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Creativity Greenhouse

At-a-distance collaboration and competition over research funding

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Abstract. This paper describes the design and evaluation of a novel mechanism to develop research proposals and distribute funding: Creativity Greenhouse (CG). Building on an established funding sandpit mechanism for co-located participants, communication technologies and structures were designed to support similar activities at-a-distance. Given a particular topic, selected academic participants collaborate during an ideation phase, then form sub-groups around selected ideas to develop research proposals and compete for the available research funding. This paper details the motivations for developing a distributed approach, before describing our iterative design process and trials. We describe an iterative design and evaluation process to support at-a-distance ideation, group formation, and then competitive development of proposals in a shared virtual space, leading to the detailed evaluation of a full-scale CG event that resulted in the distribution of £1.85 Million of funding. This work contributes a novel, fully-developed mechanism to produce research projects, evaluated ‘In the Wild’. Our findings are explored with regards to distinctions and similarities between co-located and distributed events, participant well-being and pastoral care, and the capacity of technologies to mediate complex combinations of cooperative and competitive group work. Through this, we contribute knowledge of how to effectively support research funding events, and also to wider understanding of high-stakes, computer-mediated processes, that involve complex creative and social processes.

Keywords. Ideation, Collaboration, Competition, Research Funding, Communication Technology

1 Introduction

Research funding is a relatively scarce resource, and funding bodies employ a variety of mechanisms to distribute funds effectively. While the goals of funders may vary, a common aim is to increase the proportion of ambitious, high-risk projects involving innovative collaborations. Prendergast et al. found that around 60% of the funding bodies responding to their survey stated that they funded ‘high-risk’ research, with around 80%

stating that originality in proposals was indispensable (Prendergast, Brown et al. 2008). In the same context, Heinze identifies that the advent of a highly competitive funding landscape is relatively recent, and that this was thought to support the best ideas and collaborations to succeed (Heinze 2008).

Competition for limited resources necessitates a selection process in some form. Such a process is generally employed to validate proposed ideas against the prevailing view of the research community, with peer review being most commonly used. However, it has also been argued that such approaches stand in the way of potential paradigm shifts, and that "... funding structures with a strong peer-review component tend to overfund mainstream research that follows established research lines, particularly in traditional disciplines" (Heinze 2008). In a recent poll of UK academics, 71% were in favour of changing the peer review process, as it is seen to form a barrier to new academics and to truly novel projects (Caines 2011).

In this paper we focus on the adaptation of a mechanism developed and regularly used by our funder - the Engineering and Physical Sciences Research Council (EPSRC) – which has also found popularity in adaptations elsewhere: The Ideas Factory Sandpit. This is a multi-day event during which selected participants collaborate to explore new ideas and rapidly develop research proposals. Groups form around ideas in a facilitated process and then compete for substantial funding resources, with decisions being made at the close of the event. To address reported drawbacks of this approach with regards to inclusiveness and costs, we collaborated with the EPSRC to develop 'Creativity Greenhouse' (CG), a mechanism for conducting similar sandpits at-a-distance. Through this research, we contribute specific understanding of the design and evaluation of a novel computer-mediated mechanism for proposing and funding research - an essential process within the research landscape, and one that is underexplored in terms of existing literature. Beyond this, we highlight broader issues with the computer-mediation of group activities that involve both collaboration and competition, and have significant consequences for those involved. This is again an area that has lacked research to date, yet it is becoming ever more common that such socially complex, high-stakes activities are conducted through computer mediation.

In the following two sections, we explain the sandpit concept and review relevant research around computer-mediated group creativity, collaboration and competition. Section 4 then outlines the 'Research in the Wild' approach taken to design and evaluate Creativity Greenhouse. Section 5 describes early trials and findings, then section 6 provides a detailed analysis of a full-scale CG event. Using this, section 7 explores distinctions and

similarities of conducting such events while co-located or distanced, and provides socio-technical recommendations for implementing such an approach, with section 8 providing summary conclusions.

2 Funding Sandpits: An Innovative Mechanism to Encourage Ambition in Funding Applications

Although many funding bodies aim to fund high-risk research, there remains a perception that potentially valuable speculative work struggles to secure funding, and that decisions are overly reliant on the applicants' track record (Prendergast, Brown et al.). In this context, three phases of the funding process are typically distinguished (Susan, Guerin et al.). The *development* phase includes the funder defining the scope, researchers identifying questions, the funder collecting proposals and any iterative refinement. In the *selection* phase, funders choose projects to fund. Within this it must be considered who selects, the process, and the criteria. The final phase is concerned with *supporting the research*. Stimulating transformative research, which is multi-disciplinary, adventurous and high-risk-high-return, is a stated aim of the EPSRC, a major government-sponsored research funding body in the UK. EPSRC has trialled various approaches to stimulate such transformative research. However, those mechanisms were not seen to achieve the desired culture change. In response, and over the last 10 years, EPSRC have developed the Ideas Factory programme, which amongst other approaches includes the sandpit concept described below (EPSRC).

2.1 The Sandpit Concept

Sandpits are seen as an alternative to the standard approach of academics proposing and peer-reviewing proposals over extended periods amongst their own circles. A sandpit is an explicit attempt to nurture group creativity and perturb the existing landscape of research ideas by bringing together a diverse group of individuals to an intense, well-supported event, usually focused on a particular topic (e.g. 'Transport Grand Challenges' or 'IT as a Utility'). They draw inspiration from Creative Problem Solving (CPS) approaches to structure group creativity (Osborn 1953) (Creative Education Foundation 2013). Facilitators will prompt groups to explore a given challenge through defining aims and objectives, considering the background and clarifying the problem.

The focus then switches to generating ideas, and then to the refinement and selection of solutions and plans based on these. All phases have divergent and convergent elements. Brainstorming plays a vital part in CPS, and the production of many ideas, and importantly, the re-use of others' ideas, is actively encouraged.

Context and interaction with others are key factors in shaping how creativity manifests itself (Fischer 2005). In this regard, EPSRC carefully design the context, processes and resources for sandpits. The standard form is a five-day residential event, with participants brought together in a venue to first collaborate to develop themes and ideas in connection with a given challenge, and then to compete for funding resources in self-selecting groups. The key mission is the creation of multi-disciplinary teams around ideas that will not be funded through other routes. This is both evident in the selection process at the individual level (e.g. willingness to engage, lack of preconceptions) and for the whole group (e.g. a balance of seniority, disciplines and institutions) (Maldé 2010). EPSRC invites people from a wide range of backgrounds perceived as relevant, and challenges participants to work with those who have a different view of the world (Giles 2004). This multi-disciplinary nature increases the likelihood that participants do not know each other beforehand. It is therefore essential that participants have time and space to assess who they would like to work with, and form a suitable team to address a shared problem (EPSRC 2013).

Participants are asked to remain at the venue for the duration, and avoid other appointments or work. The process is guided by a director and a team of mentors who advise on the topic and provide feedback, and a team of external or in-house facilitators who lead group interactions and keep the process flowing through the key CPS stages. Representatives of the funding body are also available to advise on funding details (see table 1) (EPSRC 2010).

Table 1. The roles in an Ideas Factory Sandpit

Director	Overall topic responsibility
Mentor	Topic specialist, mentoring on research methodology and project management
Facilitator	Expert in CPS process, resources, external, internal
Research Council Staff	Process facilitation and funding advice
Speaker	Invited as specialist or to perturb existing views

Participant	Carefully selected academic participants
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Although featuring a range of activities and iterations, each sandpit can be broken down into two main stages: whole-group collaboration and divergence in stage 1 and sub-group competition and convergence towards proposals in stage 2. During stage 1, roughly the first 2 days of a 5-day event, participants will collectively explore the topic from multiple perspectives. Participants are actively discouraged by facilitators to discuss solutions at this stage and instead to fully explore the space of relevant ideas. At the same time, participants will get to know other's personalities and skills. Different group configurations are actively encouraged at this stage. As the event progresses into stage 2, participants are expected to commit to a combination of proposal idea and associated sub-group, and the event becomes convergent and competitive. Groups work intensely on their proposal, including multiple rounds of presenting to peers, facilitators and funders to gain feedback. Through this, participants act as formative peer reviewers for the competing proposals. On the last day, groups make a final pitch, and funding decisions are made by the director, mentors and funders (EPSRC 2008).

2.2 Funding sandpits in practice

To date, EPSRC have run over 40 sandpits, including joint activities with other organisations. Numerous projects from these sandpits are running or completed. The concept has gained traction in wider UK academia where shorter events with often a lower amount of funding are facilitated within a single institution (Dale 2009), and also in the US, where the National Science Foundation has run an equivalent process: Ideas Lab from 2009 (Collins, Kearney et al. 2013).

The concept has been well received, although financial commitment is comparatively low (Heinze 2008). Prendergast et al. single out the Sandpit approach as 'innovative and visionary in its assessment of applicants, avoiding an over-reliance on track record' (Prendergast, Brown et al. 2008). Quality is seen to be more effectively scrutinised, the process drives innovation and funding decisions are more transparent in a process shared between reviewers (other participants) and funders (Susan, Guerin et al. 2013). Sandpits are seen to result

in unexpected groups forming to tackle questions in new ways, ideas are communicated clearly when faced with a deadline, and innovation is better supported than through traditional processes (Collins, Kearney et al. 2013). However, there are also more critical views: The selection of participants re-introduces a form of peer-review, albeit more of participant CVs rather than their proposals (Goldberg 2011). The micro-management of interactions has antagonised some researchers (Corbyn 2009). It can be hard to bridge the disciplinary divides in language alone in the time given (Giles 2004). As funding is to groups, participants may feel compelled to join even if their fit is poor, and the combination of social norms and limited time make it difficult to reject potential group members or resolve difficulties. Thus, groups might turn out to be non-functional when funded (Collins, Kearney et al. 2013). As group formation is essential to success, it might be that ‘social operators’ are rewarded over those who are most brilliant (Goldberg 2011). Also, the mixture of collaborative and competitive behaviours required, combined with unsuccessful ideas being rejected in ‘slow motion’ can be very hard for participants to deal with (Mervis 2009).

From the EPSRC’s experience, two further issues have become prominent: Sandpits are expensive to run in terms of travel, accommodation, venue and catering costs. Secondly, because of their residential nature, sandpits could only ever be attractive for those willing to travel and be away from home and workplace for a lengthy period of time, a point also raised by (Goldberg 2011). Many suitable people (e.g. those with care giving duties) will find it unattractive or impossible to leave their homes for up to a week in order to participate. EPSRC were therefore.

Drawing on their experience with co-located sandpits and the identified shortcomings with regards to cost and inclusion, the EPSRC aimed to create and evaluate a distributed sandpit mechanism. The question to be addressed and the major research question for this paper, was whether sandpits could be conducted when participants are remote from each other and the facilitation team, and to understand the technological, social and psychological issues raised in supporting this endeavour. To address this, we directly collaborated with EPSRC, the proponent of the sandpit process, and the funder of this research.

3 Group creativity, collaboration and competition at-a-distance

Translating the sandpit process described above into a mechanism that would work at-a-distance required extensive work to design and adapt available communication technologies. This work was conducted in the broad context of Computer Supported Cooperative Work (CSCW) and in what follows we briefly review the most relevant research pertaining to the technological support of group creativity, collaboration and competition.

3.1 Group creativity

In the context of this paper, the support of groups being creative is particularly relevant, given that the main aim of the sandpit process is to increase levels of innovation in funding applications. Creativity is a sociocultural process, where the process and outcomes are shaped by external factors as well as individual effort (Csikszentmihalyi 1997) (Sawyer 2012). Group creativity involves the sharing of ideas, listening to and evaluating others' ideas, and processing of combining and refining these. Social interaction can potentially improve outcomes through diversity (Fischer, 2005), but is difficult to manage, with identified problems such as 'blocking effects' where multiple ideas cannot be expressed efficiently (Diel and Ströbe 1991), and 'evaluation apprehension' leading to nominal groups of individuals being seen to outperform groups in idea generation (Diehl and Stroebe, 1987). On the other hand, there is evidence that heterogeneous groups perform better, as long as the diversity in skills is relevant for the group task and skills do overlap. More generally, it is clear that facilitation processes are valuable (Paulus and Brown 2007).

The first electronic brainstorming systems supported collocated groups with a facilitator guiding the process and the software allowing individual input and group consideration in an anonymous form (Nunamaker, Dennis et al. 1991). This later turned to the support of distributed groups (Kay 1995). However, the role of social norms and how they are perceived within a communication environment may affect processes such as idea generation (Sproull and Kiesler 1986). Similar technologies have developed to support longer-term scientific laboratories (Wulf 1993, Farooq, Carroll et al. 2005) and more recently to the areas of e-Science and Cyber-Infrastructure (Jirotko, Lee et al. 2013).

When attempting to support group creativity, designers have recognised the importance of the spatial and organisational context, leading to the design of physical spaces around specific processes to support creative behaviour (InQbate 2009) (Doorley and Witthoft 2012). When conducted online, group creativity requires support for the building of a joint interaction spaces where members can effectively reference and return to the

ideas and concepts developed within the group (Sarmiento and Stahl 2008). Such support would require specific technological responses and in what follows we review related work to support collaboration more generally.

3.2 Collaboration

From the mid-1980s the field of CSCW has focused on the social, psychological, economic and technological aspects of collaboration across a variety of organisations (Grudin 1994). As a field, CSCW has been concerned with mediating between multiple individuals over and above individual tasks or problem solving, with a particular focus on providing support for awareness and coordination (Dourish and Bellotti 1992). The basic problem space can most simply be expressed by considering the two-dimensional matrix mapping synchronous and asynchronous interactions against co-located and not co-located interaction as expressed by Johansen (Johansen 1988).

Technological responses to this problem space have been very varied and far-reaching. *Asynchronous* group support includes technologies such as Email, Internet forums and file stores. With high-speed networking wide-area implementations of groupware became possible, such as BSCW (Bentley, Horstmann et al. 1997), which allows the collaborative authoring, annotation and version control of texts and media. Today, collaborative authoring of documents is commonplace, as for example demonstrated by the Wikipedia platform and its uses, and current groupware systems such as Google Apps (Google Inc. 2014) are used by individuals and organisations (Google Apps was selected as one part of the Creativity Greenhouse platform as will be outlined in section 4.3.). Related, but purpose-built tools are now also frequently used to manage software development when developers are distributed, for example across multiple time zones and therefore working asynchronously. Beyond challenges that are common with other remote collaboration contexts (communication, group awareness, coordination, etc..), specific additional challenges such as source code control as well as process, quality and risk management of the software project arise in this collaborative context (Jimenez, Piattini et al. 2009).

Building on the telephone network, *synchronous* distributed collaboration technologies have made use of video in a number of different formats, beginning with video telephony, which was made publicly available in the 1970s (Fish, Kraut et al. 1993). The extension to video conferencing includes more than one party in a single call, originally focussing on comparatively formal occasions (Fish, Kraut et al. 1990). Video conferencing in office settings was typically set up in dedicated rooms and meetings were scheduled with certain participants and

focussed on an agreed agenda. Reynard adds that video conferencing was designed to support short term, focussed activities with little support for general awareness beyond that of the people involved directly (Reynard 1998), and arguably this is how current Internet video tools such as Skype are being used now. This type of interaction only covers a small portion of how people interact when they physically meet. Meetings are certainly arranged but interaction tends to be much more informal (Fish, Kraut et al. 1990). In response, media spaces are a group of technologies that were derived from video conferencing to include more informal, less organised conduct in telecommunication technologies and have been used to allow for distributed presentations (Jancke, Grudin et al. 2000), group awareness (Dourish and Bly 1992), remote office shares (Adler and Henderson 1994) but also for the connection of public places (Galloway and Rabinowitz 1980). Interaction in media spaces takes place in an ad hoc way with randomly encountered participants and an evolving agenda that is interactively negotiated. One of the draw-backs of media spaces is that they are non-spatial, only providing a limited, flat view into the remote interaction space and providing limited awareness of people's interaction with shared resources. Without an internal spatial framework, it is difficult to see what and who others are attending to, what they are pointing at or who they might be facing, as people's conduct is separated from the space it is produced in and from the space where it is received (Luff, Heath et al. 2003).

Research into collaborative virtual environments (CVEs) has been at the centre of attempts to create suitable frameworks for remote collaboration in response to the above. CVEs provide 3-dimensional spaces shared at-a-distance, with an avatar being the conduit to communication with others (Benford and Fahlén 1993). CVEs have been used for a variety of applications in the past from entertainment, teaching to training (Benford, Greenhalgh et al. 1999, Craven, Taylor et al. 2001, Blanc, Bunt et al. 2005) (Rickel and Johnson 2003). Though commercial platforms ActiveWorlds (Schroeder and Ann-Sofie 2000, Schroeder, Huxor et al. 2001) and then SecondLife (Linden Research Inc. 2006), saw a dramatic rise and decline, popular new hardware such as Oculus Rift suggests a significant new wave of VR. CVEs have also been tested in the context of a number of creative activities, for example to visualise curricula or in architectural design (Drettakis, Roussou et al. 2007, Prasolova-Førland 2007). In this context, Heldal argues that CVEs can provide both the required co-presence and individual space necessary to allow groups to be creative together (Heldal, Roberts et al. 2007).

Most directly applicable to this paper are those technical developments, which combine a spatial framework and live video (Han and Smith 1996, Nakanishi, Yoshida et al. 1996, Reynard and Benford 1996). Just like in an

ordinary CVE, people can move around virtually, form groups and have conversations with each other, whereby the level of video and audio quality can be controlled as a function of the distance between people. The video itself provides a much better rendition of facial expressions and some information about the physical context of a person than CVEs by themselves ever could. Extensions of this work have then included the location of large scale windows into virtual worlds connecting multiple physical office space (Schnädelbach, Penn et al. 2006) in a ‘hybrid spatial topology’ (Schnädelbach 2012), exploring the long-term effects of office shares across a mediating CVE. One of the commercial implementations of the ‘video in CVE’ approach (OpenQwaq open source community 2013) underpins the work reported in this paper and the rationale for its choice is further explained in 4.3.

3.3 Collaboration and competition

While collaboration mediated by computers has been the subject of a large body of research, only very limited research has looked at communication technologies within the contexts of both collaboration and competition in a single technological setting. Where it does exist, such research differs significantly from sandpits in terms of the rewards – sandpits often having very high-stakes in terms of the importance of gaining research funding to an individual and to their organisation. In contrast, researched areas of computer-supported competition include Massively Multiplayer Online Role Playing Games (MMORPG), where competitive elements combine with the forming of collaborative groups, often with strangers, and online learning environments where grades are a rewarded for winning teams in competition (Gilson, Maynard et al. 2013). In MMORPG, research suggests how characteristics of individuals impact upon the development of collaboration and competition, for example some gamers are more interested in achievement and thus the competitive element of their experience, while others are more interested in the building of relationships as a motivation (Herodotou 2010). Other work has explored how gamers show bias in their choices of collaborators based on their experience levels, but are less concerned when choosing competitors (Yuan, Zhao et al. 2007). In considering these findings, it must be expected that the manifestations of competitive or collaborative behaviour exhibited in gaming, and the experiences of those involved, will differ from those found in a work-related, high-stakes activity such as a research funding sandpit.

While research is sparse, it is possible to identify analogous distributed activities supported by networks that show similar elements of collaboration and competition in high-stakes work situations. A recent and particularly

visible form of this is the rise of ‘Open Competitions’, with the Netflix Prize being a high profile example. In this case, a reward of USD\$1 Million was given in 2010 for achieving the specific goal of a 10% improvement over the recommendations produced by a basic algorithm. The structure of the open competition led to ‘competing communities’ in which certain knowledge is shared openly in stages, while other knowledge is brokered (Villaroel et al., 2013). It is significant that the winning team was formed out of a merger of formerly competing teams, exemplifying overlaps of competition and collaboration where a combination of open sharing *and* small groups competing with each other is seen to produce the most valuable result. At the same time, these competitions strongly differ from research funding sandpits in terms of the facilitation, structure, timeframes and well-defined outcomes.

3.4 Technology and management structures for the Creativity Greenhouse

Olson and Olson argued that distance matters but that remote collaboration can succeed, if particular conditions are met (Olson and Olson 2000). Specifically, groups that share common ground to achieve work that is not strongly coupled in organisations that are ready for collaboration and have the right technology can succeed. Technology develops rapidly and a review of the issues already highlighted how quickly the field had moved on (Olson, Olson et al. 2009), while not being co-located will still matter for a variety of group work tasks. Indeed, the review by Cummings & Kiesler (2002) suggests that close proximity remains beneficial for collaboration and that greater structure in the management of distributed group work is a potential answer to some, but not all, of the causes of difficulties with distributed group work. For example, an informal hierarchical structure was found in more successful distributed R&D teams, in contrast to co-located R&D teams, where a flexible, organic way of working with a flat hierarchy was considered best (Hinds & McGrath, 2006). Distanced groups are also expected to be more likely to succeed if they have an existing degree of cohesiveness (Cummings & Kiesler, 2002). However, overly structured management of groups may be counter to the aims of a project such as Creativity Greenhouse, as task decomposition can “depersonalize interaction”, reduce opportunities and eagerness to learn from others, and impede “the exchange of expertise and discovery” (Cummings & Kiesler, 2002).

Notwithstanding available technologies to date, what has been investigated through the research discussed in this paper presents a unique combination of technologies and management strategies to support groups to first

collaborate and then compete for funding, as will become clear in the following sections. Arguably, this combination in a context of collaboration readiness and technology support allowed for group work on highly coupled tasks and the establishment of common ground in a very short time span.

4 Developing the Creativity Greenhouse – A Research in the Wild Approach

Due to the importance of social and work-related factors in interactions around research funding, it was agreed that only highly-realistic study settings would provide suitable test-beds for evaluating the proposed funding mechanism and the systems for supporting it. EPSRC and ourselves were therefore keen to conduct this research ‘In the Wild’ (Chamberlain, Crabtree et al. 2012), through direct experience of employing the mechanism to distribute funding. This approach allows us to provide a detailed understanding of the resulting mechanism, as well as rich data from evaluations in realistic contexts of use.

An iterative development and deployment process was conducted over ~24 months to establish a technology infrastructure, process and resources, and to deploy, evaluate and refine this three times in different settings.

Table 2 provides an overview of the events with their goal, the funding resources available, length and participants.

Table 2. Project phases 1- 3, increasing the complexity and realism at each stage.

<i>Phase</i>	<i>Type</i>	<i>Goal</i>	<i>Funds Available</i>	<i>Length</i>	<i>Participants</i>	
1	Funding Event	Comparison of Co-located and distributed	Up to £50,000	1.5 days	14 & 10	Internal research and academic staff
2	Funding Event	Distributed trial with external participants outside of host university	Up to £300,000	4 days	7	External – Invited with selection via EOI
3	Funding Event	Evaluation comparable to full IDF Sandpit	Up to £1,500,000	5 days	16	External – Open call with selection via EOI

4.1 Study Methodology

We applied a multiplicity of user-centred methods including naturalistic in-event observation, the analysis of video and audio recordings, surveys, and focus groups to investigate the events. Our focus was on user experience, both from the perspective of participants, and the facilitation teams. This included individual and social issues including presence, collaboration, and enjoyment (Slater, Sadagic et al. 2000) (Schroeder, Steed et al. 2001). We also captured technology acceptance (Venkatesh, Morris et al. 2003) and probed for views on the event process and outcomes. During the first two phases, the aim was to quickly feed forward learning to the next iteration, refining the approach. For the final event, the aim was to provide as realistic a scenario as possible, and produce an in-depth understanding of proceedings synthesised from multiple strands of data. An increased emphasis was placed on detailed thematic analysis of video recordings, while also taking into account surveys filled in on a daily basis, focus groups early in the event and at the end, and reflective discussions post-event with the facilitation team.

4.2 The technology used for the Creativity Greenhouse approach.

Here we account for the choices of communication technologies deployed in CG. Background literature and prior experience framed this in combination with more practical concerns such as availability and functionality. Considering the multiple phases and activities within a Sandpit we derived a complex set of demands. These were captured in discussion with the EPSRC and from reviews of previous sandpit process plans. The activities that needed support are summarised in table 3.

Table 3. Sandpit activities that need to be supported through selected communication infrastructure

Communication	Public communication. Private communication between individuals and amongst groups.
Ideation	Individually and in groups, where ideas need to be generated, documented, shared, discussed and clustered, guided by facilitators
Documentation	Formally documenting work, e.g. the funding proposal, to be presented, persistence of documents, maintenance of a peer review audit trail
Presentation	Presenting material to others at various stages of the process
Forming groups	Individual forming and re-forming groups suitable to them

Critique	Allowing peers (other academic participants) and the event organisers (facilitators, mentors, director) to critique ideas and proposals
Facilitation	Taking participants and mentors through the various stages of a sandpit process
Directing /Mentoring	Supporting and shaping ideas so that they are relevant to the sandpit topic
Pastoral Care	To look after participants ensuring that individual and group tensions can be identified and addressed

Across these specific activities, it was clear that any system needed to support multiple roles, where facilitators driving an event have different requirements from participants (see **Table 1.**). It was also evident that both moderated synchronous interaction (i.e. facilitated whole team episodes) as well as more self-motivated asynchronous interaction (i.e. work with documents in sub-groups) needed to be supported. This led to a split of the review of available communication technologies into two areas: synchronous communication tools (audio and video conferencing and CVEs) and asynchronous collaboration tools for shared documents (groupware).

4.3 Internal comparison of candidate communication technologies

Given the above criteria, we selected two synchronous communication technologies (Adobe Connect Pro and OQ), each in combination with one asynchronous communication technology (Google Apps) for an internal comparison. The following provides a very brief description for each technology. *GoogleApps* was chosen as the asynchronous groupware solution (Google Inc. 2014). This provided the best match of features of the available systems, including shared editing, persistent storage of documents and presentations, and the streaming of presentation material. A further useful feature was support for the creation of forms, which were used to structure participant assignments as well as for our evaluation purposes. *AdobeConnect* is a standard web video conferencing product (Adobe Systems Inc 2013) that works by creating a “meeting”, with an optional start and end time. Users may join and share a meeting space, containing windows for various utilities such as screen sharing or text chat. Importantly, the tool allows the set-up of groups within each meeting so that people can discuss issues separately, but these must be set-up by the meeting ‘owner’. There are facilities for presenting, and facilitators could post links to GoogleApps pages in text chat. *OQ (originally Teleplace)* (OpenQwaq open

source community 2013) is a collaborative virtual environment (CVE), that can act as a shared meeting space. Participants control avatars in a designed virtual space, communicating with others and accessing resources such as Google Apps documents which can be displayed directly in the virtual world. There are also facilities for brainstorming (e.g. virtual 'sticky notes'), presenting and text chat. A key feature and key difference to Adobe Connect is that people can self-organise: Individuals decide where they want to be in the space and with whom, simply by positioning their avatars. Although OQ does provide video streaming, there were limitations to the scalability of this to large group situations in practice.

Formative Comparison of Technology Options

An initial event was conducted to compare the technology mash-ups in a pseudo-realistic formative study and identify the most suitable combination of tools. As a small formative study, teams of two participants were given a design exercise that was relevant to their workplace. From a co-located control room, event and technical facilitators took two sets of four participants through 60-90 minutes sessions, and an evaluation team observed and distributed surveys after each session. Both technology configurations were seen to broadly work by participants and moderators. For the EPSRC, the marginally higher participant preferences for OQ and GoogleApps, as well as the advantage of the spatial metaphor that allowed people to self-organise into groups and around resources, resulted in the choice of *OQ* and *GoogleApps* for the subsequent trials.

5 Iterative Design and Deployment of the Creativity Greenhouse

In this section we detail the iterative development of the CG mechanism. This includes findings from two formative studies, which compared co-located and distributed versions of the same event structure, and then invited participants from outside of the host institution. For brevity, we present only essential findings and changes to the mechanism resulting from these early trials. We then provide a detailed analysis of the final phase, in which the fully developed CG approach was utilised in a highly realistic manner, closely aligned to a standard sandpit, in section 6.

5.1 Early Iterative Trials of Creativity Greenhouse

5.1.1 Description of Phases 1 and 2

Phase 1 was conducted with the aim of comparing a co-located and distributed event with the same underlying structure. A total of £50,000 was available for the successful project(s) in each event, designed to act as pump-prime funding to develop larger projects. In the co-located event, 14 researchers followed the sandpit process in a hotel. In the distributed event, 10 researchers collaborated remotely while based in their offices, using *OQ* and *GoogleApps*. Both events lasted 1.5 days, as a shortened version of the sandpit format (see **Fig. 1**)

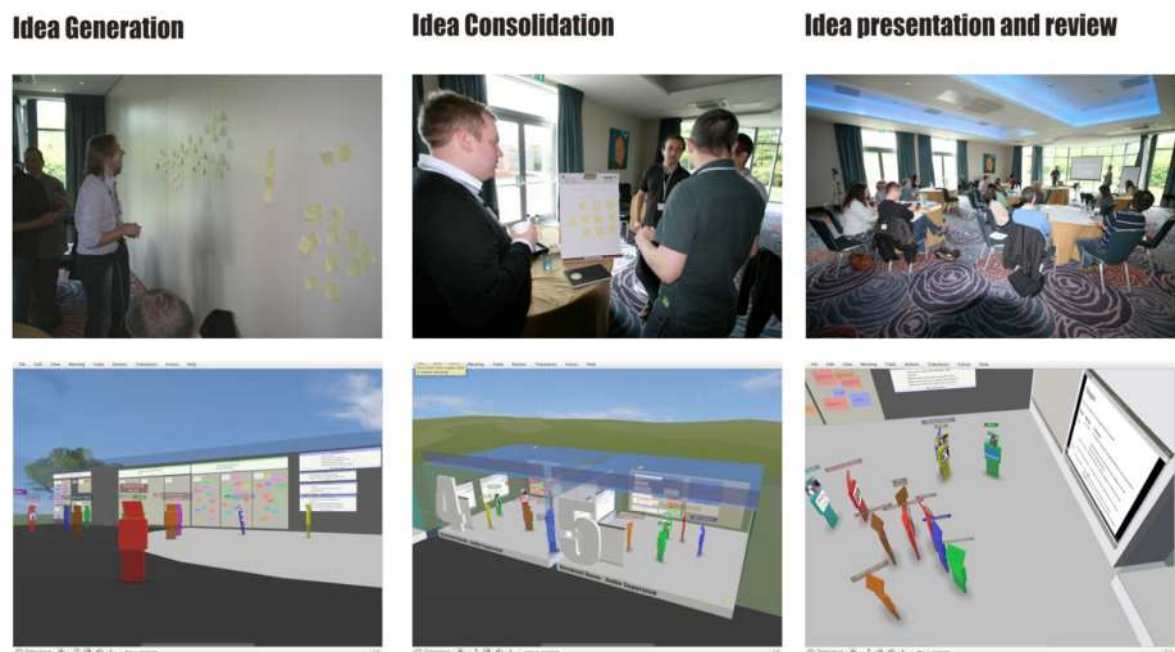


Fig. 1. Phase 1: Co-located event in the hotel (top) and distributed event using *OQ* and *Google Apps* (bottom), illustrating the three key sandpit phases of Idea Generation, Idea Consolidation and Idea Presentation and Review

For phase 1, participants were given topics of ‘The ‘Lifelong’ in the Lifelong Contextual Footprint’ for the co-located event and ‘Living with the Internet of Things’ for the distributed event. After introductions, an afternoon was spent in full and sub-group discussions of the topic and in representing and clustering ideas. By lunch of the next day, sub-groups reported back and received critique from peers and the facilitation/mentoring team. That afternoon, final proposals were pitched to the director and mentors, leading to a funding decision. For the distributed event, a ‘control room’ was established to co-locate event facilitators and evaluators.

Phase 2 increased realism by involving researchers across multiple organisations and changing the length to 3.5 days. EPSRC invited ~40 pre-selected participants to the event, around the topic 'IT as a Utility'. Nine applied and all were accepted, having provided a satisfactory Expression of Interest. Two subsequently dropped out, leaving seven at the event. Drawing on feedback from phase 1, that initial socialisation was problematic at a distance, the event was redesigned to include a day-long co-located meeting, followed by 2.5 days of distributed meetings. £300,000 of funding was made available, and EPSRC awarded ~£200,000 to the team for a collaborative research project, which has since been concluded (<http://sertes.net>). A key limitation was that low participant numbers led to only one team and proposal, and hence a lack of competition.

Evolution of Supporting Technological Structures

The use of OQ and GoogleApps (**Fig. 2.**) evolved over the trials. The aim was to configure these tools to support the activities and flow of the CG process. In the OQ virtual world, four zones were designed for phase 1: One was broadly for presentation, used for proposal pitches and other whole group presentations (e.g. external speakers). It is framed by a light grey quarter circle on the floor.



Fig. 2. The OQ virtual space (left) in combination with the document workspace GoogleApps (right)

This presentation zone was embedded into a much larger zone for whole group work. The central space acted as corridor and overall gathering place, with the size kept down to afford maximum awareness between participants. As can be seen in the figure, wall space is used to make resources visible via built-in web browsers and sticky notes, which were used extensively. Around the perimeter, 5 breakout rooms were arranged for sub-group activities. Finally, a virtual facilitation room was located near the presentation area. When in a breakout

room, people could see across the entire space but only hear the people with them in the breakout room. Table 4 provides a high level mapping of how the tools supported the key phases in CG.

Table 4. Technologies available to academic participants for the five key activities

	<i>OQ</i>	<i>GoogleApps</i>
Communication	Movement and orientation of avatar, which locates: Audio channel (bound to audio region), Video channel (in groups >10). Private text chat was also available.	Comments on Documents
Ideation	Generating, Sharing and Arranging virtual 'sticky notes' on virtual surfaces facilitating CPS	Provided Pro-formas (raising specific topic), standard documents
Documentation	Placing and making visible GoogleApps documents within OQ (through a web browser)	Standard Documents
Presentation	Placing and making visible GoogleApps presentations and standard documents within OQ (through a web browser or pasted screen shots), Presenting using Audio and Video from these resources.	Standard presentations
Forming Groups	Joining or leaving OQ breakout rooms	Accessing grouped resources

Given the additional length and complexity of phase 2, a larger layout was designed to accommodate extended versions of activities such as representing or sorting ideas. The layout still incorporated the same four zones, but an innovation was to make the length of the space flexible through a partition that allowed the room to be extended or contracted for different phases of the event (Fig. 3).

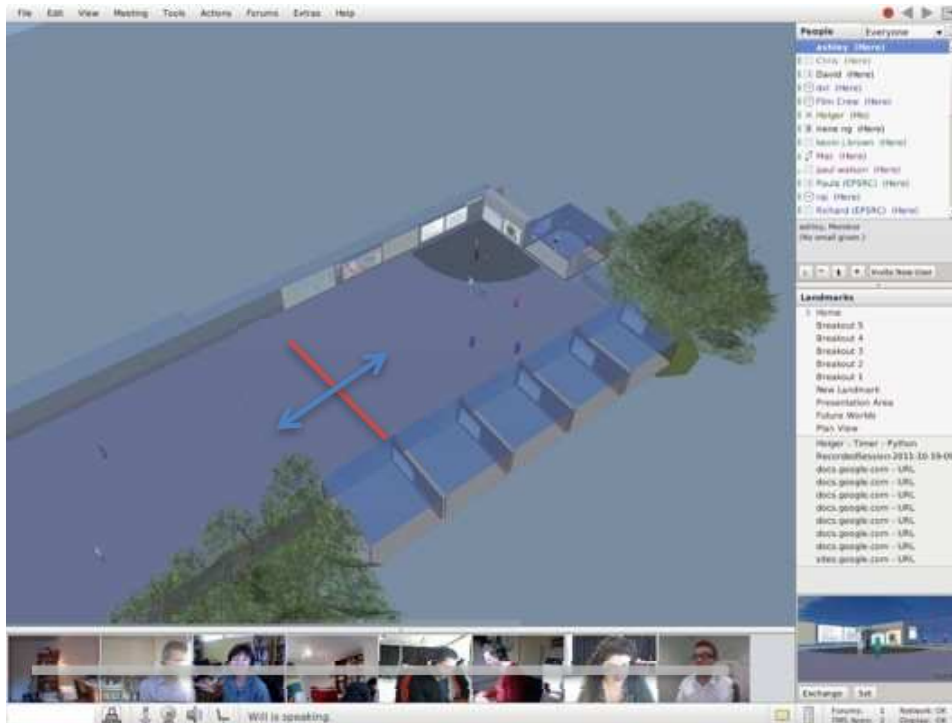


Fig. 3. OQ spatial layout in phase 2 with spaces for presenting, whole group work, break-out group work and facilitation team space. A slideable partition (indicated in orange) allowed the adjustment of the size of the space.

Evolution of Event Structure

In light of social and technical difficulties of participation at a distance found in phase 1, phase 2 introduced an initial co-located meeting before the distributed work commenced. This was held at a hotel and began with an evening briefing of the aims of the project and time for socialising. The following day was held at our research lab and included demonstrations of OQ and GoogleApps. Participants both freely explored the technology and were guided through exercises with key functionality. The remainder of the morning was used to introduce the topic of the event and the afternoon allowed participants to explore this topic collaboratively.

The first distanced, virtual meeting was then preceded by a ‘technology clinic’, during which facilitators were available to check the set-up that participants would use, and provide further individually-tailored training. These changes were made in response to phase 1 feedback that requested increased opportunities to learn to use the tools. The following 2.5 days of the event were then fully mediated by the technology infrastructure.

5.1.2 Findings of Early Trials

Here, we describe lessons drawn from phases 1 and 2 thematically, with regards to co-located and distributed CG interactions and to facilitation.

Co-located and Distributed Interactions

Very broadly, the co-located and distributed events in phase 1 performed in a similar fashion with regards to reported individual experience, social interaction and project outcomes. This was despite a steep learning curve and significant technical and usability problems with OQ, which were overcome by active facilitation work. Problems initially impacted on awareness, co-presence, turn-taking and interaction with resources in some cases, but once people had grown accustomed to the technology, the task at hand came to the fore. As the event was important to participants, they were motivated to continue even when the tools posed barriers.

The experienced facilitators and mentors considered the quality of the funding proposals broadly equivalent between the co-located and distributed events, which was a key positive given the aims of the activity. The project funded through the distributed event (Intergenerational Interpretation of the Internet of Things) led to several published papers, and further related projects.

As it was proposed that an initial co-located meeting would be included, phase 2 allowed us to evaluate co-located and distributed work in a different way. To summarise the end of day survey results, participants reported the highest meeting of expectations and technology acceptance, the highest ability to communicate and the lowest levels of isolation, while physically co-located on the first day. The trend is then negative as participants become remote from each other, particularly with regard to isolation, but in most cases these scores then recover to some extent towards their original level over the course of the distributed part of the event, although reported levels of isolation remain higher than during the co-located part of the event.

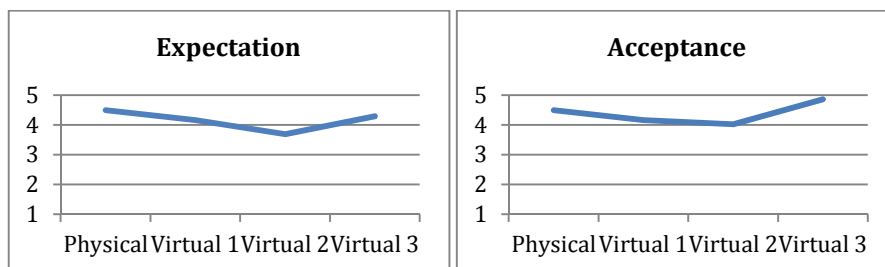


Fig. 4. Mean ratings for ‘To what extent did today’s meeting meet your expectation?’ and ‘Given today’s experience, to what extent would you like to participate in a meeting like this again?’ on a 5-point Likert scale (N Physical = 5, N Virtual 1 = 6, N Virtual 2 = 5, N Virtual 3 = 6).

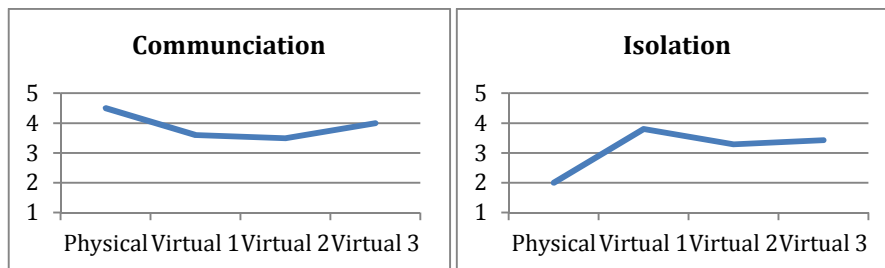


Fig. 5. Ratings for ‘To what extent did you communicate well with others during the meeting?’ and ‘To what extent was anyone (including yourself) ‘isolated’ compared to other people?’ (where low scores indicate low isolation) on a 5-point Likert scale (N Physical = 5, N Virtual 1 = 6, N Virtual 2 = 5, N Virtual 3 = 6).

Comments captured in the surveys discussed technical problems as contributing to the sense of isolation, but also a general difficulty with distributed creative collaboration, with one noting that ‘*Ideation is a social thing and being in a hotel affords much more of this...nevertheless its been fruitful for 2.5 days and we have an idea that is as exciting as any other*’ The post-event focus group backed this up, with statements that ‘... *the social aspect of the physical event is gone*’, and the idea of a ‘*virtual coffee corner*’ was raised.

This relates to a complex tension between providing opportunities for home-working, breaking up the intense use of the technology, and providing for informal social interaction. Having realised the tiring effect of proceedings, dedicated breaks were introduced, which were intended to be spent away from the desk and virtual environment. Conversely, academics lamented the lack of opportunity for socialising, suggesting dedicated activities and space to socialise in the environment for future events. At the same time, others appreciated the ability to work from home, stating ‘*It is great that we finish at 4:30 and I am at home...Being at home, it makes me comfortable, I can reflect better and think better*’. These tensions are explored further with reference to the final trial in section 6.

Facilitation of Distributed Events

From the facilitators’ perspective, it was noted that CG made some activities easier than a co-located sandpit, for example resources were quick to organise and rooms could be adapted in size to cope with proceedings.

Resources were easy to display and change, the technology was responsive to ad-hoc changes to plans, and the spatial layout could be adapted easily.

Comments also made clear that the technology facilitated effective monitoring of the participants, primarily to ensure good progress of the event, however mentors and facilitators are also evaluating the participants and groups. However, there is an interesting tension with how this may be viewed by participants: In a physical meeting room, presence is generally clear to everyone, but in the virtual environment, awareness was often limited. This led to some comments that *'The people watching, recording us are like ghosts, kind of breaks down the trust and privacy.'*, and that *'Facilitation irritates me (don't know who is listening)'*. Both participants and facilitators found the usefulness of the 3D space subsided after the initial phase of getting to know each other and the topic. It was less important when working on documents and communicating within sub-groups.

In terms of progress, the facilitation team observed how academic participants struggled with the switch from early collaboration to production, but conceded this was normal for any sandpit. The team also commented on whether people were getting along, evaluated the tone of discussions, the level of engagement by individuals, and the commitment that individuals showed to the process. Through this, the event team was clearly aware of the social tensions that arose, but expected this as part of the process.

Back channels were essential for facilitators to communicate on areas such as observing participant fatigue or individual technical issues. A separate virtual facilitation room appeared to be very useful, as well as the co-location of some of the facilitators / mentors in a physical shared space.

5.2 Phase 3 – A Full Creativity Greenhouse Event

Building on the process described above, the most extensive CG event followed the structure of phase 2, employing an initial co-located meeting, and a similar spatial layout. The total length was 5 days, and the funding available increased to £1.5 million (akin to a standard IDF sandpit). Unlike previous phases, participants were invited through an open call to UK academics. As in other sandpits, academics applied by submitting expressions of interests (EoI), where they were asked to focus on their potential approach to the topic ('Work-life Balance'), instead of track record. It was stipulated that they should be available to connect from a European location to avoid network issues. A panel decision by the director, mentors and event facilitators led to 18 academics being invited, of whom 16 took part and 15 gave us consent to use their data in the evaluation.

Event Structure.

On the first afternoon, the academics met in person with each other, the director, mentors, event facilitators, technology facilitators and researchers. Following lunch, the event facilitation team introduced the project and aims of the event. Speed-networking followed, then a detailed introduction of the technology, and a first discussion of the topic. Dinner followed at the participant's hotel with further talks and team building activities. Next morning, the co-located meeting continued with talks and discussions on the topic alongside group building exercises. A knowledge map was assembled as a shared means to capture the expertise of participants. Following lunch, participants travelled back to their respective homes.

Four days of distributed interaction then followed, using the technology infrastructure, officially running from 9am until 5 or 6pm. As in phase 2, a technology clinic was the first activity, where participants logged in remotely to test their set-up with the technology facilitators and to receive any further training required. The event then followed the typical CPS process with phases of ideation, critique, consolidation and presentation until the final pitches and funding decisions were made.

The larger number of participants increased the parallel with a standard sandpit, as they could not reasonably expect to form a single group, or for all groups to receive funding. As such, the event was characterised into two parts: collaboration and then competition. **Part 1** includes *Day 1 (co-located), Days 2 and 3*. During part 1, participants took part in activities to generate and describe themes and broad ideas, as well as getting to know each other better. They were collaborating at this stage and were not intended to form sub-groups that would produce actual proposals. **Part 2** includes *Day 4 and Day 5*. It is characterised by sub-group formation with some continuing changes of membership, and competition amongst the sub-groups to create proposals that would be funded.

A project control room co-located the evaluation team, technical facilitator, and event facilitators. The director and mentors connected from their respective work places. They concentrated on guiding academics through the topic but also contributed to the management of virtual resources when needed (e.g. sorting and moving ideas captured on 'sticky notes'). The director and the mentors collaborated very closely with event facilitators to guide the event and to make the funding decision.

Spatial structure.

Drawing on the feedback collected from the previous events, the virtual spatial layout was expanded, while retaining the prior features. In anticipation of larger participant numbers, the number of facilitation rooms was raised to 12, which were made available in stages. This was again achieved by a sliding partition, that here could be moved to reveal more or fewer facilitation rooms. An additional side room was available, hidden initially by a flexible partition and notice boards. A series of flexible partitions was staggered down that space to allow variable access and flexibility in the wall space available.

The presentation area was augmented with two rows of seats to help organise the group viewing a presentation in that area (see right). Clicking on seats would 'sit down' the avatar to represent viewing behaviour. To provide a virtual space away from facilitated activities, a landscaped 'outdoors' space including trees was added near the presentation zone (see left). The facilitation room was implemented as a separate forum this time, technically distinct from the main space, to make it more private and prevent access by participants, while those in other roles had full access to both the main forum and the facilitation forum. As this was a larger trial, we found it untenable to support concurrent video streams between all participants. During full-group events video was therefore curtailed to the person currently speaking. Multiple concurrent video was however available to sub-groups in breakout rooms.

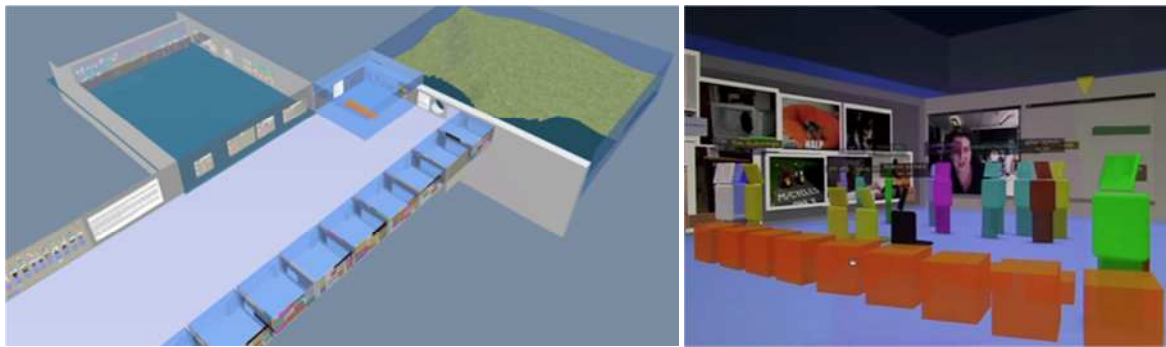


Fig. 6. Phase 2 Event 2 - Spatial Layout and 1st person view into presentation area

Following feedback from the previous trials concerning the lack of informal social activities, the lack of physical activity and the difficulty to socialise with participants across the technology platform, a physical resource box was distributed to each of the academics: the Creativity Bento Box. As well as providing a standardised web camera and headphones to all participants to reduce technical difficulties, this included artefacts to support a variety of shared activities (e.g. drinking tea, assembly of a puzzle, a task away from the desk). Broadly, this

resource was highly appreciated by the academics during the initial phases of the event, however reporting the full evaluation of it is beyond the scope of this paper.

6 Life in the Creativity Greenhouse

We will now reflect on interactions and experiences in phase 3. We draw on all available data sources as appropriate, synthesizing a view of this final event from end-of-day surveys, two focus groups, in-event observations, and the analysis of video recordings of the event.

6.1 Conducting Core Activities.

To begin with, we will briefly describe the ways in which participants interacted with the technology to conduct the core activities necessary to participate in CG.

Formal Presentations

Presentations occurred throughout the entire event: initially by the organisers, invited speakers, and then academics pitching their ideas. Later, individuals gave these on behalf of groups. The speakers video would be displayed at the front with their slides next to them as appropriate. The use of video in this way was considered a positive feature to structure interactions. One viewer commented that: *“it's really nice being able to see the people who we're all talking to and seeing the back of other people's heads”*. However others noted that they found presenting to the whole group disconcerting due to a lack of feedback, with one stating that: *“I would have really appreciated being able to see people at that point... I found it completely disorientating. Normally I feel fine presenting and ...it was really, really difficult. Like talking to yourself”*.

Whole-Group Ideation, Representation and Presentation

The use of virtual sticky notes to represent initial ideas and comments was a key practice in the virtual space, see **Fig. 7.** (left). Any participant was able to create such notes on any of the environment's surfaces, adding and later editing text as required. However, further work with these representations was difficult when compared to physical co-location. One participant stated that: *“I think it's a brilliant tool to use to brainstorm ideas...but categorising them was very difficult”*. Maintaining an overview of the large surfaces that were used for notes

was not possible while also reading the content of those notes, and sorting their content therefore required frequent avatar movements. In focus group 1, participants also noted that activities around sticky notes did not spark conversations in the way they would when co-located, and almost total silence occurred throughout a session of sticky note use. Further comments confirm a lack of nuanced awareness of others, highlighted by statements that: “... *everybody trying to do that activity at the same time was confusing*”, “*in real life you can speak to the people who are moving...rather than addressing everyone*”, “*you can’t see the action that they are about to make, you can’t see them going for the same thing as you*” and thus it felt like an “*impersonal push and shove*”. A lack of audio spatialisation, with everyone in the same audio region (e.g. a room) hearing everything in that region, contributed to this. This could cause an aversion to speaking up, and reduced the ability to focus discussion on those nearby. There is however, a sense of adaptation to the circumstances over time, for example that “*the second time we did it... we agreed topics to help us and that was a lot easier*”.

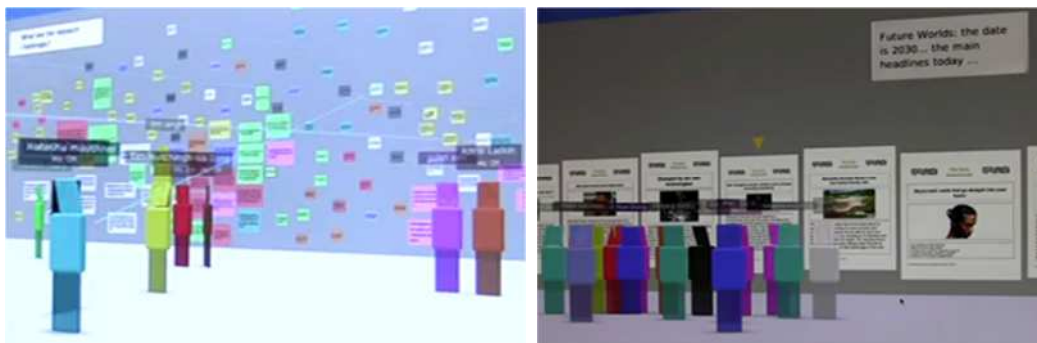


Fig. 7. Adding, viewing and clustering sticky notes of ideas and Presenting at posters after group discussions on Future Worlds

A benefit seen in supporting these kinds of activities virtually is the ability to create more wall space as required. In addition, the virtual world approach meant that at times, participants could stumble upon resources on the walls that they were previously unaware of while walking through the environment. The flexibility of the CVE also allowed for a crossover between this and the presentation form of interaction discussed in the previous section. In one particular case presentations were given by the posters of each of the groups - see fig. 7 (right). As with full presentations, the individuals were asked to switch their video on when they were presenting or asking questions. This demonstrates that diverse forms of group interaction can be achieved, which was important to parallel the types of interactions that would occur when co-located.

Sub-Group Formation and Working Together

The second half of the CG event is characterised by competitive, convergent work in sub-groups formed around particular proposal ideas. Individuals decided which group to join, and group membership is intended to remain flexible and evolve. The virtual environment generally supported group formation and flexibility of membership well, as participants were able to self-organise by moving their avatars into the breakout rooms that facilitators had associated with specific topics. However participants mentioned awareness difficulties related to the virtual environment, for example that *“I went to a room and I was the only person there, and that made me feel very (negative)...that wouldn't happen in a physical space because ... you'd see who you wanted to be with and you'd tag along”*.

The private chat feature could also play an important role by facilitating one-to-one interaction while remaining with the whole group, with one academic commenting in the later focus group that *“I really like the intimacy of the private chats... that you can be part of something bigger, but you can be exchanging little jokes or little comments...you feel connected...with that particular person”*.

Despite this, some participants felt that group formation still depended on the time spent together when co-located, with one stating that: *“it's quite impressive how within such a small amount of time together (during co-located Day 1), that you work out who you're going to get on with very quickly...there were allegiances between people that were formed very early on which could make it hard for other people to join in, but I think that it would be impossible...to come together in such a small amount of time only in a virtual environment and develop those kind of trusting relationships”*. During the post-event focus-group, participants voiced agreement that the physical meet up was essential to the success of the event.

Also despite best efforts, it was clear that there remained a lack of informal interaction at a distance to lubricate the development of groups and relationships. This is discussed by facilitators and mentors at the end of Day 3 as they evaluated the progress made, and compared this to sandpit events. It is noted that in the sandpit, participants would be talking at the bar, over dinner and during breakfast. Thus there is a lot less time overall where participants are interacting with one another, even if there are a similar number of days in the event.

Proposal Development

Groups made use of audio-separated breakout rooms for their proposal development to maintain privacy. They were provided with a Google Document readied for them in ‘their’ breakout room by the event facilitators. Groups then used provided tools alongside backchannels to collaborate on the proposal development. There were reports of the use of various other communications channels in the later stages of proposal development, for example Skype and telephone calls. One participant noted that at the stage of developing their proposal “*given the choice, I would have moved to Skype and used Skype and Google Docs. But...we were able to consult the Sticky Notes, that was what was in (OQ)*”.

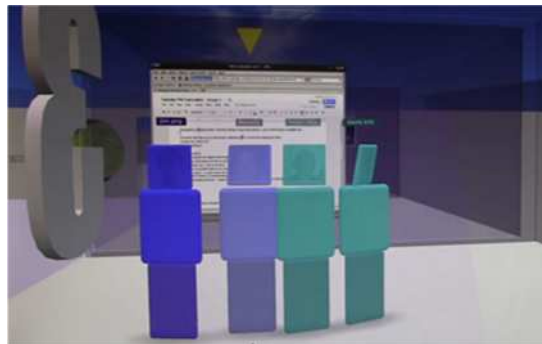


Fig. 8. Small group discussions in a breakout room

There was general agreement that the benefits of the virtual environment are clearer in the early stages of idea generation and group formation, and that there is a switch in requirements in proposal development work, e.g. a statement from the post-event focus group: “*I thought the video...worked quite well in the beginning, but when we were using the Google Docs and we were just using the audio...we didn't really need the video then*”. In particular, the type of collaboration enabled by shared authoring in Google Docs was valued with one academic stating for example: “*you could actually all work on the same document, whereas, you know, if you're physically all in the same room and you're all using different computers, it's quite difficult to collaborate*”.

6.2 The Evolution of Groups and Proposals

In this section, we describe the observed processes of forming groups and devising proposals as the event progressed.

Ideas as anchors

As already discussed, part 1 of the event was focused on getting to know others and working in a range of (assigned and self-assigned) small groups to develop and present ideas. One of the facilitators notes that at this stage participants are “... *all going to be looking for anchors ...*” to frame their proposal work later on. While pointing at posters describing ideas, another facilitator states that “*there may be a bit of that and a bit of that and a bit of that, that comes together ... next week*”. As shown in figure 9, groups changed membership throughout. Early activities used assigned groups, but later groupings for proposals evolved around individuals and themes.

Some proposal ideas and group ties were visible in early, co-located interactions. In particular, a ‘Future Worlds’ exercise on day 2, asking people to imagine a world impacted by the topic in 50 years time, outlines many of the themes present in one of the funded proposals, and three of the four final members of group G1 (see figure 10) worked together during that exercise.

More broadly, core themes devised in activities such as the ‘Research Challenges’ exercise of Day 3 were referred back to by mentors when evaluating proposals – e.g. that group G4 did not link strongly to these themes. As such, a group’s ability to position themselves amongst the ideas and topics raised, while producing something suited to their group membership, and distinct from others, is key to success.

The shift towards competitive groups

The morning of Day 4 marked a shift towards competition. Participants each gave a presentation, which facilitators intended to be a non-competitive expression of a theme or question the presenter would like to follow. Feedback from academics noted some confusion about the nature of these presentations, which some took to be a pitch to present their proposal idea. After the presentations, individuals were asked to put a ‘*wow factor card*’ next to individual’s ideas that impressed them. The facilitators were aware that this could be “*divisive*” and they allowed participants to favour multiple pitches that suggested a potential connection. In the post-event focus group, it was agreed that at this point participants felt they shifted sharply from collaboration into competition. For some who had not been to a sandpit before, this came as surprising and difficult. This was re-enforced by clear representation of the popularity of ideas/participants, as individuals received a diverse count of wow factor cards, with one having 10 and several getting 8, while another had 2 and one received none.

To the question ‘Was today’s meeting what you expected?’ in the post-day 4 survey, an academic with previous sandpit experience responded that: ‘*Having been through a sandpit before [my expectation] certainly*

was [met]. I was impressed how well the physical techniques translated to a virtual environment'. In contrast, a participant without prior experience responded that: '*I thought we would be able to discuss in a number of small groups our ideas in context of pitches and then choose who to work with. Instead everyone just brought out their pet topic and promoted it with what seemed like a pre-prepared script. As a result I was totally lost*'. This more critical view was repeated elsewhere and suggests that experience may well play a role on perception and even performance.

Following the individual pitches, participants were asked to move towards forming groups, but facilitators made it clear that group membership could be fluid or multiple. Fig. 9 shows how these evolved during the competitive stage, but retained some semblance of groupings in earlier stages. Firstly, 2 large groups emerged, containing around 8 people in each. Following lunch on Day 4, one of the large groups split to become two smaller groups of 4, while the other large group remained together for longer, but had split by the end of the day, with two groups of 3 emerging instead. There were now 4 groups in total. The final day then broadly saw the same groupings, with only one key change: the move of academic 12 from G4 to G3, and this occurred overnight. There were no major changes to groups during day 5. However #13 remains outside of any group at the end, having continued to change groups, or be external to any group, throughout proceedings.

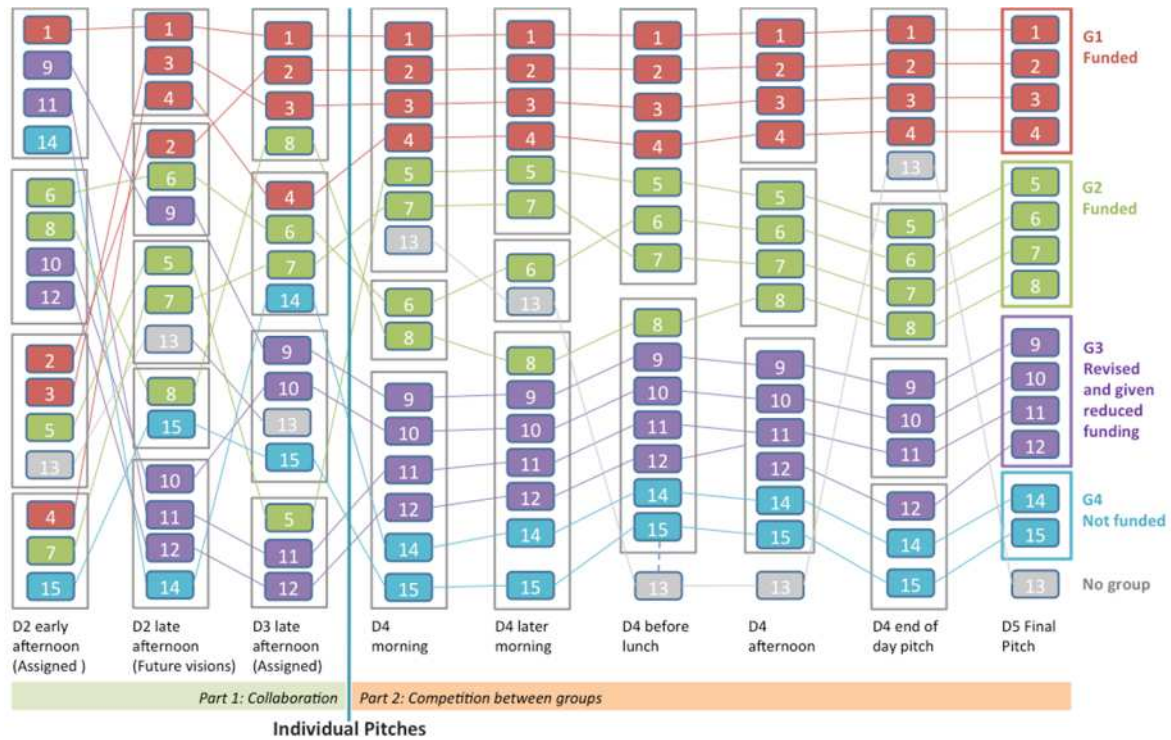


Fig. 9. The key stages in the development of groups: Day 2 (co-located) and Day 3 (distributed) occur during the collaborative part 1 of the Creativity Greenhouse. Days 4 and 5 (distributed) occur during the competitive phase of the project. Part 1 and Part 2 are separated by the individual pitches held on the morning on Day 4.

The above provides evidence that participants were able to move between groups, form new sub-groups and break away from others. It is a positive finding that the CG enabled this behaviour in the way it did, as flexibility of group membership is an essential part of the way that funding sandpits are conducted. However there was also concern about the lack of detailed knowledge of others, with statements such as: *‘I have no idea about the other guys I’m working with; we all seem amazingly lovely...but we don’t know each other ...’*.

It was clear that establishing the groups carries social difficulties. That activity would be difficult in a physically co-located setting too, but, conducting this over communication technologies caused additional problems: In the post event focus group, participants reported difficulties, which may have discouraged sustained group switching. e.g.: *“... we were finding it difficult to get into rooms and out of rooms and ... those technological limitations really impacted on our ability to do what we were encouraged to do, which was still*

move around". Several others agreed with this statement. Individual feedback provided in our surveys emphasises this further. When we asked people 'To what extent did you feel that anyone (including yourself) was isolated today?' in the end of day 4 survey, we can see that the process itself was highly challenging and that the computer mediation added to this. E.g.: '*... organising ourselves into groups was very, very difficult under time pressure in a virtual environment...I am sure that I excluded people without necessarily intending to and in a way that I would never do in a physical space*'. It is also interesting to note that some changes to group formation were conducted outside of the official channels for communication, and outside the 9am-6pm period during which events were recorded. As well as private chat in OQ, participants used text messages, phone calls, Email and Skype to conduct these sensitive moves.

Evaluating the outcomes

The mentors, director and event facilitators made the funding decision in the OQ facilitation room following the final pitches. This session lasted for approximately an hour and discussed all the projects in turn with regards to funding criteria, the underlying idea, progress made during the event, the relevance to the event topic, the group's reaction to feedback, the development of the group itself, and the combined skill set. As a result, two proposals were funded at the full amount requested (G1 and G2), one proposal was funded as a smaller feasibility study (G3), and one proposal remained unfunded (G4). In addition, a network grant was funded for the participants to continue their discussions and potential collaboration.

There were mixed opinions from participants on the strength of the outcomes, mostly related to the sandpit concept in general. On the positive side, an academic noted during the post-event focus group that the "*... pressure does, I think, stimulate creativity... so if you think about that greenhouse metaphor, I think it did make [the idea] grow very quickly*". However participants noted a lack of time for thoughtful reflection, and for grounding ideas in existing research as problems of this approach in the post-event focus group. The survey responses provide another window into the academics' views of this topic. When asked 'To what extent did this event push your ideas?' the mean ratings were around 3.5 and above (see **Fig. 10**. left), but opinions were quite divergent. One academic responded in the day 4 survey that: '*this has been one of the most stimulating intellectual activities that I have taken part of in recent years - not only did it push my ideas in new directions but it also made me realise that ideas...that seemed too 'way out' were actually possible to materialise in*

collaboration with other people I met through this event. In complete contrast another academic stated (also day 4 survey) that: *'The idea I am working with is pretty much exactly the same kind of idea I would have come up with before coming to the sandpit...In fact there's a possibility that it is less radical and less ground-breaking...The enforced group work with people you have only just met - the overt politics of positioning - the appeal to and concessions for group processes all suggest ideas being formed which are much less radical.'*

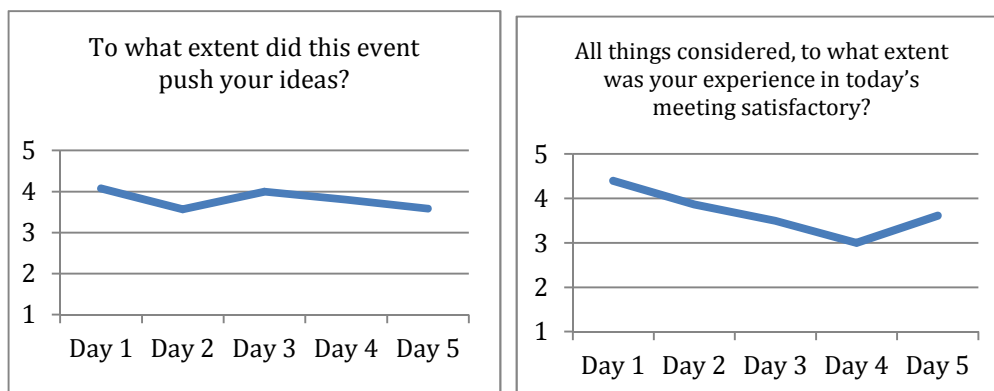


Fig. 10. Responses to 'To what extent did this event push your ideas?' and 'All things considered to what extent was your experience in today's meeting satisfactory?' on a five point Likert Scale in end-of day surveys (N Day 1 = 15, N Day 2 = 15, N Day 3 = 10, N Day 4 = 11, N Day 5 = 13).

We also tracked the extent to which academics were satisfied with the proceedings each day. As **Fig. 10.** right shows, the mean rating drops substantially for Day 4 – when the event turns competitive - to around 3 from a high of 4.4 out of 5. It then seems clear that having received funding positively influences some final day ratings: e.g. *'We were very happy of course that our project was given the green light so I might be biased. I feel the experience was worthwhile and valuable'*. But even with this, reflection on the process was still tempered, with one academic stating that *'our group got funded...but it's a pretty brutal way to go about it. I appreciate the idea of (a) working on something intensively that normally you wouldn't find time for, (b) shortening the odds of getting funding and (3) meeting new people to collaborate with BUT it seem an oddly unreflective, uninformed, reactive way to go about doing research.'* Overall, it can be seen that CG and sandpits clearly provide a viable alternative to standard grant applications, but are not a perfect model for research proposal development.

Reasons for success

The evaluation data provides some scope for considering how events related to success in proposal building. In particular, the later split of the second large group: (participants 9-16) could be perceived to have negative effects both emotionally and on outcomes: From this split one group emerged that received a reduced amount of funding, and the other had their proposal rejected. In addition, the split of this group appeared to be acrimonious, while participants 1-8 split in a more amicable manner into two groups that received full funding. Time for iteration of the proposal was key, with Group G4 left with less time to devise their pitches, and receive and respond to feedback. At the end of Day 4, the group are referred to in their presentation as a “*Phoenix rising from the ashes*”, “*hatched over the last half an hour or so*”. They then go on to lose a further member to another group in the final day. When they pitched, the mentors requested a stronger articulation of how the proposal fits within the theme, which - in their view - failed to materialise. In contrast, other presentations at this stage make clear how they are responding to prior feedback.

This highlighted other aspects in which group formation related to outcomes. It was deemed that G4 lacked a good composition of skills, with one key skill missing. This was communicated to them on Day 4, but the group did not change composition, and would not have had easy access to the missing skill given that other groups had formed already. Also, it was clear that reactions to mentor feedback were important, with G1 moving away from some initial ideas in reaction to feedback, while G3 was seen as comparatively inflexible. In this sense, it is clear that mentor and facilitator awareness throughout the process – rather than just at the point of final pitch – was a key factor, and one that differed to some extent in CG when compared to the co-located sandpit.

Despite concerted efforts, the technology was a barrier for some participants. Getting used to the virtual environment could be an initial distraction from progress, for example one academic stated that: “*I found myself being very side-tracked by what it could do... so I was sort of learning, thinking, contributing, doing this, doing that... I just found it quite overwhelming at times*”. Technical problems were unevenly distributed, and included losing mobility in the virtual world, failures of audio or video, and crashes and network problems that kept participants out of the environment. An argument could be made that this impacted on success, with two of the participants with notable technical problems ending the event without funding. However most participants experienced some difficulties, so it is difficult to draw a strong conclusion.

6.3 Facilitation and Mentoring.

The organisers judged the work of running CG to be broadly similar to co-located funding sandpits. For example, after an initial session on Day 2, an organiser commented: “... *once you are settled into a session... there is a strong parallel with the effectiveness (of) the real world version*”. There were also some benefits over running the event in a co-located fashion. E.g. in facilitator survey responses, the multiple paths of communication inside and outside the system were highly appreciated, allowing them to deal with problems behind the scenes and hold confidential discussions. The events of day 4 and the individual pitches brought a lot of discussion over private chat to one of the facilitators, who reported very positive feedback. Beyond direct communication, the team discussed how the technology provided good ways of interacting with material presented by participants, allowing them to comment easily and influence the direction of emerging themes by creating notes and organising contributions.

The positive view of the approach extended to the difficult individual pitch period, in contrast to the majority of academics. All members of the organisation team who provided feedback in the end of day survey agreed that the pitches went well or very well. In this context, they specifically acknowledge the period of uncertainty and the fact that this period of the event would always have been testing. They also acknowledged the frustration that group forming and breaking can give rise to, and that groups handle this in more or less effective ways. However, the organisers repeatedly pointed out that this was as difficult in a co-located event.

Depending on when in the process the bidding groups formed, it was clear that they had varying levels of input from mentors, and this was likely to negatively effect the proposal outcome. Discussion during and following the final day within the event, in the focus group and in survey responses made clear that there was not enough time for the organisers to discuss the developing proposals with academics. Discussing their aim to provide feedback on par with that given during a standard sandpit, one event organiser stated that they felt that this CG event had only equated to a 3-day co-located event in this regard. The engagement with mentors was also contrasted to a co-located sandpit event, where one participant noted: “*You get to speak to (the mentors) over dinner... and tea and coffee because they sit down next to you*”. As with the formation of relationships and groups, distributed communications reduced this valuable informal time together.

6.4 Well-being and Pastoral Care

Issues around pastoral care activities in this intense, yet distanced, virtual context are of particular concern. The organisers have a further role in caring for the wellbeing of participants, and throughout the event but particularly in the competitive latter stages, discussed this through a separate private forum. This was used for sensitive discussions, to maintain awareness and to discuss next steps. Concretely, discussions concerned how academics coped with the process, whether groups were working well, and what corrective actions might be appropriate. In one instance, an academic was known to have left a group at a late stage, so there was an expectation for a need for pastoral care. Text messages were used to communicate with them, ensuing it was kept separate from on-going activities in OQ, and the facilitators discussed this in their private forum. One noted that it was hard to assess the situation because *“without the body language, I’m not sure”*.

The pastoral care support offered amongst peers was also seen to be important and impeded by distance. Returning to the crucial switch from collaboration to competition on Day 4, one participant discussed how: *‘...yesterday, when effectively, competition comes in ... I felt very emotional. I’m sure other people did as well, and being in a virtual world meant that the human comfort that we could provide each other was far harder... just being able to see what’s going on for someone’*. Another quote illustrates how the lack of interaction away from facilitation impacted care among participants: *‘in the physical sandpit you’ve got those coffee breaks...lunches and ... evenings where you have chats to people about how you’re feeling ... you realise that the other people are feeling exactly the same way and that’s very different [from] going home and being on your own’*. In a more positive way, academics expressed that the technology had the result of allowing for greater personal space, with one participant noting that *“you don’t have to do face...you don’t have to impress your management”*. However, it is this potential to hide problems that makes it difficult to be aware or offer support where needed.

Academics also highlighted the physical strain that CG caused. Participation required lengthy periods sitting in a single position with one participant noting: *“I found it really tiring and really constraining, because although I’m always online and always replying to email, I’m moving about...I found it really quite difficult to be in front of a screen all day...and I’m sure it’s my own fault for having the wrong sort of chair, but I’ve actually got really awful neck ache”*. Another noted that their ears ached from wearing the headphones for long periods, and another that their knees were sore, noting that *“I never sit this long, you’re just not moving”*. Facilitation

already included some physical tasks to get people up and moving. Observations and feedback also made clear that the organisers had a difficult balance to strike, where encouragement to get up was welcome by some and dismissed by others as patronising. Some stated that they felt worried about taking toilet breaks or leaving their computers for even short periods, partly because there would not be the awareness amongst others that they had left, that there would be as they walked out of a physical meeting, or the ability to smooth over these short breaks by asking others what they had missed. There is however suggestion that this is partly due to the nature of the event as well as the technology, with one participant stating that: *“you feel this tremendous pressure to be here and catch every word, because it seems like every aspect of it is so important...”*.

6.5 Connections to Life beyond the Creativity Greenhouse

CG aimed to support an intense shared activity, but without removal from the usual home or work context. When studying this, it was clear that CG had a complex impact on participants' personal situation and their interactions with those around them.

Participants were told that the event would require their input from 9am-6pm each day. There was particular emphasis on this being a full-time occupation, with one facilitator stating on the first day: *“... please don't try to shoehorn your day job...make it clear to family and colleagues that it is not fun you are having”*. Facilitators also suggested that some work should continue outside structured hours in a less formal way, e.g. stating that: *“spending quarter of an hour before you go to bed... talking to your partner at home, reflecting on ideas, it doesn't necessarily come just from manic sessions”*. In practice, work outside the stated hours clearly occurred, with some participants noting that they worked through the evening of the penultimate day 4. But groups self-organised in this respect, and one noted that *“our team decided that we weren't going to work into the middle of the night, we sort of agreed a general working practice... setting the boundaries ...consensually, right, we're going to stop at six o'clock, six thirty, whenever we did stop last night’*.

In comparison to standard co-located funding sandpits, the lives of participants had greater potential to make itself visible. There were instances where participants felt compelled to attend other events during the days – e.g. one left early to take some pictures of their daughter's graduation ceremony in the lunch break, another stated to their group that they were very sorry but had to attend a short meeting.

In some cases the event had engaged those close to the participants, with one noting that their children “*wanted to dress me up as my avatar today, ... but I thought no, it's a serious process*”. In a generally incidental and light hearted way, audio often leaked into the virtual space from participant’s various home locations. In one exchange the facilitators and mentors jokily note that they can hear an aircraft coming into the virtual environment. At one point, a participant left the audio on while they made a phone call external to the event, which was broadcast unknowingly into the environment until the organisers found a way to isolate them.

In other cases, participants noted that even though they were physically close to others, their participation in the event created a psychological barrier. During the post-event focus group, one stated that “*you can go home and physically be with them, but I felt like I wasn't mentally with my family at all*” and another later noted that “*you can't really debrief with people at home or colleagues, because they just don't understand this intense thing you're going through*”. Later, it is suggested that having an official stop point, after which participants stayed online for “*a coffee*”, would have helped with this transition.

7 Discussion

Research funding sandpits combine collaboration and competition in an intense, high-stakes activity. This is challenging both to take part in and to support, whether co-located or distanced. While technologies exist to support collaborative work, and some competitive activities, at a distance, these combined characteristics present interesting challenges and additional tensions. In this section we define implications of our research with regards to how co-located and distributed sandpit events are similar and contrasting, how collaboration and competition were supported together through the technology, and issues relating to the wellbeing of those involved in such activities.

In response to a fundamental question underpinning this research - Is it possible to conduct a Sandpit to a suitable quality while distanced using computer technologies? The answer is yes, but with compromises and sensitivity to particular needs. Ultimately it was deemed essential that participants meet in a co-located manner at the beginning of the event, that facilitators adjust the structure and expectations, and that multiple technologies are used to cater for the different activities and stages of the process.

Participants appreciated the ability to work intensely in developing new collaborations and projects with less time away from home. However, technology offered a lower quality of social interaction, including lack of facial

expression or body language, difficulty in shared use of artefacts such as sticky notes, and lack of shared informal time together. There were concerns about privacy and trust, and isolation of individuals due to technology issues and due to the process. Overall though, the communication technology did support interaction to a suitable level, especially once participants had time to get used to the infrastructure and with the extensive technical and facilitation support. This is shown in the outcomes: Participants were able to conduct the activities required to complete a funding proposal, developing research ideas, forming and re-forming research teams, and producing proposals that were judged of a suitable quality to receive funding. CG led to four funded UK EPSRC research projects (EP/J021601/1 SERTES; EP/K025201/1 Digital Brain Switch; EP/K025392/1 Digital Epiphanies; and EP/K025678/1 Family Rituals) and one funded network (EP/K025619/1 Balance Network, Exploring Work-Life Balance in the Digital Economy), with a total value of £1.85 Million. Smaller projects funded through phase 1 have produced peer-reviewed publications and other valued outcomes.

The co-located IDF sandpit concept has been lauded generally as a valuable alternative means for the distribution of funding resources and more specifically for its innovative assessment of applicants (Prendergast, Brown et al. 2008), high levels of innovation within proposals, a transparent review process (Susan, Guerin et al. 2013), and new unexpected groups being formed around specific research (Collins, Kearney et al. 2013). As such, we begin our discussion of the implications of the development of the CG approach by defining the main similarities and differences that arose.

Table 5. Similarities between the IDF sandpit and the Creativity Greenhouse approaches

Stress and Intensity While the main CG event was seen to be intense and stressful, this is considered to be the same in co-located sandpits by those experienced in both.
Awkwardness of Social Interactions around Group Formation While participants could find the need to join, leave, or split groups socially awkward, this is also difficult in face-to-face situations. Participants successfully managed these activities in the CG, as seen in Fig.9.
Split between Collaboration and Competition Moving between collaborative and competitive situations is an important and difficult part of the sandpit experience, but it is not seen to be different between the CG and co-located sandpit situations.

<p>Not for Everyone</p> <p>While CG does widen opportunities through requiring less time spent away from home, the intensity, stress, and social interactions that are characteristic of sandpits are still present and are likely to be unsuited or unpopular with some people.</p>
<p>Existing Ideas have a Major Role</p> <p>While CG successfully brought together new teams of people, it is clear that some of the key ideas in the proposal outcomes were brought into the event by academics, and made visible early in the event. This is expected to be similar whether co-located or distanced, but may warrant further research given the desire for creative thinking during the event and the ability of processes to influence creative thinking.</p>
<p>Detachment from Home / Work Life</p> <p>While in a co-located sandpit there is a clear physical and mental detachment from the normal place of home and work, in CG the participants also reported a mental disconnect, or inability to switch back into their normal life when logging off for the day.</p>

Table 6. Differences between the IDF sandpit and the Creativity Greenhouse approaches

<p>Progress made over time</p> <p>Experienced facilitators and mentors felt that progress during the 5-day CG event might only be equivalent to only 3 days of a co-located sandpit event. Factors in this include: The lack of informal social times together, the overhead of technical mediation of certain activities, and the lack of social cues.</p>
<p>Physical Issues</p> <p>While intensity and stress are a similarity across both types of event, CG leads participants to spend extensive time at the computer, with participants feeling pressures not to leave. Various physical stresses are reported as a result of this.</p>
<p>Social Cues</p> <p>It is clear that for facilitators and participants, a lack of social cues at a distance can cause difficulties around awareness of the well-being of others.</p>
<p>Lack of Informal Time Together</p> <p>Logging off and leaving the computer was important (see physical issues above). However this is a</p>

difficult tension because it produces a lack of social time together, which is clearly valued for progress, wellbeing and outcomes.

Technical Barriers to Success

As technical problems can befall particular participants, there is a risk that the process becomes unfair due to their inability to engage to the same degree as others in what is an intensive activity.

Ability to be at Home / Work

CG offers an ability to be located at home or work and maintain care giving roles outside of the hours of work. In some cases these intertwined with the event (but see Detachment from Home / Work Life above)

Building on the above reflection, we conclude with a summary of the key recommendations from this research. These can support the broader research community in utilising distributed funding activity structures. They are also relevant to the design of other event structures, which involve distributed, high-stakes collaboration and competition.

7.1 The use of communication technologies to support collaboration *and* competition

One of the key themes emerging from CG has been the need to support diverse types of social interaction within the supporting system. While support for collaboration has been a theme of research for several decades, the importance of group formation and competitive sub-group production in CG distinguishes it from this. Given the wider rise of sandpits, and the advent of related computer-mediated activities such as open competitions, there appears wider potential for meaningful activities mediated by technology that combine collaboration and competition. Therefore we will discuss findings that emerge from CG in this regard.

The switch between the paces and aims of collaborative and competitive phases caused the largest amount of friction and difficulty for participants. A sense of isolation, and a lack of space for unstructured social interaction (as would occur over meals, breaks, or in the bar in a co-located event) could compound these problems. Individuals must make difficult social choices and acts, with limited awareness and means of communication.

The overall approach of combining a synchronous collaborative virtual environment (CVE) with an asynchronous groupware system was shown to be effective in supporting whole group collaboration, sub-group formation, and competitive working within those groups. Google Docs integrated within OQ provided the

communication functionality to support participant and facilitation activities. Flexibility in designing virtual spaces, and using and displaying resources made the systems adaptable to these shifts.

At the same time, there are clear changes in the way in which these tools were used, and the issues of importance to the participants, between these phases. Most obviously, in collaboration and group forming, the spatial approach was particularly valued. In competitive small group work, this was far less important and document-based interactions coupled with direct communication via audio, video and text were the main requirement. While having a group 'room' made sense, the continuing spatial metaphor caused privacy concerns around the lack of awareness of who was present or could see or hear proceedings.

The requirement to then return to interactions with the whole group (e.g. to give pitches) meant that a full separation of technologies was unlikely to work well, and would also add additional learning costs when participant's comfort with the tools is already a concern. Instead it is important to understand and accommodate these tensions between working together and competing within the same system.

A competitive situation also leads to concerns about the level playing field provided by the technology. It is important to note though that even without technical or usability issues, significant complexity would remain in this. The technical set-up of each of the participants (their hardware and connectivity), the combination of the technologies use and the levels of technical literacy of each of the participants are hard variables to work with. The project took steps in this regard by providing standardised web cameras and headsets, and in providing technology clinics and continued support. Such work is very important to fairness in distanced, competitive situations. Awareness of difficulties could also allow those judging work to factor this into their assessments.

Independent of the technologies provided, back channels took on an important role and are seen as critical by participants and facilitators. Sub-groups chose to use these tools, which may help them if they can apply their existing digital skills in this way, but it did disrupt awareness of events for the facilitation and research teams.

Recommendations for combining collaboration and competition

- Utilise synchronous and asynchronous technologies in support of the core collaborative and competitive activities, expecting shifts in the patterns and tensions around use over time.
- Allow people an influence on the pace of proceedings.

- Counteract technology learning curve and level the playing field with a training phase before the event and in-event training and continuous support.
- Offer multiple channels of communication that are suitable for the various types of communication and their underlying motivations (i.e. the differences between presenting to all, feeling secure in communicating in a sub-group and offering pastoral care).
- Acknowledge that technologies can advantage and disadvantage people. Consider in advance where standardisation is beneficial (e.g. providing web cameras) and where flexibility will be appreciated by participants (e.g. using email or phone calls in addition to the provided tools).
- Provide maximum visibility of others, resources and the process during collaborative and group forming sessions, and awareness of sub-group members, privacy, and shared documents within competitive sessions.

7.2 Key Supporting Structures

The structure for the CG event was refined to include an initial co-located meeting and time for a ‘technology clinic’ as well as the actual event days conducted at a distance. Event teams and academics agreed that the physical meeting was critical to relationship forming and getting started. It was clear that technology and distance slowed proceedings thereafter. This resulted in suggestions that less was achieved in the same amount of time as a standard sandpit. It is expected that an additional one or two days spent could bring the outcomes of a CG event to a par with a co-located sandpit, however the physical and mental wellbeing of participants would be a concern in extending the event length at the same intensity.

The spatial metaphor offered by OQ underpinned a number of key interactions in the system. Academics were able to self-organise around each other, the organisation team and the virtual resources. The way that resources were persistently displayed in the virtual space allowed for public display and discussion of material, which could be returned to for ‘group remembering’ (Sarmiento & Stahl, 2008). The spatial layout provided different zones for different activities. The general structure of funding sandpits tends to be largely the same, but it needs to be adaptable on a fine level to respond to differences in the groups and topics that emerge. This need for

flexibility was well supported by the technology infrastructure, making changes to resources and spatial layout possible on the fly.

Recommendations in Designing Supporting Structures:

- Organise a co-located meeting before proceedings continue in a distributed fashion, use this for initial social bonding and technology training.
- Precede the distributed event with a training phase involving participants' actual hardware and location.
- Choose technologies that allows participants to fluidly self-organise around others and resources.
- Set up the space so that it follows the devised process and can be adapted easily to the changing needs of different stages of the activity.
- Counteract the fact that proceedings are slowed by the technology by extending the event or lowering expectations of the completeness of outcomes.

7.3 Evolution of Ideas and Groups

Activities such as sandpits can be conceptualised as the introduction of a set of people with pre-existing research interests to each other, followed by an evolutionary process of selecting, combining, and developing these ideas over the event. It is notable that people were successfully able to move between groups, form new sub-groups and break away from others. These are activities that carry social difficulties whether in a co-located or virtual setting, and it is a positive finding for CG that groups evolved as they did. However, participants reported that technology can make this process more difficult. Group memberships changed until the very final day, but groups that emerged later had the greatest difficulty to develop fundable project ideas, partly because of ramification in terms of feedback from mentors. Having the right composition of skills in a group was considered very important, and participant's awareness of the skills within their current group, or those available across all the participants, may have been more limited in the virtual space.

Recommendations for Supporting Sub-Group Formation and Working:

- For any given event structure and chosen technology, maintain the essential capability for participants to create ideas and form groups around those ideas
- Fully communicate the difference between the phases for collaboration and competition before the event
- Specifically communicate the barriers that the technology presents to the group forming phase and how to deal with those difficulties
- Explicitly represent the skills and background of each participant throughout the event as an aid to forming balanced groups
- Consider means to continue the valuable work achieved by those who did not succeed in getting funding (e.g. a forming a network and continuing to meet)

7.4 Wellbeing and Pastoral Care

Whilst comparable co-located events are also intense experiences, the technology caused difficulties for others to be aware of wellbeing, as well as provoking participants to spend extensive periods at a computer which led to physical complaints. When they detected issues, the facilitation team were pro-active in engaging with people through private back channels. It is difficult to say how many participants having real issues were being missed though, and the divergent feedback from participants compared to that of facilitators about the switch between first and second phase of the event might be an indicator of this. Participants also reported that they found it hard to look after one another, where coffee breaks would typically allow for this to happen. However, this same lack of awareness also allowed participants to be alone when required, taking time to get away from the attention of the event, and this was valued by some.

Life at home spilled over into CG a number of ways, but presented only minor distractions. However, participants were clear that the intended benefit of being at home during the event is limited. One might be physically present, but participants felt mentally elsewhere. The switch from event time to home time was seen as particularly jarring, as there was no commute or wind down.

Recommendations for Wellbeing and Pastoral Care:

- Communicate barriers that the technology presents to effective pastoral care from the facilitation team and amongst participants in order to raise awareness.
- Structure participants' technology use through breaks away from their desk to avoid fatigue.
- Make time to introduce and discuss home life for everyone at the event, so that people's contexts can be understood better. This can be an effective way to bond with others while at a distance.
- Find ways to make group formation less socially awkward while maintaining the relevance to choosing the right ideas and people.
- Advertise a dedicated contact for pastoral care with that person actively and regularly making contact with all concerned. Fully advertise how participation in the event will affect life at home, allowing for physical but not necessarily mental presence and intense work conducted in the context of home life.
- Introduce dedicated but voluntary winding down phases or informal social time at the end of each day.

8 Conclusion

The Creativity Greenhouse project has taken an In the Wild approach to exploring the potential of technological support for the emerging sandpit approach to producing and selecting research proposals at a distance. Building on a tradition of research in technologies for collaboration, it is notable that this context combines collaboration and competition, and is also high-stakes in terms of the potential value of the outcomes to the individual participants. As such, our findings are a specific contribution to innovation in the use of technology to support research. They also function as a broader case study of the types of complex social interactions that are becoming more widely conducted at a distance with computer mediation. In this, we find that accommodating contrasting activities is possible within collaborative virtual environments and groupware, but that the patterns of behaviour, use of tools, and concerns of participants will change, moving from need to communicate and represent ideas, through socially awkward but critical group evolution, to sensitivities around measuring progress and dealing with privacy during competition. Facilitation and monitoring of the physical and mental wellbeing of participants in such intense situations is clearly a further issue to which we have provided examples and recommendations. As computers both provide scope for structuring distributed work in new ways,

and more work – including particularly research collaborations - is conducted at a distance, this work provides insights and inspiration for a range of relevant computer-supported activities.

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10 Data Accessibility

The analysis of the use of Creativity Bento Box draws on personal and sensitive data in the form of small-sample size surveys, focus groups and audio-visual recordings of interaction. Participants did not give consent for this data to be published in a publicly available data repository.

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