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**The Social Dimensions of Collaboration in
Co-Working Spaces**

by

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A Dissertation submitted in part fulfilment of the
Degree of Master of Science Built Environment
Space Syntax: Architecture and Cities

Bartlett School of Graduate Studies

University College London

September 2017

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Abstract

Despite recent efforts to understand and improve work environments, motivated by the need of designers and stakeholders to grasp their social and spatial dynamics –and better respond to users’ needs– co-working spaces remain an under-investigated typology of workspace. These community-driven workplaces differ in many ways from traditional offices, however, existing studies on office spaces aid the design of a research tailored to enquire into this sub-type. The development of a methodological framework for the analysis of co-working spaces is one of the main objectives of this thesis.

Space syntax theory guides the exploration of this type of complex building, an evidence-based approach that is demonstrated here to have a significant contribution to the understanding of the built environment and social phenomena. By systematically observing human behaviour in space and performing analytical models of it, this research investigates the social dimensions of collaboration: a progressive consideration of collaboration as a practice that begins with spatial awareness of others, potentially leads to interaction, and ultimately gives the affordance for collaboration. The focus is on the potential of co-working spaces to facilitate professional collaboration between independent yet co-located workers. Through the study of a co-working space in London, this research has found that interaction and collaboration are complex behaviours that can be better understood through the combination of analytical tools derived from space syntax theory and social networks analysis, an innovative approach to interpret and represent spatial data applied to co-working spaces.

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Acknowledgements

My sincere gratitude to Dr. Kerstin Sailer, who not only got me interested in this topic, but was a continuous source of inspiration and motivation throughout this research project. Further thanks to the lecturers of the Space Syntax programme for their stimulating lectures and informal talks. Also, Petros Koutsolampros and Rosica Pachilova for their contribution in this project.

I would like to thank the members of Main Yard Studios for allowing me to conduct observations in their co-working space and providing me invaluable insights in different stages of the research. Special thanks to Paul Baynton for his generous cooperation and disposition to contribute to this project.

I extend many thanks to my friends and classmates for the personal and academic support. Also to my boyfriend, for his limitless patience.

Finally, this work is dedicated to my family, especially to my mother and sisters for their unconditional support.

1. Introduction

According to the BCO (2016), co-working spaces have an important role to play in providing workspace and support for SMEs (micro, small and medium sized enterprises), a sector that not only has become a significant contributor to the London economy, but generates nearly 50% of employment opportunities in London (the insurance and financial sectors excluded). Co-working spaces emerged from the need of independent professionals (who worked from home or as nomadic workers) for a community-oriented workspace that would provide some of the facilities of a traditional office. The fast speed at which co-working spaces are growing and evolving, enabled by the mobile revolution (Rainie and Wellman (2012) among other factors, suggests that attention should be given to the underlying principles that govern this practice –and the spaces in which it takes place– in order to better support the business development and guarantee the wellbeing of its users. This research aims to study collaboration in co-working spaces (a behaviour that is sustained to be an affordance of interaction and mutual awareness) and test whether these spaces hold their promise of offering community-driven workspaces where members grow professionally. The intention is to contribute to the understanding of space's role in supporting or inhibiting the social practices that this working mode entails.

To identify the ways in which the spatial configuration, or layout, of co-working spaces affects human behaviour, with particular interest in interaction and collaboration among co-located yet inter-dependent professionals, is one of the principal concerns of this research. Of particular interest is the detailed enquiry into the relationship between individuals, workstations, and their physical surroundings; furthermore, the establishment of links between the emergence of behavioural patterns and the tangible (spatial) and intangible (managerial) dimensions of collaboration in of co-working spaces.

1.1 Motivation and Objectives

The motivation to enquire into co-working spaces is not from the start a spatial one. There is a widespread notion, reinforced by co-working companies themselves, that these spaces provide more than just rentable workspace but a whole range of social experience. In fact, the phrases “social connections”, “community building”, “idea exchanging” and “networking opportunities” feature in almost any co-working space’s website and social media platform. Co-working spaces are advertised as having an intrinsically social component, one that, considering that most of their members are formerly nomad workers (who come from working from home and other isolated working forms) is certainly an attractive feature. But, is this assurance of a collaborative, network-generative, and interactive workspace, in effect, a reality? And if so, are these leading to business growth and the establishment of professional ties? These questions lead to the hypothesis that if co-working spaces are indeed generators of interaction among co-located yet inter-dependent workers, then there are specific spatial attributes affecting these social phenomena.

The main objective is to examine all the factors that constitute co-working spaces i.e. design features such as furniture, lighting, programme, and so on, but also the role of the administration of these spaces in facilitating human relations by means of events, workshops and other added benefits. By doing so, a major aim is to measure how much is space, as a variable among many others, having an impact on the specific human behaviours under study.

1.2 Dissertation Structure

The contents of this research are structured as follows. In **Chapter 2**, existing literature on the main themes of this research is reviewed, and a theoretical framework is established as a guide to the subsequent analysis. **Chapter 3** provides an overview of the methodological approach of the research and describes the analytical tools implemented and developed. **Chapter 4** introduces the co-working space that will serve as case study for the testing of the methods. Furthermore, **Chapter 5** gives a detailed spatial description of the case under study, combining theoretical and empirical knowledge into the analysis of configurational and behavioural data on the case study. **Chapter 6** discusses the main findings of this study, acknowledging how these relate to existing theories and contribute to the development of space syntax research.

2. Literature Review

This chapter aims at discussing the theoretical framework of the research through a brief overview of its constituent parts. The overall purpose is to introduce the notion of 'co-working' and situate it within the broader context of working modes and trends, with particular focus on the spatial configuration of their interior spaces and specific social phenomena that take place within them. The current paradigm shifts in workspace design and management, and the place occupied by co-working in this fast evolving industry, will be discussed in the first part, as well as an introduction to co-working and its history. The second and third parts explore two social processes associated with co-working: inter-organizational collaboration and networking opportunities among co-located workers as results of the physical environment and community management. The last part introduces 'space syntax' theory focusing on the interior scale and the socio-spatial attributes of the layout in workspaces.

2.1. Co-working Spaces: Definition, Background and Current Debate

Co-working spaces are defined as open-plan office environments in which professionals work alongside other unaffiliated professionals for a fee (Spinuzzi, 2012). Originally, the term 'co-working' referred to the new alternative workspace of the freelance economy (Fuzi, Clifton and Loudon, 2014). Although freelancers' presence is still significant in co-working spaces, the diversification in terms of members in the last years has transformed the initial concept of this type of workspace. Today, not only start-ups and freelancers join co-working spaces but also other groups such as small and medium-sized enterprises (SMEs), large corporate employees and start-ups who have grown and remained as small firms.

Parallel to this, recent studies shift the definition of co-working spaces away from the users and highlight the fact that these spaces are defined by social aspects: “co-working spaces are differentiated from the offer of a traditional business centre by the emphasis on supporting or facilitating the potential for interaction between users of the space including networking, topic clubs and social events” (URS, 2017, p.9).

According to the BCO (2016), the concept of flexible and/or collaborative workspace can be traced back over decades with Lloyds Coffee House, acknowledged as the first in London from 1688. These ‘flexible’ and ‘collaborative’ workspaces are considered the first precedents to co-working spaces. Membership clubs and business associations, which commonly offer a space for people with similar interests to meet and share ideas, can be viewed as another precedent; however, workspaces intended to be collaborative did not formally appear until the 1990s (BCO, 2016).

Particular historic events and global trends have enabled co-working and its development. The global financial crisis of 2008 significantly accelerated the growth and flourishing of co-working spaces as start-ups and independent workers benefited from collaboration and networking as drivers for growth, as well as enjoying social interaction (BCO, 2016). Additionally, the increasing number of independent workers who acknowledged the disadvantages of remote working posed a demand for a physical space that catered for their work and social needs, a gap that came to be filled by co-working spaces.

Perhaps more influential in making co-working possible is the mobile revolution—including cell phones, laptop computers, cloud-based applications, reliable internet access, data encryption, social software, screen-sharing tools, and more—which play a key role in enabling the ‘work-anywhere’ movement (Hok Group + Corenet Global, 2016). At the core of the technological processes that

have contributed to the emergence of co-working is the idea of 'networked individuality' introduced by Rainie and Wellman (2012), which refers to the fact that people function less as embedded group members and more as networked individuals. According to Rainie and Wellman (2012), in addition to the mobile revolution, the Internet and the social networks revolutions form the 'triple revolution', which in turn makes networked individualism possible. This autonomy conferred to independent professionals—who are no longer bound to a place or corporation— by the 'triple revolution', especially the mobile one, has been embraced by co-working spaces in terms of their adaptability to the flexible work modes enabled by 'networked individuality'.

Regarding the ways in which they operate, according to the BCO (2016), co-working spaces often come bundled with other services: information and communications technology (ICT), copying, printing, human resources training, development and mentoring provided through lectures, seminars and events; and even health insurance for employees. Access to a network of other skills, such as accounting, legal services, public relations and media, is also provided through membership linkage (BCO, *ibid.*). This way, the co-location of non-related professionals and teams, coupled with external management of social activities, represents a potential for networking processes to take place. Another benefit for co-working spaces' members is the flexibility of occupation, which, in turn, gives flexibility to the cost of using or renting space (URS, 2017). Traditional corporate businesses have taken advantage of this by renting co-working spaces for some of their teams as a way to manage growth or shrinkage.

The BCO, in its 2016 report, cites among the challenges for co-working spaces the fact that coffee shops, libraries, train stations, and bus stops act as 'short-term co-workspaces' where the price of membership is already included within the purchase of a coffee, travel, or payment of local taxes, which questions the need for co-working spaces in the first place. Nevertheless, it also accepts that

co-working spaces offer more than a transitory place to work, and their users are willing to pay for it; “in effect they pay for space that gives them qualities not available elsewhere: sociability/ community, flexibility and access to a range of outsourced services” (BCO, 2016, p.9). The aggregate value of a community-like environment and the opportunities for social and professional gains resulting from physical co-location is one of the pivotal claims of co-working spaces providers. Just how much this is the case and the effect of spatial and managerial factors on these processes will be explored in subsequent stages of the research.

2.2. Co-working Spaces and Inter-Organizational Collaboration

Collaboration is defined by Heerwagen et al., 2004, as ‘working together’. Effective collaboration entails both individual focused tasks and interactive group work. Accordingly, “collaborative work environments require spaces, furnishings and technologies that support both individual focus and group interaction, while also facilitating transitions between these activities” (Heerwagen et al., 2004, p.511).

Work is increasingly dependent on knowledge and creativity, and this work is more collaborative (Fuzi, Clifton and Loudon, 2014). Co-working spaces differ from traditional workspaces mainly in one factor: the co-location of independent professionals with no required personal or professional affiliation. “Although co-workers work together, that work involves different, contradictory objectives, attached to and pulled by the network of activities in which each co-worker engages” (Spinuzzi, 2012, p.418). Thus rising questions about the actual emergence of collaborative relations, and if present, the causal factors involved in the process.

Capdevila (2014) argues that co-working is an organizational form that by its very nature facilitates inter-firm collaboration and notes the lack of hierarchies present in these spaces as an essential quality of inter-firm collaboration in co-working spaces. Furthermore, Capdevila, 2014, affirms that despite the exponential expansion of co-working all over the world, there is not yet a clear understanding of why individuals and micro-firms are attracted to collaborate and how the collaboration takes place in physical co-location. Advances in this direction are aimed with this research.

2.3. Co-working and 'Networking' Processes

Co-working spaces provide an environment where members can meet and potentially develop business opportunities with individuals that they might otherwise not meet. Thus, co-working spaces provide a setting for networking and business development (URS, 2017). Co-working spaces often afford opportunities for networking among businesses, and also facilitate events to engage local people and other co-working spaces through a multinational network, e.g. hubs (URS, 2017).

A common reason for joining co-working spaces is that they offer opportunities for social interaction and networking, which enable the development of entrepreneurial activities (these may be organic or facilitated) (Fuzi, 2015). In co-working spaces, according to Fuzi, *ibid.*, hosts or facilitators play an important role in stimulating relationships and enabling more synergies to happen, thus referring to a facilitated networking scheme. Some providers enable trading between businesses located within the co-working spaces and are encouraged to make use of the services offered by other co-located businesses (URS, 2017). "Much of co-working's value rests on who else is co-working; indeed, many of

these spaces have subsequently hired or designated community managers who can structure interactions, facilitate introductions, and otherwise introduce greater social coherence—that is, managers who can orchestrate the networking of external activities within the site” (Spinuzzi, 2012, p.432).

The management function is also important for maintaining the social and shared experience of the co-working space. This refers to the opportunities that are created for occupiers to socialise, share experiences, learn and develop business relationships (URS, 2017). Although space is provided for improvised meetings to occur, most of them tend to happen naturally, although community facilitators play an important role in creating different modes of engagement to stimulate interaction, networking and collaboration among members (Fuzi, 2015).

2.4. Spatial Properties and Space Syntax

In terms of the interior space and its design, in most co-working spaces the emphasis is on informality and mobile working (URS, 2017). The workspace provision typically includes a range of options, such as individual drop-in desks ('hot desking'), dedicated desks, group tables, soft furnishing and meeting areas (URS, 2017). In this regard, Sanders (2014) recognizes a series of elements, or social environments, that conform the setting of co-working spaces; the furnishing schemes that conform them are identified as: phone booth, high-back chair, work desk, lounge grouping, classroom, studio/media room, high-top café table grouping, seminar/conference room, communal table, editing suite, commons, and theatre (Sanders, 2014).

In addition to the physical qualities of co-working spaces, this research is concerned with the configurational aspects that choreograph the activities within them. For this purpose, space syntax theory is introduced in this section.

Space syntax theory and methodology focuses on social relations and spatial configuration and their synergic relation (Hillier and Hanson, 1984). "Space Syntax research found that the quality of social life within a space depended on the position of this space within the fabric of a city or a building: more integrated spaces were found to be livelier and frequented by more people while more segregated spaces showed lesser frequentation (Sailer, 2010, p.34). The interest of this research is in the studies of spatial configuration and human behaviour in complex buildings, more specifically in the case of office environments. There is a vast tradition of space syntax research on traditional offices, however, little is known on co-working spaces.

Some of the most salient findings on office spaces include the work of Grajewski (1993) which showed that office buildings "seem to have 'natural use' patterns where the spatial configuration of a buildings has a consistent effect on the distribution and levels of interaction" (p.72). In terms of interaction, one of the main focuses of this study, Sailer (2010) found that intensity of interaction was higher between people located close to each other and also more intensive within subdivided areas. Rashid et al., 2006, found that "visible co-presence may be important for face-to- face interaction in an office, and that an office with more visible co-presence may result in more face-to-face interactions regardless of movement" (p.842). Contrary to most space syntax research on urban settings, Steen and Markhede (2010) found that, in office settings, the value of integration does not explain the patterns of movement and the places where interaction takes place. Furthermore, Sailer and Penn (2009) found that most collective behaviour in offices i.e. interaction, collaboration and knowledge flow emerge in ways that are unique to the organisation in question.

In terms of co-working settings, Kueasirikul (2015) analysed visibility properties in co-working spaces and their relation with the perceived attractiveness of these spaces as well as the impact of configuration on organisational cultures. The work presented here offers a different approach to co-working spaces: by testing new ways to measure and interpret the syntactic properties of a co-working setting, it aims at a level of description of the spatial and behavioural components of the environment that further develops the present understanding of interaction and networking in co-working spaces and questions their effective contribution to professional collaboration.

The presented overview serves as a starting point for the empirical stages of this research. The degree to which the layout of co-working spaces affects complex collaborative processes and networking opportunities facilitated both by space and community management —given by the diversity of disciplines and organizations— is a main concern of this study, using space syntax as primary method and theoretical core.

3. Research Methodology

This chapter presents the methods adopted in this research to assess the social dimensions of collaboration in co-working spaces. According to Heerwagen et al., 2004, there are three components of the social facets of collaboration: awareness, interaction, and collaboration. Building on this premise, the methodology is structured following the relation between the three dimensions (i.e. awareness gives potential for interaction, and interaction gives potential for collaboration) suggesting a progressive approach that considers 1) how one dimension is enabled by the other, and 2) how these relations materialize in space. The way to do so is by attempting a detailed description of the spatial configuration and social behaviours that relate to each of these dimensions, using a co-working space in London, called Main Yard Studios (MYS) as a case study to test the viability of analytical methods to establish a link between this sub-type of workspace and the social core of collaborative relations.

For each of the three components –or stages– for collaboration (awareness, interaction, and collaboration itself) a series of analytical methods are used in the description of the co-working space under study, some of them adapted from existing research on the field, and others developed for the specific purposes of the present study.

Data collection in a private setting such as MYS raised a number of ethical issues, especially from site observations and conducting snapshots of static activities. Members of the co-working space under study were informed of the research before these took place, which prevented any issues while on-site observations were being made.

3.1 Syntactic Analysis of the Layout

The affordances in term of visibility (ability to see) and permeability (ability to move) of MYS's layout are analysed through Visibility Graph Analysis (VGA) performed in DepthmapX software, an analytical tool used to understand the built environment. The visibility graph is analysed using graph measures of Connectivity and Visual Mean Depth both on a global scale (radius n) i.e. accounting for all the relations from one point in the graph to all others. Two models are constructed: one at eye level (considering everything that is visible including transparent surfaces and openings) and the other at desk level (including furniture and obstructions to movement).

3.2 Observation Methods: Static Activities

Eighteen rounds of hourly record of activities in MYS were carried out throughout two working days. The recording of observations was done using a software application called Snapshooter provided by Spacelab, an architectural firm in London, UK. Three main behaviours were being observed: sitting, standing, and interacting. In the case of sitting, a distinction was made between sitting in own desk, unplanned sitting spaces, unoccupied desks, and temporarily unoccupied desks. Photographic evidence of space usage was conducted simultaneously as well as an hourly description of observed behaviours in the form of diary notes for a qualitative account of the space.

3.3 Brand's (2017) 'Spatial Schemata' technique

The 'spatial schemata' is a "representational technique for spatial and visibility conditions that promotes the identification of categories of spatial experience" (Brand, 2017, p.1). This outlook challenges existing methods to represent human experience in space and is proposed here as a potentially useful technique to aid the description of co-working spaces –originally intended for museum space analysis– by adapting the method to the case of MYS and the particular aims of this research. One question for this research is if the logic applied to museums has the capacity to be adapted and used to analyse workspaces.

Spatial experience is represented by mapping space usage throughout time of different groups of members: co-workers who are studio-based and nomadic ones (no assigned desk). According to Brand (2017), in order to identify spatial schemata, there must be a representation that allows the recognition of patterns. For this, Brand (ibid.) developed a series of steps which served as a guideline for the application of the method. In order to respond to the research questions of this study, one main variation is introduced which is the shift of the notion of 'path', which, for this purpose, is defined by the on-site mapping of movement flows of four individuals as they go from one space to another as part of their daily routines. This is particularly important because the focus here is not on all potential trends of spatial experience on a global scale, but on the contrasting qualities of local experience distinguishing between two specific member groups

The values corresponding to two Measurements: Visual Mean Depth and Connectivity (located on the Y axis) were plotted against spatial variation in time (located to the X axis) of a sample of four randomly chosen members and their movement patterns recorded for a complete working day. This was done by previously defining a strategic location for the observer (from which the highest

visibility was achieved), and, each time the selected individuals changed space, the time, route taken, activity, and length of stay was annotated and subsequently plotted in a graph taking after Brand's method (for a detailed description of the technique see Brand, 2017).

3.4 Potential Network: SNA of Visual Fields

Social Network Analysis (SNA) is concerned with a collection of individuals or social entities and the relations or links that exist between them (Wasserman and Faust, 1994). Furthermore, it analyses how an individual is inserted in a structure and at the same time how the relations between the individuals give rise to the overall structure (Hanneman and Riddle, 2005). The term 'Potential Network' is used here to define the network constructed from the visual connections between desks, assuming as potential interaction, for each location, all other visible desks.

The resulting network is studied using SNA to determine each desk's affordance for interaction. The network approach is argued here to help understand visual relations and their implications for interaction by the representation of workstations (desks) as nodes and the visual relations between them as ties in a graph. Similar methodological attempts have been made in order to respond to existing lack of methods to assess syntactic properties at the building scale. Comparable approaches include the Positioning Analysis by Markhede and Koch (2007) and later Spatial Positioning Tool (SPOT) (Markhede et al., 2010).

In order to arrive at the Potential Network, the first step was drawing partial isovists in DepthMapX from every desk location in the layout, limiting the view at 170° in the direction of each seat. A dataset was generated accounting, for each desk location, the desks contained within its isovist catchment area. Isovist area and number of visible desks were calculated for each desk location. The data

was analysed using UCInet, a software for Social Network Analysis by Borgatti and Everett (2002).

3.5 Co-Presence Network: SNA from Snapshots

The Co-presence network is introduced as a new way to analyse interaction using concepts of SNA by establishing interaction links as social ties in a floor plan and further contrasting this with actual (observed) interaction. For the construction of the co-presence network, this approach considers all possible connections accounting for spatial proximity and layout constraints (such as partitions).

3.6 Interaction Network: SNA from Snapshots

The last stage of the network approach is the representation of observed behaviour. Stationary activity serves as empirical data, isolating from all observed behaviours (i.e. standing, sitting and interacting) only the interactive relations among members of MYS. For the construction of the interaction network, the point data from the eighteen observation rounds of static activities is used (only interaction), also accounting for the number of exchanges between desk locations.

4. Introduction to the case study

A co-working space in London is selected as case study with the primary intention to test the methodologies presented in the previous section. This chapter introduces the co-working space in question, Main Yard Studios (MYS), presenting the physical context in which it is situated as well as an overview of its most salient characteristics in terms of programme, facilities, membership schemes, and social events. Rather than limiting the scope of this research to the particular conditions of MYS, it uses it to empirically test a series of existing and innovative methods of analysis, aiming to arrive at new knowledge that can contribute to the development of research on co-working spaces.

4.1 Location

There is a particular cluster of incubators, accelerators and co-working spaces in the inner East London area (London Boroughs of Islington and Hackney extending to Shoreditch, St. Luke's and Clerkenwell/Farringdon, and also in areas in Camden and City of Westminster), which have bundles of business dealing with communication, digital technology and other creative business sectors (BCO, 2016).

The selected case study is a medium-sized co-working space located in Inner London, United Kingdom, in the London Borough of Hackney, specifically in the area of Hackney Wick (Figures 1-3). This east London area is characterised by diversity, and MYS, as a business inserted in this community, is not only an active participant in communitarian happenings, but also aims at perpetuating the essence of the area through the design of its facilities (Figures 4-5).

Figure 1. London Boroughs Map

Source: www.maps-london.com/img/0/london-borough-map.jpg

Figure 2: London Borough of Hackney 2002-2014

Source: Hackney London UK blank Ward map.svg

Created using Ordnance Survey Data

Figure 3: Hackney Wick Location Map

Source: Hackney Wick Neighbourhood Centre Planning

Figure 4: Immediate Surroundings of MYS

Figure 5: Exterior of MYS's Building

4.2 Programme and Interfaces

MYS is a co-working space that offers workspaces for independent workers and professional teams. The organisation currently functions as a mixed use co-working space that integrates independent professionals under an individual drop-in desk modality (hot-desking) and professional teams/ companies (dedicated studios). Although co-located, these two groups operate independently, a division that is also materialized in space.

In terms of its programme, MYS is composed by seven studios, a meeting room, a kitchen, a kitchenette, reception, breakout space, toilets, and central area with freestanding workstations (Figures 6-8).

Figure 6: Programme and Facilities

Figure 7: Interior Space

Figure 8: Facilities

Hillier and Hanson's (1984) argument regarding how spatial design generates different kinds of interfaces between social groups supports the assumption that MYS's layout, through its programmatic intention to segregate functions, also generates distinct social interfaces which are related to the two working modes and their location within the layout. "An 'interface' is a spatial relation between or among two broad categories of persons (or objects representing persons) that every building defines: inhabitants, or those whose social identity as individuals is embedded in the spatial layout and who therefore have some degree of control of space; and visitors, who lack control, whose identities in the buildings are collective, usually temporary, and subordinated to those of the inhabitants" (Hillier, 1996, p.198).

The notion of interfaces as described by Hillier (1996), distinguishing between inhabitants and visitors, could aid the understanding of the social dynamics of MYS if these categories are transferred to nomad and studio-based workers, adding to the definition of their affordances the perceptual dimension. Each of these groups have distinct affordances for movement and interaction which are a consequence of their ability to physically and visually access other areas. Members working from a studio have exclusive access to their space, to which other studio members and hot-deskers have only partial visual connection to; however, the fact that hot-deskers are allocated in the open-plan area, their workspace also becomes part of the visual and physical domain of the studio-based members. Thus, the nuances related to the mixed membership types within the same workspace affect how interfaces are constructed both at a functional and a perceptual level.

4.3 Membership schemes

The two membership categories in MYS are dedicated desks and studio offices, shown in Table 1.

Offices	
1 to 2pp	£575 pcm
3 to 4pp	£650 pcm
5 to 6pp	£850 pcm
7 to 8pp	£1050 pcm
Dedicated Desk	
1 pp	£200 pcm

Table 1: Memberships and Prices

Source: mainyardstudios.co.uk

In terms of choosing a co-working space, price is a key factor. Price is also identified as having an impact on space usage given the level of commitment from the members: low cost of membership results in lower level of commitment since a low monthly investment in a space gives flexibility to keep it whilst working from other locations at different points in time.

4.4 Social events

A number of events are coordinated by the MYS management team such as social animation, mentoring programs, lectures, and workshops. Although part of their offer to members, these events are not very frequent (once a month or once every two months in average).

One activity that is a part of the weekly schedule is the 'sharing breakfast', an opportunity for the members to socialise while having breakfast in the communal kitchen space.

5. A spatial description of MYS

The need for analytic theory and descriptive methods of the built environment has been a recurrent theme in space syntax research, especially in its early stages. Hillier's (1996) argument for 'non-discursive techniques' for the description of spatial and formal patterns in order to bring light to the deficiencies in architectural theory in neutrally describing the built form is seminal to the subsequent development of space syntax methods. Building from Hillier's premise, this research perpetuates the importance of detailed enquiry into what exactly is it that space 'does' as a way to understand a layout (in this case a co-working space in London), establish behavioural patterns, and foresee design outcomes. This descriptive-analytical section is structured as follows. The case of MYS will be analysed following the social dimensions that lead to collaboration describing specific aspects of the configuration and social trends associated with it, showing the findings of the analysis resulting from the use of the methods introduced in Chapter 3.

5.1 Spatial Awareness and Co-Presence

Penn (2005) argues that the potential use of a space and its relations of accessibility and visibility are the basis of its appropriation (which differs between social groups and times), "however, the potential inherent in these differences is present in a plan prior its occupation, and it is this potential which is appropriated for social acts" (p.4). When considering interaction as a social phenomenon, this potential is the result of co-presence, the idea of being in the presence of others without the need to be in direct contact with them. "Encountering, congregating, avoiding, interacting, dwelling, conferring are not attributes of individuals, but patterns, or configurations, formed by groups or collections of people. They

depend on an engineered pattern of co-presence, and indeed co-absence” (Hillier, 1996, p.20). Hillier’s argument for an underlying configurational foundation of collective behaviour in space guides the exploration of MYS’s layout in terms of its affordances for co-presence and interaction, which are considered here as primary drivers for collaboration.

5.1.1 Visibility

Visual connections between spaces and individuals are essential for co-presence. The extent to which visibility within an interior space is promoted or limited is a response to the functional requirements of each particular space and achieved through design; however, these decisions regarding the enhancement or limitation of visual proximity between individuals and spaces have additional, more nuanced, effects that relate to perception. The spatial configuration of MYS (combining enclosed studios with open plan office space) has not always been the case. The studios were implemented as a way to secure a steady income (revenues from drop-in desks lack consistency given the flexibility of the memberships and the short length of the leases) but supposed a challenge for the planning of a co-working space that is by nature a dynamic, flexible, and open community of creative professionals. The solution was the peripheral disposition of enclosed studios, incorporating transparent surfaces with the intention to make them visually permeable into the open plan areas. If the VGA at eye-level (weighted by visual mean depth) is considered (Figure 9), it is clear that at a global scale, most of the spaces have high visibility (warm colours represent lower MD values), thus suggesting that members have a high level of awareness of the presence of others. However, due to the height of the internal windows, this awareness is significantly lower from the point of view of a seated worker (most common position throughout the day) which evidences the limited impact of transparencies, in this case, in potentiating co-presence (Figures 10-11).

Figure 9: VGA (eye-level) – Visual Mean Depth (radius n)

Figure 10: Studios and partitions with windows at eye level

Figure 11: Studios and glass partitions

Figure 12 shows Visual Mean Depth values for each space in the layout. Studios tend to occupy the deeper areas as expected, however there are different visual affordances for each of them depending on the location and opaque/transparent surface use. Some areas like the Kitchen and Studio E have a wider range of values, suggesting potential for more diverse behaviours within them.

Figure 12: Visual Mean Depth values for each area. Values go from 2.02 (warmer shades) to 5.07.

In contrast, visibility at desk-level (Figure 13), represented in the VGA accounting for all visible elements at desk height, shows a different picture: studios are visually deeper in the layout, thus reducing co-presence in the totality of the space as portrayed in the same analysis at eye-level. The open-plan area remains highly visible from all spaces, but the impact of the glass partitions from the point of view of a seated individual is not meeting its purpose to increase mutual awareness of the presence of other studio workers and hot-deskers. Circulations and facilities are highly visible, increasing their potential for encounters.

Figure 13: VGA (desk-level) – Visual Mean Depth (radius n)

5.1.2 Movement and Spatial Experience

Following visual relations, the affordances and characteristics of movement within a layout are fundamental for face-to-face interaction. Hillier and Hanson (1984), when discussing buildings and their genotypes, assert that the spaces inside the boundaries (to refer to a building's interior) are a series of "separate events, not a continuous system, (...) they are experienced one by one as individuals, not as a single entity sustained by physical connections" (p.144). Boundaries inside a building allow for the organisation of interfaces, and at the same time affect how users perceive and read the space as they experience it. The term 'spatial experience' is used here to refer to individual and collective facing of the physical space that compounds a building's interior and the perceptual properties that derive from movement in space and time. Peponis et al., (1997) identify movement as vital for intuitively recognising spatial patterns, claiming that we are not able to experience buildings in their entirety from one specific location due to the complexities generated through partitioning and subdivision of the interior space to cater for different functions.

The first assumption is that, in the case of MYS, the mixture of open-plan (Figure 14) and cellular (Figure 15) office layouts affects the spatial experience of the users allocated to either one of these schemes. The studios behave as independent cells which share the facilities in the common areas with hot-deskers. Since the open plan area includes both workstations and facilities (kitchen, printing area, breakout space) this becomes overlap space between the two groups, but it is argued that there is a distinction between being in visual and physical proximity to these complementary features of the workplace and being isolated from them.

Figure 14: Member groups: 'hot-deskers'

Figure 15: Member groups: 'studio-based'

The following hypothesis is formulated after site observation of usage patterns of each of the groups: If there is a functional and physical separation in MYS's co-working space between studio-based members (who work amongst each other in enclosed, individual spaces) and 'hot-deskers' (members who do not have assigned desks and make use of the drop-in desks in the open plan areas), then the spatial experience of each of these groups is not only different but rooted in syntactical properties of the layout.

Brand's (2017) spatial schemata technique is used as an evidence-based method to test it. This representational method allows the depiction of the typical behaviour of different user types through mapping their paths and recording the syntactic properties of the spaces they occupy in time. Figure 16 shows the 4 members selected and their paths. The constructed schemata (Figure 17) shows that hot-deskers have a lesser change of spatial experience compared to studio workers (who go from the deepest, least connected and secluded spaces to the open areas of the layout to make use of the facilities).

Comparing the spatial experience of the four observed members, it can be noted how the case of F4 fosters a very segregated initial position but short periods of access to highly integrated areas, showing an intermittent contact with the community aspect of the co-working experience. Furthermore, F4's spatial experience illustrates how the individuals in the studios 'detach' from their working activities by accessing facilities located in spaces with different properties, a change that could be beneficial for the wellbeing in the workplace. HD30, behaves similarly, however the openness of its initial position in the layout, although not very integrated, increases its level of autonomy and the choices of paths become better informed by an increased visual field. On the contrary, HD26 is located in the most integrated area of the layout and is less stimulated by fluctuations in the types of space, giving this position a more stable situation resulting from the familiarity with the configuration.

Figure 15: Sample of four co-workers to map their spatial experience.
 (Red Node identifies the desk and the numbers represent the sequence of displacements)

— Mean depth
— Connectivity

Figure 16: Spatial Schemata representation

In terms of potential for interaction, the main difference that derives from the spatial experience of the two groups is argued here to relate to the notions of visibility and control. While individuals in both spatial groups have the opportunity to leave their workstations and deliberately approach others for interaction, the affordance of hot-deskers is considerably higher for two main reasons:

1) Hot-deskers are in closer proximity to circulations and are visually exposed, thus becoming more susceptible to being approached to engage in interaction.

2) Hot-deskers have a higher level of control over their involvement in interaction in the common areas: visual proximity to the areas where most interaction occurs (kitchen, printing area and breakout space) turns into information about who is present where, which allows them to use these areas for interactive purposes while the studio users' unawareness of the levels of co-presence reduces their chances of encounter.

This approach to spatial experience and the use of the spatial schemata representational technique have proven that a building is a “mechanism of generating and constraining patterns of encounter and avoidance” (Sailer, 2015, p.34:5). Movement was addressed from a spatial experience point of view, highlighting the ways in which displacement from one space to another affects individuals on a perceptual level, but at the same time impacts their affordance for interaction.

5.2 Potential Interaction

Spatial configuration has been shown to potentially affect human behaviour in space given the layout's intrinsic properties (deriving from design). In terms of interaction, the aspects of occupation, desk location, and visual fields are introduced in this section as properties of space that directly affect potential for interaction.

5.2.1 Desk Occupancy

Occupancy is an aspect argued here to have an important effect on the potential for interaction. A space used to its total capacity has a higher potential for interaction resulting from an increased number of individuals available to engage in conversation. It follows that if a space has low occupancy, the number of possible encounters –and interactions– is proportionally reduced. Taking this into account, an occupancy study was conducted in MYS in order to establish a space usage overview. From the multiple visits to the site, an initial observation was made that this co-working space was not being used to its total capacity (Figures 16-17), a fact that was confirmed by systematically accounting for hourly desk occupancy throughout two working days (Figures 18-20).

The observed low desk occupancy suggests some underlying reasons for this to happen, which are not evident at plain sight. The evidence suggests that three main factors have a direct incidence on this:

1. The number of available desks surpasses that of rented desks (Table 2)
2. The cost of a desk in this co-working space is relatively low if compared to other companies offering similar services. The reason why this affects usage is

the fact that the level of commitment is lower and allows for member to maintain a desk at MYS whilst working from other locations at different times.

3. The data gathering was conducted during the month of July, which coincides with summer holidays, which decreases the amount of people working during this time.

Figure 16: Hot-desking area – low space usage

Figure 17: Hot-desking area – low space usage

Figure 18: Density map of observed sitting (from snapshots data)

Figure 19: Density map of unoccupied desks (from snapshots data)

Figure 20: Density map of temporarily unoccupied seats (from snapshots data)

Rentable Space	Area	Total capacity (number of desks)	Total rented (number of desks)	Total rented (percentage)	Observed Occupancy (respect total capacity)	Occupancy (respect total rented)
STUDIOA	28.32	4	3	75%	42%	56%
STUDIOB	27.47	6	2	33%	31%	93%
STUDIOC	27.93	4	2	50%	19%	38%
STUDIOD	26.40	2	2	100%	22%	22%
STUDIOE	39.31	3	2	67%	35%	53%
STUDIOF	74.13	8	8	100%	62%	62%
STUDIOG	44.54	8	2	25%	10%	40%
HOT-DESKS	98.86	36	24	67%	26%	39%
TOTALS	366.97	71	45	65%	31%	50%

Table 2: Actual occupancy assessment considering available, rented, and occupied desks

The occupancy study allowed for the establishment of a real picture of how MYS is used, the areas with higher rent demand and how each of the areas perform on a daily basis. If the occupancy percentages respect total capacity and total rented are compared (Table 2), it can be noted that although the space is not used to all its capacity, actual occupancy is higher respect the number of rented desks. Actual occupancy (respect rented desks) is of a 50% (although showing an increase of a 20% respect its total capacity, remains low).

5.2.2 Desk Location and the Visual Field: Implications for Interaction

The visual field is calculated through partial isovists covering the visible area for each desk location. Isovist area is taken into account and also the number of visible desks as a measure of the social factor associated with visibility (Tables 3-4). The assumption is that a high number of visible desks from a given location has a high impact on potential interaction. In relation to desk occupancy, one hypothesis is that the desks that have the highest occupancy (thus the most preferred ones) are so because of their higher potential for interaction resulting from a larger number of co-workers in visual proximity.

Table 3: Visual Fields from each desk. Partial isovist drawn at 170 degrees overlaid with visible desks

Table 3.1: Visual Fields from each desk. Partial isovist drawn at 170 degrees overlaid with visible desks

Space	Desk ID	No. of Visible desks	Isovist Area (sqm)
Studio A	A1	3	7.79
	A2	3	8.09
	A3	3	9.72
	A4	8	42.27
Studio b	B1	1	20.20
	B2	1	15.39
	B3	11	80.35
	B4	5	25.74
	B5	3	8.19
	B6	3	8.08
Studio C	C1	7	68.48
	C2	1	12.02
	C3	1	7.59
	C4	1	7.97
HOT-DESKING	HD1	29	228.22
	HD2	29	230.25
	HD3	4	126.58
	HD4	4	120.68
	HD5	24	191.67
	HD6	25	192.10
	HD7	12	162.58
	HD8	13	168.54
	HD9	15	141.26
	HD10	14	143.84
	HD11	22	217.17
	HD12	22	214.45
	HD13	4	75.03
	HD14	5	83.30
	HD15	31	271.78
	HD16	30	261.97
Studio D	D1	1	19.80
	D2	13	211.46
Studio F	E1	1	15.05
	E2	1	15.05
HOT-DESKING	HD17	32	214.84
	HD18	32	213.07
	HD19	32	210.48
	HD20	30	205.69
	HD21	31	203.23
	HD22	30	203.14
	HD23	15	160.80
	HD24	15	148.64
	HD25	14	150.52
	HD26	14	155.99
	HD27	11	156.00
	HD28	13	163.50
Studio F	F1	8	69.79
	F2	8	66.37
	F3	4	31.69
	F4	4	31.70
	F5	3	38.01
	F6	3	44.37
	F7	8	64.07
	F8	8	63.73
	F9	2	10.93
Studio G	G1	1	9.51
	G2	1	9.43
	G3	1	8.44

	G4	1	8.44
HOT-DESKING	HD29	10	70.50
	HD30	10	70.49
	HD31	9	67.30
	HD32	8	70.34
	HD33	7	41.55
	HD34	7	40.73
	HD35	7	42.70
	HD36	7	43.44

Table 4: Desk locations, isovist area and number of visible desks

Figure 21: Isovist area/No. visible desks Scatter Plot coloured by space

The numeric values extracted from the isovists are presented in Table 4 and further analysed in a scatter plot (Figure 21) which shows an overall trend of increased isovist area resulting in higher number of visible desks. The colours of the graph by space show how the different affordances for interaction: hot-deskers and one desk in Studio D have the highest potential, whilst the desks with reduced isovist area and number of visible desks have a considerably lower affordance.

5.2.3 Potential Network: SNA of Visual Fields

The potential network is new way to represent and analyse visual fields data from isovists (showed in Tables 3-3.1). It is an attempt to push the boundaries of traditional methods by introducing isovist data into SNA analytical tools. The ways in which each desk position is embedded into the system of visual relations is argued to have direct impact on spatial affordances at different levels. Two dimensions are explored: 1) The relational properties of each desk (node) with the rest of the system (connected by visual ties), and 2) The configurational properties of desk location. The hypothesis is that the location of each desk in the network (evaluated through different graph measures) is related to syntactic properties derived from the layout, thus affects members' potential for interaction.

The SNA of visual fields is weighted by two centrality measures. First, the measure of 'Degree', which in this case shows who are the best visually connected desks in the network; and second, the measure of 'Betweenness' which attributes a notion of power to those positions in the network who serve as 'intermediaries' because of their strategic position within the structure (Hanneman and Riddle, 2005).

According to Hanneman and Riddle (2005), the nodes with more ties to other nodes (in this case visual ties) are in advantaged position because of their higher level of alternatives to satisfy needs (thus less dependent on others). The SNA is presented first in terms of abstract relations (Figure 22) and then overlaid on the floor plan (Figure 23). Figure 22 shows the clustering of the nodes according to the area, and captures how the hot-desking areas attract most of the visual ties.

Figure 22: Potential Network's abstract representation – Degree Centrality

Figure 23: Potential Network overlaid on floor plan – Degree Centrality

Comparing both representations, more nuanced results are observed in the overlaid SNA on the plan (Figure 23). The use of transparent surfaces allows for vision to permeate between open-plan areas and enclosed spaces (an assumption formerly confirmed by means of VGA), however the SNA adds further information, not only in terms of visualisation but also in the number of actual ties and desk-specific information. The biggest nodes in both graphs represent higher degree centrality (best visually connected), thus, seats HD1 to HD28 have the highest potential for interaction given their high visual connectivity. Nevertheless, this potential is not observed to impact desk occupancy.

On the other hand, if the constructed network is weighted by betweenness centrality, it is observed that some desks in MYS act as information holders or 'bridges' between spaces and groups. The SNA weighted by this measure is again represented both by its abstract structure and overlaid on floor plan (Figures 24-25). The desks with strategic positions, in the case of MYS, HD28 and A4, based on their isovist fields alone are not advantaged in terms of isovist area or number of visible desks, but their position is such that are visually tied to several different areas which confers these desks higher control within the network.

Furthermore, the desks F7, F8 and B3 show that within the same studio some desks are in privileged position and act as information holders; these desks have higher awareness of the presence of others, have higher autonomy and control derived from being visually tied to more spaces, and ultimately have a higher potential for interaction.

Figure 24: Potential Network's abstract representation – Betweenness Centrality

Figure 25: Potential Network overlaid on floor plan – Betweenness Centrality

Mutual visibility within the network is another suggestion of stronger visual ties between desks, anticipating increased interaction between individuals in these locations. Opposed to the notion of power, which gives agency to the individual to engage in interaction, mutual visibility is argued to lead to interaction based on spatial properties of the layout and furniture disposition. Figure 26 shows a comparison of SNA weighted by degree centrality highlighting mutual visual ties. Whilst Figure 27 implies strong visibility between desks in the open plan area and enclosed studios, the reality is that visual connections are mostly one-sided, and if mutual ties are isolated (Figure 28) the resulting network shows that visual ties are constrained by physical boundaries, and with the exception of desks C1 and D2, happen among desks within in the same area i.e. hot-desking or studio. Actual interaction is anticipated to follow this trend.

Figure 26: Compared visual ties: all possible ties (left) and only mutual ties (right)

Figure 27: Network of all visual ties highlighting mutual ones

Figure 28: Network of only mutual visual ties

The series of analyses conducted to test the initial hypothesis that desk properties studied through SNA relate to syntactic properties of the layout (and both affect members' potential for interaction) evidenced the difference in terms of affordance for interaction between every desk location in an office's floor plan. SNA, through centrality measures, aided the representation and visualisation of assumptions made from isovist fields and VGA and added a new layer of information regarding each desk (node) in the network of MYS.

5.3 Realised Interaction and Co-Presence

On-site observations and analytical tools allow for the construction of a global picture of interactive behaviour in MYS. Different methods serve to enquire about how individuals interact with others sharing the same facilities. In the case of co-working spaces, there is limited research on whether their spatial configuration differs from other workspaces in the behaviours they promote, and also limited empirical work that evaluates their level of success in constructing the interfaces necessary for collaborative and community-driven work. This section explores how face-to-face interaction takes place in MYS and attempts to test methodological hypotheses that could contribute to the development of research in the subject.

5.3.1 Observed Interactive Behaviour

Overall, MYS was observed to be fairly active throughout the day. The observed activities include sitting, standing and interacting, noting a higher concentration of activities in enclosed spaces (Figure 29). Table 5 shows space usage throughout two working days, highlighting the highest value for interaction (Wednesday 11:00) which corresponds to the 'sharing breakfast' weekly event.

Figure 29: Density map for all observed activities (from snapshots data) – denser clusters represent higher concentration of activities

Day:	Tuesday									AVG
Round:	10:00 - 10:15	11:00 - 11:15	12:00 - 12:15	13:00 - 13:15	14:00 - 14:15	15:00 - 15:15	16:00 - 16:15	17:00 - 17:15	18:00 - 18:15	
Activities	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Sitting everywhere	95%	87%	73%	76%	72%	62%	84%	77%	71%	77%
Standing everywhere	5%	3%	9%	5%	6%	19%	6%	10%	7%	8%
Walking everywhere	0%	10%	18%	19%	22%	19%	9%	13%	21%	15%
Interacting	26%	17%	24%	26%	6%	29%	13%	50%	29%	24%
Day:	Wednesday									AVG
Round:	10:00 - 10:15	11:00 - 11:15	12:00 - 12:15	13:00 - 13:15	14:00 - 14:15	15:00 - 15:15	16:00 - 16:15	17:00 - 17:15	18:00 - 18:15	
Activities	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Sitting everywhere	88%	87%	83%	91%	96%	87%	83%	78%	75%	85%
Standing everywhere	0%	10%	8%	3%	0%	3%	6%	17%	7%	6%
Walking everywhere	13%	3%	8%	6%	4%	10%	11%	4%	18%	9%
Interacting	0%	63%	36%	45%	15%	13%	25%	30%	18%	27%

Table 5: Space usage averages from eighteen observation rounds of static activities

Visual proximity was not found to have significant impact on interaction. If the VGA at desk level (weighted by visual mean depth) is compared to observed interaction, it is clear that hot-desking areas are in greater visual proximity on a global scale, but this does not result in interaction, whereas studios are visually 'deeper' in the layout but have a higher level of interaction (Figure 30).

Most interaction takes place in the studio areas, this is due the fact that independent teams work in these spaces and interaction among them is necessary. Previous empirical studies have shown the tendency for people to interact in individual workspaces even when other choices are available in semi-public and public territories. Rashid et al., (2006) attribute this to the idea of spatial culture of interaction, which relates to the social and cultural aspects of an organisation as a driver for interaction, rather than only accounting for the spatial affordances. Furthermore, hot-deskers use headphones most of the time, this makes interaction whilst sitting not frequent. People standing are mainly in the spaces where there are facilities: kitchens and printing areas (Figure 31).

Social events such as the "Wednesday communal breakfasts" were observed to mostly attract users of hot-desking areas. Studio users tend not to join this social moment and are observed to remain in their offices during this time. This suggests that teams do not have frequent interaction with other teams or with the independent workers of the space. However, independent workers actively participate and are observed to engage in lively chatter. This behaviour is to some extent predictable if the professional aims of both groups are considered: independent start-ups and freelancers are more likely to be interested in networking and the establishment of links with other professionals, whereas consolidated teams are more likely to have defined goals and depend less on creating contacts and acquiring social capital.

Figure 30: Interaction density overlaid with VGA (MD_n)
Denser clusters of interaction are found in enclosed studios

Figure 31: Density map from snapshots data for standing and moving activities.
Higher concentration of individuals standing close to spatial attractors i.e facilities

The opportunity for interaction is mainly through random encounters outside of the desks, but the function and form of the space limits this potential. The most visually integrated areas are located in the primary circulation, which provides the opportunity for members to walk past each other regularly, however the space does not allow for them to stay and chat since that would represent an obstruction to the flow within the space. This follows Hillier's (1996) argument that activities that involve interaction are by definition likely to occur in convex spaces, however movement (in this case though the corridors) is essentially linear since for it to be intelligible it requires unobstructed lines traversing the spaces.

5.3.2 Co-Presence Network: SNA from Snapshots

The co-presence network considers physical space as constraint for tie formation and considers all possible interaction due to proximity and visibility. This network portrays the affordance of this layout for interaction to occur accounting only for co-presence given by spatial configuration. The co-presence network (Figure 32) shows all the ties that could arise in this space from desk positions.

Figure 32: Network of potential interaction

5.3.3 Interaction Network: SNA from Snapshots

The interaction network (Figure 33) consists of realised interaction in space and is the final stage of the assessment of this particular social behaviour in MYS. SNA is proposed to represent interaction from snapshots data, and considers spatial ties given by observed (actual) behaviour on-site.

Figure 33: Interaction Network

Figure 34: Network of potential interaction and network of actual interaction

Professional bonds are observed to be the main driver for interaction. The potential for interaction is observed to be met when transpatial relations exist (in the case of seated workers) and face-to-face exchanges occur in locations where professional teams are present (including hot-desking area). Desk locations with the highest number of observed interaction meet two conditions: occupiers are part of the same team and also share common interest (evidenced by informal chatter).

Affordance (potential from desk location)	Co-Presence (from occupied desks)	Interaction (from observations)	Degree of interactivity*
41%
2%
10%
100%
46%
16%
27%
0%
16%

*Percentage of realised (actual) interaction from potential from desk location (Affordance).

Table 6: Comparison of potential-actual interaction networks by space

The potential network presented in section 5.2.3 identified desks F7, F8 and B3 as being in advantaged position respect the rest within their enclosed spaces, and act as information holders. They were argued to have higher awareness of the presence of others, higher autonomy and control, and a higher potential for interaction. In effect, the interaction network (Table 6) showed that F7 and B3 have the highest frequency of interaction within their own spaces (F8 is unoccupied), suggesting a correspondence between potential and realised interaction in space.

The interaction network proves the hypothesis formulated in section 5.2.3 which anticipated interaction to be a consequence of mutual visual ties, in the case of MYS constrained by physical boundaries. Table 6 integrates the co-presence and interaction network clustering the nodes (desks) by area in the layout of MYS. It introduces an intermediate network that considers actual occupancy i.e. those desks that are rented and observed in use. Table 6 also shows the average degree of interactivity by space, from which the most salient finding is the low level of interaction in the hot-desking area (2% respect the affordance from desk location). This low level of observed interaction in the open-plan area (where freelancers, start-ups, and independent workers are based) portrays an image of co-working spaces that questions their impact on face-to face interaction and the formation of professional ties leading to collaboration.

6. Discussion

The case of MYS has served to empirically and analytically assess the social dimensions of collaboration in co-working spaces. Space syntax theory constitutes the main theoretical grounding of this research, and this section situates the main findings of the thesis within existing syntax theories, presenting its contribution to the development of the field (particularly concerning the study of complex buildings) arguing for methodological innovation as a way to achieve this.

Through empirical data gathering and analytical methods it was found that visual proximity does not always lead to interaction. It was shown that hot-desking areas are in greater visual proximity on a global scale, but this does not result in interaction, whereas studios are visually ‘deeper’ in the layout but have a higher level of interaction. Two main drivers for interaction exist in MYS:

- 1) Spatial drivers: mutual visual ties (which take place in enclosed and secluded spaces) as a result of physical properties of the layout.
- 2) Transpatial drivers: professional orientation (freelancers and start-ups versus consolidated professional teams); these two groups have different social needs which results in higher networking and collaboration between independent members (hot-deskers) than teams (studio based members).

Traditional syntax theory would suggest that segregated spaces lead to less frequentation of users, thus, less interaction. This research provides evidence against this assumption, adding more nuanced insights regarding visual integration and its impact on interaction. By considering interactive behaviour as a process that emerges out of spatial affordances, but is also affected by external factors, traditional theory and methods were challenged and new methods proposed for a predictive approach to interaction in co-working spaces.

Furthermore, differential advantages were found from desk locations in the layout. The affordances for interaction differ according to desk position and, after studying various attributes such as control, preference, integration, connectivity, and visual depth, these location-specific properties were proven to affect the potential for interaction. In terms of method, SNA was shown to aid the understanding of desk positioning and visual ties, and it was found that the combination of syntactic analysis with social networks analysis is particularly insightful in office environments.

7. Conclusions

The complexities of human behaviour in interior spaces, tending towards individualized responses to the built form, challenged the present enquiry into the social dimensions of collaboration in co-working spaces. Hillier and Hanson (1984) argued that buildings play a key role in organising specific forms of social relations. In the case of co-working spaces, this research has proven that the spatial dimension, including configurational aspects, layout properties, furniture arrangement and visual relations, have an impact on the social processes that take place within them. More specifically, this research has found that, contrary to traditional space syntax theory suggestions, in the case of co-working spaces, visual integration does not always lead to interaction since this behaviour was empirically demonstrated to occur in a higher degree in secluded spaces. Additionally, it showed differential affordances for interactive and collaborative behaviours from desk locations.

Studying only one case is identified as a limitation of this research; ideally, it would have been a comparative study (which proved impossible for practical reason of gaining access). This supposes a disadvantage in the generalisation of the results and the establishment of general trends applicable to co-working spaces as a type. Collaboration is concluded to be a social behaviour that develops over time, and the empirical enquiry into co-presence and interactive behaviours as stages towards collaboration remain a suggestion of potential inter-organisational collaboration in co-working spaces. Future research could consider collecting data on actual collaboration and compare it to the sort of data gathered for this research such as the co-presence, visual fields and interaction networks.

The main contribution of this research is the methodological development towards an analysis of collaboration that considers its social dimensions (going from awareness of others and interaction to actual collaboration). It demonstrated the viability of integrating space syntax methodology with social networks analysis for the representation, visualisation, and analysis of spatial data. The adaptation of the network approach to different datasets and research questions challenged preconceived ideas regarding integration as a driver for interaction and raises new questions for the development of social and syntactic study of complex buildings.

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Appendix 1

Supporting data from Snapshots – desk occupancy

	Max Occupancy	on round	Min Occupancy	on round
All desks				
Whole:occupied	41%	Wednesday, 12:00 - 12:15	16%	Wednesday, 11:00 - 11:15
Whole:unoccupied	59%	Wednesday, 15:00 - 15:15	84%	Wednesday, 15:00 - 15:15
Day 0	37%	Tuesday, 13:00 - 13:15	22%	Tuesday, 10:00 - 10:15
Day 1	41%	Wednesday, 12:00 - 12:15	16%	Wednesday, 11:00 - 11:15
Whole:occupied	86%	Wednesday, 12:00 - 12:15	34%	Wednesday, 11:00 - 11:15
Whole:unoccupied	14%	Wednesday, 16:00 - 16:15	66%	Wednesday, 11:00 - 11:15
Day 0	77%	Tuesday, 13:00 - 13:15	46%	Tuesday, 10:00 - 10:15
Day 1	86%	Wednesday, 12:00 - 12:15	34%	Wednesday, 11:00 - 11:15

Appendix 2

Raw aggregate Snapshots data – all activities

Activities	Tuesday									Wednesday								
	Day:																	
	Round:																	
	10:00-10:15	11:00-11:15	12:00-12:15	13:00-13:15	14:00-14:15	15:00-15:15	16:00-16:15	17:00-17:15	18:00-18:15	10:00-10:15	11:00-11:15	12:00-12:15	13:00-13:15	14:00-14:15	15:00-15:15	16:00-16:15	17:00-17:15	18:00-18:15
	19	30	33	42	32	42	32	30	28	24	30	36	33	27	30	36	23	28

Sitting everywhere 18 26 24 32 23 26 27 23 20 21 26 30 30 26 26 30 18 21

Standing everywhere 1 1 3 2 2 8 2 3 2 0 3 3 1 0 1 2 4 2

Walking everywhere 0 3 6 8 7 8 3 4 6 3 1 3 2 1 3 4 1 5

Interacting 5 5 8 11 2 12 4 15 8 0 19 13 15 4 4 9 7 5

Activities	Tuesday									Wednesday								
	Day:																	
	Round:																	
	10:00-10:15	11:00-11:15	12:00-12:15	13:00-13:15	14:00-14:15	15:00-15:15	16:00-16:15	17:00-17:15	18:00-18:15	10:00-10:15	11:00-11:15	12:00-12:15	13:00-13:15	14:00-14:15	15:00-15:15	16:00-16:15	17:00-17:15	18:00-18:15
	19	30	33	42	32	42	32	30	28	24	30	36	33	27	30	36	23	28

Sitting everywhere 18 26 24 32 23 26 27 23 20 21 26 30 30 26 26 30 18 21

Standing everywhere 1 1 3 2 2 8 2 3 2 0 3 3 1 0 1 2 4 2

Walking everywhere	0	3	6	8	7	8	3	4	6	3	1	3	2	1	3	4	1	5
Interacting	5	5	8	11	2	12	4	15	8	0	19	13	15	4	4	9	7	5
in space	19	30	33	42	32	42	32	30	28	24	30	36	33	27	30	36	23	28
as percentage of people in space																		
Activities	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Sitting everywhere	95%	87	73	76	72	62	84	77	71	77	88	87	83	91	96	87	83	75
Standing everywhere	5%	3%	9%	5%	6%	19	6%	10	7%	0%	10	8%	3%	0%	3%	6%	17	7%
Walking everywhere	0%	10	18	19	22	19	9%	13	21	13	3%	8%	6%	4%	10	11	4%	18
Interacting	26%	17	24	26	6%	29	13	50	29	0%	63	36	45	15	13	25	30	18
		%	%	%		%	%	%	%		%	%	%	%	%	%	%	%