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The Future of Innovative Workplaces

A socio-spatial investigation of interaction patterns in accelerator and incubator workplaces

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ABSTRACT

The Covid-19 pandemic was a catalyst towards shaping the future of the workplace. This shit from a physical workplace to a virtual one was an eye-opener to many organizations, especially innovative workplaces (incubators, accelerators, coworking spaces, and FabLabs) to adapt to a more flexible mode of working. This resulted in second-guessing the importance of the physical environment and its influence on shaping organizational culture. The aim of this study is to build an understanding of the parameters needed to shape decisions made towards changing the mode of working in innovative workplace. For this purpose, this research investigates the major influences that lead to the emergence of organizational cultures, from organizational goals, spatial influences, social structure, and technology. Using analytical and empirical methods of research to assess human behavior in the physical environment of accelerator and incubator programs, calculated decisions can be made in implementing new modes of working to innovative workplaces without impacting their organizational culture. Founders Factory, an accelerator and incubator program in London, was used as a case study. The research investigated the company's organizational goals, social structure, and workspace. The results suggest that interaction patterns in accelerator and incubator workplaces are driven by organizational goals and common social ties, but space plays a major factor in spontaneous face-to-face interactions allowing for easier communication patterns.

KEYWORDS

workplace, space, social ties, organizational culture, collaboration, innovative workplaces.

1 INTRODUCTION

Over the years the workplace has shifted significantly to respond to social and economic changes. Today the trend lands on workplace flexibility, an opportunity to adjust where, when, and how to work (Hill et al. 2008; Lai et al. 2009). This rise is addressed on one hand in firms, where employees are given the flexibility to where the staff can perform their job, and on the other hand is relevant to the increase in number of entrepreneurs, freelancers, and start-ups. To service this growing group of workers, there has been a rapid rise in collaborative coworking enterprises that provide workspace within a social environment such as accelerators, incubators, coworking spaces, and fablab (Capdevilla 2013; Waters-Lynch et al. 2016). These "innovation and creative labs" introduced by Smidt et al. (2014) are considered as "…configurations that enable organizations to be open to external creative influences, as well as generating and promoting knowledge and innovations…" (Smidt et al., 2014 p.236). To attract entrepreneurs and freelancers to these workplaces, certain benefits are promised to potential users. These benefits vary in terms of social environments, networking opportunities, and places for learning and transfer of knowledge (Carbal and Winden, 2018).

A change in the spatial layout was essential to adapt to the new notion of workplace flexibility. In the 1960s, Robert Propst "action office" was the first open space office consisting of different working hubs. The model was meant to be non-hierarchical defining an efficient- driven system that promotes flow of creativity by movement (Saval,2014). Even though Propst amended his initial idea by placing partitions between desks,known as the cubicle layout, the open plan came back to trend in today's workplace layouts. Being an active based model, promoting movement and co-presence, the open plan is considered an ideal layout for transfer of ideas, networking, and for creating an innovativeatmosphere (Bernstein and Waber, 2019).

1.1 Social and Spatial Impact of Covid-19 on the Future of the Workplace

Today, the Covid-19 pandemic might have acted as a catalyst towards shaping a new future for the workplace. The work mode has shifted completely from a physical environment to working remotely. This change gave rise to new notions of flexible working, questioning the importance of the physical environment in shaping organizational cultures. A recent survey by the Financial Times found that 49% of UK-based companies are planning on reducing lease space, while 30% of their "work at home" staff will probably stay in that configuration (Bersin, 2020). This shift to complete remote working opened a door to new workplace issues, most of which relates to work/life balance, problems with using technology, and two-way communication patterns.

Nevertheless, productivity did not seemto be an issue (ibid). The future of the workplace is trending towards "hybrid" work locations working from home some days and going to the office for meetings (ibid). The Covid-19 pandemic shed light on various issue leading to new social and economic structures prevailing. Will the workplace flexibility model be on the rise? Is the office still an important

factor in shaping organizational cultures? What is the future of the workplace?

1.2 Purpose of the study and Research Questions

Questioning these changes must be taken into consideration in the upcoming trend of the workforce, both socially and spatially. Hillier's (1996) argument for 'non-discursive techniques' describes the need for architectural theory to shed light on the spatial and formal patterns of the built environment. In the aims of trying to answer some aspects of these questions in the context of this study, analytical theory and descriptive methods of thebuild environment were used to address the workplace changes taking place. Before we landon a new trend, we need to understand what kind of behaviors are changing and what arethose we want to create.

This research enquires the different phenomena that come into play in the emergence of an organizational culture. This descriptive-analytical research will help assessthe influence of the physical environment on interaction patterns across the organizationalstructure of accelerator and incubator programs. The case of Founders Factory will be analyzed following spatial and transpatial [1]phenomena that drive social behaviors, leadingto the emergence of organizational culture. In the means of exploring new trends that mightgovern the future workplace decisions, this study is conducted to investigate:

What are the factors that influence interaction patterns in accelerator and incubator programs? And how can these factors be used to influence future workplace decisionswithout impacting their organizational culture?

To reach our aim, this study has the following objectives:
First objective: To explore the relationship between collaboration and organizational goals inthe Foundry Company.
Second objective: To explore the different phenomena that influence interactions inaccelerator and incubator workplace.
Third objective: To evaluate the impact of future trends, such as remote working in incubator and accelerator workplace culture.

2 THEORY

In the aim of establishing a theoretical framework for this study, this chapter concentrates on presenting a review of the literature starting with an overview of the emergence of accelerator and incubator programs and its organizational goals. It also provides brief presentations of theoretical discussions on interaction patterns in the workplace and different factors that influence the emergence of an organizational culture in the physical space. Finally, this chapter highlights

1 A transpatial system is a classof spatially independent but comparable entities which have global affiliations (Hillier and Hanson,1984).

various studies that investigate how remote working has impacted the work environment during the pandemic.

2.1 Overview of accelerator and incubator programs and their organizational goals

Innovation is the engine of economic and social growth in a knowledge-based society (Powell and Snellman, 2004). One of the main sectors that adds to economic and social prosperity is the creation of new businesses, known as start-ups. Start-ups are defined as a project started by an entrepreneur that seek to develop and validate a scalable economic model (Katila et.al., 2012). Start-ups added more wealth into the economy, creating better standards of living through innovative technologies, and increased the nation's GDP (Gross Domestic Products) (Miller and Bound, 2011). With the technological boom that appeared in the last decade, technology investors decided to invest a sum of capital in start-ups which lead to the rise of the accelerator program.

Start-up accelerators also known as " seed accelerators or business accelerators" (here we refer to them as just "accelerators") are limited durational programs lasting three to six months that help cohorts of start-ups with their entrepreneurial process (Cohen et.al., 2019). The main organizational goals behind these programs is to provide an environment which reduces the costs and overcomes barriers for start-ups to launch and grow their businesses (Miller and Bound, 2011). To do so, key benefits are provided for participants of these organizations from small amounts of seed capital, working spaces, and a platform for networking, education and mentorship opportunities from program directors, peer ventures, and external participants commonly referred to as "mentors"(Cohen and Hochberg, 2014). A sub-sector of the initial accelerator program are incubators. Incubators are organizations that constitute or create a supportive environment for the "incubation" of start-ups (Grimaldi and Grandi 2005; Chan and Lau 2005). Incubator programs refers to "a collection of techniques that can be used to prove an idea, develop a team and de-risk ventures for later stage investors (Dee et al, 2015, p. 10). Similar to accelerators, workers in incubators can receive an integrated package of services such as shared workspace, coaching, networking, and access to capital (Dutch Incubation Association 2018).

In their article, 'The promise of a co-working environment', Victor Cabral and Willem van Winden (2018) conducted an empirical study to assess the benefits that collaborative workspace (such as accelerators, incubators, co-working spaces, and fabrication labs) provides for their users. Co-working spaces are defined as business services model in which professionals work alongside other unaffiliated professionals in a shared office space (Spinuzzi,2012). Fabrication laboratories (also known as FabLabs) are small scale open workspaces offering fabrication usually for product designers and other sub-sectors of the art community (Menichinelli,2011).

These benefits are categorized according to two business benefits, collaboration and generic business development. The results of this empirical study show that each collaborative workspace varies in its combinations of collaboration and generic business development. Accelerators and incubators programs offer more emphasis on generic business development in comparison to collaboration in alignment with their organizational goals: to help start-ups grow and scale their business. As for co-working spaces and FabLabs, a balanced mix between business development and collaboration portrays that users work by themselves with the additional benefits of potential for networking with other people.

2.2 Interaction patterns and organizational behavior

Studies suggest that space was proven to be an incubator of social interactions within the same spatial proximity in different types of workspaces. Wineman et al.(2009) found that nearness of college faculty offices played a significant role in collaboration or co-authorship of academic papers. Allen (2007) identified three types of technical communication used by knowledge workers: coordination, information and inspiration, and concluded that proximity to co-workers was the most important characteristic for inspiration to occur. As for co-working spaces, Bencosme (2017) study suggests that people in the same spatial proximity are highly likely to interact. Not only spatial proximity plays a role in interaction affordance but also visual ties. 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).

The concept of space and transpatiality was first introduced in the Social Logic of Space by Hillier and Hanson (1984). The authors argue that the relationship between individuals is explained either as a spatial function (spatial) or as a social function (transpatial) of conceptual closeness. Nevertheless, this does not mean that transpatial factors are not spatial, but rather space is considered as a socially produced manifold. Implementing this to the workplace environment, Sailer and Penn (2009) argue that the reason behind distinct behavior across similar spatial configurations is that “knowledge-intensive organizations require characteristic spatial configurations, thus forming a distinct space-organization relationship” (p.95). Moreover, their results reflect that some human interactions in the workplace are driven by social ties and common identities rather than spatial location or physical distance (ibid).

2.3 Technology, interaction patterns, and the remote environment

Technological advancements have added an extra factor in assessing interaction pat- terns in the workplace. Remote interactions have become a means of communication not only for individuals

who are in different spaces, but rather in the same spatial proximity. In an investigation of the effect of open plan offices on human collaboration, Bernstein and Turban (2018), research was focused on the impact of remote interactions (email and instant messaging) on face-to-face interaction patterns. Their empirical findings suggested that open plan offices reduced face-to-face interactions by 70% and that was due to an increase in electronic interactions by 20% to 50%. It was observed that due to openness of space, an employee might look around to see if the particular person is at their desk and contact them electronically, instead of having a face-to face interaction showing that face-to-face interactions and electronic interactions are poor proxies to each other.

Kruet et al. (2002) discuss how distributed work, between office space and remote space, can alter the organizational culture due to changes in communication between employees and how they organize themselves and their work. The authors analyze why remote interactions are not as successful as physically shared environments. In their study, they reflect on initiating communication in physical collocation has consequences on frequency of encounters (Kruet et al.,2002). Moreover, physical mobility and visual channel are important for people to initiate communication. Face-to-face interactions happen in real time, hence there is a better interpretation of the subject due to visual, auditory, and gestural cues that allows the speaker to know how the message is being understood and how it has been delivered. These issues have not been solved by media channels all at once in comparison to physical interactions, that is why face-to-face interactions were mainly used for negotiations. As for remote channels, they were used for follow-up communication between team members.

Opposing to Kruet et al.(2002) argument about distributed work, Farrer (2020), a remote work strategist, suggests that the transition to virtual collaboration is possible for knowledge-based workers to adopt in the future regardless of the workplace location based on the following criteria: Virtual workplace accessibility, asynchronous communications, and result-based tracking. Virtual workplaces and information management technology will make access to resources easier outside the office space. As for asynchronous communications such as emails, instant messaging platforms, and recorded videos will allow for a transparent and continuous flow of information between team members.

2.4 Impact of remote working during the pandemic on start-ups

The workplace has shifted abruptly to remote working due to the Covid-19 pandemic.
This has significantly impacted the workforce routine, work/life balance, productivity, and engagement. Due to this recent situation, surveys and articles have been exploring the impact of remote working on the workforce and the future of the workplace. In a recent study compiled by

Founders Form and TechCrunch, 63% of the surveyed start-ups will be reopening their offices with changes in their mode of working. The majority will be moving into a distributed flexible remote working model (some with permanent offices, some without), a small number will go back to normal return to work, and a very small number plan will go fully remotely (Butcher, 2020). In the results of the survey, many have cited the importance of face-to-face interactions especially when trying to build team culture in early-stage companies. Remote working has increased productivity due to working more hours whereby, 55% of start-ups said they have worked more than normal, 30% worked the same number of hours, and 13% worked fewer. Founders Form Founder Brent Hoberman commented on the results: “The results prove both that early-stage tech founders are adaptable, and that entrepreneurship is one of the best-suited professions to remote work. Furthermore, there are clearly opportunities for new types of even more flexible shared social workspaces with a vast majority of those surveyed still seeing value in face-to-face interaction” (ibid).

2.5 Conclusion from literature review

The aim of our empirical study is to have a better understanding of collaboration affordances in accelerator and incubator programs, and if interaction patterns between the members of the organizational structure help in the business development of start-ups. As for the various parameters that affect interaction and communication in accelerator and incubator programs, the literature review shows that these are divided into three factors: spatial, transpatial, and technological.

For spatial factors: proximity, visibility, and spatial layout offers affordances to the way organizations behaved. Sailer and Penn (2009) also suggest that social ties and conceptual closeness is a main factor that can affect interaction patterns in the workplace.Finally,Bernstein and Turban (2018) showed that technological advancement such as email and instant messaging has proven to be an inhibitor of face-to-face interaction in open office space. As for comparing interaction patterns between remote and office environment, Kruet et al. (2002) argue that remote interactions are not as successful as physical interaction due to lack of communication initiation, frequency of interactions, and having grounded interactions. In contrast, Farrer (2020) suggests that remote interactions are even better than physical interactions if they follow certain criteria. Nevertheless, due to the pandemic the workforce has shifted abruptly to full remote working and this has impacted their work routines, organizational culture, and creative outputs. As for start-ups, Butcher (2020) survey suggested that distributed work might be the new mode of working for start-ups in the future since their productivity has increased and their business goals were not affected by remote working.

3 INTRODUCTION TO CASE STUDY

Founders Factory, an accelerator and incubator program, was used as a case study aiming to arrive at new knowledge that can contribute to the development of research on innovative workplaces.

3.1 Organizational structure and goals

The organizational goal of Founders Factory is to power the growth of start-ups. Their organizational structure consists of the a) start-up teams joining the accelerator or incubator program and b) operational team that provide mentorship for start-ups. Start-ups that join the factory are from various sectors such as healthcare, education, artificial intelligence, beauty, media, travel, retail, and financial technology. A variety of benefits are promised to start-ups while joining the factory depending on the programs they are admitted to. For early stage start-ups, they are placed in the incubator program for a duration of six months, provided with £150,000 in capital per start-up, free workplace, and mentorship to test their ideas. As for later stage, more developed start-ups, they usually join the accelerator programme for six months to benefit mainly from the mentorship that can help scale and grow their businesses. In addition, they are provided with £30,000 in capital per start-up and free workspace. Founders Factory team in the London cohort consists of 70 employees specialized in various fields. The operations team is divided into business development and creative teams. The business development team is responsible for start-up growth, product, fundraising, and talent. As for the creative team, they help start-ups to enhance their marketing and branding image. This diversity amongst the operations team provides a well-rounded mentorship to help start- ups grow and scale their businesses.

3.2 Spatial Layout and Program Distribution

The workspace is an open plan layout consisting of 15 meeting rooms, 2 workspace areas,3 seating areas, an event space, and service areas. It has access to a common atrium seating space with other firms' office space on the same floor. The seating arrangements separate different groups (business development operations, creative operations, accelerators, and incubators) of the organizational setup in space shown in Figure 1. The space is divided by long corridors into different compartments allowing for visitors to experience the energy of the office before reaching their destination. Meeting rooms are distributed in different areas of the office space. As for the seating areas, they are in various areas acting as quiet informal meeting/quiet working zones for people to concentrate. The seating area near the kitchen usually acts as an event space but is mainly a quiet informal meeting room when no event is taking place.

Figure 1: Distribution of functions and seating arrangement of social groups in space

4 DATASETS AND METHODS

4.1 Research Design

In the aims of investigating the influence of space on social formation, interaction affordances were investigated in terms of chance encounters by movement and visual co-presence. Hiller and Hanson (1984) argue that space is an influencer of social interfaces characterized by movement and co-presence creating a field of probabilistic encounters. Based on the following argument, from on-site observations, path traces were recorded every half hour for people who moved concurrently in space and crossed paths. These potential patterns of interactions were depicted in a social network analysis (SNA), an analytical tool concerned with the links or relations between a group of individuals/social entities (Wasserman and Faust, 1994). As a representation of visual co-presence in space across different social groups, an isovist analysis was conducted. A set of points visible from a given vantage point in space (Benedikt,1979) were drawn from each person's seat to surrounding desks. Inter-groups and cross-group degree of inter-visibility across workstations was represented in the overlapping of the isovists for each social group. The results of interaction affordance through visual co-presence were abstracted in a SNA.

To access people's behaviour in space, on-site observations took place on February 18 till 20, 2020. These days were chosen to capture various levels of activity at different intervals during the week (beginning, middle, and end). The recording of data based on observations, done manually every half hour from 10 am to 6pm, noting people's occupation and three main

activities in space: seated, standing, interacting. The data from these snapshots were processed into empirical data of inter-group and across-group interaction patterns in space using R software; later represented in a SNA of actual interaction patterns.

4.2 Data Procedure

Movement give rise to different probabilities of chance encounters, creating potential interaction patterns between social groups. These encounter affordances between people who concurrently moved and crossed paths, resulted in an inter-group and cross-group database of potential for interaction abstracted into a SNA.The results of the SNA of potential interactions were compared with the results of SNA of actual interaction patterns that emerged from movement.

Visual factors such as integration and visual openness is an influencer of face-to-face interactions in space (Chaboki, 2013). The isovist analysis conducted from each person's seat to all other seats represents the number of people this person has visual links with. This notion of visual copresence leads to interaction affordances across space. Potential interaction constructed by visual links across space was developed by Bencosme (2017). The database from the isovist analysis were then abstracted into a SNA of inter-group and across-groups of interaction affordances (through visual links) .The results of SNA of potential interactions through visual copresence were compared with SNA of actual interactions across workstations from observation data.

To determine if spatial or transpatial factors influence interaction patterns in a workplace, a measure of socio-spatial correspondence was created. The concept of correspondence and non-correspondence theory was one of the early concepts in space syntax theory developed by Hiller and Hanson (1984). The authors describe the overlap between the spatial and transpatial solidarities; systems with high degree of correspondence are systems in which conceptual closeness (transpatial) overlap with their ordering in space creating a system with close boundaries. As for non-correspondence systems the opposite is true. Non-correspondence systems are open systems bringing people together (ibdi). Derived from Sailer and Thomas (2019) method of determining the degree of overlap between social closeness of people and their spatial closeness, the degree of overlap in this case will be between spatial closeness and the occurrence of interaction. Yule's Q measure, which describes the association of two sets of variables indicating the strength of the relationship (Vann,2011), is used to calculate the relationship between spatial closeness and interaction patterns. This calculation was conducted for the different types of interactions that occurred inter and across social groups relations (table 1).

Finally, from the results of the socio-spatial findings and the review of literature on future modes of working, an assessment can be done on impact of remote working or distributed work on the organizational culture of accelerator and incubator programs.

Yule's Q = $(a \times d - b \times c)/(a \times d + b \times c)$

		SPATIALLY	
		Close	Not close
INTERACT	Yes	a	b
	No	c	d

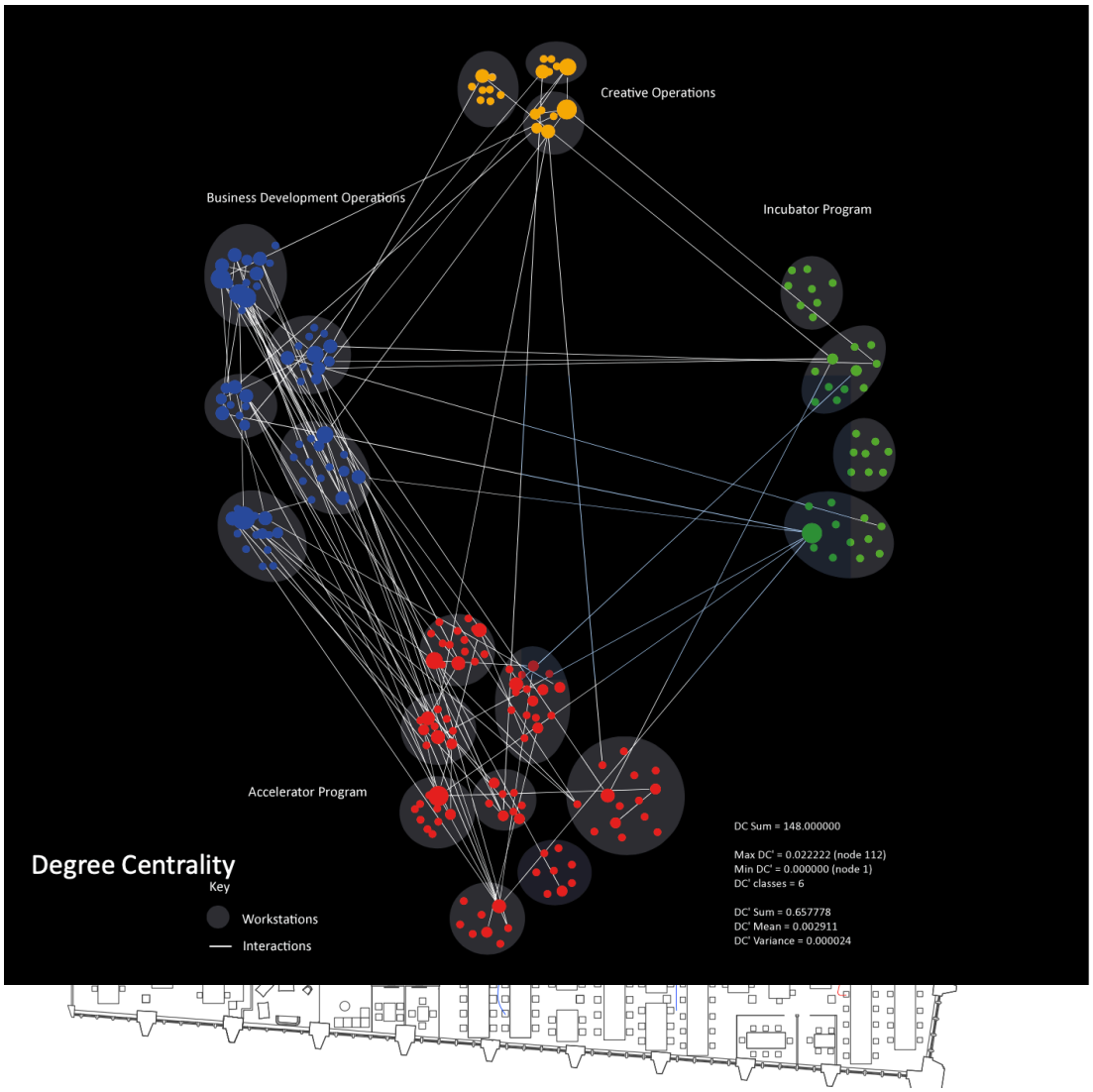
Table 1. Association of spatial closeness and interaction in Yule's Q

5 RESULTS

To understand the role of space in the emergence of social structure in innovative workplace, a thorough analysis was conducted of the spatial layout of Founders Factory. The aim behind this investigation is to explore the spatial phenomena that influence interaction patterns in accelerator and incubator workplaces. In the case of accelerator and incubator workplaces, there is limited research on the behaviour patterns they promote. Also, limited empirical work has been done to evaluate their spatial structure in relation to their community needs.

5.1 Potential interaction through movement co-presence

Referring to Hiller and Hanson's argument that the spatial network creates different interfaces through movement and co-presence, this socio-spatial logic was put under investigation in the case of Founders Factory. To understand spatial encounters and the different probabilities of social interfaces that emerges from movement, the argument presented is if two or more people move concurrently in space and cross path (in this case all people in Founders Factory are socially linked by being part of the same cohort), these encounters might materialize into interactions. An example is shown in Figure 2 illustrating path traces (from observation data) of individuals from different social groups that movedconcurrently in space. As they crossed paths, this creates a probability for them to stop and interact. The database of individuals that crossed paths, showing the people who crossed paths and the type of social relationship formed from



interaction affordances (operation – operation or operation – start-up),were processed into empirical findings and abstracted into a SNA presented in Figure 3.

Figure 2: Example of people from different social groups moving concurrently in space

The SNA in Figure 3 represent the four different social groups in the organizational structure: creative operations team, business development team, accelerator teams, and incubator teams. The figure illustrates their spatial arrangement across their workstations (grey circles) and their spatial arrangement in relation each other (each team arrangement in space). The SNA model is weighted by “Degree” centrality. Degree centrality is the count of total number of connections linked to a vertex also considered as a popularity measure (Hansen and Smith, 2011). In the case of potential interaction through chance encounters, “degree” captures the individual that crossed the most paths with others in the office.

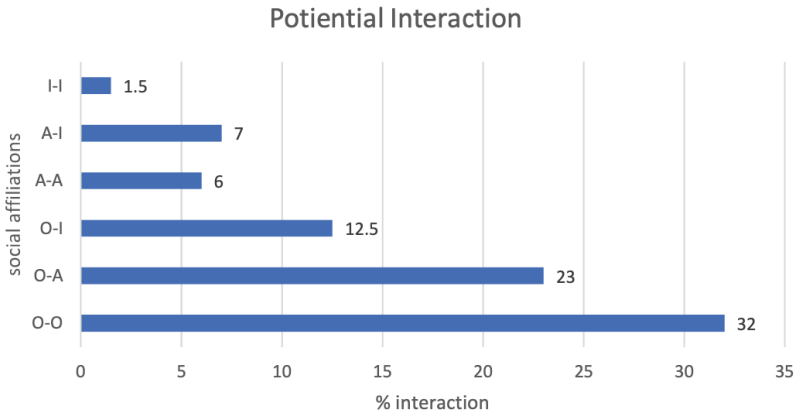


Figure 3: SNA of potential interaction patterns from chance encounters measured by Degree Centrality derived into empirical findings.

From observation studies 100 people were followed, in which 68 of them crossed paths. These probabilities of encounters leading to interaction affordances presented in the SNA show the following results:

- The biggest nodes size in figure 3,a member of the accelerator team (node 112), represents the person who crossed paths the most with other members of the Foundry (degree centrality).This person crossed paths with different member of the business operations team and other members in the accelerator programs, creating potential for interaction.

- As for potential interaction patterns interpreted from the empirical data of SNA shows the different probabilities of inter-group and cross-group relations emerged. Most of these potential interaction patterns (32%) were between inter-group and cross-group members of both departments of the operation teams (business development and creative operations). Next were operations with start-up teams (23% for operation – accelerator) and (12.5% for operations and incubator teams). As for start-ups teams, the highest potential for encounters was between accelerator and incubator members (7%) followed by members of the accelerator team (6%) and members of the incubator team (1.5%) as they cross path with other members in their programs.

The results presented show, that members of the operations team tend to move the most in space. Their encounters with different members of the operations teams and between start-ups teams were the highest. The results also reflect that these probabilistic encounters create different social

interfaces leading to a dynamic network of interaction patterns and information flow across all members of the organizational setup.

5.2 Potential interaction through visual co-presence

To better identify potential visual awareness across the different social groups when at their workstations, an isovist study was conducted. The isovists were mapped, using R software, from each workstation to all other workstations within its visual field. This process was simulated to each workstation across all departments. The isovist's field of vision angle was 170 degrees considering visual awareness across spatial proximity (Bencosme, 2017). This process explores the levels of visual co-presence between teams and across teams presented in Figure 4. To simulate a more realistic analysis, desktops acting as visual barriers are included. Today, in the open plan layout, desktop screens act as separators between people sitting across and adjacent to one another. This adds a new layer of physical boundaries potentially having an impact on social boundaries over and above spatial proximity.

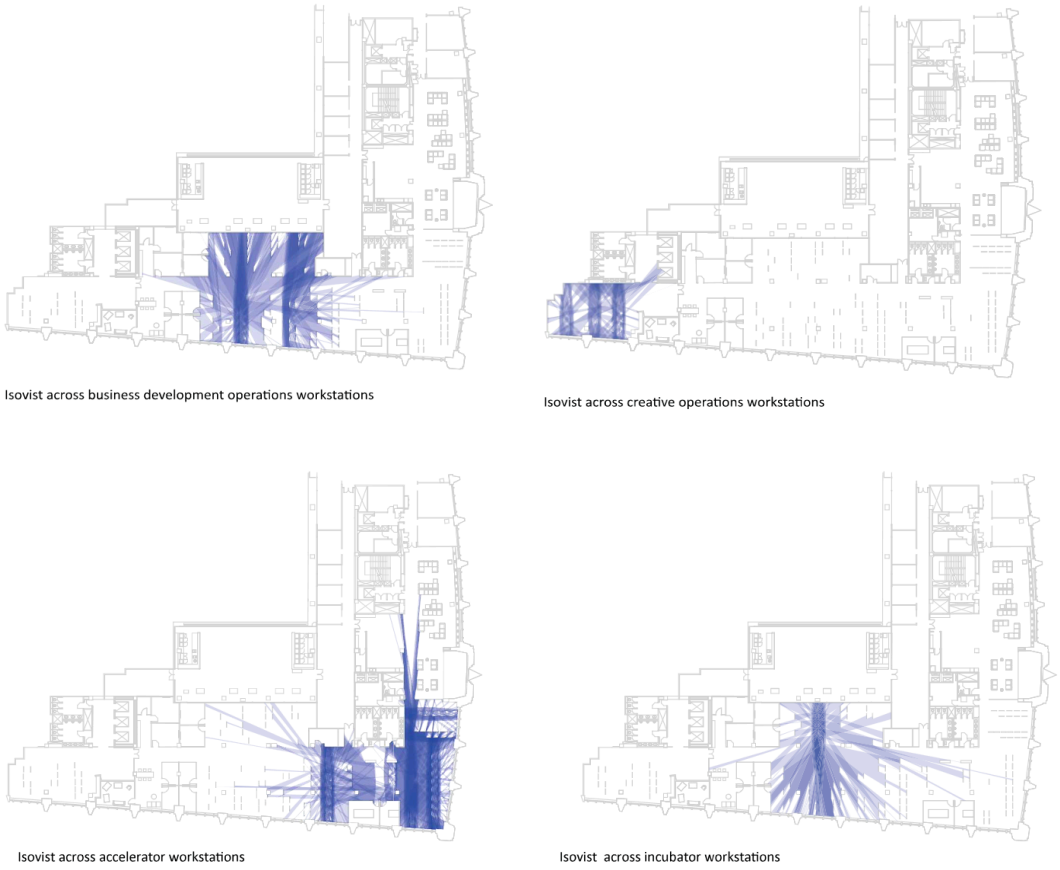


Figure 4: Mapping of isovist (with screens) across workstations of each social group

In Benscome's (2017) investigation of interaction affordances through visual co-presence, she developed a new methodology of introducing isovist data into SNA analytics tool. The basis of this methodology comes from the argument that the positioning of workstations in space is embedded into the social system of visual fields leading to interaction affordances. In the case of Founders Factory, the results of the isovists presented in Figure 5 is abstracted into a SNA to illustrate potential for interactions through visual interconnectivity between the social groups. The SNA measured by "degree", shows the individual mostly seen in the network by others. The SNA diagram represents each social group in relation to their seating arrangement and each workstation is presented in terms of spatial proximity to each other.

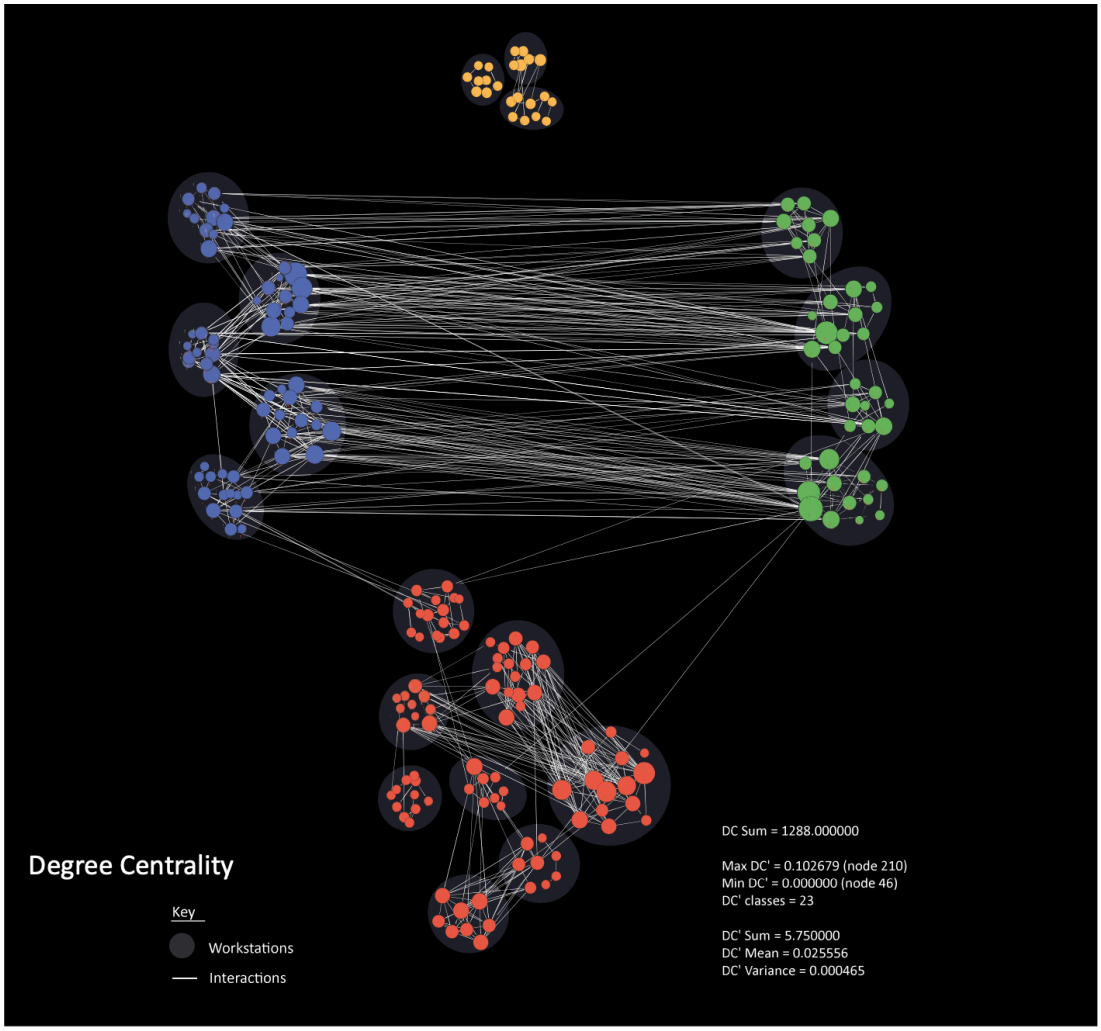


Figure 5: SNA of potential interaction patterns through visual co-presence measured by Degree Centrality

From the results of the analysis in Figure 4, the shades of blue colour represent the degree of visual interconnectivity across workstations. For the accelerator program, there is a high level of inter-groups visual interconnectivity, especially individuals located in the areas marked with darkest shade of blue colour. Some visual links connect those accelerator desks which are found close to the operations and incubator workstations. As for the incubator workstations, strong

visual links connect individuals in the middle desk and the operations desks. Some visual links are also present between incubator desks and accelerator desks positioned across the main corridor. As for operation teams, the business development team has high levels of inter-group and cross group visual interconnectivity mainly with the incubator team. Also, there are visual links between the operations' workstations and the adjacent accelerator's ones. Finally, the creative operations team are visually interconnected to each other with no visual connection to other departments.

In the SNA (Figure 5), shows that node 210 has the biggest node sizes in the system in whole, reflecting that the individual in that seat can mostly see and be seen in the network. Translating this graph into an interpretation of interaction affordances through visual co-presence, the highest inter-team's potential for interactions are accelerator teams and business operations. Members located in highly visually interconnected seats have the highest interaction affordances. Potential for interactions between members of the incubator programs does not seem promising. Their visual links are directed more towards the business operations team, reflecting high potential for interaction between them. Creative operations teams are not highly inter-visible as a social group compared to the others; hence this group is expected to have the least interactions in the social network.

Referring to Penn's (2005) argument, that visual awareness in space is essential for the affordances its holds in terms of social interaction, this analysis can lend itself to depicting prospective patterns of interaction between social groups through visual co-presence. In the case of Founders Factory, an abundance of interactions might occur between accelerator teams. The same goes for the business operations teams, with great focus on interacting with the different teams of the incubator program. Interaction patterns seem relatively low between the business operations team and accelerator teams, as well as start-ups of the accelerator and incubator programs. Creative operation and the rest of the teams have no interaction prospects and relatively low inter-team interaction affordances.

6 FINDINGS

Real time observations and analytical analysis were held to build a realistic picture of the socio-spatial dynamics in the workspace environment at Founders Factory. Spatial, social, and technological phenomena were investigated to understand what influences interaction patterns in accelerator and incubator program. This analysis looks at spatial qualities that influence interaction, social relationships formed in the organizational structure, and types of interactions patterns that took place.

6.1 Interaction Patterns in Founders Factory

Accelerator and incubator programs fall under the umbrella of flexible workplaces.One of the main aims behind the openness of the spatial layout is to promote an active and interactive atmosphere between members of the organizational structure.To understand the social structure at Founders Factory, snapshots were conducted every half an hour with an average of 120 people/hour being tracked.

Founders Factory was observed to be an active workplace. Figure 6 presents a superimposition of all snapshot data taken showing peoples' behaviour in space. Interaction patterns in the space correspond to 37%, while the rest were working on their own. Focusing only on interaction patterns in the office, Figure 7 demonstrates where these interactions were taking place. People interacting standing up (27%) took place across the corridor space (10%), between workstation, and in the kitchen (7%). Most interactions (73%) happened when people were seated .These interactions took place across the accelerator workstations and in meeting rooms (26% each), followed by business development operations desks (14%), seating areas (6%).Interactions across incubator workstations (7%) and creative operations (5%) had the lowest rates.

Figure 6: Superimposition of all snapshot data taken showing peoples' behaviour in space

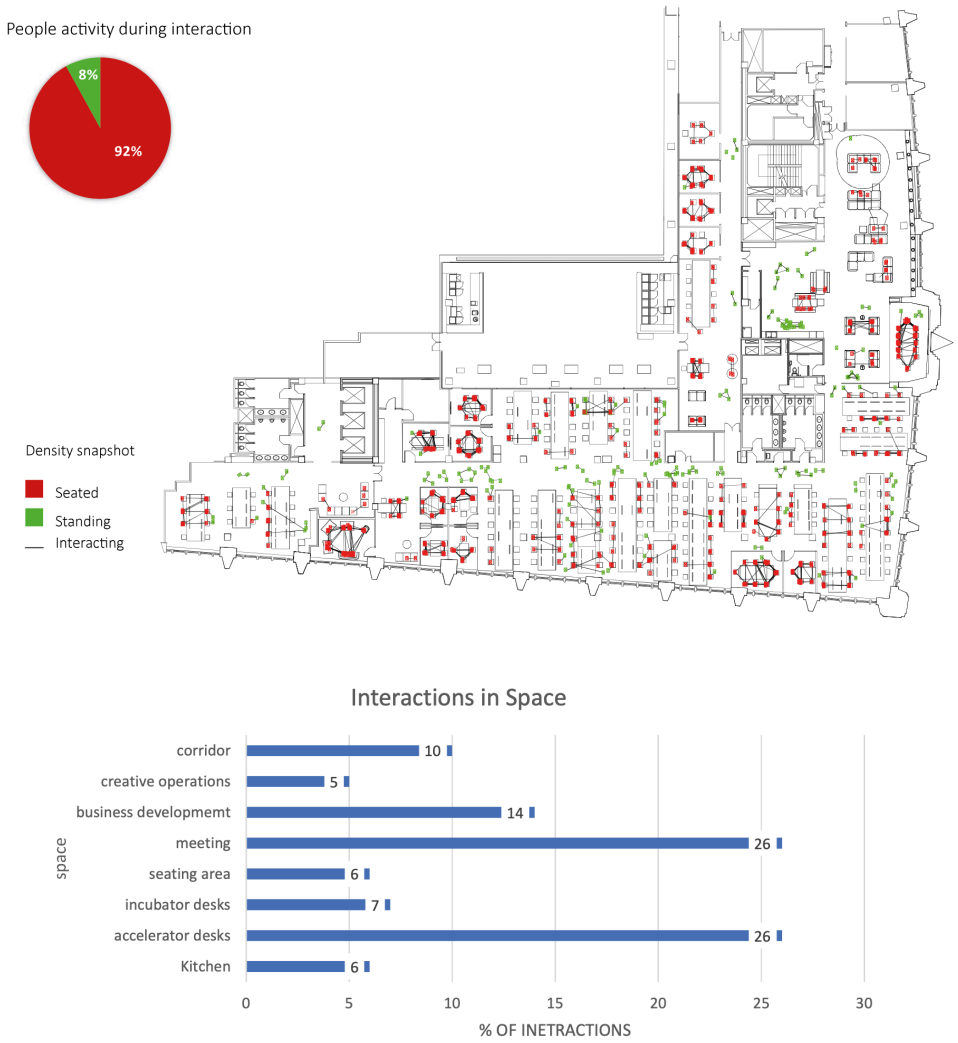


Figure 7: Spatial and Empirical findings representing interaction in space

Face-to-face interactions in Founders Factory consist of three types, formal meetings, informal meetings, and spontaneous interactions. Formal meetings were pre-scheduled meetings done for collaboration; informal meetings were pre-instigated casual meetings done to collaborate between different entities. Spontaneous interactions were a form of informal interaction that was sudden happening by chance for social interaction or collaboration (Kraut et.al.1990). The open layout space in the office attracted most interactions. These interactions were both spontaneous and informal interactions happening across workstations of organizational departments; plenty of these spontaneous interactions took place in the corridor areas and kitchen. Formal meetings were held mostly in meeting rooms,but some informal meetings took place in seating areas were people interacted for quick chats or due to unavailability of meeting rooms. Upon looking at interaction patterns in space, interaction across workstations often happen between members close to each other (spatially). What was also noticed is that informal interactions were taking place at workstations between a standing person interacting with a seated group/person (figure 7).

What should be put into perspective is the following: What type of relationship consists between people interacting in spatial proximity? Also, these informal/spontaneous interactions happening in space, do they emerge from spatial factors or are their transpatial elements that come into play? These observations lend itself to a deeper investigation of socio-spatial dynamics of interaction behaviour happening at Founders Factory.

6.2 Organizational Goals and Social Structure of Founders Factory

Interaction patterns depend on various factors of which social ties are relatively important. To understand why these interactions are taking place, we need to go back to the organizational goals of accelerator and incubator programs. The organizational structure of the Founders Factory consists of two main entities, the operations department and the start-up teams that join the foundry. The main objective of the operations teams is to mentor and guide start-ups towards helping them to grow and scale their businesses which involves collaboration between both operations and start-ups.Moreover, both departments of operations team, business development and creative operations, need to collaborate with each other to advise start-ups with their business development. Start-ups that join the accelerator program are usually in an advanced stage with their company, hence they are more likely to be composed of teams of 2 to 6 people. But some are sole founders. As for start-ups at the incubator stage, teams need to be formed during the program, so a high degree of interaction and idea exchange need to happen for teams to be formed. Also, start-ups join the program to network and help each other through discussing common issues and obstacles.

Highlighting organizational goals and structure enhances our understanding of the social structure and the different social relationships taking shape in the spatial environment. Figure 8 illustrates face-to-face interactions in space to capture the types of relations taking place between social groups. The results indicate that the highest percentage of interactions were between members of the operations team (O-O,31%). These interactions happened between inter-teams of the business development and creative operations, as well across-departments. Followed by high interaction between start-ups of the accelerator program (A-A,27%) and across accelerator and operations teams (O-A,20%).Interactions patterns between incubator start-ups were relatively low (I-I, 12%) as well as incubator and operations teams (O-I,10%). No interactions happened between accelerator and incubator start-ups. The results confirm that organizational goals are an influencer of interaction patterns especially between operations and start-ups. The results were abstracted in a SNA shown in Figure 9.

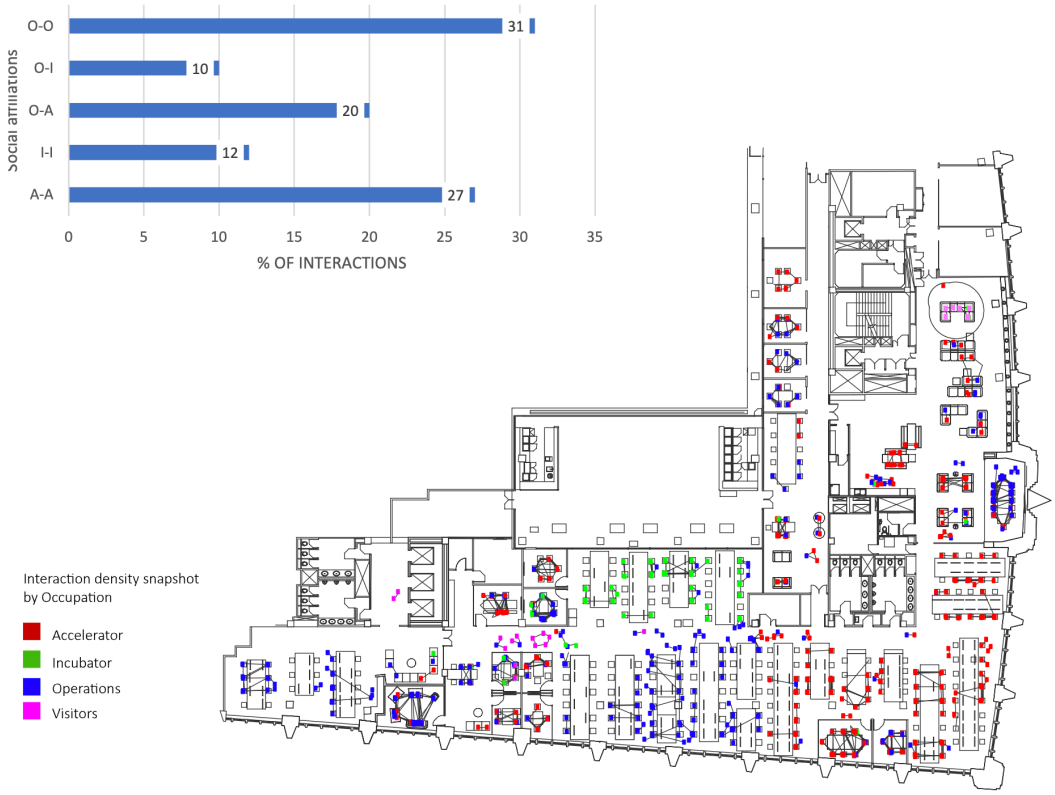


Figure 8: Spatial and Empirical findings representing of social affiliations created from interaction patterns

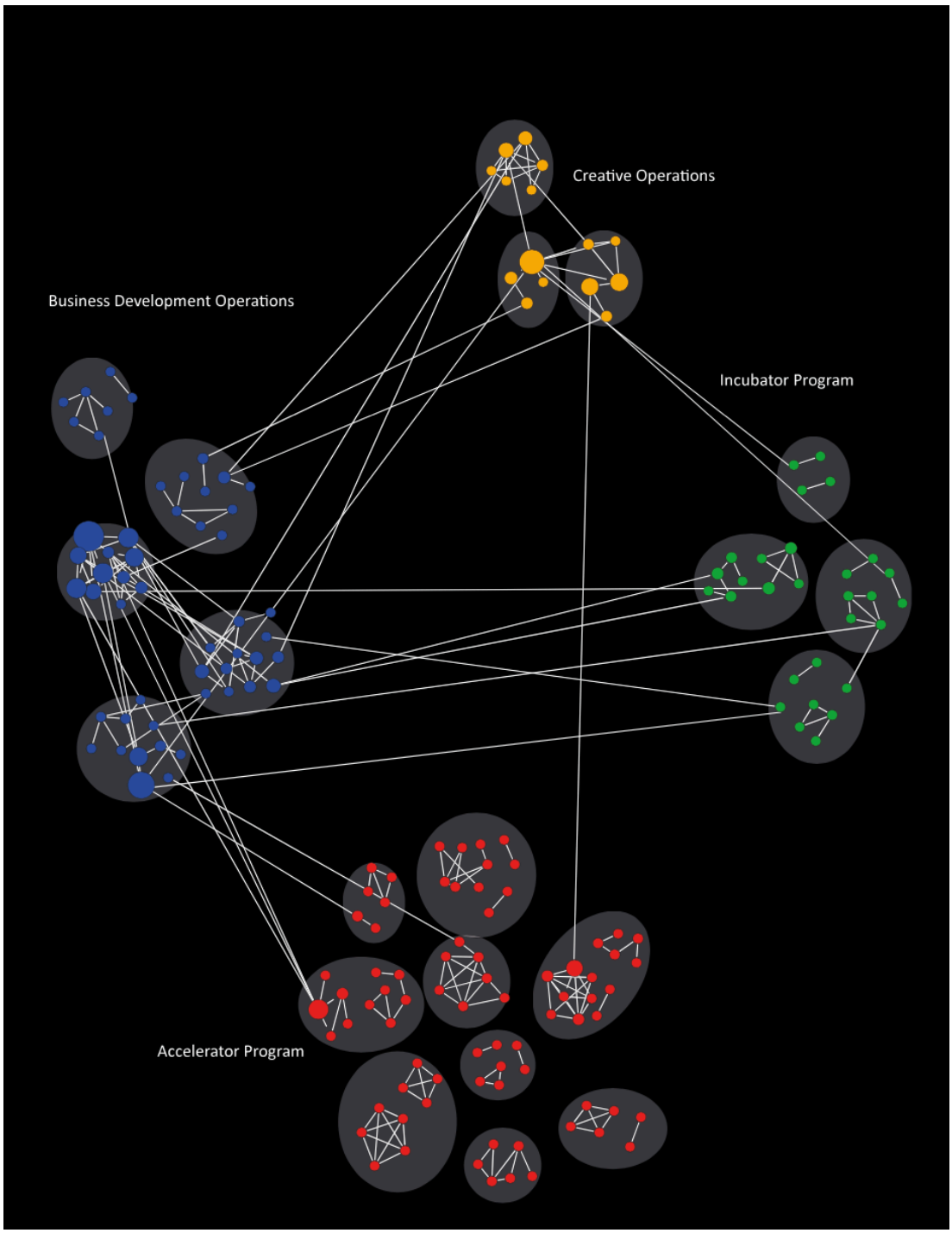


Figure 9: SNA of all interaction patterns that took place inter and across social groups

6.3 Spatial Proximity, Movement, and Social Relationships

To identify if spatial forms govern these social qualities presented in the above results, an SNA was performed. The SNA was illustrated according to two spatial factors, visual co-presence and movement. First, interaction patterns that happened across workstations were highlighted and compared with results of the interaction affordances through visual co-presence. Second, interaction patterns that were the result of movement were illustrated and compared with the

results of potential interactions resulting from path crossing. Both SNA were measured by degree centrality.

The SNA of actual interaction patterns that happened across the workstations of different social groups is presented in Figure 10. The results show that interactions are happening within spatial proximity across social groups. Starting with the operation teams, interactions in the creative operations are between groups of people seated facing each other on the same workstation. Interactions across workstations were still in the same spatial proximity, whereby people seating behind each other interact. The same situation was happening between workstations of the business development team. Interactions were bound in spatial proximity between people facing each other on the same workstation and between people seating behind each other across workstations. For start-ups, the situation changes. Interactions were in spatial proximity, nevertheless these interactions were bound by members of the same team only. In both accelerator and incubator programs, teams are seated facing or next to each other hence they interact. Nevertheless, different teams seated next to each other or facing one another did not interact. The only interaction that happened across different teams was in the incubator program. When asked, the two people were part of the same team before they broke up and created other teams.

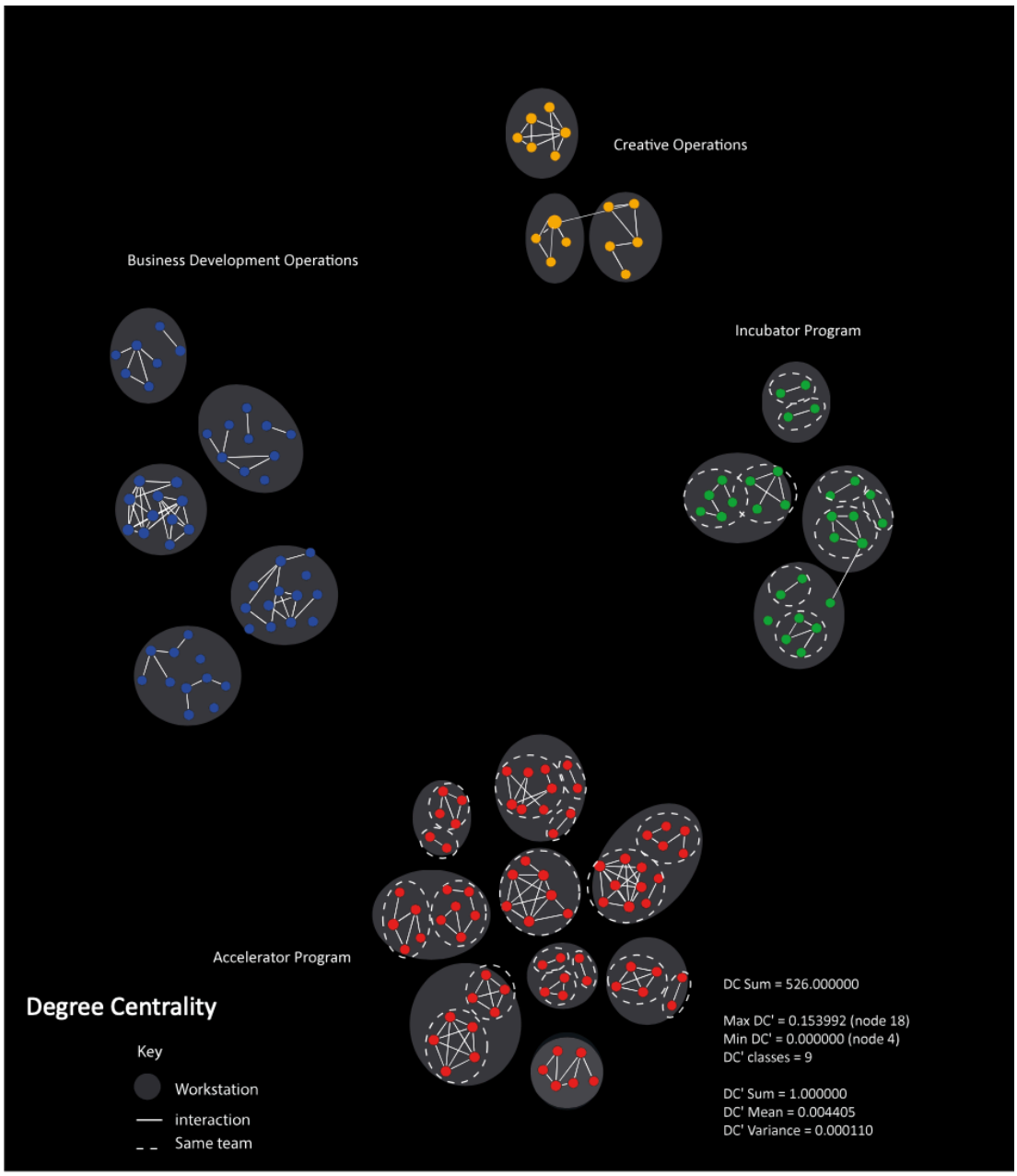
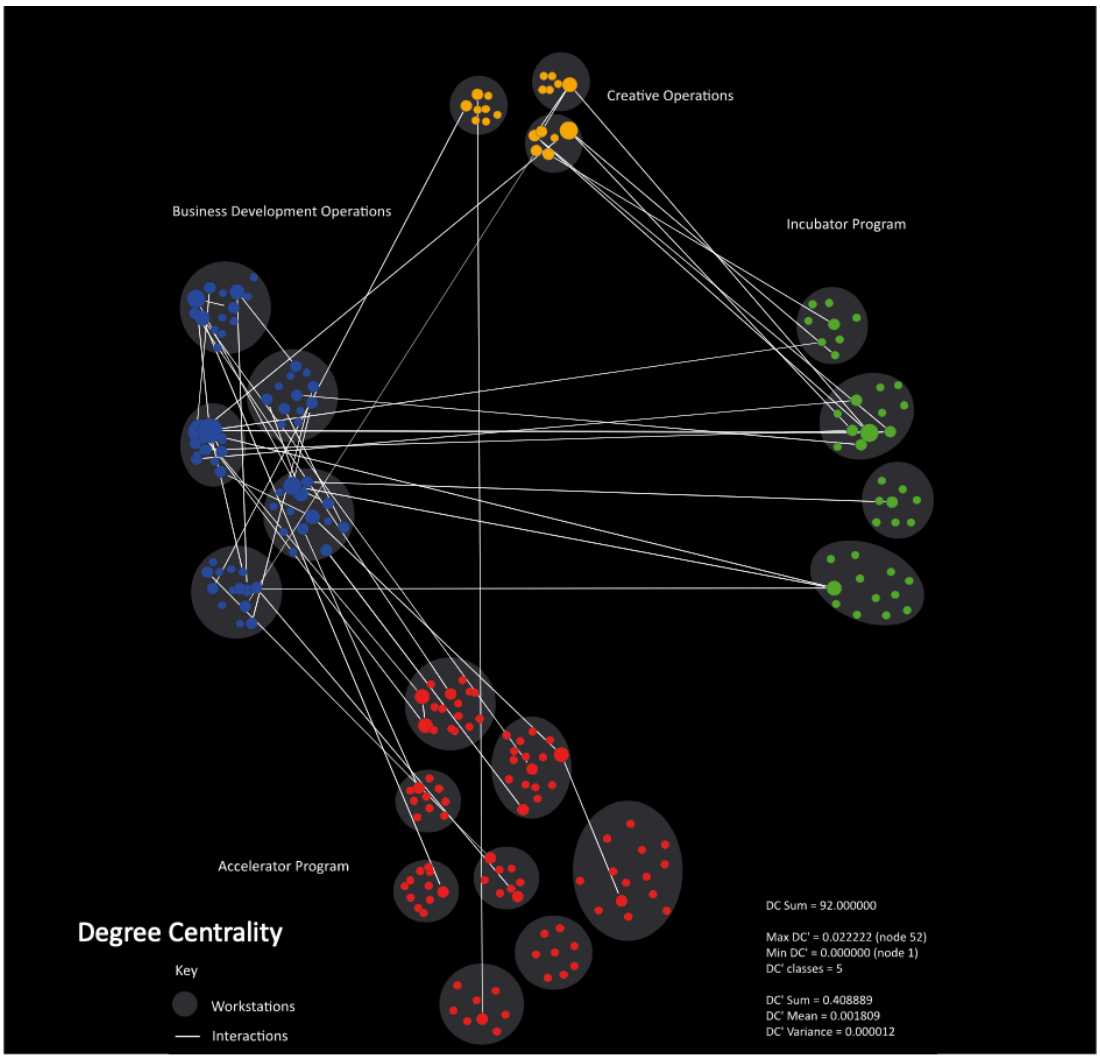


Figure 10: SNA of actual interaction patterns across workstations (only) measured by Degree centrality



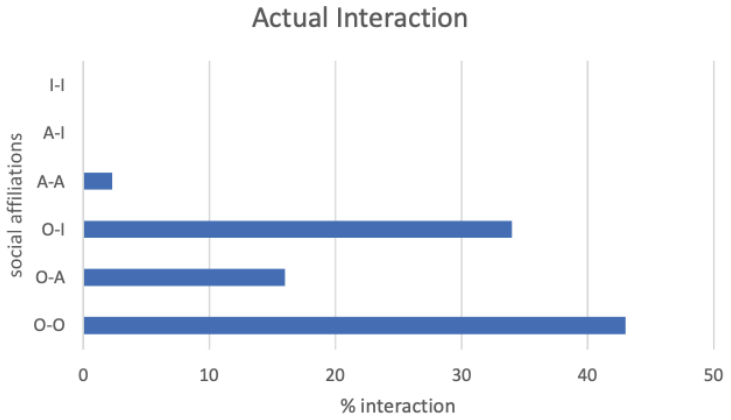


Figure 11: SNA of actual interaction patterns that occurred from movement (only) measured by Degree Centrality, and empirical results of SNA.

The results show that members of the operations team that were not seated across the same workstations or are in different spaces moved towards each other to interact. These interactions were the highest interaction pattern instigated by movement (43%).

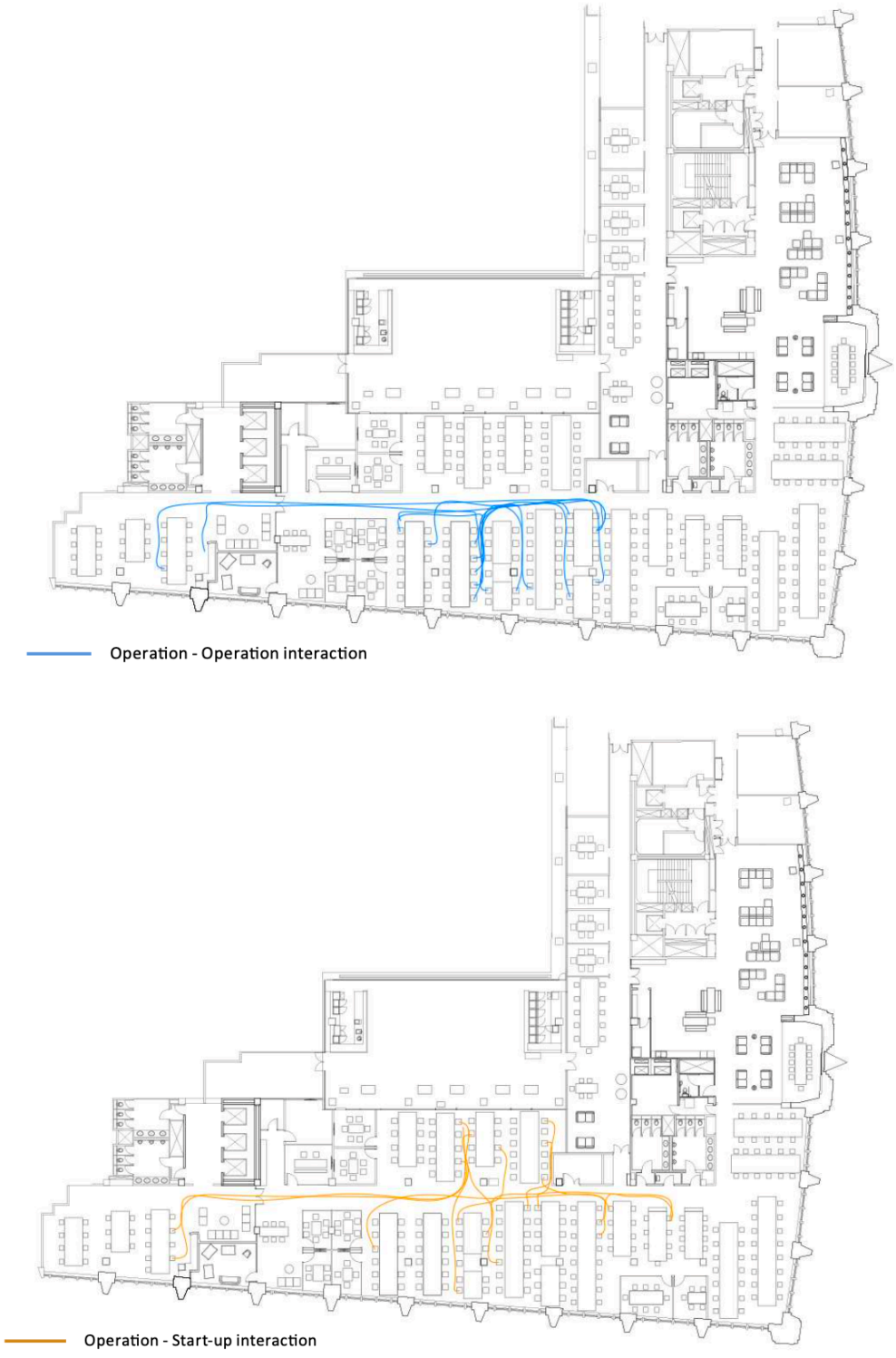


Figure 12: SNA of all interaction patterns that took place inter and across social groups

The second highest interaction pattern was between creative operations and incubator teams (34%) followed by operations with accelerator teams (16%). Only one interaction occurred

between different team members in the accelerator program. During observation,cross-group interactions across workstation were noticed to be intentional, people moved across workstations to interact with a specific person (figure 12). When asked, these face-to-face interactions that occurred between operations team and between operations and start-ups were first instigated by remote interaction (email or instant messaging). People checked if the person they wanted to interact with was at their desk and moved towards them to chat.

Comparing the later results with the results of potential for interactions through visual co-presence, Figure 13 clearly shows that visual co-presence was not the major influencer of interaction patterns in Founders Factory. If visual co-presence was a factor, start-ups sitting on the same workstations would have interacted. As for the results of actual interaction patterns from movement compared with potential interaction from path crossing, interaction patterns were completely different (figure 13). People moved based on pre-instigated informal meetings either at workstations or in seating areas. Only 8% of interactions were spontaneous, as people crossed paths with others in corridors and kitchen.That is why interactions were less. Potential for interaction between social, like across start-ups could have occurred from chance encounters, but the results of actual interactions patterns proved that interaction were predetermined by conceptual closeness.

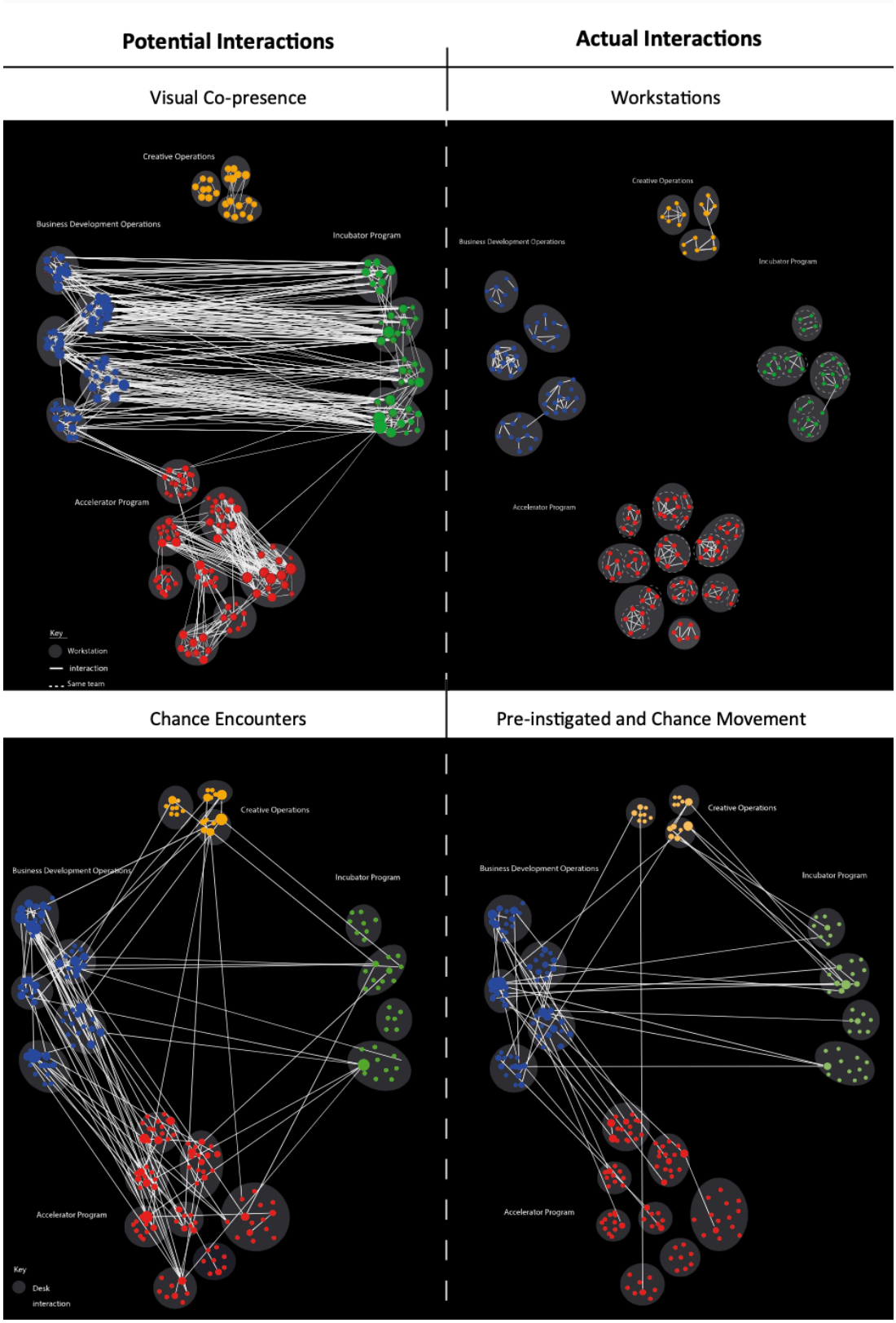


Figure 13: Comparing Potential and Actual interaction patterns through visual co-presence and movement

6.3 Social Boundaries – Correspondence and non-correspondence theory

The results of the above findings relate to Hiller and Hanson's (1984) concept of correspondence and non-correspondence theory. This theory help unlock if space influences interaction patterns or if interactions are purely transpatial. To measure the degree of correspondence, Yule's Q measure was used to associate two variables, the first being interaction patterns (Yes/No) and the second is spatial proximity (close/not close). These calculations were done for all interaction patterns that occurred across social affiliations (A-A, O-A, O-I…) (table 5). Yule's Q values of +1 means perfect positive association, i.e. all people in each social affiliation who are spatially close interact. As for -1 value, it means negative association, i.e. those who are spatially separated interact. The stronger the association between space and interaction, the more social boundaries there are. The value zero is associated with no interactions occurring in any spatial closeness or separation.

		Spatial	
Social affiliations		Close	Not Close
Interact	yes	# of people that are spatially close and interact	# of people that are spatialy not close and don't interact
	No	# of people that are spatially close and don't interact	# of people that are not close and don't interact

Table 3. Association between space and interaction patterns across social affiliations

Social Affiliation	Degree of correspondence
O-O	-0.55
A-A	0.9
I-I	0.65
O-I	-1
O-A	-1
A-I	0

Table 4. Results of Yule's Q calculation

The results of table. 6 shows that teams of the accelerator program have the highest degree of correspondence (0.9), followed by teams of the incubator programs (0.65). Degree of correspondence between members of the operations team show that members interact across spatial separation. Nevertheless, there seems to be social boundaries across spatial proximity in the operations teams. As for operations with start-ups, spatial closeness and interactions show absolute negative associations. While interactions across teams' start- ups never took place in space. This shows that start-ups have a high degree of correspondence, creating an exclusive

system of strong boundaries. As for the operations team, they represent more of an open system with no spatial and social boundaries. That is why interactions between operation and start-ups were fluid.

The following results clearly state that interactions were purely transpatial. Social boundaries existed in the case of Founders Factory, whereby people with conceptual closeness interacted. This closeness was a result of organizational goals, social affiliations are formed to collaborate. These collaborations happen between members of the same team, or between operations and start-ups. Moreover, people who were socially close sat within spatial proximity. As for movement, due to spatial limitations at Founders Factory, operations teams had to move to be able to interact with others.

6.4 The Role of Space

Space was not the main influencer of interaction patterns in the case of Founders Factory, but space played a role in the emergence of these interaction patterns. To understand the role of space, each inter-group and cross-group interaction patterns were represented separately to reflect on different types of interactions that occurred between group affiliations (formal meeting, informal meeting, or spontaneous interaction). The results of inter-team and cross-teams' interactions in space presented in Figure 14 shows that:

1) Face-to-face interaction between members of the accelerator teams' (A-A) were mostly spontaneous interactions (46%) (chats or questions) happening in the same spatial proximity across their workstations. Follow-up meetings and conference calls are essential part of accelerator start-ups progress, taking place in meeting rooms (35%). Informal meeting (15%) are the lowest type of interaction for accelerator teams, taking place in seating areas.

2) Interaction patterns in the operations team (O-O) are divided almost evenly between spontaneous and formal meetings. Spontaneous interactions happened across desks between members in the same spatial proximity (31% business development desks and 18% creative operations). Operation teams also used to bump into each in main corridor (2%) and interact. Operations team's follow-up meetings and cross department meetings, happening in meeting rooms, was also a major type of interaction (43%). As for informal meetings, only 6% of interactions took place in seating areas.

3) Incubator start-ups (I-I) mostly interacted spontaneously, with 55% of interaction taking place across desks and 11% of spontaneous interactions occurred in the main corridor. Informal meeting (11%) took place in the seating areas and few interactions were formal meetings, due to the early stages of their companies.

4) Informal interaction between operations and accelerator start-ups (O-A) took place across their workstations (25% accelerator desks and 13% operations desk) and in seating area (21%) for a quick chat. As for spontaneous interactions, they took place across corridor as people bump into each other (7%) and kitchen (5%). Weekly follow-up meeting (33%), takes place once a week in meeting rooms to see the teams' progress.

5) Interaction patterns between operations and incubator start-ups (O-I) were mainly informal taking place across workstations (31% incubator desk and 19% operations desk) or in seating areas (19%). Operations and incubator teams also bumped into each other at corridors (11%), or kitchen space (3%) and interacted with each other. Meeting were also set once a week for follow-up on progress and discussing ideas (24%).

Spontaneous interactions was the most common type of interaction. This type of interaction pattern was manifested spatially through spatial proximity and movement. People in the same spatial proximity, across all social groups, interacted spontaneously either to chat or ask questions… This type of interaction seems to facilitate information flow between team members and people who work together. As for spontaneous interactions through movement, inter-teams and cross-teams used to interact when bumping into each other in corridors or kitchen. Even through spontaneous interactions were bound by social closeness, space was the major influencer of this type of interaction.

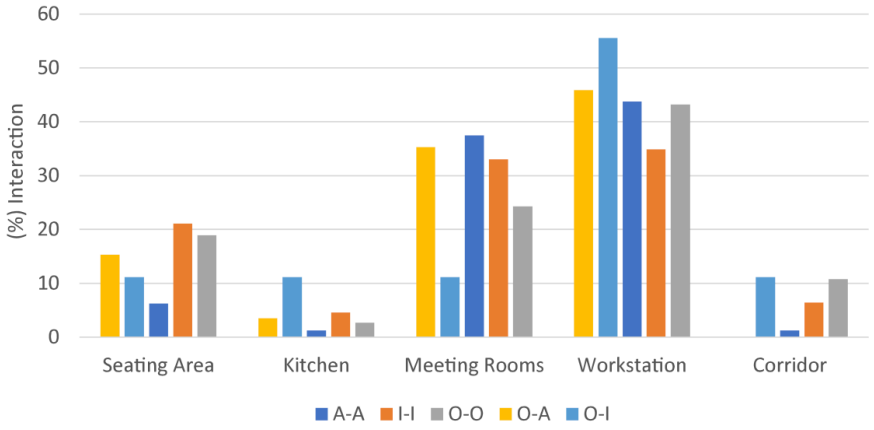


Figure 14: Spatial and empirical representation of interaction patterns in space across social affiliations

CONCLUSIONS

In the aim of exploring the factors that influence the emergence of the organizational culture in incubator and accelerator programs, the empirical and analytical findings in the case of Founders Factory help address the following questions a)What is the relationship between collaboration affordances and organizational goals in accelerator and incubator programs? b) How does the spatial, social, and technological factors impact interaction patterns in accelerator and incubator workplace?

In contrast to Cabral and van Winden's (2018) results, that accelerator and incubator programs emphasis more on generic business development in comparison to collaboration, organizational goals were the primary driver of collaboration affordances and social relations in the Founders Factory. Interactions were limited across same team in accelerator and incubator programs, between cross-departments and inter-teams for operations, and between operations team and start-up teams to guide their work developments. Human interactions were driven by social ties and common identities rather than physical distance, aligned with Sailer and Penn (2009) argument. At the Foundry, social groups were arranged separately in space, nevertheless spatial separation did not influence operations- start-up interactions or operation-operation interactions.

Their need to collaborate and work together was the major influencer of movement in space. Interaction patterns across spatial separation were pre-instigated by online messaging channels or emails, leading to face-to-face interactions through movement. These results contradict with Bernstein and Turban's (2018) findings that technological interactions created less movement in space, hence fewer face-to-face interactions. People still felt the need to interact face-to-face. Moreover, people who were conceptually close were also spatially close. Same teams in start-ups were placed in spatial proximity. Even members of the operations team with common work objectives are spatially close. What was highly evident from measuring degree of correspondence was social boundaries in space. Social boundaries were strong across start-up teams. No interaction, spontaneous or formal, occurred between accelerator and incubator programs even though chance encounter happened in the corridors or kitchen. Moreover cross-team interaction in start-ups was very rare even though teams were in spatial proximity and even visual proximity. Screens did act as barriers for different teams placed facing each other, but conceptual separation was the ultimate barrier between start-ups. As for operations, all members tend to interact, but there was a bit of social boundaries seen across spatial proximity. Nevertheless, operations correspond to an open system. Space was a major influencer of serendipitous informal face-to-face interactions across spatial proximity and movement. This resulted in fluidity of information flow and social interactions across teams making work smoother and creating a dynamic environment.

The following results help create a better understanding of social structures and spatial influences, thus allowing designers to create conscious workplace decisions. From the review of literature, future trends seem to be headed into distributed work with a major focus on remote interactions. This study was not able to research the influence of remote interactions on organizational culture at Founders Factory due to time limitation, nevertheless, the importance of comparing physical interactions to remote interactions can help provide a well-rounded understanding for future research on how remote working might impact organizational culture. My hypothesis based on findings in the physical setting assume that interactions across social groups will be the same since physical space was not an influencer.

In his paper, The Nature of the Artificial, Hiller et al. (1985), present three laws governing space and society: the law of the object whereby the configurational relations between objects lead to the construction of space, the law from society to space by which different types of social relations require different type of spatial pattern, and law from society to space such that spatial structure has its effects back on society. In the case of the Founder's Factory their laws in operation are from the social to the spatial, as the patterns of spatial behaviour reveal that group affiliation and organizational purpose impose limitations on spatial culture. The future of the workplace needs a more profound understanding outside the limitations of trends, but rather a process of design guided by knowledge of human behaviour and organizational culture. In the attempt to understand the major factors that influence interaction affordances in accelerator and incubator programs, this research looked at the relationship between collaboration affordances and organizational goals. Also investigated spatial, social, and technological influences on Founders Factory culture. These influences were set as parameters to evaluate the impact of future work trends on the workplace culture of accelerator and incubator programs.

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