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DIS 2018

Proceedings of the 2018

Designing Interactive Systems Conference

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**Association for
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Design and Diversity: Welcome to DIS2018 in Hong Kong

We are pleased to welcome Designing Interactive Systems DIS 2018 to Hong Kong. DIS 2018 is the first of its kind in two ways. It is in Asia for the first time. It is also in an art and design school for the first time.

The theme of the conference is Design and Diversity. The theme reflects a classic design theme - and also a foundational distinction in philosophy - of universals and particulars. Should we, as designers, follow Silicon Valley in its quest for products that engage everyone on the planet, or the architect Glenn Murcutt's conviction that he can only build in places he knows so well that his designs can be outstanding? The underlying logic of this question divides designers and design disciplines and emerges in every design process.

This theme operated as a guiding tool for selecting our four keynotes, professors Jodi Forlizzi, Kun-pyo Lee, Phoebe Sengers and Erik Stolterman. During their years in design, they have lived through its diversities. We were happy that they accepted the challenge to share their experiences and thoughts about diversity to the benefit of our community. The theme was also our tool for directing the DIS community into the future. A few years from now, we hope, we will start to see answers to the challenges our keynotes are posing to us.

The nucleus of the conference organization were two chairs and three technical chairs. This small group invited sixteen Subcommittee Chairs, three Pictorials chairs, and two chairs each for Workshops, Provocations and Work-in-Progress, Doctoral Consortium, and Demos. These chairs recruited 100 Associate Chairs, who recruited 1818 reviewers. Our review and decision schedule was brutal, but the organization worked through it efficiently, always with humor, and with collegial respect.

DIS 2018 received 645 submissions: 405 for full papers and notes submissions; 71 for pictorials; 23 for workshops submissions; 107 for Provocations and Work-in-Progress (out of these, 19 were Provocations); 20 for Doctoral Consortium Submissions; and 19 for Demos. Acceptance rates were: 23% for papers and notes, 24% Pictorials, 55% for Workshops, 73% for Demos, 53% for PWiPs, and 50% for Doctoral Consortium.

All this work led into a highly competitive conference between 9-13 June. June 9-10 were reserved for Workshops and Doctoral Consortium, and June 11-13 for 28 paper sessions. Pictorials are not in separate sessions; they are treated the same way as Full Papers. The 11th of June became an Experience Night of Demos, PWiPs, and a small design exhibition, which illuminated interaction design in Hong Kong and the Pearl River Delta. As extra, we organized a post-conference trip to a few technology companies in Shenzhen, China.

The program reflects the highly diverse nature of our discipline. We could not see any particular trends in papers, but a few observations may be possible. Two thirds of submissions focused on the following two human-oriented subcommittees: Experience and Methods and Processes. In comparison, the two technically oriented committees were smaller, but the quality of papers was particularly impressive in the Technical Innovation subcommittee. We expected to see more papers in design fiction, but with few exceptionally creative exceptions, fictional papers did not fare well in the review process. We also expected more papers on diversity, sustainability, global and civic issues, but did not. Looking at our own PhD students, however, we believe this work is maturing over the next few years. We saw several papers that try to bridge the gap between interaction design and more traditional fields of design like crafts. Machine learning is becoming a research topic, as is everyday life, with all its richness including themes like interaction with pets, microbes, and food.

Finally, our sincere thanks to sponsors. The Chairs also want to thank the chairs of DIS 2016 and DIS 2017. In particular, Ilpo Koskinen wants to thank Oli Mival and Marcus Foth; their help was crucial in creating the architecture of the conference. From Subcommittee Chairs to reviewers, the community came together beautifully. It was their volunteer work that keeps this community going; our sincere thanks goes for all of them. At the back end, we want to thank ACM and the Hong Kong Polytechnic University for their support. Our thanks also goes to Lisa Tolles for preparing the publication on tight schedule. Our local committee, especially the treasurer Christine Tsin, deserves a big thanks; this conference would not have happened without her. Our final thanks of course goes to the participants, who took a week off from their busy lives to travel to Hong Kong to present their work for their peers and to mingle with the community.

We welcome you to enjoy DIS 2018 in Hong Kong, one of the world's iconic, albeit less well known cities!

General Chair

Ilpo Koskinen

Co-Chair

Youn-kyung Lim

Technical Chairs

Teresa Cerratto-Pargman

Kenny Chow

William Odom

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"More than just Space": Designing to Support Assemblage in Virtual Creative Hubs Jandy Luik^{1,3}, Jenna Ng¹, Jonathan Hook² ¹Department of Theatre, Film and Television, University of York, York, United Kingdom ²Digital Creativity Labs, Dept. of Theatre, Film and TV, University of York, York, United Kingdom ³Department of Communication, Petra Christian University, Surabaya, Indonesia {jel525, jenna.ng, jonathan.hook}@york.ac.uk

ABSTRACT This paper aims to understand interactions at creative hubs, and how this understanding can be used to inform the design of virtual creative hubs – i.e., social-technical infrastructures that support hub-like interactions amongst people who aren't spatially or temporally co-located. We present findings from a qualitative field study in UK creative hubs, in which we conducted seventeen observations and ten interviews in three sites. Our findings reveal a range of key themes that define interactions within creative hubs: smallness of teams; neutrality of the hubs; value of the infrastructure; activities and events; experience sharing; and community values and rules. These interactions together form a network and elements that influence one another to make a creative hub more than just physical space. We employ the concept of Assemblage introduced by Deleuze and Guattari to explore this network of interactions and, in doing so, reveal implications for the design of virtual creative hubs that seek to replicate them. **Author Keywords** Informing design; creative hub; assemblage; interactions; form of content and expression. **ACM Classification Keywords** H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION Creative hubs are generally co-located places in which startup companies come together to interact with a network of other startups, hub managers, venture capitalists, trainers and mentors, hub facilities, activities, and events etc. Creative hubs have many different manifestations such as co-working spaces, training institutions and incubators [16,31]. This work is licensed under a Creative Commons Attribution 3.0 Unported License <https://creativecommons.org/licenses/by/3.0/> <https://creativecommons.org/licenses/by/3.0/> DIS '18, June 9–13, 2018, , Hong Kong © 2018 Copyright is held by the owner/author(s). ACM ISBN 978-1-4503-5198-0/18/06...\$15.00

<https://doi.org/10.1145/3196709.3196758> Residing in a creative hub is widely regarded as beneficial for the development of new startup companies, offering a range of support from training, mentorship, knowledge exchange, business advice, office space, access to funding and networking [47]. However, creative hubs tend to follow a model of development in the creative industries that depends on companies being co-located. This is potentially problematic, especially for startups that are not geographically located in, or near, a city (usually a capital or major population center) that has the concentration of work, talent and wealth to support a creative hub(s). This can result in problems such as uneven economic growth, cultural homogenization and the lack of regional cultural influence on the products of hubs [5]. The rise of digital media presents opportunities to address these challenges, with digital tools supporting employees in creating, sharing and collaborating on work outside of traditional centralized workspaces [26]. Despite these advances, residing in a co-located creative hub still offers distinct benefits to new startup companies and, as

a result, talent and capital continues to be centralized in major cities [5]. We, therefore, envisage the development of virtual hubs: social-technical infrastructures that provide workers who are not geographically co-located with beneficial aspects of working in a creative hub. While the concept is promising, no current systems exist that can come close to replicating the experience of working within a hub. However, with in-depth understanding of the way hubs function for their inhabitants and their interrelations, we believe virtual hubs can nevertheless be effective in replicating the beneficial properties of creative hubs. In this paper, we contribute to the development of this understanding by presenting a qualitative field study of interactions in UK creative hubs, set within a theoretical framework drawn from assemblage theory. We conducted seventeen observations and ten interviews in three sites. As we hypothesize that it is the relational elements of the experience of working within a creative hub that will be most likely lost when 'going virtual', we focused our study on these aspects. Our data analysis reveals six themes: smallness of the team; neutrality of the hubs; value of the infrastructure; activities and events; experience sharing; and community values and rules. We then employ the notion of assemblage, as first expressed by Gilles Deleuze and Félix Guattari, to theorize the interrelations between human (such as startup founders, hub management, and mentors) and non-human elements (such as technological tools) [13]. In so doing, we show that innovation and creativity in creative hubs emerges from continuous interrelations among these elements, specifically in relation to three key concepts from assemblage: formalization, configurations of bodies, and co-functioning. These findings illustrate how creative hubs form an assemblage that is much more than just a space for people to meet and work. We believe that our findings and their analysis through the lens of assemblage will benefit the field of Human- Computer Interaction (HCI) by informing the design of social-technical infrastructures that seek to replicate beneficial relations within creative hubs and other co- located working spaces.

Moreover, this paper contributes to the introduction of the concept of assemblage to the HCI field with an illustrative case study.

RELATED WORK

In this section, we discuss literature relevant to our vision for virtual creative hubs and the findings of our particular study. We discuss studies of creative hubs, existing systems that have the potential to support hub-like interactions, and conclude by introducing Deleuze and Guattari's notion of assemblage, which is central to our analysis.

Previous Studies of Creative Hubs

Previous studies have identified several key qualities of creative hubs, which extend beyond the spatial co-location of their inhabitants. Studies show the importance of social capital to entrepreneurs, especially in the technology sector [2,27,33]. Social capital of entrepreneurs is accumulated in this kind of space because of the association of individuals who have worked together in other companies over time [35]. Social capital is "a social relational artefact, produced in interactions but that it resides within a network" [2:p.249]. It can comprise of individual and collective social networks that help entrepreneurs to gain access to information and know-how [6]. In creative hubs, knowledge exchange can happen through formal knowledge transfer activities, knowledge spillovers, and transfer of tacit knowledge. Knowledge exchange can be expected in creative hubs that promote cooperation amongst internal firms and linkages between firms and academic institutions [39]. Another key quality of creative hubs relates to incubation, i.e. the nurturing and development of emerging businesses. In particular, the intent of many technology business incubators is to help startups by providing enabling linkages that assist new businesses to survive, scale up, and grow [32]. Venture capitalists present in hubs also play important roles in financing, selection, collective learning, embedding and signaling, in a complex innovation network of agents (such as that found in Silicon Valley) [18]. Studies of emerging sites of technical innovation such as hardware incubators, hackathons, and hackerspaces, where people experiment with new ideas about the relationships amongst corporations, designers, and consumers [28] are also closely related to the idea of creative hubs. For example, makerspaces have been shown to play a variety of roles in the civic life of communities [42]. Thus, key qualities such as social capital, knowledge exchange, incubation, and experimentation can also be expected to impact the value and experience of these spaces. These key qualities make the co-located development

of products within a creative hub an attractive, if not essential, proposition to many startups. Providing access to these benefits for startups that cannot be located in a creative hub (e.g. those unable to be based in a capital city) through appropriately designed socio-technical infrastructure is at the heart of our research vision.

Systems that Support Hub-like Interactions

A number of technological systems have been developed to support the interaction of distributed people across spatial boundaries, with particular attention paid to this topic in the CSCW community. For example, researchers have developed understandings of topics that relate to non-co-located working: how geographical distance of a collaborating partner influences one's willingness to initially cooperate with, be persuaded by, and deceive that partner [7]; trust in globally distributed systems [1]; cultural diversity in distributed workgroups [15]; nomadism and freelance creative work [26,29]; and crowd work [20,25]. Many systems are already in use in current creative hubs to support collaborative work, such as Slack, Trello (web-based project management), Skype and Hangouts (for video conferencing), live streaming technology, and collaborative productivity software such as Google-Docs, -Sheets and -Forms. A previous study showed that there are six categories of tools that are currently used to support collaboration in co-located creative hubs: on-site, e-learning, 1-on-1 ICT exchange, online recruitment, virtual communities, and mobilizing the online crowd. These provide support in three forms: as hand-holders, as network boosters, and as seed capital providers [17]. We are not the first to consider the development of a virtual creative hub. Several platforms have already been developed such as virtual accelerators (i.e. Startdoms), virtual incubators (i.e. Kolaborasi), and learning resources (i.e. WebFWD). However, we have observed that these tools focus on supporting the functional aspects of what happens in creative hubs (e.g. how to create customer value propositions, financial and metrics, and steps of developing startups). Our study attempts to inform the design of systems that seek to replicate the more intangible benefits of working in a hub setting, in particular the interactions between the networks of elements that a hub comprises. In this paper, we present findings that show how a set of these particular, relational qualities are at the heart of what startups value about the creative hub environment (e.g. informal talk, shared enjoyment of activities, different intensities of hybrid social-work interaction, the aesthetic of the building, and the presence of various human elements). We, therefore, contend that the design of future virtual hubs will need to extend beyond just considering functional aspects of what it means to inhabit a creative hub, but to explicitly replicate the more ephemeral, relational qualities that define the experience. We argue that attention to the interactions and relations between inhabitants of creative hubs will be particularly crucial, because these are likely to be the qualities of the hub experience that are degraded most strongly by a shift into the virtual space.

Assemblage as an Analytical Framework in HCI

We use Deleuze's concept of assemblage as a lens to analyze and conceptualize our findings. The term "assemblage" comes from the French word, "agencement", as it appears in the work of philosopher Gilles Deleuze, and some works with Félix Guattari. As translated, assemblage is better understood as arrangement, as in a "working arrangement", in order to give a sense of processual and contingency rather than a static situation [10]. In that sense of the contingent, there is also a notion of being somewhat unfettered, flexible – as N. Katherine Hayles describes, "the notion of an arrangement not so tightly bound that it cannot lose or add parts, yet not so loosely connected that relations between parts cease to matter; indeed, they matter a great deal" [22]. Moreover, these parts, while connected, are multiplicitous, heterogeneous, different; as expressed by Deleuze and Parnet: "What is an assemblage? It is a multiplicity which is made up of many heterogeneous terms and which establishes liaisons, relations between them, across ages, sexes and reigns – different natures" [14]. This heterogeneity could be human and non-human, actual and virtual, material and immaterial, and corporeal and incorporeal. The critical formulation of assemblage in Deleuze's work thus lies in two elements: the heterogeneity of the parts; and the interactions of those heterogeneous parts and their intensification of each other. One example of assemblage by Deleuze is that of a knight, a horse and a pair of stirrups that show "an assemblage of the type man-animal-manufactured object: Man-Horse-Stirrup"

[13,14]. This assemblage is not merely a form of content consisting of a collection of different objects, but a collection of interactions in their midst, evoking, as its form of expression, a new synthesized power greater than the sum of its parts, and new sets of affects in war: This is a new man-animal symbiosis, a new assemblage of war, defined by its degree of power or 'freedom', its affects, its circulation of affects: what a set of bodies is capable of. Man and the animal enter into a new relationship, one changes no less than the other, the battlefield is filled with a new type of affects. [14:p.70] Assemblage thus enables the exercising of these different components – it emphasizes the processual and, as such, creates meaning in the dynamic arrangements of its heterogeneous elements. However, a point of attention in using assemblage to analyze creative hubs is formalization, which can be used to understand what keeps the assemblage intact and what can transform it. There are two formalizations in Deleuzian terms of assemblage: the form of expression and form of content, and both forms are in a state of reciprocal presupposition [13]. As Ian Buchanan writes, "in practice, the assemblage is the productive intersection of a form of content (actions, bodies and things) and a form of expression (affects, words, ideas)" [10:p.390]. Both co-exist in "reciprocal presupposition" [10,13,14]. The form of content is reducible not to a thing, but to a complex state of things, bodies and action, while the form of expression is reducible not to words, but to a set of statements, discourses and ideas arising in the social field [13]. Therefore, two assemblages exist where one organizes relations of the content elements and another one on the expression elements. In assemblage, the elements or bodies that comprise a phenomenon can be human and also immaterial things. "Bodies may be physical, biological, psychic, social, verbal: they are always bodies or corpora" [14]. As such, a body is said to consist of a composition of forces [12] or, in this sense, capacities [9]. A body is not a static being or a bounded subject separate from those other bodies, but, rather, is a composition of relations amongst the capacities of other bodies. In that sense, the capacity (or potentiality) of a body is infinite, compared to the actual property that can be counted and determined. Another key point in an assemblage is that it is co- functioning; it is a symbiosis [14]. With assemblage conceptualized as this multiplicity of heterogeneous terms, what holds this arrangement together? What is its central binding in order to think of the co-existence and co- arrangement of its disparate elements in a meaningful way? Deleuze and Parnet continue: "Thus, the assemblage's only unity is that of co-functioning: it is a symbiosis, a 'sympathy'. It is never filiations which are important but alliances, alloys; these are not successions, lines of descent, but contagions, epidemics, the wind." [14] As mentioned above, the critical formulation of assemblage in Deleuze's work thus lies not only in the heterogeneity of the parts and relations that constitute them, but also in the "co- functioning" of those heterogeneous parts and their intensification of each other. Such "co-functioning" is changeable, fleshly, inconstant. As Müller and Schurr deconstruct from Deleuze's formulations: "Terms such as 'contagions', 'epidemics' and 'the wind' hint at the fluidity and ephemerality of assemblages and at their unpredictability, while 'sympathy' and 'symbiosis' suggest that there is a vital, affective quality to them." [34] For this reason, we contend that the concept offers an appropriate lens through which to identify and interrogate the relational properties of the experience of inhabiting a creative hub. We argue that assemblage is a relevant concept for informing HCI discourses, because of its focus on the relational aspect of experiences. Previous studies in HCI have employed Deleuze and Guattari's concepts of the rhizomatic [20, 21], of minor scientist [19] and of assemblage and affect [41]. Specific to assemblage, there are also works such as sociotechnical assemblage [40], sociomaterial assemblage [36], and big data as a data assemblage [24] that contribute to HCI discourses. As a secondary contribution of our work, we aim to further demonstrate the relevance of assemblage to HCI through the presentation of an illustrative case study of the concept as applied to a set of qualitative findings.

STUDY METHOD

In this section, we describe a qualitative field study in UK creative hubs, in which we conducted seventeen observations and ten interviews in three sites. The aim of this study was to gain an understanding of the relations among the elements that comprise existing creative hubs, which will, in turn, inform the design of virtual hubs.

Sites, Participants and Recruitment

We started this

multi-site field study by first identifying creative hubs that might be included, from a list provided by TechCity and Nesta, and the British Council [43]. We approached the management of these hubs and requested access to conduct our study. Of the ten hubs contacted, we received approval from three, which were located in three different cities in the United Kingdom. Each of these hubs operates in a specialized field with a collection of startup companies. The hubs included in our study were (codes used to maintain anonymity):

- CH1 – A franchised hub (i.e. which benefits from an identity and collateral from a larger brand) that focuses on supporting data-driven startups. CH1 provides members with services including: support for startups, access to meet-up events and a co-working space, and opportunities to participate in innovation projects. CH1 operates both as a co-located space and employs some virtual tools to support interactions between members. We conducted ten observations and six interviews in this hub. We conducted two interviews with the management at the hub and one with a member startup.
- CH2 – A hub comprising a large number of tech startups (nearly 80 companies). CH2 operates as a software incubator, and co-working space for tech companies in different sectors: Fin-Tech, Med-Tech, analytics, games, SaaS products, and cloud solutions. CH2 provides services such as office and co-working space, and event space; shared access to meet-up event and training from consultants; and networking with investors. We conducted three observations and three interviews at CH2.
- CH3 – A university-based creative hub that provides knowledge and early support to students and graduates with tech and non-tech startups. Support provided by CH3 includes: organizing events and competitions, facilitating networking with professionals, mentoring, and the provision of office space. We conducted four observations and one interview in CH3.

Recruitment of interview participants began during informal conversations with hub members during periods of observational work. A subset of those spoken to were selected for interview, with the aim to gain a range of perspectives from hub members employed in different roles, including: hub management, sponsors, startup employees, attendees at hub-organized events, project leaders, and workshop leaders. All participants were informed that their identity and the identity of the hub they were part of would be anonymized in our analysis and all forms of dissemination. Data Collection and Analysis Seventeen observations (one-two hours each) were made by the first author, during attendance at activities in the hubs' regular programs, such as training, meet-ups, courses and seminars, and hackathons (all-day). Field notes and audio recordings were taken during observations, with the prior knowledge of participants. The aim of our observations was to document common practices or activities that might be taken for granted by hub members – and, as a result, may not be mentioned in interviews – but would nonetheless be definitive to a hub's value and experience. Ten interviews were conducted (lasting between 15-45 minutes). Interviews were held at a time most convenient for the participant, and took place in an informal setting. Interview participation was voluntary and audio recorded with the prior permission of the subject. The topics discussed were centered on each participant's interactions within the hub, e.g., with mentors, with members of their team, and with members from other organizations. We also asked how the participants perceive the influence of other resources such as the facilities, ideas, and activities, to their interactions at a hub. When reporting our findings, we identify the role of interview participants with the following codes: Hub Management (HM), Project Manager at Hub (PM), Sponsor (SP), User of Co-Working Space (CW), Event Participant (EP), and Startup Member (SU). The data gathered during the study was analyzed using a thematic approach, following guidelines set out by Braun and Clarke [8]. An inductive method was followed, with transcripts of interviews and field notes first open-coded to highlight initial themes in the data, which were then iteratively refined. From the emergent themes, we then analyzed the data in terms of formalization of content and expression in an assemblage. The qualitative analysis software NVIVO was used to support this process.

FINDINGS: MORE THAN JUST SPACE In this section, we categorize the relational qualities of creative hubs that resulted from our analysis into six key themes. These themes illustrate a range of findings that together make a creative hub more than just a physical co-located working space. Working in Small Teams was a Necessity, but also Valuable One

commonality observed across the hubs studied, was the importance of the “scrappy” way that hub elements connected with each other. We use the term scrappy in this context to refer to a tension between the need for teams to be small, often due to the resource constraints facing startups, and the need to complete the plethora of tasks required for the successful development of a product and business. Members of a startup [SU2] in CH2 that consisted of less than six people expressed the need for smart decisions in resource expenditure, and to keep their operation efficient with a small team. Startups in CH1 also employed small teams in the early stages of their development, “we have the skills and capabilities within the team and financially, it wasn’t realistic for us to employ [more] people” [SU3]. While the scrappy way that startup teams operated in the creative hubs studied was in many ways a product of necessity, it was also viewed as having a positive impact on the way that collaborations were formed within the hub space. Retaining a small team was said to make startups appear open, flexible and, therefore, inviting for collaborations with other hub elements. The startups and hubs’ teams surveyed commonly operated by keeping only core skills needed in house, and drawing on others in the hub space for additional skills. This approach was seen to be particularly valuable in opening up opportunities for collaboration with others in the hub (e.g. to fill skills gaps in small teams through reciprocal expertise sharing) and, consequently, bringing new ideas and perspectives from the community to address challenges. The smallness of startups also necessitated that they share office space to save money. The hubs in our study made this possible by providing co-working office space for small startups and individuals. One co-worker noted that office space was essential, but “I don’t want a full office because that’s going to cost a lot more money.” [CW1]. Co-working spaces were not only valued for their cost amongst hub members, but also for providing a community of like-minded people to work within. The smallness of startups was also supported by the hubs in a number of additional ways. Hubs were said to provide a sense of security for members of small precarious startups, because it was common for staff of failing companies to be quickly rehired by the businesses around them. HM2 described an example of what happens when a startup nearly fails: “It [failure] happens in different ways but what we always see, the great talents in the companies they get sucked up by other companies in the building, they all ended up working for other companies in the building” [HM2]. As a consequence of this support mechanism it was found that many of the people who worked in the hubs felt like citizens of the hub rather than the companies they work for. CH1 also supported the small-ness of teams by providing nascent startups with a brand that is bigger than their own. This meant that they could remain small, while benefitting from the ‘big-ness’ of the hub: “being backed or part of the [hub] provides validation and credibility for both business model and, in general, the company” [PM1]. The management teams also employed similarly small and determined teams to run their creative hubs and facilitate collaboration amongst hub networks [HM1, HM2, HM3]. For instance, HM3 had a dual-role: to manage the operation and to provide early support for the founders of startups, “The vast majority of my role is organizing, kind of programs and events, and getting people along to be part of a panel, making people come along...[and] also working to find opportunities, and then, to support individuals on the one-to-one basis.” [HM3] The manager of CH2 noted that operating in a similarly small team enabled a sense of empathy with hub members when performing these tasks: “We are a scrappy startup here ourselves, the companies in here respect the fact that we are going through some of the same pains as them.” [HM2] Neutrality of Hubs was Important, and Enforced through their Funding Model Hub members and organizers felt that it was important that creative hubs were independent and neutral spaces. The perception of a hub not being owned or in any other way controlled or dominated by one single viewpoint and/or agency was viewed as essential for its success by participants: “If it’s owned by either one of them [public sector or sponsors] they would find it hard to collaborate. So being independent and neutral is really important.” [HM1] Maintaining a hub’s neutrality was, however, reported as being a challenge, as the range of stakeholders that startups needed to interact with to achieve their goals could each bring potentially divergent agendas. Actively configuring and negotiating the relationship between

different agendas, so that everyone could have their say and receive what they need, was recognized as a crucial part of a hub organizational team's role. While valuing the neutrality of the hub space, participants also noted the importance of a culture in which companies retained strong and well-defined 'personas'. Maintaining and presenting this identity and territory, while remaining respectful to the identities and territories of others' was viewed as crucial to establishing productive links between hub members. The management of CH1 applied this by, "being as open as possible and letting other people tell us what they want us to be" and by being "transparent, ...share everything" with the hope that "people know that we share everything, and we would tell them everything that we will do" [HM1]. A culture of transparency, wherein every company and team member involved should be upfront and open about what they do without anyone seeking to push their agendas on anyone else, was seen as the best way to achieve this goal. The culture of openness and transparency amongst hub members was seen to be supported through events run within the hub space, which allowed hub members to share their expertise and information. These included: informal meet-ups and socials, training from consultants or groups of people with particular expertise, and hackathons. A participant at an event in CH1 expressed that the open and transparent culture of events at that hub was reinforced by its focus on open data: "by its nature, the topics we are discussing are about being open and about sharing information, and so, I think it automatically attracts people who want to be involved [in that way]" [EP1]. However, the management of CH2 also described a case where participation in a series of events run by an external party had decreased because it was not perceived as aligning with the hub's neutral culture: "they were fundamentally selling their things. And when we first started we'd see 30 people go to this talk, and then 20, and 15, and then in the end, people realised they were, like, being sold to." [HM2] The bootstrapping approach through which CH2 funded their operation was also identified as a key constituent of the independence of that space. "We have no money from the government or city council, we are entirely bootstrapped, we make our money through renting the place out" [HM2]. Bootstrapping refers to an approach to financing a company through private funds or revenues received alone, rather than external help or capital. By funding themselves in this way, the management of CH2 felt they were able to strengthen their 'persona' as a neutral space, because they weren't subject to unwanted influence from the agenda of one dominant funder. A tenant noticed this, "the culture in here is very clear", and "they have grown organically, which is what you're trying to do, what [our] startup is trying to do." [CW1]. Sharing this finance model, and the relative independence it afforded, with members was said by the tenants and hub management to contribute to maintaining the neutrality of the space.

Value of Infrastructure in Supporting Relational Aspects The creative hubs studied appeared to operate like an ecosystem, an interconnected set of human actors and infrastructure where each element played a particular role in supporting the system. This theme focuses on the value of infrastructure in supporting this hub ecosystem. The intimacy of the hub ecosystem was reported by the manager of CH2 as important and, potentially, threatened by expansion. The form of interactions between hub members was said to noticeably change when the layout of the building, facilities and infrastructure were reconfigured to accommodate more people. For example, HM2 realized there was a time when the expansion of the space by adding floors hampered interactions between members, "It was really worrying for a while, we were just like, has the expansion damaged it in some way." [HM2] The management team quickly observed this change and reconfigured the space. As a result, a communal space was developed, "We took this space here, so that there is a big communal area, people come and hang out, event space is just there, co-working here as well." [HM2] While quickly resolved through action by the management team in this case, this finding demonstrates how important the form and configuration of physical elements of creative hubs are to creating a positive ecosystem, in addition to the human- elements. The importance of a hub's infrastructure was also observed to relate to the physical layout of the building. CH1 had their event space and the working space on the same floor, while CH2 had separated blocks for the office space, communal area, and event space. This configuration meant CH2

could conduct events without stopping other activities like co-working and meetings. In terms of the physical facilities, both CH1 and CH2 provided a kind of coffee corner or café for members and visitors to the hub. These tangible facilities were said to be significant for relationship maintenance, “when I wanted to get coffee, there were a couple of people there playing table tennis [in the communal area]. So I had a chat to them, just said hi, and how is it going, that kind of thing, it just keeps a relationship open” [CW1]. The presence of non-work related infrastructure, such as a table-tennis table, allowed members to form and build relationships by playing games together, as did interactions at workplace wellness activities such as fitness events and massages organised by the hub. The hubs’ digital infrastructure also helped to maintain relationships among the members of the hub and to expand the hub’s activity. The website and social media of the hub offered a space to present the management and hub members’ activities and to reach larger audiences, as was observed by their routine updates and engagement. For example, CH1 posted updates on their activities and calls for participation in events on their website. Internally, hubs and their members commonly used online communication and collaboration channels like Google groups or Slack to maintain communication [HM2, PM1]. The existence of open and free digital tools was also used to extend the accessibility of CH1’s services to serve startups across countries. As PM1 described: “We use emails, chat, hangouts, we use Google forms, Google docs, sheets. We have a mailing list if we have to push out information, but for interaction it would be Slack.” [PM1]

Activities and Events Brought and Catalyzed Effective Collaboration CH1 and CH2 weren’t just co-working spaces, but organized lots of events that brought together their members with their extended networks. During these events, hub members came together with other participants who were not members of the hub (e.g. including experts, sponsors and members of other companies in the region) to collaborate, often around shared challenges. For example, in CH1 hackathons were organized to solve problems encountered in collaborative projects: “the most important thing is creating spaces for people to convene around the problem, for a hackathon and as well as doing their work. So, everything else that goes around this place is as important as the project delivery.” [HM1]

Collaboration in these events happened from planning up to delivery. For example, in CH1, the challenges set at such events did not come from the hub team, but rather they were provided by the hub’s sponsors and then released to the hub’s network. First, these challenges were formulated by the sponsor and communicated through the hub’s website, then there were responses, discussions, and meetings with the hub’s network, which eventually lead to the formulation of a final challenge based on the priority of the sponsor. The collectivity of people who are keen to solve problems became one of the reasons for the involvement of the sponsor: “We help to fund this place... that’s what this place does, it takes challenges, and people coming up with solutions” [SP1].

Another example of how events afforded collaboration was seen in more informal settings, in which fostering casual relationships between hub members and others could lead to work-related collaboration. CH2 held social events on Fridays that allowed startup members to, e.g., play table tennis, share drinks and eat pizza and, while doing so, informally share information and plan collaborative work. For example, a member of one of the startups said: Hey does anyone here want to play table tennis on Friday night? Bring your drink. And that was like 30 people, 40 people just chatting, and they weren’t necessarily chatting about work, but when their conversations came out, they said oh you are in data visualization, oh cool, well, we are doing stuff with machine learning around data visualization, so let’s meet-up” [HM2]

Experience Sharing Related more to Business, than Technical Knowledge The relationships founded through interactions between those present in hubs were valued in terms of experience sharing, from ‘veterans’ to ‘novices’ in particular. New startups were said to benefit from access to experience and tacit knowledge from more established startups occupying their office space, because these companies had learned lessons from progressing further down a similar path to the one that they were taking. This kind of tacit, informal, ad- hoc knowledge sharing was seen to be more beneficial than more formal sharing of experience, such as through training courses: “Sometimes we use the phrase trickle down mentorship”

[HM2] or, as one participant conveyed, because of a “shared understanding about the problems [we’re facing]” [CW1]. The management of CH2 realized the value of these more informal, tacit knowledge sharing mechanisms and sought to foster them: “If they can talk to a company in here, it’s like people just ahead of them. If we can get companies talking to companies, they’ll each support each other.” [HM2] The knowledge sharing mechanisms provided to startups within the hubs studied were primarily focused on business aspects of their operation. For example, for startups in their early stages and those scaling up, the support required related to “validating assumptions and scalability: how do you scale, how do you build a team, how do you put together a sales strategy” [PM1]. The reason for this focus was because it was acknowledged that the kinds of companies present in the hubs studied would be more proficient with the technical, rather than business, aspects of their work: “We only work with tech companies, but actually we [did] support more to the business side because a lot of them are bootstrapping so they have technical experts in the team” [PM1]. However, while technical expertise was acknowledged as being available in the hub, assistance was often provided by the management to enable the right knowledge to be found amongst the hub’s network: “Basically, we need to find a partner who can actually help us to realize what we are trying to do. I said to [the hub management], ... we need some introductions to find someone who can help us to develop this”. [SU1] Experience sharing in managing startups mostly took place in arranged online and face-to-face activities, which were often designed to meet the particular people’s needs. For instance, in CH2 a group communication channel was setup for the C-level group (e.g. CEOs, CTOs, COOs) that enabled them to ask, “high level questions, [such as] I need to do R&D tech credits or something like that,” and for, “something quite practical, and they will get 15 or 20 responses from people who have done it before.” [HM2].

Community Values are Important and May Need to be Enforced to Preserve a Supportive Atmosphere

The management of CH2 stressed the importance of the “intangible” qualities of working within creative hubs, which, in turn, had tangible benefits for their members. The manager of CH2 expressed this by saying “a place like this is about the intangibles that can have a tangible effect on your business.” [HM2] The use of this term reflects a general recognition that creative hubs were more than just spaces to work in, but rather the interrelations brought about by these spaces, while sometimes subtle and ineffable, led to very clear benefits. We use the term supportive atmosphere to convey this array of benefits. Community values were a key aspect of the supportive atmosphere of hubs. In CH2, the community values of the hub members acted as a driving force to the hub management team to keep them providing support for the startups, “It’s really more about the community value that’s the thing that excited us, providing companies with access to the mentorship that they require, professional services they require, investment access, creating a culture where people are supportive.” [HM2] A tenant who had been there since the establishment of CH1 mentioned: “it’s more that people are working on similar things. So, you got shared experiences. It is kind of there already, you just bring it out.” [CW1] That is to say, this shared value is something vital and realized by both intrinsic qualities of the community and the efforts of the hub management to support and enrich it. The importance of maintaining these community values led the hub management team to develop a set of rules for hub members. These community rules were a publicly communicated mechanism to establish and maintain a shared set of values, which would underpin the state of relations between members and others who interact with the hub. The manager of CH2 spoke about how the motivation for developing such a formalization of community values was driven by past undesirable experiences, in which people who had not behaved in a way fitting with the hub’s values had been viewed as having a negative impact on the space. “Someone got through, and they seemed really nice and great, and then before you know, they are taking out their frustration on other people in the building. It is not always that easy to spot one.” [HM2] In response to this, the hub team decided to conduct interviews with prospective members before they would be allowed to join the space. These interviews were described as an assessment of “good fit to the community”, which took place during a series of meetings: “Quite often to get space here, we have three meetings. [We] try to

suss them out and see what they're thinking, if they are a good fit for our community.” [HM2] DISCUSSION

In this section, we interpret the findings of our study using Deleuze & Guattari's notion of assemblage, with the intent of developing a holistic understanding of the dynamics of the interrelations between human and non-human elements in creative hubs. We then suggest how both our findings, and their interpretation through the lens of assemblage, can be used to inform the design of virtual creative hubs. Creative Hubs as Assemblages Although our findings highlight a range of distinct properties that define the creative hubs featured in our study, they also indicate that hubs are complex and interrelated systems that cannot be understood in terms of their individual parts, but rather must be considered in holistic terms. As an example, consider the value observed in the smallness of teams present in the hub. Working in small, sometimes interdependent, teams was seen to be conducive to knowledge and experience sharing. Yet, gaining this benefit was contingent on trust in others in the hub. This trust was, in turn, dependent on the culture of transparency and neutrality that came about from an interrelation of funding models, rules developed and prescribed by the hub members and management, and relationship building during events (n.b. many of which were conversely dependent on the smallness of the teams in the way they functioned). An assemblage is a 'thing' that makes a thing (i.e. a creative hub). A creative hub (one thing) is a material form of a co-located space, where its inhabitants gather and collaborate to increase their social capital, exchange knowledge and experiences, experiment, and nurture their nascent companies. What makes this state of affairs function the way it does is its assemblage (another thing) – “the assemblage is a virtual entity with actual effects” [11]. By suggesting we consider “creative hub as assemblage” we propose to think about creative hubs beyond their qualities at face value, but also in terms of the components that make them the way they are. Since assemblages have a form of content and a form of expression [10,13,14], then creative hubs also consist of a form of content and form of expression. Further, by looking at the origin of content and expression which focuses more to form rather than substance [13], then an assemblage is like a container. A container that has a shape or form for its content and has an expression to make it look appropriate. We analyze how this form of creative hub is chosen and appropriate for the inhabitants. Specifically, we map the six themes we have uncovered in the above analysis to three key concepts from assemblage (N.B. the connections are not exclusive, and some themes map onto more than one concept): (i) formalization (content and expression); (ii) configurations of bodies (team-hub-infrastructure); (iii) co-functioning (activities and events; experience sharing; community values and rules). Formalization (content and expression) The elements of an assemblage configure and co-function to constitute “what is said and what is done” [13]. We can, in turn, map this onto our central articulation of the creative hub (and its interactions) as “more than just space”. On the one hand, it assembles the themes of collaborative effort and neutrality, the idea of community values and a supportive environment, and a shared understanding in one coherent declaration. We share interest in the need to understand this rhetoric, identities, and values that are entangled in communities [44], while at the same time we would also like to see the material/tangible configuration. Thus, on the other hand, “what is done” is the form of creative hub as more than just a working-space for the startups and the associated inhabitants. If we consider creative hubs as assemblages, the form of content is an in-between space of work-share-play and the form of expression is the discourse, idea development and expectations on collaboration, sharing and sustaining etc. that happen there. The content form of a creative hub exists because of the working arrangement of the facilities like office space, co-working, and event space and the supporting infrastructures such as flexibility of the layout, digital infrastructure, and amenities. Arrangements of knowledge/experience and cost sharing also contribute to this intermediary form. As seen in our findings, there are formal collaborations (workshops, talks, meet-ups, and hackathons), informal collaborations (small talks in communal areas and online groups), skills sharing, and indirectly office cost-sharing with other startups. Another element that contributes to the form of content is play in the sense of games (table tennis and other non-work - relaxing activities) and experimentation. Such experimentation

was seen in, e.g., “brief intensive colocation” [46] activities or Hackathons and other tinkering activities. The form of content relates to the expressions observed in the study, as it affects the encouragement of collaboration and sharing, the values and neutrality of the environment, meaningful support and knowledge sharing etc. Yet, as in assemblage, we see that the form of content does not simply lead to the form of expression in a one-way relationship, and vice-versa. Rather, there is a reciprocal relationship where content and expression come into existence together (e.g. inhabitants’ willingness to play games together and the existence of shared values are likely to be co-dependent and to develop, in dialogue, over an extended period of time). A manifestation of these two formalizations can be seen like this. Instead of going to a fancier or more formal space, startups decide to go to an ‘in-between’ space of work-play-learn to interact with like-minded people (form of content) in the belief of the affordability of that space, the previous success stories of tenants, and the collaboration and supportive environment they will get by co-locating at that space (form of expression). This contingent equilibrium and reciprocal demand between both forms keeps the assemblage (creative hub) intact, and in turn, attracts more people to the space. Nonetheless, it can also be de-stabilized if there is either a new physical/material element (e.g. expansion of the building or a new form of co-location space) or new expression (e.g. where one starts to worry about the neutrality). The current assemblage will then be about reconfiguring its territory, where the elements will remodel the current forms, to the point where the startup founders find another alternative.

Configurations of Bodies

Examples of bodies in the hubs studied include the startup teams, the hub team, the ethos of hub and its infrastructure and finance. We could see, for example, that the connections amongst the infrastructure, the hub ethos, the financial constraints, core-competencies, plethora of tasks attempted and completed, and other startups together constitute a team body with specific qualities that are observed, such as their smallness. Hence, the current state of a body with current qualities is not its final state but a becoming, where we are more concerned with the capacity for potentiality, and a more anticipatory approach [21]. Moreover, the ethos of the creative hubs such as the culture of openness, transparency and financing through bootstrapping together engendered the hub body with a quality of “neutrality by funding model”. Yet the configuration of neutrality and funding are not free from potential tensions; it is a dynamic configuration. Thus, the observed qualities from our themes identified above – the smallness of a team, the neutrality of the creative hubs, and the value of infrastructure – are not determined by essence of the element, but by its relations. By thinking that qualities are not given but earned from interactions, we also echo the account that each “sense of quality” is “mutually enacted through its entanglement in practice and use” [4]. We can say that these qualities exist, but they cannot exist without the other qualities (or at least they cannot function without them). Therefore, assemblage shows us that the configurations of bodies lie in the qualities defining the hub that are inherently interdependent with each other. In that respect, assemblage theory also allows us to re-think the hub in terms of the dynamism in those movements, their spaces for rupture, and the creative consequences of rupture in those relationships. In turn, the network fluctuates, ebbs and surges in those spaces in relation to the interactions within it, existing in continual flux [23] - a state of virtuality which is key to more deeply understanding the power and value of the network.

Co-Functioning

A team is not (automatically) free to function in events; those events and the willingness and ability for a team to take part are caused by the relation to the function of the hub and its infrastructure. For example, a Friday event is a productive realization of the collaborative relation of the three elements. A small team of a startup has observed the routines of other startups and told the hub team about conducting an event, the hub team then listened to this idea in which they wait for a community-based approach free from a hidden agenda. Consider the supportive nature of the office-café-game infrastructure, then a Friday event can take place at the creative hub. This co-function can happen because the elements are connected by a collaborative relation. Hence, relations are there, exist in between bodies, but they are passively waiting for realization [9]. Conceptually, these relations are affective relations, where “affect”, as explained by Massumi, is intensity

[30] and a capacity to affect or be affected; or in this case, is a capacity that a body has to form specific relations [9]. Affects are not the product of bodies, they are the means by which bodies are empowered to act [41]. For instance, one of the capacities (affect) is the capacity to engage or be engaged in the events, and this affect circulates the team body, the hub ethos body and the infrastructure body - and they experienced it. These bodies are then the affected bodies, and they are connected by the affective relations. Accordingly, when a body is co-functioning with another body, it means an affect in that body is forming the (affective) relation with an affect from another body. For example, the experience sharing relation became informal chat or group chatting because the bodies experienced a sharing-affect. Therefore, the practical or the activities emerge as the consequences of these affective relations. We take this notion to read the relationing in terms of its importance and consequences. Relations configure the quality (which is the first point of our analysis); the qualities themselves don't just come about because of the configuration of the hub, but rather they have to be enacted by relations. The communities do not gain their qualities because of the way they are configured, but they gain them through people's active participation in the context of those qualities: people 'doing communities'. A similar case would be a hackerspace, which relies on care and on community involvement and engagement [45]. The configured quality in a body makes connections with other bodies, and subsequently this relational process allows for consequence or effect. We refer to this relational process in the creative hubs studied as collaborating, sharing experience and making a supportive community. The collaborative relation fostered the growth of the casual event at one of the creative hubs, the experience sharing relation led to the trickle down mentorship and support mechanism, and the relation as community brought out the community values and rules. Therefore, we can see these activities, events, mechanisms and rules as a consequence of a relational process. Implications and Strategies for Design Our aspiration in conducting this research was to inform the design of interactive technologies that facilitate hub-like interactions amongst people who aren't spatially or temporally co-located. Here, we reflect on how our findings and their analysis through the lens of Assemblage can inform the design of such virtual creative hubs. We discuss two strategies, which align with Bardzell's notions of critique-based and generative contributions [3]. The findings highlight and articulate a range of elements, activities and qualities that comprise the creative hubs in our sample. One strategy to employing these findings in the design of a virtual hub might be to provide virtual tools that seek to functionally replicate aspects of these elements and activities as they were observed. For example, tools might be developed to support business-focused experience sharing and mentoring, or online events arranged to facilitate relationship building amongst startups. Yet, what we learn from our field study is that the value and experience of individual elements of the hubs studied were strongly dependent on other elements and the way they co-function as an assemblage. Therefore, we argue that when seeking to replicate an element of a creative hub in a virtual counterpart (e.g. online equivalents of the events that we observed to foster collaboration amongst startups) designers must consider how they will co-function within the broader assemblage of the virtual system (e.g. how equivalent trust and shared values upon which open sharing was contingent can be developed), so that similarly beneficial qualities of elements can be subjectively generated in this new configuration. We argue that, as demonstrated in this paper, Deleuze and Guattari's Assemblage may provide a valuable conceptual framework to assist designers in appropriately responding to such relational aspects of creative hubs. For instance, identifying the forms of content and expression that make an aspect of a co-located hub function the way it does, and remaining reflective of the reciprocal relationship between them, could help sensitize a designer to how that aspect may, or may not, translate in a particular virtual hub technology or configuration. An alternative, or complementary, strategy to design in this context may be to not directly target the functional elements of existing creative hubs as the core focus of attention. A rich set of tools already exist that could be used, off-the-shelf, to support a number of activities observed in our study. For example, online chat systems, such as Slack, might be employed to functionally support forms of experience sharing

similar to those that we saw in our sample (and they already were to a degree). Yet, as we noted in our discussion of related work, it is clear that there remains value in situating a startup within a creative hub above and beyond what these tools can offer. Instead of seeking to replace existing online collaboration tools with new systems, designers might instead analyze the qualities that arise from their assemblage and, where those qualities diverge from those observed to be beneficial in co-located hubs, conduct targeted design interventions that aim to reconfigure these relations. As a hypothetical example, a visualization of the languages and technologies checked into the software repositories of different companies within a virtual hub might be developed to re-create the kind of lightweight awareness of skills and experience that resulted from multiple companies inhabiting shared offices in co-located hubs. This may, in turn, inspire the organization of skills sharing events around those technologies that could be conducted using existing video conferencing tools.

CONCLUSION We have presented findings from a qualitative field study in UK creative hubs. Our findings show the elements that define the experience and value of working in creative hubs are critically independent on each other. By using the concept of assemblage, we can read this interaction in terms of bodies, co-functioning and formalization. Based on the analysis of our findings in these terms, we propose two strategies for designing virtual creative hubs. First, an approach that seeks to ensure that elements are considered in terms of their relations to others, by employing assemblage to understand the design context. Second, an approach where focus is placed not on functional activities carried out in a hub, but rather on interpreting compositions of existing collaborative working tools as assemblages and intervening where their relations and co-functions do not support the beneficial qualities present in co-located hubs.

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