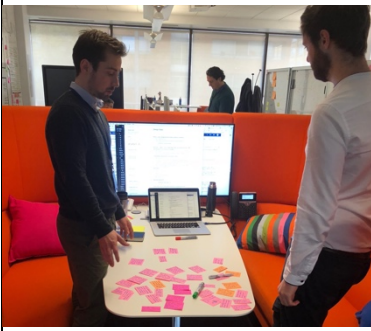
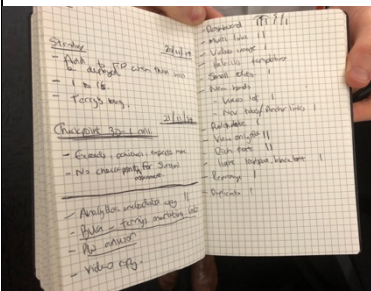
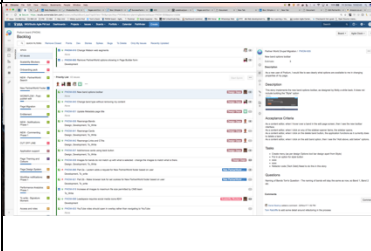
The first vignette traces a short work story which demonstrates the assemblage of both physical and digital artefacts within a single setting. This assemblage is configured and used to support completion. Having recently worked to a deadline to launch the WYSIWYG platform, the team have been eagerly soliciting and capturing user feedback to ensure the platform is well received by users and stakeholders (see Figure 12: Wall of Faces, page 91). As the team then shift their attention from the launch to product support and enhancements, the manager recognises the need to plan a suitable backlog of work based on user feedback as explained in Figure 13.

The work activity begins with an impromptu meeting between the manager and the business analyst. The two team members decide to use the booth as the physical setting for their meeting. The booth is selected as it is perceived to be an informal space which provides noise isolation and proximity of team members with shared access to a table and digital screen. Here the team members surround themselves with an assemblage of artefacts including the wall of faces, which was created on a moveable whiteboard along with physical notepads for note taking and Jira project management software which is displayed using a laptop on the booth screen.

The team members review the comments on the physical wall of faces, grouping them by common themes and regularly cross-referencing against known issues and planned work which is already captured within Jira. As the activity is performed by the two members within this workspace for an elapsed coded time of 62 minutes, there is a progression of output from physical to digital form. The sticky notes attached to the physical whiteboard are gradually translated into hand-written notes within a notepad, which are subsequently entered into digital form as Jira work activities for later code development. This removal of stick-notes from 'Wall of Faces' represents resolved and newly created issues in Jira. The story completes and the workspace is disbanded as the manager feels he has created enough content to support a three-month backlog of work.

**Figure 13: User Feedback Prioritisation**

Time	Purpose & Participants	Description	Assemblage	Evidence
20 <sup>th</sup> Dec	Analysis by Manager	Manager has identified from the Agile Team Tool that the team has a 10 day backlog of work, the target is 90 days.	Agile Team Tool	
21 <sup>st</sup> Dec 10:20	Impromptu meeting arranged between Manager and Business Analyst	<p>Impromptu meeting organised to review feedback from users.</p> <p>The objective is to capture themes and subsequently agree a prioritisation of future work activities to address the gaps in backlog of work.</p> <p>Meeting convenes in team booth with as assemblage of physical and digital assets used to help the team organise and complete their work activity.</p>	Booth  Whiteboard with post-it notes  'Wall of Faces' on moveable whiteboard  Notepads  Jira	
10:28-11:07	Work Activity	<p>Manager decided to hold the meeting in the booth to provide noise isolation and, stop cross-conversation with other team members.</p> <p>The booth is seen as an informal meeting space which provides close proximity of team members, access to a shared digital screen and table space.</p> <p>Discussion and agreement on prioritisation of work activities based on feedback from users.</p> <p>Includes collaborative brainstorming, discussion and coordinated planning.</p>	As above, captured by time-lapse video	

11:07 – 11:18	Interruption for Manager	<p>Manager leaves booth temporarily to retrieve an item and is subsequently interrupted by the other team members with unrelated questions.</p> <p>Business analyst keeps working independently.</p>		
11:18- 11:29	Manager returns and work activity continues after 11 minutes	<p>Session concluded after approximately 1 hour as manager felt he had created enough content to support a 3 month backlog of work.</p> <p>The removal of stick-notes from 'Wall of Faces' represents resolved and newly prioritised issues.</p> <p>Output is handwritten list of backlog items based on user feedback. These actions were written into notepad due to perceived faster speed of entry. The manager will later transfer these into JIRA as potential 'stories' for the backlog.</p> <p>Meeting concludes.</p>		 
11:30	Individual task - Manager	<p>Manager converts physical notes from meeting into Jira Stories.</p> <p>This work was done individually as the manager felt it didn't need further input or collaboration with others.</p>	Individual workstation using Jira	



### 5.3.2 Vignette 2: Default Landing Page

The second vignette which is described through Figure 14, traces members of the development team as they work on an agile story to enable IBM business units to create a landing page within the IBM.com domain structure for their respective business unit, for example: <http://www.ibm.com/cloud>.

The story begins with a developer team meeting within the team booth which lasts for 56 minutes. Here the developers review Jira requirements for a story before sketching and discussing potential options on paper to arrive at their proposed solution. A senior and junior developer agree to complete the story and assign themselves the work activity within Jira. The meeting ends at a scheduled time and team members return to the team desk.

After 15 minutes a Slack exchange between the two developers is used to coordinate pair-programming activity at the team desk. The senior developer reconfigures his position at the team desk to sit adjacent to the junior developer where they bring together their respective workstations at the team table with their software development environment. This spatial arrangement was coded to continue for 195 minutes as the pair-programming work activity is performed until the majority of the work is completed and the junior developer agrees to continue the remaining work individually at his desk.

The following day a Slack interaction between the two team members reconvenes the pair-programming activity, this time at the senior team developers' desk for approximately 105 minutes. As the code is completed, the senior developer creates a 'pull request' in GitHub which sends preconfigured notifications via Slack, email and Jira to other developers (seated adjacent to the senior developer) for peer review. The two developers cease their work activity and disband the assemblage.

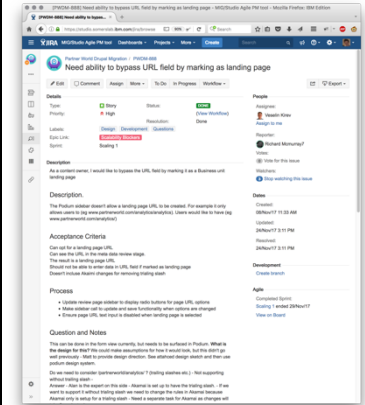

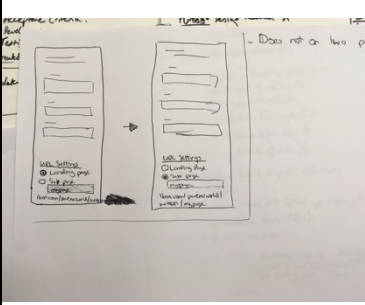
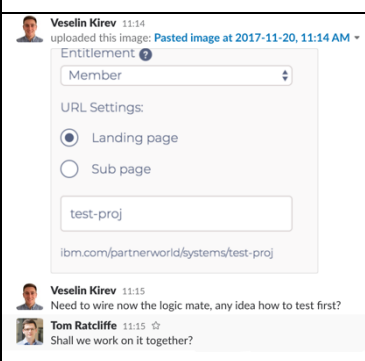
The next day, the junior developer reviews the code and asks a clarifying question to the senior developer using the comment feature within GitHub. The code is then submitted to a peer reviewer whom asks the senior developer a related question using face-to-face interaction. Once satisfied with the answer, the reviewer approves the code pull request. The code is then merged into the code repository ready for production deployment, resulting in further Slack and Jira notifications to wider team members.

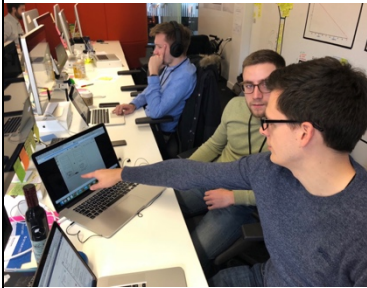
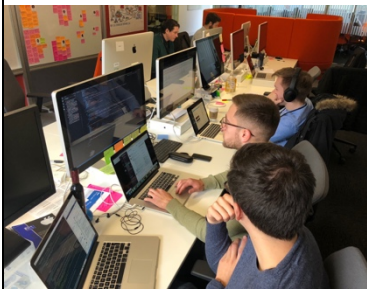

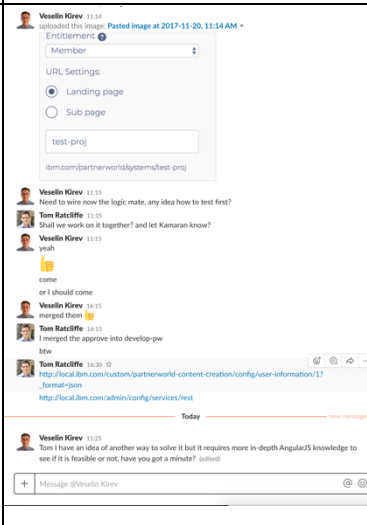
This vignette demonstrates a continuous appropriation of spaces between team members to create proximity in both physical and digital form. These forms are mirrored and mutually

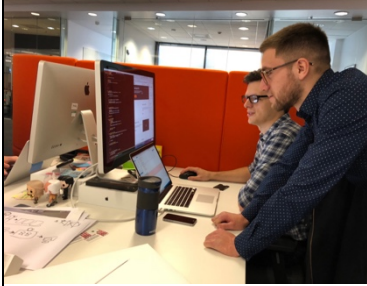
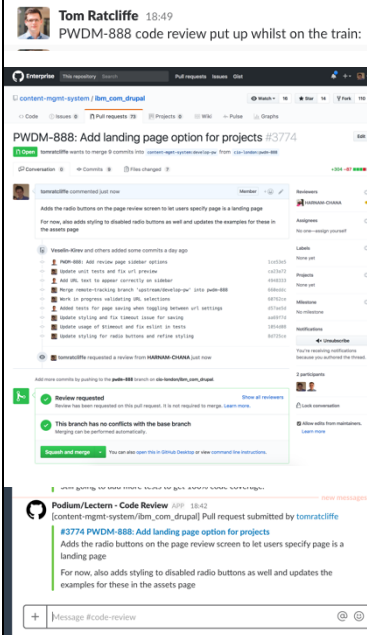
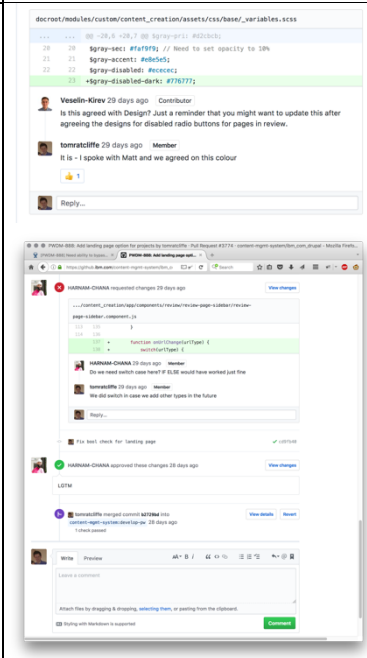


constituted. For example, when digital interaction is used to suggest and invoke the developers to reconfigure their positions at the team table so they can be seated together. These interactions occur as a continuum across both physical and digital with regular switching between the various mediums.

**Figure 14: Default Landing Page**

Time	Purpose & Participants	Description	Assemblage	Evidence
20 <sup>th</sup> Nov 10:03 – 10:59	Developer team meeting to discuss open work items	<p>Development team review Jira story together in booth. They then discuss options and agree a proposed solution which is sketched on paper.</p> <p>The booth was selected as informal meeting space which provides close proximity of team members, access to a shared digital screen and table space.</p> <p>Two developers (junior and senior) are assigned to complete the story.</p>	<p>Booth</p> <p>Paper</p> <p>Digital display screen</p> <p>Jira</p> <p>Webex (remote team member)</p>	  
11:14	Slack communication between assigned developers	Assigned developers agree to begin pair-programming.	<p>Jira</p> <p>Slack</p>	

11:15 – 14:30	Pair programming work activity between assigned developers	<p>The developers reconfigure their seating arrangement to sit in close proximity at the junior developer's desk.</p> <p>They work on the story together and agree how the code should be written and tested to complete the story.</p>	<p>Team table</p> <p>Laptops with external display</p> <p>GitHub</p> <p>Jira</p> <p>Slack</p> <p>SDK</p>	  
14:40	Developers break from pair-programming and revert to individual work	<p>There is no longer a need for both to work together as an approach has been agreed and majority of the story has been completed.</p> <p>The junior developer agrees to complete the remaining work.</p>	Team table	
21 <sup>st</sup> Nov 11:25	Slack communication between two developers	The junior developer contacts the senior developer to request for support with integration of the new code. They agree to sit next to each other again.	Slack	

11:35 – 13:20	Collaborative Work	<p>The developers continue the conversation, this time at the senior developers' desk.</p> <p>The senior developer agrees to finish task including merge of the code.</p>	<p>Team table with laptops + external display</p> <p>GitHub, Slack and SDK</p>	
18:49	Code completed by senior developer	<p>Pull request submitted with supporting text message in Slack by senior developer.</p> <p>GitHub generates automated Slack notification, Jira status update and email notification for other developers.</p>	<p>Slack</p> <p>Github</p> <p>Jira</p> <p>email</p>	
22 <sup>nd</sup> Nov 11:14	Peer review of pull request	<p>Junior developer reviews code, clarification questions posed and answered within GitHub.</p> <p>GitHub notifies additional reviewers whom ask a face-to-face question before approving the code pull request with the acronym LGTM = "Looks good to me".</p> <p>The code is then merged into the code repository, ready for production, resulting in further Slack and Jira notifications.</p>	<p>GitHub with Slack and Jira notifications</p>	

### 5.3.3 Vignette 3: Notification and Comments

The third vignette which is described in Figure 15 traces the development of a new software feature for a Studio team. As marketing web content is created in the WYSIWYG platform by IBM business unit content editors, it is submitted through a review and approval process before final publishing. The process was nascent and was launched in conjunction with the platform. It resulted in comments and discussions about the proposed web content being created in various formats outside of the platform (i.e. email discussions with embedded screenshots), which generated additional work and was difficult to track alongside updates to the content. To improve this workflow, the reviewers and approvers requested the ability to add comments and annotations to these content submissions within the platform, so they can be shared between parties for revision and approval. This was to be accompanied by a feature which generated automated notifications of any new submissions/edits/approvals, so users would be aware that an action was pending.

The work activity begins with a Slack message: '**Standup please!** 😊' which sent by the iteration manager to all team members in the #general channel. Without any further physical prompting, the team members physically converge in a circular formation within the team stand-up area and begin the agile ritual where they review the status of the open work activities using Jira on a shared screen. Here, three team members including two designers and a developer, agree to begin work on the notification and comments software feature. The stand-up is completed and disbanded after 14 minutes at which point all team members return to their respective seat at the team desk.

The three team members later convene in the team booth to begin a work activity to generate ideas for the task using methods from the IBM design thinking framework. They do this as a purely physical arrangement without their laptops or any digital tools. They start by sketching ideas for potential solutions using paper and pen, as this is considered faster than digital and permits rapid feedback and annotation. The work activity continues for 53 minutes, where the team members alternate between working silently and collaboratively to brain-storm ideas. The group collectively review their ideas and select two from the sketches for short and long terms proposals. All actions are agreed and hand-written on paper before the work activity ends and the team members return to the team desk.

After a short break, the two designers (whom sit next to each other at the team table) review their shortlisted ideas and sketches together at the team table. From this, the environment shifts to a hybrid physical-digital form as they convert the sketches into a digital prototype

using the Sketch and Invision software. This process continues until the screenshots and workflow of the solution are completed and ready for sharing.

Later that day, one of the designers arranges a 60-minute meeting with a content editor to share the proposed solution for review and feedback. The meeting is held from a meeting room as a WebEx video conference with screen sharing to create proximity between the meetings members. The prototype is presented, and meeting notes are captured on paper. Three additional reviews with alternative remote users are held on the next day in the same format to capture further feedback.

The following day, the designers summarise feedback from their respective review meetings at the team desk. Further ideas are generated and discussed in paper form before agreeing to split the work between them into creating short and long-term solutions. This work activity lasts for 36 minutes. Whilst still seated side-by-side at the team desk, the designers work on their respective digital prototypes whilst occasionally collaborating using face-to-face interaction for a further 112 minutes.

Later in the afternoon, the designers arrange a 60-minute review of their refined digital prototypes to the wider team at the Titanic table - a large high-top table with 10 stools and a mounted smart board touch display. The designers explain that the meeting was held at this location to get the team away from the team desk and eliminate distractions. The space was perceived as a creative open space which facilitates a relaxed and open atmosphere considered conducive to encouraging discussion and gaining feedback. The prototype is presented on the digital smart board display, where the wider team raise concerns that the prototype is complex and will be difficult to develop within a reasonable timeframe.

Two days later, the two designers work together again at the team desk for over 102 minutes, making iterative updates on their digital designs to create a simplified prototype approach. Once ready, they hold an impromptu meeting which lasts for 22 minutes at the team desk. Here they gather around a screen to share and discuss their revised approach and secure consensus to proceed. The next stage is securing agreement from the team product owner who is remotely based. This takes place as a 30-minute WebEx meeting with the two designers together at the team booth. From this, the designers capture feedback and finalise further adjustments through a 'pair-designing' process lasting over 100 minutes at the team table.

On the final day of the story, the designers showcase their completed designs to the team


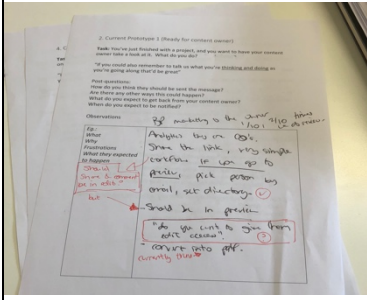
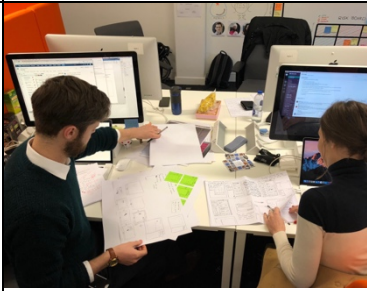
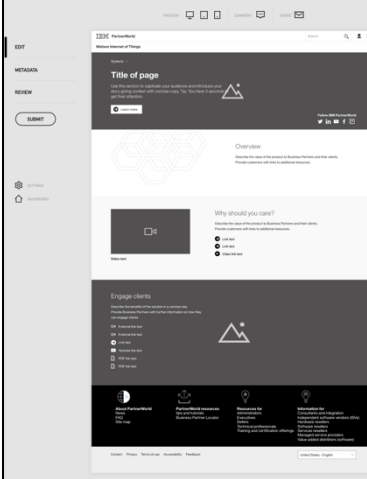
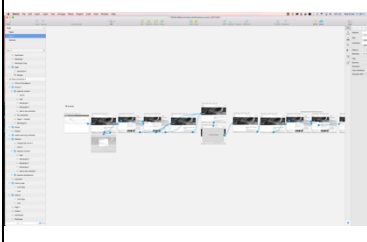
with a further impromptu meeting at the team desk. The story is then updated in Jira with supporting notes and links to the digital design artefacts which are stored in the team's cloud storage Box folder. Corresponding tasks for the development work are added to Jira as stories for the subsequent sprint.



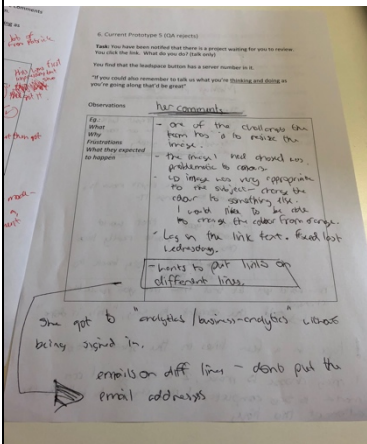

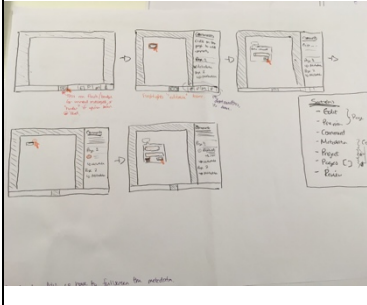
This third vignette focuses on the design-led process within the team. It shows the appropriation of a number of different places and tools, which team members routinely group and configure for specific spatial effects. It also demonstrates how team members often prefer to manipulate physical objects at the early stages of a story for rapid feedback and revision. As tasks progress, the emergent spaces of interaction extend increasingly into digital environments which are configured to bring team members together for discussion and review of the digital software artefacts.

**Figure 15: Notifications and Comments**

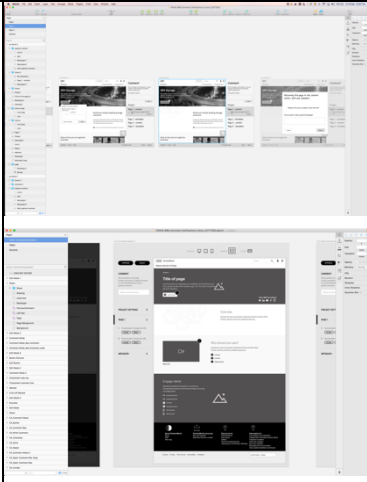
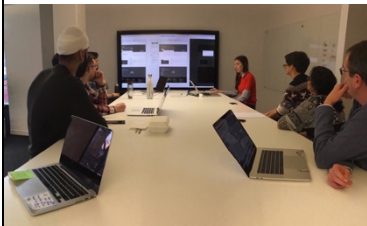
Time	Purpose & Participants	Description	Assemblage	Evidence
6 <sup>th</sup> Dec 09:47 – 10:01	Team stand-up involving all team members	<p>Team performs 15-minute stand-up commencing with a Slack reminder for the team to stand-up. Without any physical prompts, the team begin to form a circular formation around the team stand-up area.</p> <p>During the stand-up, the team review the status of the open work activities within the current sprint.</p> <p>The visual designers and a developer agree to meet following the stand-up to discuss the Jira story related to the notifications and comments feature.</p>	<p>Team stand-up area</p> <p>Slack stand-up reminder</p> <p>Jira</p> <p>Webex for remote developer working from home</p>	


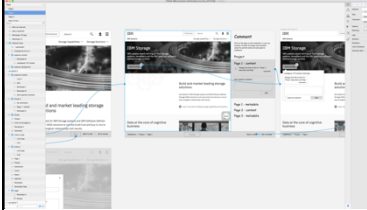
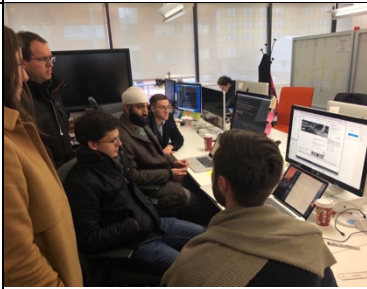

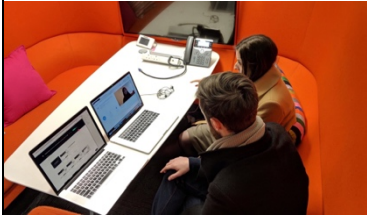



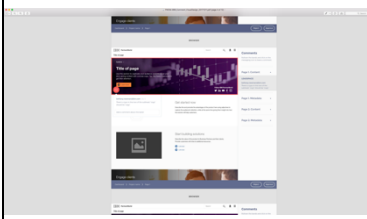


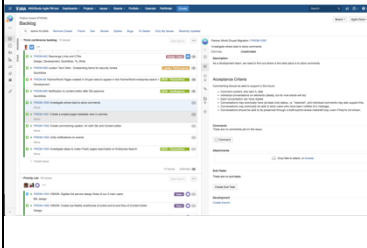
10:47 – 11:40	<p>Work activity to begin generating ideas for story using IBM design thinking framework</p> <p>Visual Designer, Junior Developer and Manager (Designer)</p>	<p>The team begin with a purely physical environment without their laptops or any digital tools.</p> <p>The start by sketching ideas for the solution using paper and pen, as this is considered faster than digital and permits rapid feedback and annotation.</p> <p>The work activity continues for approximately 1 hour, working silently and collaboratively to brainstorm ideas.</p> <p>The group then collectively review ideas and select two from the sketches for short and long terms proposals.</p> <p>The actions are agreed on paper.</p>	<p>Booth for proximity, use of table and noise isolation from the wider team.</p> <p>Use of paper and sticky notes.</p> <p>Booth screen not used.</p>	 
12:03 – 12:45	<p>Collaborative work between Designers</p>	<p>The designers review the shortlisted sketches at the team table, where they are regularly seated next to each other.</p> <p>They plan a workflow of the solution and begin creation of digital prototype.</p> <p>Thereby creating a hybrid environment which combines paper prototypes with design tools.</p>	<p>Team Table</p> <p>Paper with Sticky-notes</p> <p>Sketch - for design</p> <p>Invision - for prototyping</p>	
12:50	<p>Individual work activity at team desk</p>	<p>Designers transition to digital prototypes because they have reached initial agreement on the approach and want to share the prototypes with remote stakeholders over Webex to gain feedback.</p> <p>Design of individual screens and workflow between screens is created.</p>	<p>Team table</p> <p>Sketch</p> <p>Invision</p>	 

14:20-15:30	Stakeholder review	<p>Designer and developer arrange meeting with remote stakeholder to share designs for feedback.</p> <p>The meeting is held using a video conference to maximise proximity as much as possible. The designer explains that he not only wants to see the stakeholders face, but also hear them talking and share the prototypes on screen.</p> <p>The intention is to try to maximise proximity, ideally meeting would have been held in person using face-to-face as they still don't see body language and visual cues using Webex. The designer states he would use eye tracking software if available.</p> <p>Meeting notes are taken on paper due to speed, discretion and annotation.</p>	<p>Meeting room</p> <p>Janson.</p> <p>Webex video conference with screen sharing.</p> <p>Notes taken in paper form for rapid and quiet capture.</p>	  
7 <sup>th</sup> -8 <sup>th</sup> Dec	Stakeholder reviews	Designers and developer complete three additional interviews using the same format as above.	As above	As above
9th Dec 10:36 – 11:12	Analysis of stakeholder reviews	<p>Designers collate feedback from the four stakeholder reviews, they summarise the key feedback and spit resulting work as actions between them with 'short' term stories to be covered by Designer1 and long-term stories to be covered by Designer2.</p> <p>Further ideas are generated and sketched using paper notes.</p>	<p>Team desk</p> <p>Sharing of paper notes</p>	 



11:12 – 13:04	Individual work by Designers	<p>Designer1 and Designer2 agree to work on respective areas. Designer1 works on flow and short term version. Designer2 works on detailed visual design for long term vision.</p> <p>Designers are seated next to each other and occasionally discuss or collaborate on their respective ideas.</p>	<p>Team Table</p> <p>Sketch</p> <p>Invision</p>	
15:15 – 16:10	<p>Design and development team meeting</p> <p>Plan to perform due diligence on designs to ensure they can be implemented in a reasonable time-frame</p>	<p>Designers showcase their latest designs which have considered the stakeholder feedback to the development team.</p> <p>Detailed discussion on the 'goal' of the story, how the solution would be implemented technically and what the 'MVP' features would include.</p> <p>The designers solicit feedback and considerations for further refinement.</p> <p>This meeting was held at the titanic table to get the team away from the team desk and eliminate distractions. The space was perceived as a creative open space (unlike meeting rooms) which encourages relaxation and free talking. The table requires individuals to sit on high-top stools or stand, which will encourage focus.</p>	<p>Titanic table</p> <p>Large display screen</p> <p>Sketch</p> <p>Invision</p>	
16:30 -	Development team meeting	<p>Development team complete further investigation on technical implementation of designs. They feel that the designs are complex to implement and the cost/benefit ratio of is low. They request the designs are simplified to make them easier to implement.</p>	Titanic table	

11 <sup>th</sup> Dec 10:33	Work activity	<p>The team returns to the office to find the heating is not working. All team members adorn their coats due to low temperature within the building.</p> <p>The designers discuss feedback from the development team.</p>	Team table	
10:55 – 12:15	Work Activity	Designers work together to create modifications to designs and alternative simplified approach.	Team table  Sketch  Invision	
12:21 – 12:43	Impromptu meeting held between design and development team	<p>Design team gather around display in team area (large meeting rooms or titanic table not available) to share and discuss revised approach.</p> <p>Secure consensus to proceed.</p>	Team area  Slack	
13:00 – 13:30	Impromptu status updated and review with Product Owner (PO).	<p>Designers contact PO using Slack and agree to have ad-hoc video conference meeting to review progress and share designs.</p> <p>They discuss the time-constraint challenges of completing the work within the 1 day remaining with the sprint. They subsequently agree a MVP functionality to proceed with completion of the story.</p>	Booth  Slack  Webex	 

15:00 – 16:40	Work Activity	Designers work together 'pair-designing' to finalise approach and complete visual designs and workflow.	Team Desk  Sketch  Invision	  
12 <sup>th</sup> Dec 10:09am	Design review	Designers share final designs with team at the end of stand-up.	Team Area	
11:29am	Status updates and closure	<p>Story updated in Jira with supporting notes and links to digital design artefacts.</p> <p>The corresponding stories for development work added for the next sprint.</p>		

#### 5.3.4 Vignette 4: Create Transparent Page Logo

This final vignette which is described through Figure 16 follows the resolution of a visual software bug which involves multiple members of the team at various stages, from its identification to resolution. The story necessitates collaboration with a remote IBM employee based in India. The interactions which occur with this individual and others within the team support the previous findings which suggest that team members use rich interactions when matters are complex, require detailed explanation, or a live example. Subsequent interactions which are more transactional tend to occur using Slack or digital alternatives.

The story begins with a problem with an image asset which is logged in Jira in July 2017. The problem is considered low priority. Several team members review and comment on the problem until the manager classifies the problem as a software bug in October. The story is prioritised for completion in an October sprint, approximately three months later where it is assigned to a UX designer for resolution.

During the sprint, the manager, UX designer and a developer (whom had all contributed to the Jira ticket) initially discuss the bug at the team desk whilst referencing Jira. The UX designer assigns himself to the Jira story and moves the status to 'in progress'. At the start of the investigation, the UX designer contacts a remote colleague based in India using SameTime instant messenger, this is used to arrange a WebEx meeting for detailed discussion with screen sharing to prevent ambiguity. The decision to use SameTime for the primary interaction is based on tacit knowledge that the remote colleague is a more frequent user of SameTime rather than Slack. The WebEx meeting takes place from the team desk for approximately six minutes where the colleagues share screenshots and agree a corrected image file needs to be created and uploaded to resolve the bug.

As the WebEx meeting ends, the manager overhears the end of the conversation and offers to help the UX designer to create a solution. The two team members reconfigure their locations at the team desk to be seated adjacent to each other where they spend 4 minutes discussing the process required to create a corrected image file.

The UX designer works in isolation using the Sketch design software to create the corrected image file. Once completed, he contacts the remote developer using Slack (not SameTime) to upload the file to the server. The corresponding Jira story ticket is also updated with the status which sends notifications to a senior developer within the predefined workflow. After 93 minutes, the remote developer replies with confirmation that the revised image file has been



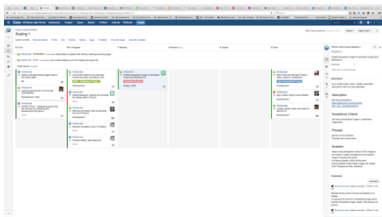
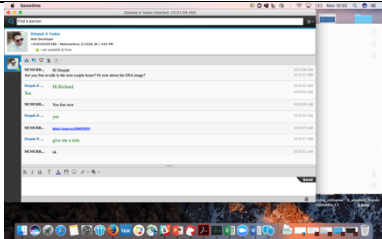
uploaded and is ready for testing. However, on testing of the uploaded image file, the senior developer finds that the image has been incorrectly configured. The senior developer stands at his workspace and notifies the UX designer using face-to-face interaction. He then carries his laptop around the table to the UX designer's workspace to demonstrate the problem with the configuration. The UX designer makes further corrections and this time chooses to send the file directly to the senior developer using Slack messaging so it can be tested locally, before being uploaded by the remote team member.


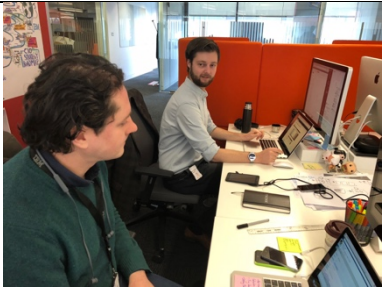
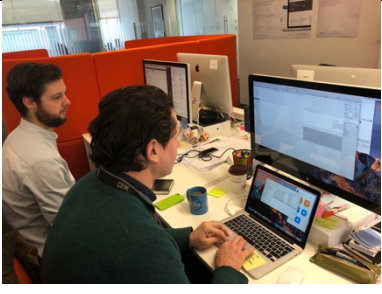
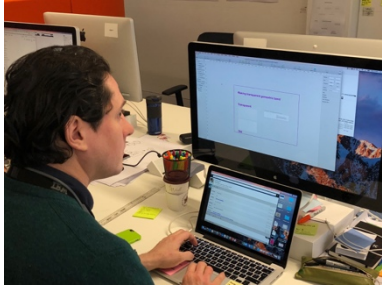

The UX designer leaves his desk to join a meeting taking place in the team booth. The senior developer subsequently reviews the updated file and confirms via Slack that the file is correct and can be uploaded by the remote developer. At this point communication temporarily breaks down and is subsequently repaired between the two members. As the UX designer ends his meeting having not seen the Slack message, he asks the senior developer using face-to-face interaction if the updated file was correct. The developer again confirms approval and mentions that he had already previously responded via Slack. With this confirmation, the communication is repaired, and the remote developer is contacted using SameTime with a request to upload the corrected image file.

The next morning, following confirmation that the file has been uploaded for testing, the UX designer notifies the senior developer that the file can be tested again. This is successfully tested and integrated into the code with a GitHub pull request which generates further Slack and Jira peer review notifications for another developer seated immediately to the left of the senior developer. The two developers discuss the story for a few minutes including exchanging clarifying comments on changes to the code base. The reviewer compares the code within the SDK environment before approving the pull request which merges the code into production. The GitHub entry is updated with before/after screenshots as evidence of the code change.


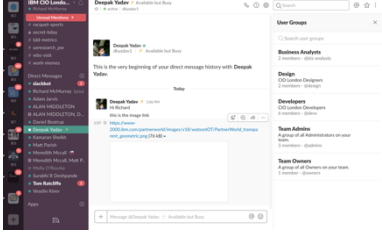
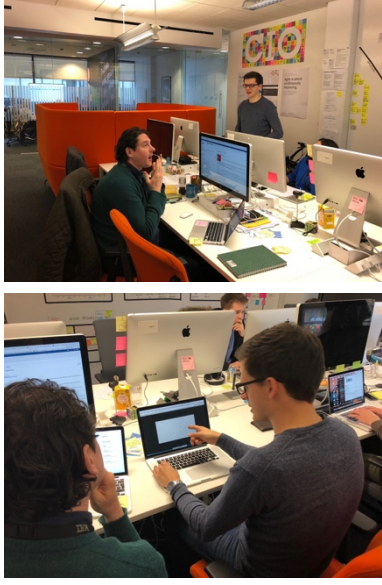
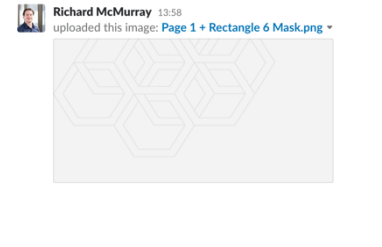
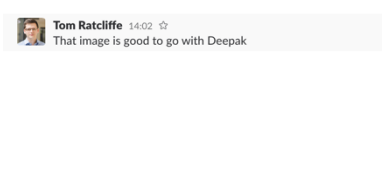
The vignette demonstrates a mirroring of conversation channels and configuration between physical and digital, particularly with work activity notifications between actors seated adjacent to each other. Communications are concurrently passed through various shared digital and physical channels over time. These interactions are inextricably linked and need to be aggregated together to trace the progress of the story.

Figure 16: Create Transparent Page Logo

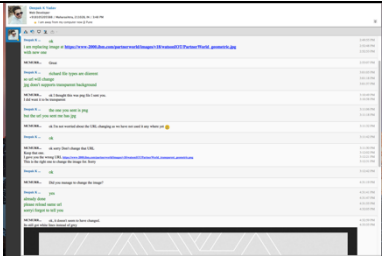

Time	Purpose & Participants	Description	Assemblage	Evidence
5 <sup>th</sup> July 14:00	New bug noted by Visual Designer	<p>The visual designer on the team notices that a particular logo does not display correctly when the background is not white. The image has been created as the wrong type of file (.jpg instead of a transparent .png) file.</p> <p>A Jira issue is created by the designer and subsequently assigned a low priority by the business analyst. The issue is looked at by the development team over the next few months and the issue is categorised as a 'bug' for investigation.</p>	Jira	
20 <sup>th</sup> Oct 10:18	Work assignment between UX Designer and Manager	UX Designer and manager discuss work assignment for current sprint. Designer discusses bug with manager and developer whom had previously analysed the Jira ticket, he agrees on the work assignment.	Team table	
10:30	Individual work	UX Designer investigates bug within Jira. Moves item from 'blocked' to 'in-progress' status.	Jira	
10:31	Request for coordination	<p>Designer contacts remote developer based in India to arrange an inpromptu Webex meeting for further discussion. He knows that the remote developer is most responsive over SameTime.</p> <p>The designer feels a video-conference is the fastest way to discuss the topic and prevent ambiguity. He also</p>	SameTime Instant Messenger	

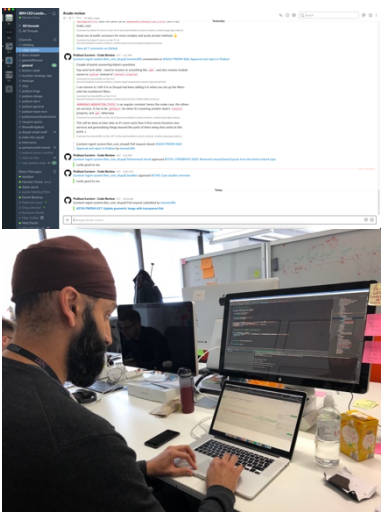
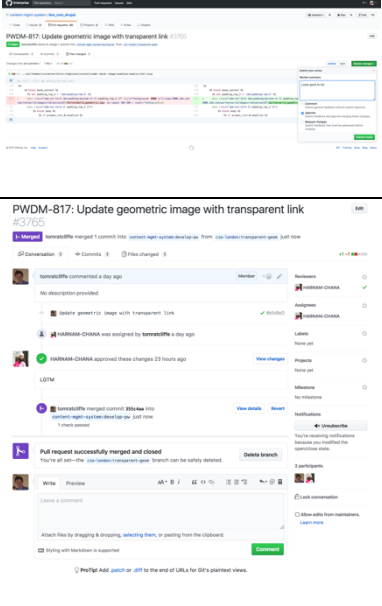
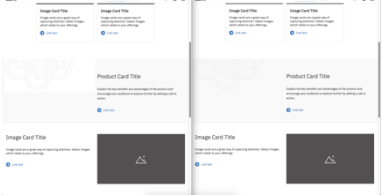
		wants to share graphics using screen share functionality.		
10:35-10:41	Webex Meeting between UX Designer and remote developer.	<p>The participants discuss the bug. The UX designer discovers no existing solution exists for the problem, therefore a new transparent image file needs to be created and uploaded.</p> <p>Meeting adjourned at the point there are no further questions. UX Designer agrees to complete the image creation work individually.</p>	Webex using screen sharing	
10:43	Serendipitous interaction	Manager's seat is next to UX designer. As he returns to his desk, the manager overhears the end of the Webex meeting and offers to help the UX designer with developing a solution.	Team table	
10:44 – 10:48	Work activity involving Manager and UX Designer	Manager and UX designer agree approach to convert jpg to png, set white colour background to transparent.	<p>Team table using laptops and external display</p> <p>Sketch</p>	
10:49	Individual work by UX Designer	UX designer works in isolation using Sketch tool.	Sketch	 <div> <p>Making transparent gemoetric band</p> <p>Transparent version</p>  <p>White version</p> </div>



11:24	Status of work notification	<p>UX designer contacts remote developer (on this occasion using Slack) to advise the work is done and asks him to upload the new image file to the server for testing.</p> <p>Posts status update in Jira.</p>	Slack  JIRA	
13:07	Notification	Remote developer confirms image has been uploaded and is ready for testing by the senior developer.	Slack	
13:52	Face-to-face conversation between Senior Developer and UX Designer	<p>The senior developer receives a Jira notification and investigates the updated image file, he advises the UX designer that the file has been configured incorrectly.</p> <p>The senior developer then carries his laptop around the table to demonstrate the incorrect configuration.</p>	Team table  Jira  Laptop	
13:57-14:03	Conversation between UX Designer and Senior Developer	UX designer corrects image, sends it over Slack directly to the senior developer to test locally, then joins meeting in booth.	Sketch  Slack	
14:03	Conversation between UX Designer and Senior Developer	Senior developer confirms the file is correct and sends Slack notification to confirm that the file can be sent to the remote developer to be uploaded to	Slack	



		<p>the server.</p> <p>Message sent over Slack as UX Designer appeared busy in the booth.</p>		
14:42	Face-to-Face repair of communication	UX designer asks developer if he had seen revised image (hadn't seen Slack response), developer confirms in person.	Team table	
16:33	SameTime conversation between UX Designer and remote developer	UX designer works with remote developer to upload the corrected image file.	SameTime messenger	
21st Nov 10:22	Work activity	<p>UX designer notifies senior developer across desk using face-to-face to confirm file is ready for testing again.</p> <p>Senior developer acknowledges and makes edits to code base to display the correct file.</p> <p>Senior developer sends pull request to Github requiring review and integration by reviewer.</p> <p>Github generates Slack notifications to reviewer, senior developer also notifies review directly as they are seated next to one another.</p>	<p>Team table</p> <p>SDK</p> <p>GitHub</p> <p>Jira</p> <p>Slack</p>	

10:24 – 10:55	Peer review	<p>Reviewer receives Slack notification. He then turns to his right and asks the senior developer a clarifying question about the pull request.</p> <p>He then completes a side-by-side code review before approving the pull request.</p>	<p>Team area</p> <p>Slack</p> <p>GitHub</p>	
22 <sup>nd</sup> November 10:12 am	Pull request successfully merged	Automated pull request.	GitHub	
24 <sup>th</sup> November	Code pushed to production	See before and after screenshot in evidence.	<p>GitHub</p> <p>SDK</p>	

## 5.4 Physical and Digital Designed in Isolation

Leaders from both the corporate real estate (physical) and IT (digital) departments recognised the importance of the new ways of working being adopted in IBM, and their respective supporting roles as illustrated in the following quote from a real estate consultant:

*“What’s changing? I think the way people work. The tools that they work with are changing. The business environment, with the way they want people to work. It starts with the IBM business agile initiative and then the physical workspace in the environment in which that work style can be performed.” (9, Real estate consultant).*

These new ways of working were being signalled both from the top and bottom levels of the organisation as necessary for IBM to compete with other technology organisations:

*“I’m seeing people in the workspace wanting to be more collaborative in a more informal team-based environment. I’m seeing walls come down and openness increase. I’m seeing the desire for improved image, look and feel, because of legacy IBM and what the next generation are comparing IBM to Google, Facebook, Apple... All the other ‘younger’ companies, so we’re consistently pointed to those, and I think the tools that people work with.” (9, Real estate consultant).*

Yet when the respective departments were asked about how the physical environment was designed to integrate with digital tools, it became apparent that both departments were disconnected from each other on this topic and were designing in isolation as shown by the quote from the real estate consultant:

*“I’d say [our requirements] go as far as the type of space and the hardware within the space, for example an AV screen and a good quality phone. We don’t tend to hear what they want to do within those things, so it tends to be, ‘We need a flat screen to connect to, we need a write-on wall’. They don’t tend to reference the virtual tools typically.” (9, Real estate consultant).*

This was also evident within the design of the IT strategy as explained by the IT executive:

*“I mean there probably is a strategy around this [integration of physical and digital environment], but I haven’t contributed to it and I haven’t seen it. In terms of the integration of the tools [with the physical environment], I think that’s a real white*

*space.” (16, IT Executive).*

This exposed the lack of role-responsibility for integrating the physical and digital environments for employees within the design of the environment. It also demonstrated the flows across physical and digital environments which were evident in practice had not yet been adequately captured by the organisation.

## 5.5 Workplace Issues

Employees generally enjoyed working within the Studio and felt a sense of privilege and pride. They felt they were an integral part of cultural and workforce change within IBM and its image change externally. However, the Studio and its improvements on the design in comparison to the remainder of the IBM building were still perceived to have shortcomings:

*“I think the biggest battle... is we cannot get a kitchen. The studio should have a kitchen... in the previous agencies the best discussions were happening in the kitchen... it is the number two collaborative space, it's very important. Also [we need] more casual space...a kind of space where people can just go and chill and read a book, we don't have that.” (10, Senior visual designer).*

The high employee density meant that the workspaces were appropriated to support a variety of activities from team-based discussions to individual focused work, often at the same time. Behaviours varied across individuals and teams, which caused issues particularly with the use of communal areas. This was exacerbated by employees being unfamiliar with others outside of their respective team:

*“In this studio the most frustrating thing is kind of imitating a modern cubicle style because you still separate the area [with dividers] and you still don't communicate the back with the front part. It's supposed to be about collaboration, but you don't know what's going on behind on that table... there's approximately 100 people and they don't know each other.” (10, Senior visual designer).*

Employees and management felt the Studio had an “energy and a buzz” compared to the general IBM building. Audible conversations including meetings could regularly be overheard in the open areas. Presentations also frequently took place in the mediascape, often with videos and music which were played aloud and could be heard throughout the Studio. As a result, the Studio was considered effective at supporting team-based work, but ineffective for supporting focused individual work due to frequent distractions.

### 5.5.1 Distractions

A central objective of the Studio was to foster collaboration and creativity amongst employees. The team-based nature of the agile and design thinking methodologies generated a lot of conversation from within each teams' respective area. However, the open plan layout of the Studio meant that employees could often overhear neighbouring conversations which were not relevant to their work. Such noise (particularly from unfamiliar sources) was considered as a distraction, which meant that employees could often find it hard to concentrate:

*"Sometimes it can become really noisy... There's a lot of teams working at the same time and they are seated next to each other. Sometimes that interferes, you are concentrating, and sometimes you are talking out loud about something you did on the weekend and the other team is trying to concentrate... there are a lot of distractions." (2, Developer).*

Employees adapted by using coping mechanisms such as the use of noise-cancelling headphones. However, the use of headphones caused employees to isolate themselves and had the opportunity cost of blocking out all noise which was counter to the strategy of encouraging collaboration within the Studio:

*"I put headphones on which help me concentrate basically, at the same time you lose discussion that might be interesting for you." (18, Developer).*

No guidelines or working practices for using the Studio areas or digital tools were prescribed. Practices were instead emergent and inconsistent within and across teams which led to occasional communication breakdowns.

### 5.5.2 Communication Breakdowns

The lack of prescribed protocols around usage of the physical Studio environment also applied to usage and integration of the digital tools. Whilst communication regularly flowed across the physical and digital environments, the emergent and inconsistent usage of these mediums meant that communication could break down, and subsequently needed to be repaired. This was evident in the following excerpt from Vignette 4: Create Transparent Page Logo, page 109, where a designer and developer were working together to resolve a software bug with an image which was not displaying as intended:

- Initially, the UX designer amends the image file and submits this to the corresponding Jira record. The update to Jira generates an automated notification to the developer as per the predefined workflow.
- The developer investigates and advises the designer that the image is still incorrectly configured. The designer makes further corrections, this time choosing to send the file directly to the developer via Slack (instead of Jira).
- The file is tested by the developer and approved by Slack reply. At this point communication breaks down as the designer does not see the Slack message.
- The designer waits and eventually asks the developer to test the file using face-to-face interaction. The developer is confused and mentions that he had already previously responded via Slack. With this confirmation, the communication is repaired.

The vignette demonstrates examples of communication breakdown and repair due to the inconsistent way the modes of communication were being used. This was supported by the following quote from the designer:

*“[The developer] had checked the file for me, but I hadn’t seen the Slack message. So, there was some confusion and time lost whilst I was waiting for him. In the end we caught each other [face-to-face] and got it resolved.” (15, User experience designer).*

This example highlights how actors were unsure of which communication medium to adopt or decided based on individual preferences. This was further evident as some employees preferred to communicate with others seated in close proximity via Slack, whereas others were more inclined to use face-to-face communication.

## 5.6 Chapter Summary

The findings have provided a detailed examination of the empirical setting including the underlying strategies of the physical and digital environments of work within the IBM Studio. They demonstrate how the physical and digital environments were conceived and designed in isolation, yet became integrated conceptually and through practice by employees whom are aware of the hybrid environment in which they operate.

The data provides evidence and demonstrates how the integration of physical and digital have become essential to the functioning of the workspaces, i.e. to support the tasks, activities

and interactions of the teamwork. The combination of physical and digital proximity enabled an ease in coordinating work, but also caused issues which required the use of coping mechanisms. The employees have common ground and a shared context which enables them to provide and command rapid responses for clarification. They control what they and others see, as well as what they do. Team members share physical artefacts that are meaningful and constantly visible and can coordinate references to these artefacts. They can reorganise themselves and the artefacts as their needs change, seeing the large-scale overview or zooming in on aspects they want to focus on. The use of walls of work and digital dashboards also helps coordinate the work as tasks flow between mediums. In essence, the organisation exists through relationships between members, mediated by both physical and digital things.

The four vignettes which trace individual stories demonstrate the routine assemblage of the combined physical and digital environments which are routinely grouped and configured for specific spatial effects. These assemblages support a continuous appropriation of spaces between team members to create proximity and order relations in both physical and digital form. These forms are mutually constituted with interactions that occur as a continuum across physical and digital with regular switching between the mediums. The interactions are inextricably linked and need to be aggregated together to trace the progress of each story. The vignettes also demonstrate examples of communication breakdown and repair, when messages are not effectively communicated or understood between parties, they are often augmented with alternative physical-digital forms as an ongoing continuum relevant to the work activity and the relative position of actors.

The data has shown that the physical environment and its usages by team members can only function as an interactional space with the concurrent usage of the supporting digital tools which are routinely combined and configured to support work activities though their perceived spatial effects. Thus, the work practices of the Studio team members can only be properly understood by looking simultaneously at the interactions happening through digital tools in conjunction with the context and relational understanding of human actors and the physical environment within the workplace.

This data was organised into 1<sup>st</sup> cycle coding which were presented through the narrative and vignettes' within this chapter. These concepts support the emergence and development of 2<sup>nd</sup> order themes leading to aggregate dimensions of (1) *spatial work practices*, (2) *physical-digital assemblages* and (3) *spatialities* that make up the basis of the emergent framework. These dimensions which are presented with additional supporting evidence in Table 2 will be explicated in the Analysis & Discussion chapter which will be structured accordingly.

Table 2: Data Supporting Crafted Workspaces

Spatial Work Practices		
Theme	Representative Quotations	Representative Practices
Strategic Practices	<i>"There is a large mediascape which has a large 4K television for showcases or to bring clients in for sessions." (20, Developer).</i>	<ul style="list-style-type: none"> <li>• Daily Stand-Up</li> <li>• Backlog Grooming</li> </ul>
	<i>"Every morning we have a stand-up at the Wall of Work where each member of the team will give a brief description of what they did yesterday." (21, Business analyst).</i>	<ul style="list-style-type: none"> <li>• Sprint Planning</li> <li>• Sprint Review Showcase</li> <li>• Retrospective</li> </ul>
	<i>"In our culture, email is seen as more formal, to cover your back or deal with an escalation. Any conversation over Slack is seen as more cooperative and that we are trying to coordinate and make work happen." (22, Iteration manager).</i>	<ul style="list-style-type: none"> <li>• Team based Work Activity</li> </ul>
Tactical Practices	<i>"We don't have a dedicated space for pair-programming. Usually we make space at the team desk or sometimes we use the booth, whatever is available really." (18, Developer).</i>	<ul style="list-style-type: none"> <li>• Brainstorming activities</li> <li>• Individual Work Activity</li> <li>• Pair-programming</li> </ul>
	<i>"We tend to change our location when we perform the different rituals, to get away from distractions, noise and encourage people to focus." (22, Iteration manager).</i>	<ul style="list-style-type: none"> <li>• Pair-design</li> <li>• War-room</li> <li>• Ad-hoc meetings</li> </ul>
Physical-Digital Assemblages		
Theme	Representative Quotations	
Ontogenesis	<i>"Usually we get to a point, when we have collaborated and made some decisions along the way, we have reached a desired outcome and need to move to the next stage... That could be breaking up work or doing some exploring... Or even just when we run out of the time." (20, Designer).</i>	
Modulation	<i>"We wanted to separate ourselves from the rest of the team to avoid distracting them...and we wouldn't have to worry about being quiet. The booth is usually available [without booking], it's close to the team and doesn't have the same time constraints as a meeting room. It's a lot more interactive than using a digital tool, which would also be slower." (3, Manager).</i>	
	<i>"We would often use the booth ...there is a television where someone would hook their laptop to share the work. It's a fairly informal environment, it's comfortable for discussion and working in. The layout is also good because you are facing each other directly and can both see the screen." (18, Developer).</i>	
Mutual Constitution of Physical and Digital	<i>"The digital tools tie together the physical spaces because you have more opportunities to interact, you have the physical and the digital, so if two people need to communicate, they've got a host of ways of doing it." (5, Business analyst).</i>	
	<i>'We had an impromptu meeting with the team in the team space – it was someone standing up and saying, and also posting an '@here' in Slack saying "does anyone have some time? I really need to discuss this" we do that quite a bit.' (20, Designer).</i>	
	<i>"The conversation continues without considering the medium. If you just tried to follow on Slack you would lose part of the conversation." (22, Iteration manager).</i>	
	<i>"Work happens in the space we are physically present, but also through writing code, delivering stories and in conversations. Work happens over email, Slack, video. Work also happens through the wall of work, it's very fluid." (22, Iteration manager).</i>	



Table continued

Spatialities	
Theme	Representative Quotations
Spatial Intent	<p><i>"We chose the Titanic table, we needed a space where everyone would fit, the booth is not big enough and a meeting room is too formal. Whereas the Titanic table is more collaborative and open air and there is a feeling of more creativity and openness to the space."</i> (20, Designer).</p> <p><i>"Our daily stand-up happens in our team area, we actually stand up and congregate around a single screen, usually displaying our Jira stories and sometimes a video conference session for anyone working from home... Doing it this way helps us to focus, stepping away from other distractions, we can look each other in the eye and read each other's signals."</i> (22, Iteration manager).</p> <p><i>"The developers will sit in the booth with the screen showing technical tools like GitHub and Sublime text editor. It takes place in the booth because there are usually 4-5 people and it's less meeting like, more exploratory, conversational, informal and highly detailed. It's not a meeting and it shouldn't feel like one... The design of the booth with the cushions and colours makes the meeting more productive and creative. It gives the junior members more of a chance to speak up, which they are definitely more hesitant [to do] in a meeting room."</i> (22, Iteration manager).</p>
Spatial Preferences	<p><i>"You can integrate Slack with a lot of other tools as well. I think it allows some team members to innovate, they enjoy that sort of thing."</i> (1, Business analyst).</p> <p><i>You feel encapsulated in the booth, with the comfort of a couch and almost the privacy of a meeting room, but without the formality."</i> (3, Manager).</p> <p><i>"We definitely have a feeling of where we can and cannot work. If you have to work in an environment where your eyes are hurting or it feels depressing, you really don't want to work in that space."</i> (10, Senior visual designer)</p> <p><i>"The big reason I like Slack is because of the integration with other tools with things like our code repository and our builds."</i> (18, Developer).</p>

## **CHAPTER 6: ANALYSIS & DISCUSSION**

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Having presented the results in the previous chapter, we now examine these findings systematically through the theoretical lens to develop a conceptual understanding of modern workspaces.

Through the analysis, two additional novel concepts are presented as aggregate dimensions (built from 2<sup>nd</sup> order themes in the coding) which extend the theoretical lens. The two concepts: *physical-digital assemblages and spatialities*, together with the earlier concept of *spatial work practices* provide the components of the emergent framework titled *crafted workspace*.

This framework provides a conceptual tool to capture modern workspaces emerging from interactions between people, work practices, and the combined physical and digital environment to be understood, so they can be designed and integrated into the office to support modern work.

## 6.1 Spatial Work Practices

Workspaces as perceived by the Studio employees, emerge out of the enactment of places within the Studio. Their *spatial work practices* create spaces for organisational action to happen by appropriating the topographic system of the physical environment and digital tools to perform a spatial realisation of the site. These views and the supporting views of the real estate team supported a view of space as something which is performed, rather than as a static container as supported by the following quote:

*“The design of the workspace is moving towards providing more activity-based function to support the activity of the employee... There is a shift to providing a variety of workplace settings to provide the user with choice; more quiet focused areas, for concentrated work; collaborative space for sharing ideas and group discussion... Work is now considered as something we do rather than a place we go. The focus of work has shifted to results driven outcome rather than being sat at the desk.” (8, Senior real estate space planner).*

The results chapter showed how the users of the physical-digital hybrid environment have developed specific ‘ways of operating’ them, analogous to the ‘enunciation’ of physical places as proposed by de Certeau (1984). Research within social ecology has examined proximity through the lens of social settings. Such physical social settings include offices, meeting rooms, and communal working spaces which are often associated with behavioural norms, mental schemas, and guidance that shape the way people behave and consequently the

expected behaviour of others (Barker 1968; Kiesler and Cummings 2002). Individuals use cues, such as specific activities associated with places, artefacts, physical boundaries, and distance to establish territories (Forsyth 2010). These territories help organise social and work practices which create and enforce common experiences leading to social norms (Edney 1976) which reinforce social ties and ownership of artefacts within them. Individuals and teams with such contiguous territories tend to interact more frequently (Moreland 1987).

Through these actualisations, the teams establish meanings and relationships between different positions and places within the Studio. Consistent with the extension of the work of de Certeau (1984) within the theoretical framework, this study finds both established strategic and tactical spatial characteristics for the *spatial work practices* used by the agile software development teams.

### **6.1.1 Strategic Practices**

Strategic *spatial work practices* are planned, scheduled and often recurrent. Within the Studio, they were planned for and built into the designs of real estate and IT departments; they could be associated with many of the formal rituals from the agile and design thinking methodologies. Although these strategic *spatial work practices* may not be formal in their nature, they have established and predictable patterns of behaviour which often includes the agenda, expected attendees, appropriation of places and digital tools. These spaces through which strategic *spatial work practices* are performed are routinely inhabited and establish association as templates for certain types of work for known actors. The *spatial work practices* are therefore familiar and are visually identifiable across different agile teams through appropriation and assemblages of the physical and digital environment in a regular configuration.

The planned layout of the Studio physical environment and intended managerial usages of digital tools were designed and built with consideration of these strategic *spatial work practices* as captured within the 1<sup>st</sup> cycle coding. From the walls of work adjacent to each respective team table for the daily stand-up, to private meeting rooms for more confidential discussions, to the auditorium style Mediascape for end of sprint showcase meetings.

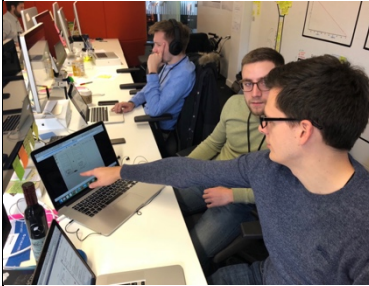

### **6.1.2 Tactical Practices**

In contrast to strategic *spatial work practices*, those which are tactical can be considered emergent, unplanned and actualised as necessary or otherwise available. Again, consistent with de Certeau, the tactical appropriation of these places “*bring to light the clandestine forms*

*taken by the dispersed, tactical, and makeshift creativity of groups or individuals*” (de Certeau 1984, p. xiv). These practices are generally impromptu, focused toward necessary collaboration, communication or coordination for individual or groups of actors whom pursue the completion of work activities. Unlike strategic *spatial work practices*, they may not be as easily visually identifiable due to their makeshift and inconsistent nature.

As the design of the physical Studio environment was activity based, particular spaces became associated with agile rituals, such as the team stand-ups occurring at the respective wall of work. However, several other routine activities had not been designed for and required team members to improvise from within their surroundings. An example where dedicated workspaces did not exist to support routine activities was pair-programming, a frequent practice used by many of the teams. Figure 17, which is created as an excerpt from Figure 14: Default Landing Page, shows how two developers improvised by tactically appropriating a variety of workspaces at the team desk.

**Figure 17: Tactical Appropriation of Workspaces**

Purpose & Participants	Description	Assemblage	Evidence
Pair programming work activity between two developers	<p>The developers reconfigure their seating arrangement to sit in close proximity at the junior developer's desk.</p> <p>Note the developer seated in the background is wearing noise-cancelling headphones.</p>	<p>Team table</p> <p>Laptops with external display</p> <p>GitHub</p> <p>Jira</p> <p>Slack</p> <p>SDK</p>	
Pair programming work activity between two developers	<p>The developers continue the conversation, this time at the senior developer's desk.</p>	<p>Team table with laptops + external display</p> <p>GitHub, Slack and SDK</p>	

This tactical appropriation was also supported by the following quote from one of the developers:

*“We don’t have a dedicated space for pair-programming. Usually we make space at the team desk or sometimes we use the booth, whatever is available really.” (18, Developer).*

This regular reconfiguration of the team desk and general noise within the Studio would contribute to workplace issues as captured in 1<sup>st</sup> cycle coding. In this example, the two developers cause disruption to another team member that can be seen in the background of the first picture wearing headphones to block out noise and distractions from their conversation. Such practice of employees adopting coping mechanisms such as wearing noise cancelling headphones was frequently visible and supported by the following quote:

*“I think it is an environment which allows for people to be disturbed very easily, therefore they put their earphones in and that’s kind of a sign not to necessarily disturb them unless it is essential.” (7, Iteration manager).*

The noise and distractions created a vicious cycle effect. As employees would appropriate meeting rooms as a workspace for increased privacy or for other tactical activities (see Table 2) such as brainstorming sessions or war-rooms. As a result, the high demand on meeting rooms consistently exceeded the available supply:

*“I tend to book my meetings upstairs [outside the Studio] due to availability. It’s very hard to book in here.” (10, Senior visual designer).*

This often resulted in legitimate meetings taking place in the open area. It was fairly common to hear audible speaker output from remote participants, or employees speaking loudly whilst participating in open telephone or video conference calls, further compounding the noise problem.

### **6.1.3 Summary**

Practitioners and scholars have argued that work processes and organisational routines can be designed to fit the context (Hackman and Oldham 1980; Wageman 1995). The two 2<sup>nd</sup> order themes relating to the origins of *spatial work practices* as either (1) strategic practices, or (2) tactical practices, enables us to understand and categorise work activities according to their planned or emergent nature. The concept of *spatial work practices* thus provides a foundational basis to understand how organisational routines and work activities are enacted through an appropriation and configuration of the environment that is constituted in practice as *physical-digital assemblages*.

## 6.2 Physical-Digital Assemblages

The environments (or topographic systems) in which we are interested, consist not only of physical objects, they also include interactions with and through digital media. Similarly to the physical arrangements of a topographic system, digital media connect, approximate, enable visibility and specific types of movements, at the same time they inhibit and restrict other movements through the transduction of space (Kitchin and Dodge 2014a). As in the conceptualisation of *code/space* (Kitchin and Dodge 2014a), modern workspaces are intrinsically co-constituted through software as essential to their form, function, and meaning of space. The use of digital tools is inextricably linked with physical interactions to support Studio members with their tasks, activities and interactions. However, different from the usage of 'software' by Kitchin and Dodge as a reified and fixed element from which the fabric of space is woven, the information systems used in organisations today such as Slack, Jira and Box are much more plastic and malleable as they can be configured, combined and tweaked. Equally important, these systems can also be deactivated, hacked, bypassed and ignored in organisational practice. Modern workspaces thus emerge as an outcome of *spatial work practices* that intertwine features of physical environments (e.g. rooms, walls, furniture) and digital technology (e.g. social networks, project management tools, collaborative digital environments).

To capture the organisational reality shown by this study, the concept of *physical-digital assemblages* is introduced to capture a configuration of workspaces which includes both physical environments and digital tools. This concept extends traditional views of sociomateriality by zooming out to represent composite assemblages of technology, physical environments, people, work, and organising in ongoing intra-action (Cecez-Kecmanovic et al. 2014). *Physical-digital assemblages* enable us to understand the place which is created as an assemblage and therefore the space (or practiced place) that is experienced in order to enact *spatial work practices*. *Physical-digital assemblages* capture the material arrangements of physical and digital elements. They include both the physical location and its configuration including the arrangement of actors, along with the digital tools which are used within that setting and how they too are configured for usage and integration within that physical setting. These tools and technologies are parts of networks, made up of actors which are greater than the sum of their parts. But none of this is to suggest that these assemblages are neutral. The depiction of the human agent as hermeneutic in this new consensus is founded on two particularly important prescriptions:

The first is that any depiction of a human agent must be contextual and relational, as

previously argued, human agents live in pockets of space and time and are not universals. There are a number of consequences of this prescription. Human agents live a context which is predicated upon action in time. It follows that human agents live in contexts that can only be partially determined, for in acting they make something take on another form and thus they determine the world. These contexts are active networks of people and things gathered in particular social situations, not passive environments. Where agents often negotiate each given context in joint action with other agents with the aid of a particular store of practical knowledge (Thrift 1996).

The second prescription is that human agents must be seen as socially constructing, not socially constructed. People are not just passively socialised into various social settings. They are continually constructing these settings and themselves and others anew depending on their context. Our actions occur interlaced with those of others, their actions and those possibilities within the environment are just as much a formative influence determining what we do as is anything we determine ourselves (Shotter 1985). Through these joint accounts, human agents progressively learn to appropriate specific regions of the office - the desk, booth, mediascape, Jira, Slack, Webex. When these linkages take place, the resulting assemblage forms the basis of a model (Holy and Stuchlik 1983), as an account-based notion of what some piece of the world is like. According to how well these models allow actors to account for the office and for themselves, they invest actors and groups with a capacity for action. They are, therefore, the chief source of agency, the explicit formulation by actors of what they are capable of doing and of what powers they have. This conception of the human agent is quite different from that found in most theories of social action (Thrift 1996).

Through the tracing of physical and digital interactions within the performative nature of space, we are able to capture and analyse the way in which physical environments and digital technologies are combined and assembled to modulate spatial and temporal conditions. We achieve this by decomposing the concept of transduced space into its component parts (as previously explained in the theoretical framework) of ontogenesis and modulation.

### **6.2.1 Ontogenesis**

Adopting a performative view of space suggests that space achieves form, function, and meaning through practice, enabling space to emerge through a process of ontogenesis. This distinct conceptualisation demonstrates space to be dynamic and continuously remodelled, reaffirmed and experienced by sociospatial practices and *physical-digital assemblages*. This process allows us to understand the space that is experienced in order to enact *spatial work practices*. The four vignettes presented within the results chapter demonstrate these *spatial*



*work practices* and the associated *physical-digital assemblages* as inherently ontogenetic. They are continually created and dismantled through *spatial work practices* in order to support work activities. The following commentary provided by a designer to support the Vignette 3: Notification and Comments vignette, page 101, demonstrates the ontogenetic nature of the spaces which emerge:

*‘Typically, we agree what we are going to work on in stand-up and if we haven’t already scheduled it, at some point in the day, one of us will say ‘do you have time now to talk through?’ at which point we would begin collaborating... Otherwise we book meetings into calendars at an agreed meeting place...Also, we have impromptu meetings quite regularly, to discuss or review stories. It happens by asking [at the table] “who has time?” and with a message like a “@here” in Slack.’*  
(20, Designer).

After formation, these spaces reach a natural or planned break point, where *the spatial work practice* discontinues, resulting in the *physical-digital assemblage* being dismantled, and therefore the spaces ceasing to exist:

*“Usually we get to a point, when we have collaborated and made some decisions along the way, we have reached a desired outcome and need to move the next stage... That could be breaking up work or doing some exploring... Or even just when we run out of the time.”* (20, Designer).

The termination of these spaces enables subsequent work activities through ongoing *spatial work practices*, which create and configure new *physical-digital assemblages* for further work to happen in a continuum of performed spaces. Within each space, a *physical-digital assemblage* is configured to enact the work practice by modulating spatial and temporal conditions between actors.

### **6.2.2 Modulation**

The flexible nature of digital technologies in the workplace, combined with the modularity of the physical features in organisations today, demonstrates their mutual constitution. Yet, the data shows it is not just software that modulates physical space. It is also significant the way that physical environments modulate software. Space therefore emerges as a result from a mutual shaping, rather than as presented by Kitchin and Dodge (2014) as being modulated by code alone. This contribution is particularly important for the dynamics in modern digital organisations and adds a new dimension to Kitchin and Dodge’s theorisation, since their focus

was to capture the role of code within emergent settings such as the Internet of Things (IOT) and within infrastructural environments including airports and digitally enabled cities.

For example, when a booth was appropriated by a business analyst and manager for a planning and review meeting, the availability and appropriation of the physical environment and collocation of actors supported work practices and simultaneously displaced the use of digital alternatives:

*“We wanted to separate ourselves from the rest of the team to avoid distracting them...and we wouldn’t have to worry about being quiet. The booth is usually available [without booking], it’s close to the team and doesn’t have the same time constraints as a meeting room. It’s a lot more interactive than using a digital tool, which would also be slower.” (3, Manager).*

A transition of physical location to support a change in work activities and to modulate proximity and behaviour was deliberate and commonplace as explained by the Agile iteration manager:

*“We tend to change our location when we perform the different rituals, to get away from distractions, noise and encourage people to focus... For example, the act of moving to a new space at the end of difficult or stressful sprint gives us an opportunity to step back and be more reflective. We take a break and that allows us to get some closure and think about how to frame our feedback in a more constructive way for our retrospective, by taking us out of the tense environment where the work happened.” (22, Iteration manager).*

The features and properties of particular physical spaces meant their usage became associated with particular *spatial work practices*. For example, the use of the team booth was particularly popular for small sub-teams to have interactions away from the wider team. This was illustrated by a designer when organising a design-thinking session with selected members from the team:

*“We specifically chose the booth because it’s a collaborative area that isn’t too closed off. We can have several people together when we don’t necessarily need the privacy of a meeting room.” (20, Designer).*

The teams generally adapted their behaviours toward the use of physical face-to-face communication for rich interactions involving detailed or complex interactions, and digital interactions for shorter transactional exchanges where team members were not sat adjacent

to each other. However, these were sometimes adapted, such as creating an agreement where the use of headphones signalled a 'Do Not Disturb' mode to others as explained by a developer:

*"If someone has headphones on [and signals they do not want to be disturbed], we don't cross the line from digital to physical." (18, Developer).*

In cases where team members had been working remotely, Studio members recognised the use of digital technologies for modulation of time and space were less effective than face-to-face communication and physical proximity. This was in spite of adopting rich digital communication technologies such as video conferencing. They reported conversations became comparatively difficult to follow and led to more formal behaviours as illustrated by an iteration manager:

*"We use video conferencing for [remote] meetings because it's easier to see visual cues, it's a more personal experience. Although when I'm working remotely, I struggle to understand exactly what is happening in all the interactions in the team area. There can be multiple conversations happening, or I can't hear properly or understand, but being remote I don't feel comfortable saying 'I don't understand' or asking them to repeat themselves. But I'm sure I would have asked for clarification if I were physically present. I don't know why, but it does happen... It feels like more of an interruption when you are remote, whereas when you are together it feels more organic to ask. Having team conversations over video conferencing tends to be less natural than when everyone is together, you feel more disconnected." (22, Iteration manager).*

This would often lead to teams and individual members organising their work activities around known or strategic *spatial work practices*. For example, if intending to work from home on a particular day, they would organise that day to include less collaborative and more individual work. Also, at a team level, specific days were often reserved for strategic work activities requiring participation of the entire team (e.g. Sprint Planning) on which all team members were expected to be physically present in the office. This expectation was often explicitly agreed and stated within their team social contract.

The proximity of the team members and availability of both physical and digital environments meant that team members could configure their work environments to suit their work activities. In practice, this meant they often configured their workspace to be predominately physical assemblages during the early design stages of software development.

Team members often preferred to manipulate physical objects during early stages of the software development lifecycle for rapid feedback and revision as supported by the following quotes from two different designers:

*“Within the early design stage, we shift back from digital to physical. Physical is nice for super quick drawing things out and sharing with those who are physically around and digital is best for formalising that or sharing it with a wider audience.” (3, User experience designer).*


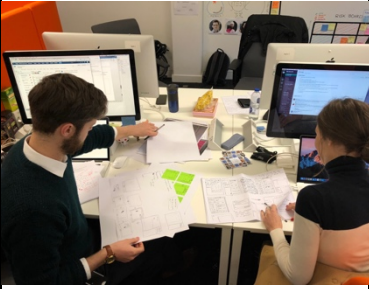
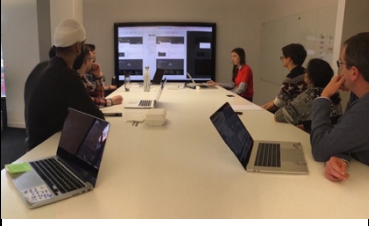
*“Typically, we will start with physical sketches and talk through them so we can iterate quickly. Sketching is much faster than working on a computer, you can work through problems faster by drawing it out and talking about it. It also removes distractions you may have from Slack messages or email.” (20, Designer).*

As tasks progressed further, the emergent spaces of interaction migrated increasingly toward digital tools as work outputs from the software development teams began to approach their final state as digital software artefacts. These tools were configured to bring team members together for discussion and review of digital artefacts before completion:

*“Once we have decided on the direction, we move to digital prototypes for intricate work to see if our ideas are feasible. The idea you could physically draw to that fidelity is unrealistic.....we can talk through and modify the digital work live because we are sat together side-by-side...At some point we are ready to bring in and review with others, I would take my computer and present to the team for their review and ideas.” (20, Designer).*

Figure 18 is created as an excerpt from Figure 15: Notifications and Comments, clearly illustrates this progression from a physical to a physical-digital environment. Here the team begin a brainstorming activity with a pure physical assemblage in the booth (note the display screen within the booth is switched off), comprising of paper and sticky notes for sketching and writing. In the subsequent prototype stage, the designers move to a *physical-digital assemblage* at their team table by including the use of Sketch and Invision software for design and prototyping alongside their physical artefacts. Finally, as the development of the story nears completion, a digital design is shared and reviewed at the titanic table.

**Figure 18: Physical to Digital Flows**

Purpose & Participants	Description	Assemblage	Evidence
Work activity to begin generating ideas for story using IBM design thinking framework	<p>The team begin with a <b>pure physical environment</b> without their laptops or any digital tools.</p> <p>They start by sketching ideas for the solution using paper and pen, as this is considered faster than digital and permits rapid feedback and annotation.</p> <p>The actions are agreed on paper.</p>	<p>Booth for proximity, use of table and noise isolation (screen not used)</p> <p>Use of paper and sticky notes</p>	
Collaborative work between designers	<p>The designers review the shortlisted sketches at the team table, where they are regularly seated next to each other.</p> <p>They plan a workflow of the solution and begin creation of digital prototypes, thereby creating a <b>hybrid environment which combines paper prototypes with digital design tools.</b></p>	<p>Team Table</p> <p>Paper with sticky notes</p> <p>Sketch + Invision software</p>	
Design and development team meeting	<p>Designers showcase their latest designs in <b>pure digital form</b> to the development team.</p> <p>The designers solicit feedback and considerations for further refinement.</p>	<p>Titanic table with large display screen</p> <p>Sketch + Invision software</p>	

This configuring of *physical-digital assemblages* in practice is consistent with the expected *spatial work practices* during the software design stages:

*“If it’s something new, we might sketch that out, if it’s a tweak to an existing design, we would do that digitally.” (20, Designer).*

Beyond selecting or substituting physical and digital communication, the data also demonstrated how actors combined components of their physical-digital environment for complementary effect. Actors would configure *physical-digital assemblages* to create simultaneous physical and digital proximity as illustrated by a developer whom appropriated a booth to support pair-programming where two programmers work together using a single workstation and a shared code base:

*“We would often use the booth, that’s useful because it is a fairly small area, there*

*is a television where someone would hook their laptop to share the work. It's a fairly informal environment, it's comfortable for discussion and working in. The layout is also good because you are facing each other directly and can both see the screen.” (18, Developer).*

By adapting and integrating their environments based on the context of the work being performed, the data demonstrates how the physical and digital modulated each other and how the environments became mutually constituted in practice.

### **6.2.3 Mutual Constitution of Physical and Digital**

The mutual constitution between physical and digital is exemplified in the following subsections by tracing team activities and analysing how the workflow and mirroring of environments had been deliberately orchestrated to integrate both environments.

#### **6.2.3.1 Workflow of Activities**

The positioning of team members at their respective desk had been deliberately orchestrated to allow communication to flow between team members in a manner consistent with the agile approach. This applied to the physical seating arrangement and was also tightly integrated into the digital tools including Slack and Jira channels notifications. The intent was to enhance the environment to support collaborative work. The orchestration was guided by a workflow analysis combined with the intention to adapt the environment based on whom needed to work with whom, whom needed to share information, and how the overall flow of work activities proceeded. For example, practitioner based sub-teams (i.e. developers) would exist and be supported by the seating arrangement at the team desk, planned and ad-hoc meetings, and also by configuration across the digital tools such as dedicated Slack channels (#devs, #bugs, #deployments) and configuration in GitHub.

The disposition of work within the team would commence with team members evaluating Agile work activities by investigating potential product needs and features through research or speaking to users and stakeholders. This research would lead to analysis involving the product owner and business analyst which would then lead to design and then finally into software development as explained by the following quote:

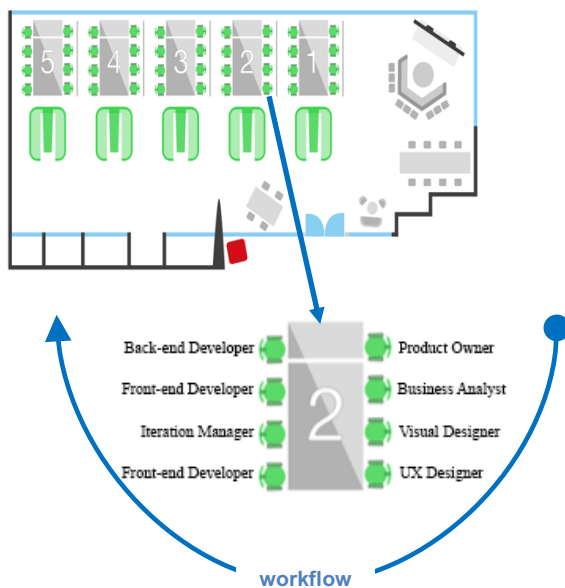
*“Usually a story comes in from a high-level requirement from one of our stakeholders to our product owner. They are the gatekeeper to the team. They would then pull in a business analyst to find out more information and evaluate why we are doing this work, and the value it could add, through research. That*



*requirement is developed into a story in Jira...once it is in the backlog it is looked at by the designers in the team...we only start development once the design work has been completed.” (22, Iteration manager).*

This resulted in a workflow of agile work activities moving in a clockwise direction across the team. It would begin with the product owner, moving through to the business analyst, then design and ending with the development team as illustrated for Studio team 2 in Figure 19.

**Figure 19: Workflow of Activities**



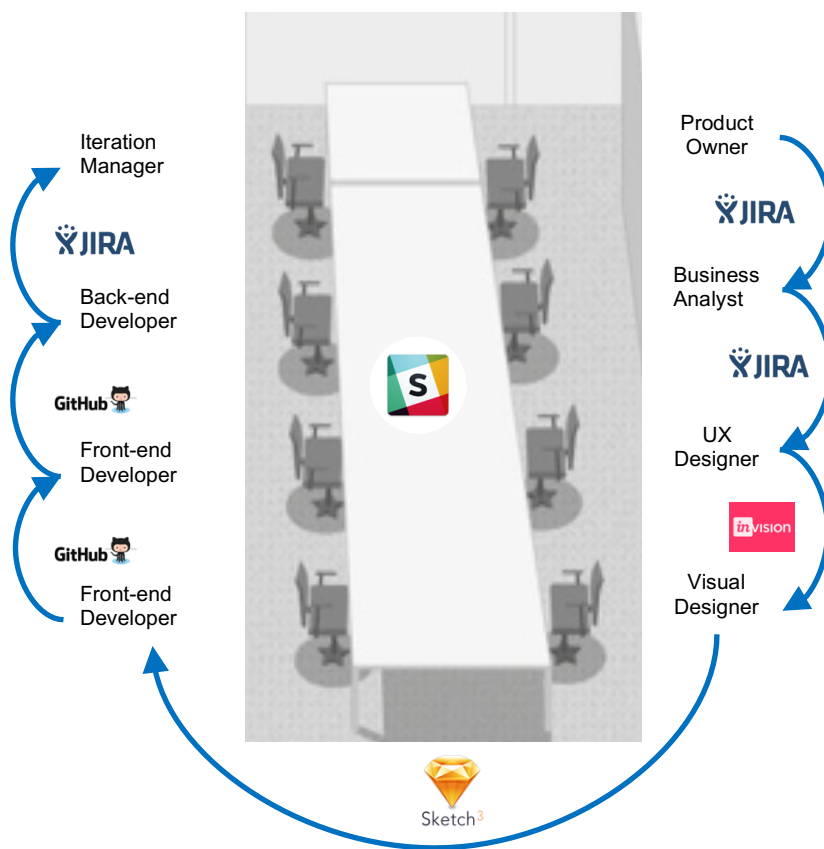
This physical seating arrangement was tightly connected with the digital activities on Slack and Jira, and was adopted to facilitate optimal communication and propinquity, so that team members could continue discussions across both physical and digital. Team members intentionally arranged their seating adjacent to those with whom they most frequently interacted as explained by a designer:

*“The other designer and I made a conscious decision to sit next to each other early on, it felt natural to sit next to each other, so we could work closely together. I also sit diagonally across from the front-end developer so we can see each other, as we frequently need to speak.” (20, Designer).*

The use of digital tools and notifications between team members was aligned to the workflow and corresponding physical proximity at the desk as illustrated by Figure 20. The product owner and business analyst would communicate physically, but also through Jira as their primary workflow tool to share requirements and acceptance criteria for new software development. From here, the business analyst would perform research which would be

captured in Jira and shared with the user experience designer digitally and communicated in person. The user experience designer would work alongside the visual designer to eventually translate these requirements in Jira to Invision prototypes. Post successful user testing, the prototypes would be created as designs in Sketch, which would be explained and shared with the front-end developer and so forth. This close proximity in the physical environment to support online activity was deliberate to allow team members to clarify anything that is posted online on Slack channels, subgroups (i.e. #Developers and #Design) or within Jira or GitHub.

**Figure 20: Mutual Constitution of Physical and Digital**



The two spaces thus evolved in a symbiotic relationship to support the flow of discussions across physical and digital environments, as illustrated by the following quote from an iteration manager:

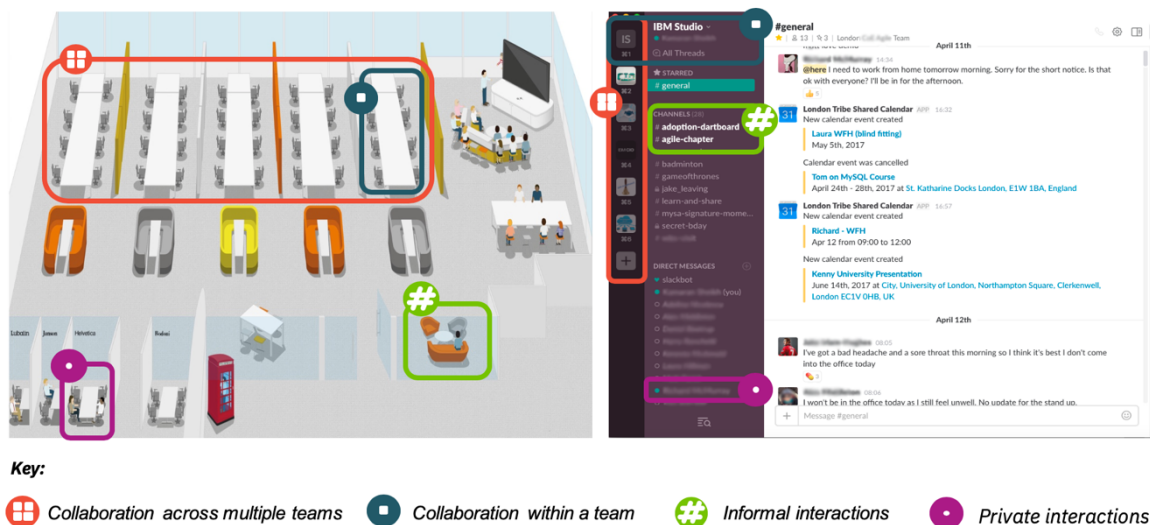
*"The conversation continues without considering the medium. If you just tried to follow on Slack you would lose part of the conversation. Typically, we use face to face for detailed richer conversations, whereas Slack tends to be more for auditable or transactional exchanges." (22, Iteration manager).*



### 6.2.3.2 Mirroring

When observing the use of physical environment and digital tools, it was also apparent how the properties and features of the digital tools mirror the configurations of the physical environment within the Studio without explicit skeuomorphic cues or properties. For example, as with the physical Studio layout, Slack enables interaction to take place across teams or within dedicated team spaces, which can then be further subdivided into more focused interactions within specific channels. This mirroring of these physical and digital structures is illustrated in Figure 21. Communication across the individual teams is available within each team's respective physical desk or Slack 'workspace'. Within each team, the #General channel can be seen to mirror conversations which take place at the shared team desk; whilst the focused #channels are analogous to the informal break-out areas of the office layout, such as a team booth or communal spaces. Further, private interactions within Slack are available as a mirror extension of the physical Studio meeting rooms.

**Figure 21: Mirroring of Physical and Digital Places**



Team member behaviours would often take this mirroring into account. For example, by broadcasting messages to their collocated across both mediums team as explained in the following a work activity involving a designer:

*'We had an impromptu meeting in the team space – it was someone standing up and saying, and also posting an '@here' in Slack saying "does anyone have some time? I really need to discuss this", we do that quite a bit.'* (20, Designer).

These shared and reflective structures, labels and arrangements were not enforced or imposed by Studio or IBM management, but instead constantly negotiated and established by the teams in the environment, where they developed in a symbiotic form. As the physical and digital co-exist with reflective properties, they were mutually constituted and often used to modulate each other as supported by the following quote from a business analyst:

*“The digital tools tie together the physical spaces because you have more opportunities to interact, you have the physical and the digital, so if two people need to communicate, they’ve got a host of ways of doing it.” (5, Business analyst).*

#### 6.2.4 Summary

The three 2<sup>nd</sup> order themes relating to composition of *physical-digital assemblages* characterised the empirical data: (1) Ontogenesis, (2) Modulation, and (3) Mutual Constitution of Physical and Digital. *Physical-digital assemblages* establish that the materiality of physical and digital exist as an assemblage in an integrated spatial environment. *Physical-digital assemblages* occur within places that actors recognise (i.e. buildings, offices, meeting rooms) as configurations which actors appropriate in order to work. The space that is actualised is not always predetermined as strategic by the organisational or the physical canvas, rather it may be determined tactically and shaped by the types of activities that take place within it through a combination of what the physical space and digital tools mutually engender. This gives due consideration to the self-assembling nature and empowerment of individuals to craft their own workspaces in addition to those which have already been prescribed.

Collectively these features are situated through both actors and the environment as actor-environment systems (Hutchins 1995a; Stoffregen 2000; Volkoff et al. 2007). These assemblages provide a vocabulary which articulates and conceptualises a configuration of the combined practiced places where work happens. They enable an enactment of *spatial work practices* for work activities to happen through properties and features which are configured within them. *Physical-digital assemblages* thus both enable and constrain the potential for *spatial work practices* which are enacted through them.

Central to *physical-digital assemblages* are the contextual and strong relational view between the environments, actors and objects. Mutual relations exist between technologies, artefacts and actors as being intertwined and inseparable. Whilst the materiality of an object or technology is experienced at an actor specific individual level, it is shaped by its environment and social context. Actors within *physical-digital assemblages* may be connected through multiple concurrent channels for example face-to-face interactions, digital

collaboration tools and configured software platforms. Assemblages are therefore deeply embedded within both physical and digital and do not permit enactment or an understanding of *spatial work practices* if either is removed.

The tracing of work activities through the four vignettes demonstrated the corresponding *physical-digital assemblages* to be a continuum of ontogenetic configurations that modulate interactions to support work activities within pockets of time and space. As *spatial work practices* are discontinued, the corresponding *physical-digital assemblage* is dismantled to enable subsequent work activities and *spatial work practices* which configure new *physical-digital assemblages* for further work to happen. This continuum of *spatial-work practices* and *physical-digital assemblages* are configured in specific ways in order to create unique spatial effects for their enactment. It is through this process that spaces are crafted and performed. These intended spatial effects are a central input to understand how and why particular workspace configurations exist and can be categorised.

### 6.3 Spatialities

For members of software development teams, success lies not only in completing tasks, but also the ability to adapt behaviours and appropriation of tools with precision in relation to the evolving form of the particular work activity (Ingold 2011). These actors familiarise themselves within their surroundings by learning how to navigate very specific material settings which enable them to collaborate (Ingold 2013) with others and their environment, through a learning process which depends on their ability to appropriate these interwoven settings as necessary (Noë 2012; Rietveld and Kiverstein 2014). As such, software development in a large team lies not only in the ability to 'write code', but through an active exploration of the possibilities afforded by the environment. This includes their choice of physical setting and digital tools, their respective configuration, physical proximity to others and social norms and working practices as necessary throughout the respective stages of the software development lifecycle.

Having established the contextual relation between environments, actors and objects, we can also establish a logical inference that same object and individual in a different environment may produce different effects as supported by the following quote:

*"Even with the same people, the setting definitely makes a huge difference in behaviours." (22, Iteration manager).*

Actors deliberately configure particular *physical-digital assemblages* to enact particular *spatial*

*work practices*. This process is a central linkage to create particular spatial effects within workspaces known as their *spatialities*. *Spatialities* are intended spatial effects which explain the link between particular *spatial work practices* and the configuration of the corresponding *physical-digital assemblage*. *Spatialities* connect what actors are trying to achieve and what the environment affords. That is the intended spatial effects to support work activities given the contextual and relational view of the environment. The emergence of this concept can be seen by examining the 2<sup>nd</sup> order themes which establish the spatial intent and spatial preferences of relevant actors.

### 6.3.1 Spatial Intent

Spatial intent within the Studio can be linked to the conceived design of the physical and digital environment as captured in 1<sup>st</sup> cycle coding. For example, the iteration manager was often responsible for organising and facilitating meetings to help the team achieve its desired objectives. This included the daily stand-up ritual, where the intent to eliminate distractions and provide rich visual cues between team members was evident:

*“Our daily stand-up happens in our team area, we actually stand up and congregate around a single screen, usually displaying our Jira stories and sometimes a video conference session for anyone working from home... Doing it this way helps us to focus, stepping away from other distractions, we can look each other in the eye and read each other’s signals.” (22, Iteration manager).*

The iteration manager also explained the spatial intent for a sprint planning meeting. Here the intent was to create an informal environment encouraging participation and open creative discussion. These spatial effects were orchestrated through the configuration of a specific *physical-digital assemblage*:

*“The developers will sit in the booth with the screen showing technical tools like GitHub and Sublime text editor. It takes place in the booth because there are usually 4-5 people and it’s less meeting like, more exploratory, conversational, informal and highly detailed. It’s not a meeting and it shouldn’t feel like one... The design of the booth with the cushions and colours makes the meeting more productive and creative. It gives the junior members more of a chance to speak up, which they are definitely more hesitant [to do] in a meeting room.” (22, Iteration manager).*

Outside of the formal meetings and rituals, the deliberate configuration of the environment

by team members to create physical and digital proximity at their team desks was intended to provide additional benefits beyond the completion of work activities. This included amplification of sharing and learning through observing others as explained by a business analyst:

*“I think when you are sat next to someone it is so much easier to learn, being right next to people with different skills set, that’s really valuable. If I want to learn from them, I can just sit next to them or shadow them or just ask a question and get an immediate response.” (21, Business analyst).*

In another example, when commenting on the Notifications and Comments vignette featured in Figure 15, page 103, the designer explained how a *spatial work practice* with the intention of sharing, reviewing and generating feedback for a product feature affected the selection of the corresponding *physical-digital assemblage*:

*“We wanted to share the invision [prototype] design, and so we chose the Titanic table. We needed a space where everyone would fit, the booth is not big enough and a meeting room is too formal. Whereas the Titanic table is more collaborative and open air and there is a feeling of more creativity and openness to the space.” (20, Designer).*

The designer continued to explain how this deliberate selection of place, and consequently deselection of an alternative was made to exclude use of a setting considered detrimental to generating discussion and feedback:

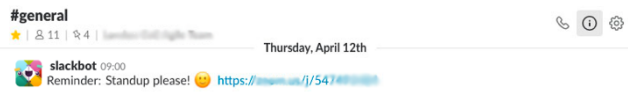
*“As an alternative [to the Titanic table], we only have one large room which is big enough for everyone... it’s walled on all four sides with no windows, it feels very formal and when we meet there, people can get heated or seize up.” (20, Designer).*

This intent to create a relaxed and informal setting was inherent to the *spatial work practice* and the success of the work activity. When combined with the attempts by teams to eliminate the use of digital distractions or prioritise physical interactions instead of digital, this also demonstrates how the materiality of the physical environment plays a significant role in shaping the use and configuration of digital tools.

Spatial intent also existed within the digital tools. Slack channels were created for a broad range of topics, both work and non-work related. The interactions within these Slack channels and across other digital platforms including Jira and GitHub modulated the interactions

between team members throughout their working day. As the physical and digital environments were combined in practice, spaces emerged as specific *spatial work practices* and *physical-digital assemblages* to modulate spatial and temporal interaction in support of work activities. For example, where a team used a ‘Slackbot’ feature from Slack to modulate the use of physical space as shown below in Figure 22.

**Figure 22: Slackbot Automated Reminder**



Here a Slack automation set at 9:00am each working day provided a reminder in their #General channel for all team to routinely perform their 15-minute stand-up. Following this prompt, and without any further physical signalling, the team began to stand and form a circular formation around their designated team wall of work. A team member would then configure a Jira screen adjacent to the team for all team members to view. This space and time therefore became a recurrent template. A business analyst from the team explained how this Slack feature was considered important to support the team operations:

*“You can create bots to remind you of things that you should be doing on a daily basis or a weekly basis. For example, we have a reminder for our stand-up just to keep us honest and make sure we are doing our Agile rituals at the right time.” (21, Business analyst).*

Whilst the appropriation of the physical environment and digital tools supported actor intended spatial effects, they also extended beyond utilitarian needs. Actors would also create *physical-digital assemblages* to support their preferences and perceived desirability to work within them.

### 6.3.2 Spatial Preferences

Teams would adjust their *physical-digital assemblages* to select and appropriate the features and properties of their environment in order to benefit from their perceived spatial effects. This was again planned and deliberate, with team members actively aware of their environment including the collocation of colleagues, their prioritisation of modes of communication, the desirability to work in various locations and the effect that different locations have on their ability to work:

*“We definitely have a feeling of where we can and cannot work. If you have to work in an environment where your eyes are hurting or it feels depressing, you really*



*don't want to work in that space. One of the reasons I became a designer is that I didn't want to work in an environment like that or in cubicles. I feel it's depressing. We should have enough lighting and windows. I feel it affects the whole working environment. More businesses have to follow what agencies and creative industries are doing. I don't believe it should only be for the creative people.” (10, Senior visual designer)*

For example, the enclosed space and soft-furnishings of the booth was concomitant with the informal and collaborative setting of the Studio as shown below in Figure 23. Team members can be seen in a relaxed slouching or cross-legged posture. This setting created unique spatial effects for small groups as explained by a manager.

*“You feel encapsulated in the booth, with the comfort of a couch and almost the privacy of a meeting room, but without the formality.” (3, Manager).*

**Figure 23: Relaxed Booth Seating**



We can also take the example of the retrospective meeting, which is often considered the most important ritual meeting in the Agile methodology. A retrospective requires teams to reflect on their successes and areas for improvement during their previous iteration. This meeting is unique as rather than focusing on work activities, it also requires the team members to be both critical and introspective of their interactions and work process. An iteration manager explained how configuration of a particular *physical-digital assemblage* was preferred to support this:

*“We used to do the retrospective in a meeting room, but now we prefer to have a change of scenery to remove the tension. Taking a break with coffee and going outside usually preceded by general chit-chat gives us a nice break, we can relax and it enables people time to gather their thoughts and emotions [on sticky notes]*

*... Doing this using digital tools wouldn't work as well...most people probably wouldn't respond, it could be more defensive and less conversational." (22, Iteration manager).*

The appropriation of particular digital tools also became associated with different meanings and purposes, consequently leading to different modulation of behaviours and activities as exemplified by the following quote from an iteration manager:

*"I suppose in our culture, email is seen as more formal, to cover your back or deal with an escalation. Any conversation over Slack is seen as more cooperative and that we are trying to coordinate and make work happen." (22, Iteration manager).*

The selection of digital platforms (such as Slack) and consequent deselection of alternative platforms (such as SameTime Messenger) was also deliberate and intended to support newer collaborative ways of working as explained by a developer:

*"We do have SameTime messenger, although we tend to use that less [than Slack], because it is less collaborative - more 1:1 rather than team based, it also isn't persistent so you can't continue conversations." (18, Developer).*

The use of the Slack became a popular choice throughout the Studio, the platform enjoyed rapid user adoption due to its ability to integrate communications from several other digital tools into a single persistent source. This allowed users to better cope with the high number of digital tools, switching costs between them and multiple communications channels. A business analyst explained how Slack was used for the integration of multiple digital tools into as a single platform:

*"You can integrate Slack with a lot of other tools as well. I think it allows team members to innovate, they enjoy that sort of thing. It can help reduce some of the work they have to do to organise things. We have a google calendar where we update our availabilities... the whole team could access that on Google, but with Slack you just setup an integration ... so they see and can plan ahead, you start to have just one place that you need to check. It becomes messy otherwise, everyone wants everything in one place." (1, Business analyst).*

A developer also discussed a similar theme and the general preference toward the Slack platform around the Studio:

*"The big reason I like slack is because of the integration with other tools with things*



*like our code repository and our builds, it can automatically notify us. It also links in with our calendar so if someone adds an event to the calendar it can inform the rest of the team automatically that they are going to be out of the office on a certain day.” (18, Developer).*

This integration functionality combined with synchronous communications and a highly customisable ‘team space’ with dedicated channels was cited as important by an iteration manager for modulating the interactions between team members:

*“The ability to create channels within Slack is a very important distinct feature... We create channels when the people in a conversation feel a topic is something other people might be interested in or the topic is going to stay relevant for a longer duration of time or requires others to be made aware – increasing visibility and transparency for other team members. It makes coordination easier and creates visibility for others to see what’s going on.” (22, Iteration manager).*

### 6.3.3 Summary and Examples

The two themes relating to the origins of *spatialities* characterise informants’ experiences of *physical-digital assemblages* through their: (1) Spatial intent, and (2) Spatial preferences. This analysis shows that as these human actors configure, adapt and appropriate physical environments and information systems, the materialities of physical arrangements and digital tools enable them to configure new *spatialities* by modulating and controlling how people interact with each other. *Physical-digital assemblages* represent the materiality of the environment which has a practical effect for actors. Changes within the assemblages therefore have a direct effect on the resulting *spatialities* which may also change or even cease to exist. The *spatiality* is an intended effect of a specific *physical-digital assemblage* which is configured to support the enactment of specific *spatial work practices*. *Spatialities* link what actors are trying to achieve and what the environment affords. They help us to understand why constituent elements and groupings within *physical-digital assemblages* are appropriated from the perspective of the actors performing the work.

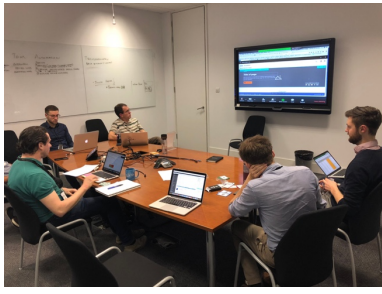
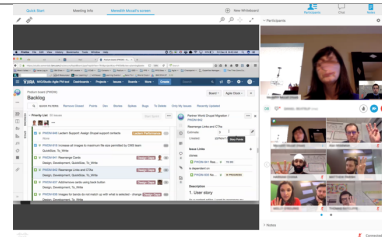
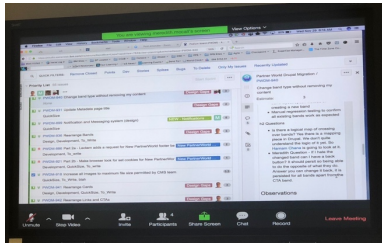
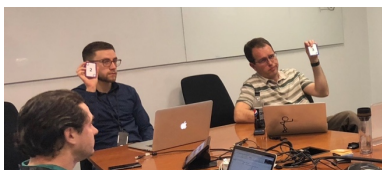
As organisations create and permit the configuration and combination of physical and digital environments, they are enabling opportunities for employees to create *spatialities*. This was not previously possible when the office layout was inflexible and work activities were more standardised and paper based. This has changed with the evolution of modern organisations which are underpinned by knowledge work, digital technologies and methodologies which encourage collaboration and employee autonomy and innovation. As modern working is

increasingly digital, modern organisational settings have become increasingly modular to enable emergent reconfiguration and support fluidity of work.

We can now apply this analytical tool by combining a *spatial work practice* and *physical-digital assemblage* to arrive at the *spatialities*. For example, Table 3 demonstrates the *spatialities* for a sprint planning meeting which is a strategic *spatial work practice*. The purpose of the sprint planning meeting was for the product owner and team to negotiate and agree work output for a two-week 'sprint'. By applying the lens to this practice, we can deconstruct this *physical-digital assemblage* into its component parts to identify the intended spatial effect and preferences, these can then be aggregated to arrive at the *spatialities* for the workspace.

In this example we can see the combined use of a meeting room, Webex video conference and digital Jira board facilitates information sharing and participation from all members. The rituals within the meeting are designed to share information to reach a consensus and agreement on expected work output. However, the *spatialities* suggest a more profound intent, by holding the meeting face-to-face within a formal meeting room and providing shared and transparent access to information, the *spatialities* demonstrate the intent to create a collective and shared formal accountability for completion of work output within the next two-week sprint. These *spatialities* allow team members not only to share digital information and modulate spatial and temporal conditions with the remote product owner, they also enable a reading of body language and signals.

**Table 3: Spatialities for Sprint Planning Meeting**

Physical-digital assemblage component	Examples	Spatialities: Intended Spatial Effects
Large Meeting Room		<p>The large meeting room is a formal meeting area with a large table, digital display and seating for 10 attendees. The room has no windows. It is available by booking and generally used only for meetings.</p> <p>The purpose of the work activity is to plan and agree the work activities to be committed by the team for the upcoming agile sprint. The meeting includes information sharing, work estimation, planning, negotiation, due diligence, consensus building.</p>
Webex		Face-to-face interactions for the remote product owner for face-to-face communication and the reading of visual cues.
Jira		<p>Digital repository of Jira stories which are used as the main discussion topic during the meeting.</p> <p>These are stored in a persistent, editable and visible output for all attendees to view during the meeting.</p>
Agile Poker planning cards		Used for estimation of effort/complexity of work activities to gain collective agreement.
<b>Spatial Work Practice:</b> Sprint Planning Meeting	<b>Type:</b> Meeting (Strategic)	These spatialities create a rich, visible and formal environment for team members to collectively agree a shared commitment of work output for the next sprint.

This same sprint planning meeting held within a different *physical-digital assemblage* would produce different spatial effects. For example, the closed meeting room could have been substituted with the open-plan Titanic table. Although the activity would still function, it would no longer retain the same formality as the use of a private meeting room. Whilst the Titanic table may be conducive to encouraging creative thinking, it may not support the intended formality or distraction free setting. The meeting could alternatively have been held entirely



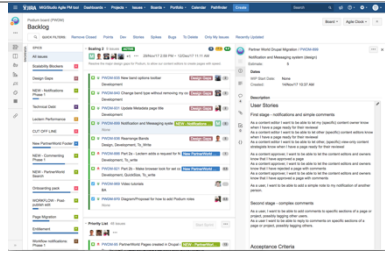
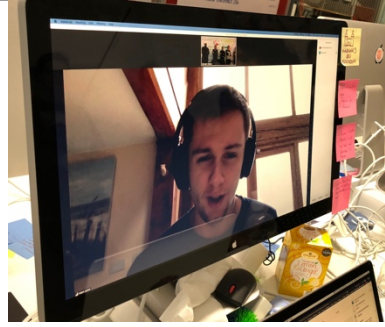
digitally by Slack. This method would have been slower due to reduced richness in communication, leading to increased ambiguity and coordination challenges. The exclusive use of Slack would also have diminished the formality and significance of the meeting as employees may be more prone to multitasking or being distracted by their local surroundings.

Next we refer back to Vignette 3: Notification and Comments vignette, page 101 and apply the analytical tool of *spatialities* to the strategic spatial work practice of the stand-up. We can again, deconstruct this *physical-digital assemblage* into its component parts to derive the intended spatial effects as illustrated through Table 4. From this, we can ostensibly establish the stand-up as a daily scheduled 15-minute face-to-face team meeting, where team members share status updates and planning of work activities against agreed objectives. However, an analysis of the activity using the lens of *spatialities* uncovers a deeper intent.

The use of a face-to-face format enables team members to read each other's visual cues and signals, whilst standing ensures the meeting is kept concise and focused. Standing specifically in a circular formation reinforces the team-based nature of the activity and shared accountability toward the team goal. The stand-up is also known as a daily 'scrum', taken from the team game rugby where players bind together to commence play. As with sports teams, agile teams are also considered to collectively succeed or fail. Looking at the digital tools, the use of a daily Slack reminder enforces both the regularity and timing of the practice. The use of a shared Jira board is used to drive the conversation as each team member speaks about progress on their assigned work activities before 'handing over' (another rugby analogy) to a colleague.

By aggregating these components, we can ascertain that the *spatialities* of this workspace are to enforce team members to share status information daily in a concise format through rich interactions which help to reinforce a shared commitment and esprit de corps within the team toward their shared goal. Whilst the updates provided within the meeting could have been provided digitally or by each team member orally whilst still seated at their desk, this would not hold the same symbolic value or create the same *spatialities*.

**Table 4: Spatialities for Stand-Up Meeting**

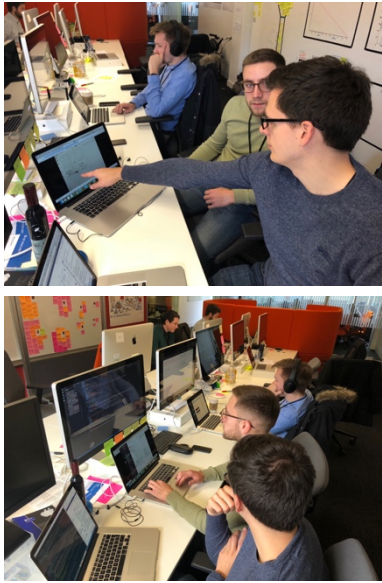
Physical-digital assemblage component	Example	Spatialities: Intended Spatial Effects
Slack		Daily reminder to initiate meeting on a timely basis.
Team Wall of Work		Proximity, face-to-face interactions, enables team to stand in circular formation, elimination of distractions.  Standing keeps the meeting brief (15 minutes) and creates a sense of team camaraderie.
Jira		Sharing status updates on work activities and blockers, planning work activities against agreed objectives.
Webex		Face-to-face interactions for remote team members.
<b>Spatial Work Practice:</b> Agile Stand-up	<b>Type:</b> Meeting (Strategic)	These spatialities enable team members to share information in a concise format through rich visual interactions to reinforce a shared commitment and esprit de corps toward their shared goal.

Next, Table 5 examines the *spatialities* for a tactical *spatial work practice* for the two developers whom organised and performed a pair-programming work activity within the Default Landing Page vignette on page 98. This *spatial work practice* begins when the senior developer reconfigures his position at the team table to sit adjacent to the junior developer. From this point, they create a *physical-digital assemblage* to bring together their respective workstations and the software development environment. This pair-programming activity lasts for 195 minutes where one developer writes code (driver), whilst the other developer (navigator) reviews the code and provides guidance. These roles are switched frequently.

The decision to reconfigure seating position to sit together not only displaces the need for any digital modulation for communication, it also creates a rich environment for synchronous exchange with temporal and spatial proximity. Whilst pair-programming is designed to improve

code quality and reduce defects, the particular *spatiality* enables reading of visual cues. This can be seen in the first picture where the senior developer points to a line of code whilst the junior developer carefully observes. This would not have been possible to the same extent if the developers had collaborated remotely or had sat opposite each other in a meeting room. Further, by sharing their environment within this collocated setting, the developers are able to exchange information through a flow of rich interactions across physical and digital space which not only ensure effective code, but also enhances sharing, learning and rapport between them. This *spatiality* was again planned and intended as the junior developer later explained that he was part of an internship programme and had been offered the opportunity to work alongside senior colleagues in the Studio to enhance his software development skills in support of his career prospects.

**Table 5: Spatialities for Pair-Programming**

Physical-digital assemblage component	Examples	Spatialities: Intended Spatial Effects
Team Table		<p>Proximity, sharing and learning of information using face-to-face interaction, laptops with external displays and SDK environment.</p> <p>The Agile Pair-programming technique enables developers to write code collectively, reducing defects and improving code quality.</p> <p>One developer writes code (driver), the other developer (navigator) reviews the code and provides guidance. The roles are switched frequently.</p>
<b>Spatial Work Practice:</b> Pair-programming	<b>Type:</b> Work activity (Tactical)	These spatialities create highly proximate interactions which provide continual context supporting collaborative problem solving, sharing and learning.

Finally, we analyse another tactical *spatial work practice* of the impromptu meeting taken from the User Feedback Prioritisation vignette on page 95. Again, we deconstruct this *physical-digital assemblage* into its component parts to apply the analytical tool of *spatialities* using Table 6. We begin by looking at the ‘Wall of Faces’ artefact which has been created to visually represent the sentiment of users and stakeholders. This feedback could have been



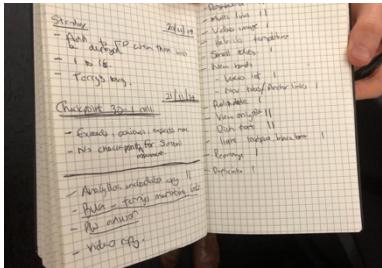
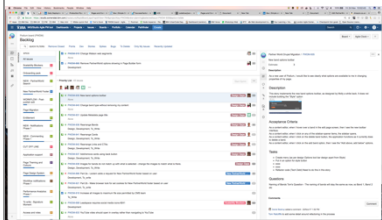
tracked within a spreadsheet or digital repository, instead the team chose to appropriate their wall of work to create a symbolic and persistent reminder of the perception of their software product. This is combined with the physical setting of the booth which provides a relaxed informal setting with a degree of noise isolation. It creates spatial and temporal proximity through face-to-face interaction and sharing of information via the digital screen and table space for manipulation of physical objects including a notepad, which is used for note taking. The physical environment is combined with the Jira software on the booth display to cross-reference against known issues and planned work. As the activity is performed, the sticky notes are gradually removed and validated against existing or new Jira stories for later code development. In summary, the intended *spatialities* of this work activity enable the two team members to create a relaxed and comfortable informal setting to brainstorm and coordinate through rich interactions. This enables them to analyse physical feedback artefacts and work through a process to migrate them to digital work activities.

These examples demonstrate the tightly linked relationship with *physical-digital assemblages* and *spatialities*. The *spatialities* are actor intended effects to support work activities. They help us to understand from the perspective of the actors performing the work, why constituent elements and groupings within *physical-digital assemblages* are appropriated. They illustrate how different *physical-digital assemblages* enable different *spatialities*. Each *spatiality* exists as an intended effect of a specific *physical-digital assemblage* which was created through enactment of a specific *spatial work practices*. The concepts are closely linked together as a unit occurring at the same time.

The aggregate dimensions can now be combined together to present the emergent framework which illustrates and provides an understanding of how physical and digital environments are being integrated as performed spaces in practice and the unique spatial effects that they enable.



**Table 6: Spatialities for Impromptu Meeting**

Physical-digital assemblage component	Examples	Spatialities: Intended Spatial Effects
Whiteboard 'Wall of Faces'		Visual repository of information which signals sentiment of users. This was analysed during the work activity.
Booth		<p>The booth is considered a relaxed informal setting with soft cushions and perceived privacy. It enables proximity for face-to-face interaction and sharing of information using shared digital screen and table space for manipulation of objects.</p> <p>The work activity includes collaborative brainstorming and coordinated planning.</p>
Notepad		Rapid capture of discussion and agreed actions.
Jira		Digital repository of agile stories, which are converted from the physical notes and Wall of Faces into digital work activities as new Jira stories.
<b>Spatial Work Practice:</b> Impromptu meeting for analysis and planning	<b>Type:</b> Work activity (Tactical)	These spatialities enable two team members to create a relaxed and comfortable informal setting to brainstorm and coordinate through rich interactions. This enables them to analyse physical feedback artefacts and migrate them to digital work activities.

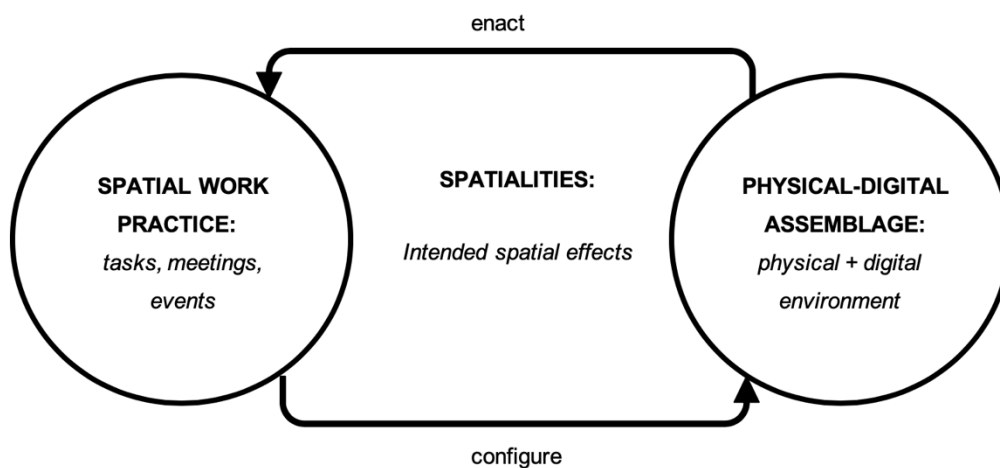


## 6.4 Crafted Workspaces

The conceptual link between *spatial work practices* and *physical-digital assemblages* provide an exploration of how this combination of material features allow actors to achieve things that were previously difficult or not possible through perceived spatial effects known as *spatialities*. Combined through a conceptual framework, as illustrated by Figure 24, *crafted workspaces* enables new knowledge to understand the performative practice-based view of space which represents the pockets of time and space that are beckoned into existence for work to be performed.

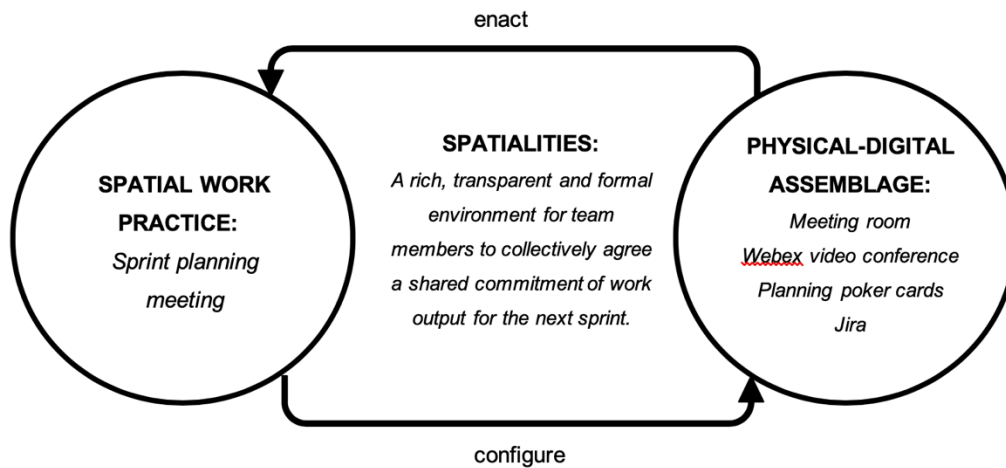
*Crafted Workspaces* enable a transcendent understanding of how integrated workspaces emerge as space in modern software organisations, shaping both physical and digital environments and defining topological relationships between people and things (both digital and non-digital), whilst simultaneously being shaped by them in practice.

**Figure 24: Crafted Workspace Framework**



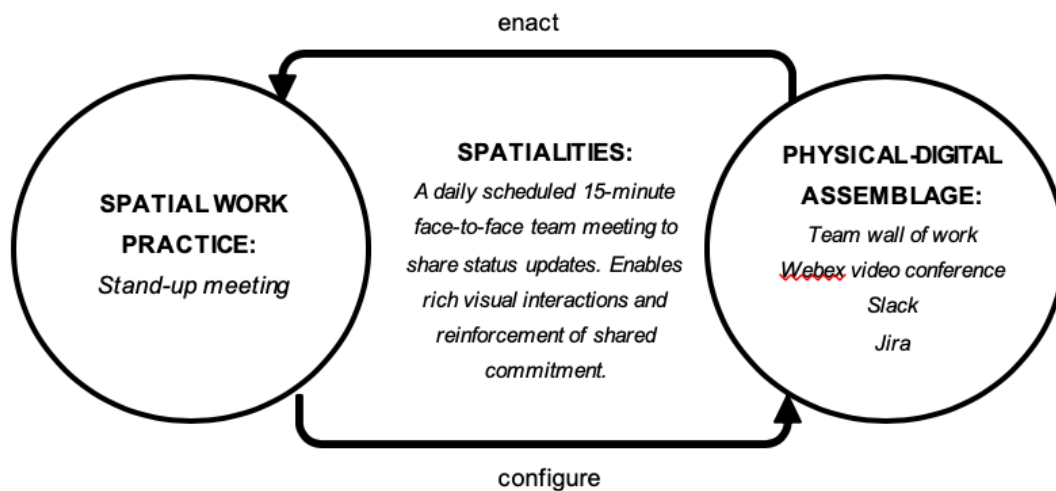
This conceptualisation is useful for shedding light on the role played by the physical environment and digital technologies in the constitution of the workspaces for software development of our empirical case study. For example, Figure 25 illustrates the *crafted workspace* for the strategic sprint-planning meeting as previously explained in Table 3. The combined use of a meeting room, Webex video conference and digital sharing of the Jira board facilitates information sharing and participation from all team members. The rituals within the meeting are designed to share information to reach a consensus and agreement on expected work output as a shared formal accountability for completion of agreed work output for the next sprint iteration.

Figure 25: Crafted Workspace for Sprint Planning Meeting



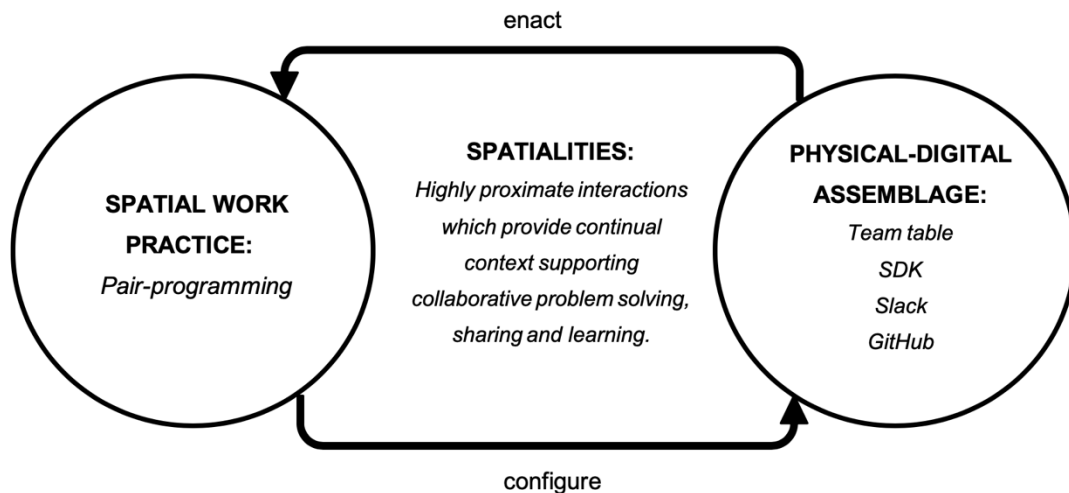
Next, Figure 26 below illustrates the crafted workspace for the stand-up meeting previously described in Table 4. This ritual is performed through a carefully orchestrated *physical-digital assemblage* with deeper symbolic purpose and meaning than sharing of status updates and planning of work activities. The modulations of the software and physical features of the office create a disciplined ordering of rich visual interactions between team members. Team members stand in unison to enforce their shared commitment and build ‘esprit de corps’ toward a common shared objective.

Figure 26: Crafted Workspace for Stand-up Meeting



Finally, Figure 27 shows the *crafted workspace* for the pair programming which was previously examined in Table 5. Here, the way digital tools modulate the production of space is different from the previous types of strategic *spatial work practices* for more recursive activities. In this case, the digital tools and physical environment operate together to support quick reaction and immediacy in discussion and focused observation in a tactical *spatial work practice*. The developers shared attention was on collaborating to solve a coding problem and the type of arrangements created to support the project were loose and informal, rather than more formal structural arrangements in strategic *spatial work practices*. This type of workspace involved an assemblage of physical seating at the team table and digital notifications across multiple digital platforms including Slack and GitHub. The *spatialities* enabled the team members to share information through a flow of physical and digital spaces with rich interactions which provide context and enhance collaboration for problem solving, sharing and learning between the team members.

**Figure 27: Crafted Workspace for Pair-Programming**



The concept of *crafted workspace* which was introduced in abstract form in Figure 24 and has subsequently been applied to three respective workspaces. It demonstrates how each workspace developed through distinct attributes that reflects physical features of the work environment and unique modulations of software to follow the patterns of both tactical and strategic *spatial work practices*. Whilst strategic *spatial work practices* may be familiar to organisations, tactical workspaces are not. They represent previously unknown or unintended practices which can now be captured and appropriately designed for.

*Crafted workspace* thus provides a unification of the aggregate dimensions which can be applied more generally to explicate how space is created and performed within modern

organisations. As a framework, it provides a novel notion of workspace as a new transcendent 'space' which combines physical with digital as a new kind of surface alongside human agency and organisational process for work to happen. It is fitted to explain activity-in-context within modern digital organisations, like a glove fits to the hand. This represents a landmark theoretical contribution with utility for information systems and organisational studies research.

## 6.5 Chapter Summary

Following the proposed methodological approach, this chapter developed the 1<sup>st</sup> cycle coding within the results to support the emergence and development of 2<sup>nd</sup> order themes through the theoretical lens. These themes lead to three novel aggregate dimensions which extend the theoretical lens: (1) *Spatial work practices*, (2) *Physical-digital assemblages*, and (3) *Spatialities*. These insights enable an understanding of modern workspaces and the basis of the emergent framework of *Crafted Workspaces*.

The use of the theoretical lens has provided an understanding of *spatial work practices* which can be categorised as having either strategically planned or tactically emergent trajectories. These tactical trajectories are made possible as employees who are given the autonomy and possibilities to reconfigure their environments.

The analysis shows how technology is routinely combined with physical space, where it is appropriated and takes shape in practice through *spatial work practices* as *physical-digital assemblages*. These *physical-digital assemblages* explain the materiality of their environment. They include both the physical location along with the digital tool(s) which are used within that setting and configured for usage and integration. They provide a vocabulary which articulates and conceptualises configurations of place for work to happen. The assemblages are inherently ontogenetic and configured as an appropriation of the combined physical-digital organisational topography, based on the needs of actors to support work activities. The relationship between physical and digital is mutually constituted which modulates the behaviours of actors based on context and relational to other actors and objects.

The construct of *spatialities* provides an understanding of why actors deliberately configure particular *physical-digital assemblages* to enact particular *spatial work practices*. This process is a central linkage to create particular spatial effects. *Spatialities* explain the link between particular *spatial work practices* and the configuration of the corresponding *physical-digital assemblage*. They help us to understand from the perspective of the actors performing the work, why constituent elements within *physical-digital assemblages* may be grouped and appropriated. These concepts are all closely linked together as a unit and they happen at the

same time. Together, they provide an exploration of how both physical and digital environments are being combined as performed spaces in practice and the unique spatial effects that these tightly integrated spaces enable through the aggregated framework of *crafted workspaces*.

The framework of *crafted workspaces* brings together each of these dimensions to arrive at a landmark novel contribution which redefines the notion of workspace to fit modern organisational settings using a performative and practice-based view of space. The framework is applied to three illustrative examples of spaces which were crafted by software development teams. This contribution enables a capture of the continuum of ontogenetic spaces that transcend physical and digital, emerging from interactions between people, work practices, and the combined physical and digital environment.

## **CHAPTER 7: CONCLUSION**

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Research on digital work has mostly neglected or marginalised the productive and essential role played by the physical environment in the adoption and appropriation of digital tools in modern software organisations. This study demonstrates that this absence of space within the information systems research is a major limitation in understanding new forms of workplace settings and practices. The study takes the nascent steps in response to recent calls to bring space back into organisational theory (Fayard 2012a; Kornberger and Clegg 2004). It does this by addressing gaps in the literature which have looked separately at technology and digital tools without seeing them in the context of the physical environment within which they are used. This is achieved through an empirical study of work in modern organisations which has examined the work practices of collocated digital workers whom combine physical face-to-face environments with digital technologies through regular interactions on the space-time continuum. It has demonstrated that space is not only synonymous with physical environments, but digital technologies play an important role too. More so it has shown that physical and digital coexist symbiotically as contextual and relationally interdependent variables as an integrated space within modern organisations.

## 7.1 Limitations and Further Research

This study was performed as case study of multiple teams within a single empirical setting. The empirical data was captured over a longitudinal period of eighteen months between January 2017 to June 2018. Whilst this work may be generalisable across similar settings with equivalent deadline-driven sequenced teamwork in modern organisational settings, further research may wish to validate this through a multiple case study approach. Given the rapid pace of change within digital work, such a study may benefit from data being captured simultaneously across multiple sources to support data analysis and increased confidence in the generalisability of the study.

The presented evidence captured the occurrence of workplace issues such as distractions and communication breakdowns. This led to tactical practices as actors attempted to adjust their *physical-digital assemblages* to mitigate these issues. Further research would benefit from specifically exploring how such issues arise and why actors adjust their *physical-digital assemblages* in response. This may help to identify causal links in behaviours and measures which contribute to workplace design and effectiveness.

From a practical perspective, the application of the *crafted workspaces* framework presented within this study could be applied to empirically study how *physical-digital assemblages* evolve over time. This may uncover endogenous factors such as heuristic behaviours as actors adjust to and adapt their environments, or how actors are affected by

exogenous changes such as their physical-digital setting, project methodologies, job roles or work activities. Such a study work may yield interesting theoretical and practical insights.

The use of a data control was not possible within this study. Such a control point would likely have included a non-located team. However, it would then have been impractical to maintain the tracing of agile work activities as they flowed across team members as the unit of analysis, unless additional resources were available to support the data capture across such a distributed team. Whilst this research was resource constrained, a study with additional resources to simultaneously capture a control group may provide interesting insights which could be used as an effective comparative measure against the phenomenon captured within a located setting. Alternatively, further research may wish to study project teams which transition periodically or permanently from distributed to located working, as this would enable a contrast in the usage and adoption of digital tools with the same actors across multiple settings.

As an alternative to the unit of analysis, further research may wish to study how space is being created with a macro lens. For example, how an entire team, multiple teams or entire Studio appropriate spaces at particular points in time. Whilst such an approach would require detailed planning and appropriate resources (e.g. broad surveillance of physical space and digital tools), it could provide theoretical and practical insights to generalise the various kinds of *physical-digital assemblages* and *spatialities*. This approach may also uncover new types of spaces, sub-spaces and how actors behave contextually and relationally not just to their physical-digital environment, but also in relation to the presence of other known and unknown actors.

Additional studies may therefore choose to focus on actors as the unit of analysis. This may shed light on territorial behaviours or how appropriation of space is impacted by the role of practitioners or the relative seniority of individuals within organisations. This may provide practical insights on the effectiveness of modern spaces of work, including potential advantages and disadvantages, adjustments and associated impacts on employee productivity and engagement.

The use of digital tools within software development teams may be considered an extreme example given the high levels of autonomy and technical capabilities of the actors within the setting. Further research may therefore wish to examine modern workspaces in other settings where knowledge workers have both low (i.e. airports, hospitals) and high (i.e. start-ups or small organisations) levels of autonomy on how their respective physical-digital environments can be configured and combined.



This study has shown that software provides a set of modulations that connect employees and constantly directs how they act. Thrift and French (2002) argue such modulations will become increasingly purposeful as organisational software becomes more context-aware and will be able to adjust processes and rules to circumstances. This awareness may provide a new kind of mechanical stance that redefines what counts as process and therefore should be monitored and appropriately explored.

It is also worth considering the implications of technology itself becoming increasingly connective through digital devices communicating with other devices to enable the automatic production of space. This has important consequences for what we regard as the world's phenomenality. Whilst this initially may be conceived of as human functions which are delegated into the machine (Johnson 2013), the advent of artificial intelligence provides previously unconceived opportunities for space (Thrift and French 2002).

Finally, previous research (Foucault 1976; De Vaujany and Vaast 2013) has demonstrated how the materiality of the environment and selected methodologies shape and constrain possibilities for action, suggesting a bounded organisational structure. Yet knowledge workers are often perceived to have freedom and autonomy within their working practices. Further studies may therefore choose to investigate how power and discipline is manifested in modern organisations through the design and configuration of the physical-digital environment and its supporting work processes. Given new ways of working are ostensibly open and transparent, creating increased opportunities for surveillance and control. To establish organisational legitimacy, this research could explore to what extent knowledge workers are supported and aided, or alternatively controlled and disciplined by modern workspaces. The categorisation of *spatial work practices* as 'strategic' and 'tactical' provides a starting point to understand where employees conform or choose to transgress by subverting their organisational environment.

## 7.2 Theoretical Contributions

Arguably the most famous and most reproduced piece of writing from Michel de Certeau's many works is 'Walking in the City' from his book 'The Practice of Everyday Life' (de Certeau 1984). This chapter provided some inspiration for indexing and researching the nature of the practices of the modern workspace. This study lays the practice of walking that de Certeau uses as a sign of the human, alongside the practice of appropriating the topography of the combined physical and digital environment as employees work within the landscape of the modern office. It finds that the practice of using digital technologies for carrying out work activities has become part of our 'technological unconscious' and is producing a

phenomenology that we increasingly take for granted. This new sense constitutes a radically different set of spatial practices which do not easily conform to de Certeau's strictures on space and place and therefore give us pause. For example, in conventional terms, organisational workspace could be considered as a way of "*conceiving and constructing space through a basis of a finite, stable, isolatable and interconnectable properties*" (de Certeau 1984, p. 94). Whilst this may hold partially true for physical workspaces, digital tools are not conventional, fixed or stable. To organisational actors, digital technologies are liquid, and their spatial structure is realised and continually co-constituted through the *spatial work practices* enacted by actors. This phenomena is quite clearly distinct from de Certeau (1984). For example, people cannot reconfigure the streets when they walk, but they can create new digital spaces to traverse almost instantly and can quickly modify notification settings, alter permissions and create integrations which continually reconfigure their digital environment. Such changes cannot easily be subsumed into de Certeau's account of the city, and so this research provides a contribution in commencing the necessary rework of de Certeau's work on everyday life to take into account how space is created and ordered within the modern organisation by combining modern offices, technologies, and working practices.

The theoretical lens provided a foundational platform through the construct of *spatial work practices* to understand and analyse the findings. This helped to support and categorise the understanding of *spatial work practices* as two distinct types. The first type of modulation supported strategic planned and recurring activities, while the second modulation supported more emergent and ad-hoc *spatial work practices*. Each type relied on specific assemblages of features of the physical and digital environment within a co-constitutive and contextual relationship which modulates the communication, collaboration and coordination of actors. This contribution is particularly important for understanding the work dynamics in modern digital organisations and clearly adds a new dimension to both the Kitchin and Dodge, and de Certeau theorisations.

To understand what kind of space and spatial relations emerge from the use of digital tools in organisations, we reconstitute the "walks" of team members through the physical and digital landscape of their modern office, i.e. the spatial practices of appropriating both physical and digital features of the workplace. Development of this concept enables us to understand the spaces that are constituted in practice. The data revealed the role and importance of the physical environment in the activities and practices of the teams. Physical interactions were integral to their practices and deeply entangled with digital interactions and activities. The relationship between both environments was symbiotic as demonstrated by the workflow of team interactions across physical seating arrangements, digital interactions and also the

mirroring of digital tools and physical space which routinely occurred at both the team and sub-team level (i.e. Slack and Studio layout). Whilst physical and digital environments may be conceived differently, the mirroring of physical and digital environments showed they also share properties such as their material entanglements, social practices and the narratives that create these spaces. Therefore, physical-digital space emerges as a result from a mutual shaping, rather than as presented by Kitchin and Dodge as being modulated by code alone.

These insights supported the development of two additional novel concepts which extend the theoretical lens and collectively enable an understanding of modern workspace that transcends physical and digital. The results chapter shows how technology is routinely combined with physical space, where it is appropriated and takes shape in practice through *spatial work practices* as *physical-digital assemblages* which are the combined constituents of the organisational canvas, based on actor needs for specific spatial and temporal modulations in order to support work activities. These *physical-digital assemblages* explain the materiality of their environment. They include both the physical location along with the digital tool(s) which are used within that setting and configured for usage and integration, thus providing a supporting vocabulary which articulates and conceptualises configurations of the practiced place where work happens.

Unlike many other aspects of communication that are clearly observable such as turn taking or head nodding, *physical-digital assemblages* are configured to support informants' accounts of their work practices and desired communicative activities. These accounts include metaphoric language utilising spatial metaphors, discussion of the considerations of communication and descriptions of the deliberate staging of such communicative events. When combined with *spatial work practices*, they capture the processes by which physical place and digital technologies co-evolve as transduced workspaces.

The construct of *spatialities* is subsequently presented to elaborate the actor intended spatial intent and preferences to support work activities. *Spatialities* explain the intended spatial effects of specific *physical-digital assemblages* as a link to support the enactment of specific *spatial work practices*. *Spatialities* help us to understand why constituent elements within *physical-digital assemblages* are grouped and appropriated. They enable an understanding of the goal-oriented action which is triggered by goal-oriented actors as they appropriate and configure the materiality of physical and digital spatial surroundings to support work activities.

These three concepts when applied together provide an exploration of how physical and digital environments are being combined as performed spaces in practice and the unique

spatial effects that these tightly integrated spaces enable through the emergent novel framework of *crafted workspaces*.

*Crafted workspaces* redefine the notion of workspace to fit modern organisational settings as the spaces of the modern office. *Crafted workspaces* enable a capture the continuum of ontogenetic spaces that transcend physical and digital, emerging from interactions between people, work practices, and the combined physical and digital environment. These socio-spatial relations exist and emerge through work activities which shape how organisational space is beckoned, assembled and performed. Each *crafted workspace* is characterised by a unique assemblage of features of digital tools and features of the physical environment from the IBM studio. These planned (strategic) or emergent (tactical) workspaces resulted from ongoing adjustments and shared understanding of the properties of the various aspects of the environment by the Studio teams. This ongoing crafting of workspaces was possible because of the relatively flexible nature of both physical and digital environments and the non-prescriptive management style surrounding the teams. It was particularly noticeable that this degree of autonomy and sense of empowerment allowed the teams to repurpose their environment to suit their needs and support work activities through their *spatialities*.

Through the performative view embedded within the theoretical lens, it became apparent how the same ‘places’ of work became different ‘spaces’ when appropriated by the teams in different ways. The ontogenetic perspective of the crafting of workspaces revealed different modulations by physical and digital features. This crafting often resulted in templates that became references for the types of assemblages which were captured within the data. This supports the literary view of the characteristics of code/space as indicated by Kitchin and Dodge: “*code/space is not consistently produced, not always manufactured and experienced identically. Instead, code/space is constantly in a state of becoming, produced through individual performance and social interactions that are mediated, consciously or unconsciously, in relation to the mutual constitution of code/space*” (Kitchin and Dodge 2014a, p. 74). However, the empirical evidence demonstrates that it is not just digital (code) that modulates the usage of physical environments as theorised by Kitchin and Dodge, but also the features of the physical environment and physical proximity that actually modulates the use, configuration and adoption of digital tools by the teams.

The conceptual basis laid down by this study goes beyond existing research within sociomateriality (Leonardi 2011, 2013; Orlikowski and Scott 2008). It responds to calls in the sociomaterial literature (Cecez-Kecmanovic et al. 2014) to perform a longitudinal study examining the workplace as an equipped context, rather than a neutral site of practice. This enables an articulation of how relations dynamically emerge through space and time. The

practice-based approach also has practical relevance by enabling an understanding of the co-constitution of the social and the material and their respective performative roles. Unlike sociomateriality, this study treats space as evolving from an assemblage of multiple components that coexist and shape each other. It therefore demonstrates how information systems research can benefit from explicitly considering the role of space through a practice lens and how specific *physical-digital assemblages* modulate modern workspaces.

This study thus begins to address the gap in research on digital work which has mostly marginalised the productive and essential role played by the physical environment in the usage and appropriation of digital tools in the modern office. It provides a vocabulary and conceptual understanding of the contextual and relational role of physical space within the contemporary workplace, which was previously a gap in information systems research. The research empirically demonstrates that the marginalisation of space in information systems research is a major limitation in understanding new forms of workplace settings and practices which are practically combined and configured by the employees that inhabit them. More broadly, the novel conceptualisation of the role of space in digital work responds to calls for addressing the role of space in IS (Fayard 2012a; de Vaujany and Mitev 2013), by building upon the literature of ways of working in modern organisations and providing the foundations to develop a notion of *sociospatialmateriality* which reveals the mutually constitutive and performative role of space within the modern digital workplace.

### 7.3 Practical Implications

The new notion of modern workspace provided by this study demonstrates why digital and physical space cannot be thought of separately in a modern organisational setting. As employees routinely configure *physical-digital assemblages*, organisations must recognise the need for dialogue, or better, unification between the disparate functions of IT and real estate within their structure. Accordingly, if organisations are to effectively support modern working practices, they may benefit from assigning role-responsibility for modern ‘workspace’ within the boardroom to overcome the existing physical and digital divide. This has relevance beyond the walls of the office, as even with remote work there is still a need to understand and account for how elements such as digital tools, Wi-Fi, seating, lighting, privacy and health and safety are combined.

Whilst space planners and architects develop standardised templates to support where employees work, it is important they study how and why employees appropriate the physical environment with combined digital technologies for a holistic understanding of modern working practices. We have established that environments for modern agile software teams need to

be modular and designed to support a range of activities, which are both individual and team based. The environments need to support recurrent and pattern-building spatial practices that are strategic and place-building in support of planned work routines and repeated activities. Crucially, these must also be supported alongside creative and emergent ways of operating spatial structures for unplanned (or previously unknown) activities into ephemeral spatial arrangements to fit immediate tactical interaction needs. The use of *crafted workspaces* provides a conceptual tool to understand how both these strategic and tactical types of modern workspaces can be captured and therefore appropriately designed and integrated into the office to support modern work.

*Crafted workspaces* also offer a significant evolution of our understanding of extant physical workspace typologies (Duffy & Powell, 1997) and activity-based work. They provide a more nuanced and insightful multi-dimensional approach which enables organisations to understand modern workspaces and how they must be supported. As organisations create and enable the configuration and combination of physical and digital environments, they are in effect, enabling opportunities for employees to create *spatialities*. This was not previously possible when the office layout was fixed, work was individual rather than team-based and work activities were performed within standard predetermined processes. This has changed with the evolution of modern organisations which are underpinned by team-based knowledge work, digital technologies and project methodologies which encourage collaboration and foster employee autonomy and innovation. As modern working is increasingly digital, organisational settings have accordingly become increasingly modular to enable reconfiguration and support fluidity of work. This flexibility is particularly important for supporting tactical work practices due to their unplanned and emergent nature. Further, when employees are both physically and digitally proximate, and therefore have choice, physical and digital environments develop a symbiotic and complementary relationship as long as they remain configurable to evolve and adapt together.

This study supports the argument within the literature that space is a social interaction system conditioned by its contextual settings (Challenger et al. 2010; Davis et al. 2011). It requires an interconnected overall organisational system (Allen and Henn 2013; Haynes 2007; Lawson 2004) with the collaboration of architects, engineers, sociologists and ICT specialists alongside staff and management (Allen and Henn 2013; Elsbach and Pratt 2007), to ensure relevant considerations when conceptualising the integration between physical and digital design (Jamieson et al. 2000). This is supported through the empirical findings which reveal how employees actively adapt working practices to appropriate features of their environment for planned *spatialities*. They have a clear sense of where and how they choose to work, which

contradicts the literature (Giddens 1984; Thrift 2008) arguing that spatial practices are often unreflective, habitual and performed without cognitive or rational thought. These senses extend beyond the utilitarian, into preferential factors for physical environments, such as comfort, informality, lighting and warmth, and digital environments to appropriate tools which offer persistence of information, integration amongst technologies and real-time synchronous communication.

The data shows that when presented with a range of communication mediums, employees' prioritised purely physical assemblages for rich interactions involving detailed or complex discussions. They also deliberately excluded digital mediums within their *crafted workspaces* to mitigate the distractions noted in the literature (Kolb et al. 2012; Leonardi et al. 2010) in support of intense periods of focused non-digital work. Digital interactions remain necessary for shorter transactional exchanges and gain increasing significance after the initial stages of the software development lifecycle. It is therefore important that these working practices are captured and understood by type, length and frequency in order to effectively design and support them. More broadly, the study demonstrates how modern workspace design may also have causal links with employee effectiveness and engagement. For example, such hyper-connected environments give rise to issues with privacy, constant connectedness and distractions which need to be ameliorated if employees are expected to engage in deep focused work within collocated office settings (Wajcman and Rose 2011).

By exploring the interaction between physical office design, technology, and changing work patterns to conceptualise the linkage of how work happens in modern organisations, this research provides a foundation not only to reflect the changing nature of work, but also to influence the form that these redesigns take and to promote consideration of the effects on individuals, organisational cultures, and technology. In this respect, approaches that focus upon capturing and conceptualising the actual patterns are more likely to result in successful workspace design and employee effectiveness than traditional mutually exclusive push-based approaches.

More broadly, this research implicitly examines the view that implementing new ways of working which focus on providing flexibility and activity-based workplaces to support knowledge work, means that offices should be redesigned to support them. For instance, IBM directly related the implementation of new collocated Agile working practices and digital tools to the opening of a newly designed office space. This supports literature which argues that simultaneous change of office and work environment act as a catalyst for new working practices to be implemented (Kingma 2018; de Kok 2016). This transformation of the IBM office space has a symbolic value designed to create a new culture and experience of agile

team-based work. As modern workplace settings and increased employee autonomy continue to gain popularity as a means to attract and retain employees, the importance of the effective design of the office will also commensurately gain importance (Waber et al. 2014).

#### 7.4 Chapter Summary

The study has employed a qualitative in-depth case study approach to capture previously unexplored spatial practices of work activities across physical and digital environments of work, with the advantages of insider access for richness in data. It explores this important knowledge gap with a practice-based view of space as performative and constitutive in the production of workspaces. The performative view of space supports the development of *spatial work practices*, a concept which is developed from extending the work of the philosopher Michel de Certeau (1984). The theoretical framework thus enables a lens and vocabulary to understand the role of both the physical environment and digital tools in the constitution of workspaces.

The findings provide a detailed examination of the empirical setting including the underlying strategies of the design of physical and digital places of work within the IBM London Studio. They reveal how physical and digital environments can be designed in isolation but become integrated conceptually and through practice by Studio employees, whom are aware of the hybrid environment in which they individually and collectively operate. The findings show how the physical environment and its usages by team members can only function as an interactional space with the concurrent usage of the supporting digital tools.

The analysis finds that *spatial work practices* are used by modern software development teams to engender different workspaces by configuring assemblages of physical and digital elements which are termed *physical-digital assemblages*. These configurations are configured as a response to their various needs with intended effects known as *spatialities*. Thus, the work practices can only be properly understood by looking simultaneously at the interactions happening through digital tools in conjunction with the context and relational understanding of face-to-face and physical interactions happening in the workplace. Combining the new concepts into the emergent framework of *crafted workspaces* provides a new notion of workspace as a continuum of ontogenetic configurations that transcend physical and digital, emerging from interactions between people, process, and the combined technology and physical environment. These socio-spatial relations exist and emerge through work activities which shape how space is beckoned and assembled into existence.

This study proposes that the conceptual and methodological approaches presented can



offer an invaluable resource to IS researchers and practitioners that are interested in achieving more nuanced understandings of how digital work is performed in modern organisations. The study therefore provides a both a theoretical and practical contribution. Demonstrating that physical interactions are not only integral to work practices and deeply entangled with digital interactions and activities, but space emerges as a result of a mutual shaping, where physical and digital coexist in tightly woven symbiotic form. Practically, *crafted workspaces* provide a conceptual tool to enable modern work practices to be captured and understood, therefore effectively designed for and integrated into the modern office. To support such efforts, organisations may benefit by assigning ownership responsibility for modern physical-digital workspace within the boardroom.

This contribution begins to address the gap in information systems research on digital work and the essential role played by the physical environment in the usage and appropriation of digital tools in modern organisations. It is therefore hoped that this research contributes towards a 'spatial turn' in information systems research, by laying some of the foundations needed to develop a notion of *sociospatialmateriality* which adequately considers the performative and constitutive role of space in digital work.

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## **APPENDICES**

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## Appendix A: Participant Consent Form

Academic Research on Smart Work in Modern Digital Organisations

**IBMer & Lead Researcher:** Kamaran Sheikh, Manager, Office of the CIO

**Academic Supervisors:** Dr João Baptista, Associate Professor & Dr João Porto de Albuquerque, Associate Professor

**IBM Executive Sponsors / Awareness:** Jeff Smith, Chief Information Officer & David Stokes, General Manager UK and Ireland

Dear Colleague,

In addition to my role at IBM, I am undertaking a PhD at Warwick Business School (WBS). WBS is IBM's higher education partner and a leading global business school. I am working alongside renowned academics to understand the emergence of new working practices and the role of space in the design of digital and physical environments to support work in modern organisations.

The ambitious developments within IBM in this area and more specifically the developments within the London Studio forms an excellent basis for this research. I would greatly appreciate your participation, which will contribute to advance understanding of modern ways of working more broadly but also will certainly provide insights of value for IBM.

You are invited to act as research participant for this project, your participation is entirely voluntary, but is gratefully received and will be acknowledged in any reports and outputs from research project. Further it will contribute toward IBM's long and proud heritage of involvement in pioneering academic theory and industry best-practices. A final report will be shared with senior leadership to improve IBM's working practices, as a participant you will be entitled to receive a copy.

The research project involves data collection with over 40 participants whom will be interviewed and may also be observed for an agreed period. Your involvement will help support this data collection phase. My role is to act as a researcher, being reflective of our practices from an academic viewpoint, rather than as an IBM employee.

Pending your participation, I will ask that you recall a recent work engagement or project. I will be asking questions within this setting around the use of physical space and digital technologies. I will be interested in how and where team meetings took place and how work deliverables were developed using a combination of offline and online interactions. It would be valuable to access and trace actual interactions and activities that spanned digital and physical work spaces.

Thank you for your consideration,

Kamaran Sheikh

## CONSENT FORM

Title of Project: Smart Work in Modern Digital Organisations

Date:

Please initial each box

1. I confirm I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions of a member of the research team and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐
3. I understand that that my information will be held and processed to be analysed by the researcher for the purposes of completing their PhD research and, where relevant, for the writing of associated academic and industry literature. ☐
4. I agree to take part in the above-named study and I am willing to be interviewed/observed and have my interview audio/video recorded to ensure accurate data capture. ☐

---

Name & Role of participant

---

Date

---

Signature



## Appendix B: Interview Guide for Project Members

1. Please tell me about the project and team which you are currently working in?
2. Now tell me about your role in this project team?
3. What are your working location(s)? *And why?*
4. Can you describe the physical environment at the(se) location(s)? *i.e. workspace, available facilities, layout, communal space?*
5. What is the distance between yourself and your team members? *Physical, timezone*
6. How do informal interactions take place between yourself and other employees?
7. How does the physical space at this location enable you to work? *Coordination, collaboration, communication*
  - a. What % of your time do you spend working face-to-face with others in these locations?
  - b. When do you decide to have face-to-face meetings?
  - c. And which location(s) do you choose for these meetings? *And why?*
  - d. In these meetings, what are the important properties of the physical space? *And why? Proximity, collisions, presence?*
  - e. Do the properties of the(se) location(s) support your requirements?
  - f. How do these properties of these spaces affect their usage?

- g. What are the constraints of the(se) location(s)?
- 
- 8. What digital technologies/platforms do you use? *Individual and collaborative working*
    - a. What % of your time do you spend working digitally?
    - b. Why do you use these digital tools?
    - c. How are these technologies selected? *And why?*
    - d. What are the important properties of these technologies? *And why?*
    - e. Do the properties of the(se) digital platform(s) support your requirements?
    - f. How do these properties affect their usage?
    - g. What are the constraints of the(se) platform(s)?
- 
- 9. How do the digital tools and technologies you use enable you to work? *Coordination, communication, collaboration*
- 
- 10. How do you determine when to use physical interaction Vs digital interaction?
    - a. Can you provide me with an example?
    - b. What are the influencing factors for using physical/digital?
    - c. If physical, does this extend work which is also performed digitally?
    - d. If so, what aspects of the physical space influences the way that digital work is extended? What are the features/characteristics of the physical space? i.e. what is the role of the office, what is the role of the architecture of the space

that is inhabited?

- e. How do you manage the flow between these physical and digital environments?

*Coordination, communication, collaboration*

11. How are these ways of working changing from previous practices?

12. When you think about where work happens in terms of space, what is your understanding of space? *Where do you work? Do you see that it partially physical/digital? How do you see that changing?*

13. Any further comments?

## Appendix C: Interview Guide for IT Department

Begin with general discussion about the Office of the CIO Tools, Project Whitewater discuss the various design considerations.

1. How do informal interactions take place between employees?
2. What is the direction IBM is heading with physical space.
  - a. What are the constraints of the(se) location(s)?
3. What digital technologies/platforms is IBM providing and the direction...ask for an overview
  - a. How are these technologies selected? *And why?*
  - b. What are the important properties of these technologies? *And why?*
  - c. Do the properties of the(se) digital platform(s) support employee requirements?
  - d. How do these properties affect their usage?
  - e. What are the constraints of the(se) platform(s)?
4. How do the digital tools and technologies you use enable work? *Coordination, communication, collaboration*

5. How do employees determine when to use physical interaction Vs digital interaction?
  - a. What are the influencing factors for using physical/digital?
  - b. If physical, does this extend work which is also performed digitally?
  - c. If so, what aspects of the physical space influences the way that digital work is extended? What are the features/characteristics of the physical space? i.e. what is the role of the office, what is the role of the architecture of the space that is inhabited?
  - d. How do you manage the flow between these physical and digital environments? *Coordination, communication, collaboration*
6. How are these ways of working changing from previous practices?
7. When you think about where work happens in terms of space, what is your understanding of space? *Where do you work? Do you see that it partially physical/digital? How do you see that changing?*
8. Any further comments?

## Appendix D: Interview Guide for Real Estate Team

Begin with general discussion about the design of the Office and London Studio, discuss the various areas and design considerations.

1. How do informal interactions take place in the office?
2. How does the physical space enable employees to work? *Coordination, collaboration, communication*
  - a. In meetings, what are the important properties of the physical space? *And why? Proximity, collisions, presence?*
  - b. How do these properties of these spaces affect their usage?
  - c. What are the constraints of the(se) location(s)?
3. Are the use of digital technologies/platforms considered when designing workspace? *Individual and collaborative working*
4. How do employees determine when to use physical interaction Vs digital interaction?
  - a. Can you provide me with an example?
  - b. What are the influencing factors for using physical/digital?
  - c. If physical, does this extend work which is also performed digitally?
  - d. If so, what aspects of the physical space influences the way that digital work is extended? What are the features/characteristics of the physical space? i.e. what is the role of the office, what is the role of the architecture of the space

that is inhabited?

- e. How do you employees manage the flow between these physical and digital environments? *Coordination, communication, collaboration*

5. How are these ways of working changing from previous practices?

6. When you think about where work happens in terms of space, what is your understanding of space? *Where do you work? Do you see that it partially physical/digital? How do you see that changing?*

7. Any further comments?