Fostering creativity through co-design and making: case studies of makerspaces in the UK

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Abstract: This paper discusses how individual creativity can be fostered through co-design activities and the act of making, especially those taking place in makerspaces. The research: i) explored the relationships between creative development and co-design activities; (ii) investigated types of co-design activities occurring in makerspaces; and (iii) identified good practices employed in makerspaces across the UK. The case study method and PACT Analysis was used to ensure the thoroughness of the investigations. The results showed that co-design and making could help foster individual creativity, as they encourage people to explore new knowledge, ask open-ended questions, plan things in advance, make decisions and defend decisions. Additionally, the research suggested that makerspaces play a key role in creating an inducive environment for people to share ideas, learn from each other and network.

Keywords: co-design; makerspaces; creativity; social values; public engagement.

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1 Introduction

Creativity has increasingly become an essential skill of the future workforce. The World Economic Forum (2016) identified the top three most sought after skills in 2020 as complex problem solving, critical thinking and creativity. Subsequently, an ability to attract, nurture and retain a creative workforce has become a key to sustainable economic development of a city/country (Florida, 2002; Mellander and Florida, 2012).

According to De Bono (2007), the renowned expert in the field of creative thinking, "*creativity is a skill that can be learned, developed and applied*". Richards (2010) pointed out that people can experience creativity in everyday activities ranging from making breakfast to solving complex problems at work. One effective way of learning and nurturing creativity is through active engagement with creative activities, e.g., co-design (Sanders and Stappers, 2008). While creative acts could take place anywhere, dedicated physical spaces, such as makerspaces, can help bring people together for learning from each other and sharing ideas (Kjällander et al., 2017). Smith (2015) observed that effective use of co-design and makerspaces could support grassroots activism and social innovation. As a result, makerspaces have exploded in popularity around the globe and there are nearly 1400 active spaces in 2016, which is 14 times as many as in 2006 (Lou and Peek, 2016), and considerable investment has gone into supporting the development of makerspaces – for example, Northern Ireland's Department for Culture, Arts and Leisure invested £350,000 into existing makerspaces in 2014 and the UK's Department of Business, Innovation and Skills (BIS) has announced plans to create a makerspace in disused military workshops (Sleigh et al., 2015). In addition, the Libraries Taskforce also committed to growing the number of makerspaces in public libraries in England (Libraries Taskforce, 2016). The global maker movement has led to the rise of research investigating the fields of makerspaces and their social impacts.

This paper discusses the principal findings of a research project entitled "*Fostering creative citizens in China through co-design and public makerspaces*", funded by the Arts and Humanities Research Council (AHRC) and Newton Fund, UK. It is a collaboration of academics from Brunel University London and Tongji University, Shanghai, and practitioners from The Glass-House Community Led Design, Engine Service Design and Tangerine. The aim is to develop a novel and inclusive means of fostering creative citizens in China in a bottom-up manner through the strategic use of co-design and public makerspaces. This paper concentrates on identifying good practices of makerspaces, which is one of the key targets in the first year of the study. Subsequently, it will explore how co-designing and making taking place in makerspaces could help foster citizen's creativity, especially those not trained in design (Saorin et al., 2017).

2 Literature review

The literature review covers three critical areas:

i   co-design process, to gain a better understanding of the process and its potential to foster creativity

ii   co-design activities potentially occurring in makerspaces and the potential benefits of makerspaces in promoting co-design activities and fostering creativity; and

iii   the ways in which individual creativity could be enhanced further through co-design and makerspaces.

The literature review results help identify suitable line(s) of enquiry for the primary research and guide the development of research questions.

2.1   The co-design process

Meyer and Norman (2020) observed that, increasingly, designers have to deal with complex problems, which require them to work with multidisciplinary teams. Hence, the authors recommended the co-design approach as a means to coordinate contributions from all parties. This is because the co-design approach excels at helping different disciplines exchange knowledge and create shared understanding, which enables them to achieve the larger common objective (Kleinsmann, 2006; Steen, 2013). Since the co-design process encourages various participants to share skills and experience, this could lead to novel solutions and improvements in many areas, including processes of idea generation, decision-making, customer satisfaction and loyalty over the long-term (Mattelmäki, 2008; Steen et al., 2011). This study follows a widely used definition of co-design proposed by Sanders and Stappers (2008): "*collective creativity as it is applied across the whole span of a design process*". It covers both the collective creativity of collaborating designers and that of designers and people not trained in design.

   A comprehensive review of design processes from various design disciplines (e.g., industrial design, architectural design and service design) conducted by Gericke and Blessing (2012) suggested that traditional design processes commonly begin with the research and analysis phase (such as establishing a need and analysis of task), followed by the ideation and development stage, e.g., conceptual design, embodiment design, detailed design, implementation, use and closeout (see Design Council, 2007; IDEO, 2011 for examples). Due to its participatory nature, the co-design process contains a slightly different structure and core components from traditional design processes. Bradwell and Marr (2008) pointed out that the co-design process required participation with a high degree of transparency and clarity of vision and direction. Thus, the exchange of information and expertise, and a sense of ownership are crucial to the process. To facilitate the development of the shared vision, Brandt et al. (2012) suggested that the co-design process involved three key activities: **Telling**, **Making** and **Enacting**. The authors emphasised that these activities are connected and repeated throughout the iterative process. Sharing stories (telling) is a key driver of active participation, while making (visualising ideas) and enacting (demonstrating how their ideas would work) enable participants to exchange information, thoughts and ideas effectively. Although sharing ideas is important, it was noted that conversations alone would not be sufficient, but creative acts are needed to help people discover their talents and help them unleash their creativity (Sanders, 2002). This is because the nature of creative tasks encourages people to ask questions that they are rarely asked, which helps them develop creativity.

2.2   Co-design activities occurring in makerspaces

Collaborating and sharing ideas is regarded as an integral part of makerspaces. The Department for Digital, Culture, Media and Sport, UK, (2017) described a makerspace as "*a physical location where people gather to co-create, share resources and knowledge, work on projects, network, and build*". It may be equipped with digital and/or traditional making tools. The collaborative and sharing nature of makerspaces enables a number of co-design activities to take place. Several studies conducted with makers (or users of makerspaces) confirmed that interactions with like-minded people were important drivers for joining makerspaces (Taylor et al., 2016). For instance, Sleigh et al. (2015) stated that the top three reasons people used makerspace were socialising (41%), learning (35%) and making (33%). Although the main purpose of visiting makerspaces for most users was still building objects, '*social aspects*' were identified as the second most important reason (Moilanen, 2012).

2.3   How creativity could be enhanced through co-design and makerspaces

According to Atkinson and Robson (2012), creative activities have a transformative potential and could impact on people's personal social and emotional wellbeing. By engaging people in a time, space and set of activities that are different from their everyday routine, they face different rules, values and relations which enable people to express themselves more freely. Sanders and Simon (2009) noted that the more active the participation is, the more profound the impact will be. They observed that creative experiences encourage people to start asking more open-ended questions that lead to new explorations. Engaging people in the co-design process not only helps to foster participants' creativity, but also leads to many social benefits, such as promoting self-help attitudes (Boyle and Harris, 2009).

   While active engagement in creative endeavours, e.g., making, has potential to help foster creative citizens and create social impact, many people lack confidence to participate in this kind of activity, mainly because they do not believe that they are creative (Richards, 2010). It was observed that people often undervalue everyday creativity (e.g., cooking a new dish), since it is not considered an artistic endeavour or a scientific discovery (ibid). Sanders (2012) pointed out that, in order to foster individual creativity, people must acknowledge their own creativity. This change of perception could be achieved by lowering the barrier for people to recognise themselves as creative individuals (ibid). The *Four Levels of Creativity* framework comprising of four key elements (doing – adapting – making – creating) was proposed by Sanders (2006) as a means of helping people appreciate creativity in everyday tasks, such as adapting artefacts to suit their needs, making things with their own hands (e.g., DIY), and creating something from scratch (e.g., a new recipe).

   It can be seen that active interactions among stakeholders are crucial to the co-design process. The act of sharing ideas and performing creative tasks during the co-design process could help foster individual creativity. The structure and setting of makerspaces have potential to support co-design activities, as encouraging collaboration and peer-learning. However, some experts identified a need to help people, especially those not trained in design/other creative disciplines, feel confident to engage with creative

activities. Sanders and Stappers (2008) observed that a lack of confidence to engage with creative activities might have been caused by a conventional practice, which only '*lead users*' (or pioneers in specific fields) were invited to be co-creators in the design process. This expert mindset made it difficult for many people to believe that they were creative. In fact, the more people engage with creative tasks, the more creative they can become. Evidently, creative disciplines, such as designers, develop creative skills in this manner, as they learn by working on design projects (Osmond and Tovey, 2015). Hence, the research began by exploring good practices employed by various makerspaces to empower people to engage with creative activities.

3   Research method

Many studies have examined makerspaces in terms of definitions, economic and social roles, and business models (see Lande and Jordan, 2014; Sleigh et al., 2015 for examples). However, there was hardly any research investigating how co-design and making activities occurring in makerspaces could help foster individual creativity. Hence, this project applied an exploratory research approach to identify

i   what types of co-design activities are occurring in makerspace

ii   how they could help foster individual creativity.

It began with examining various types of organisation that provide makerspaces to uncover good practices that could empower people to engage with creative activities. The case study approach was selected, as it enables researchers to explore the phenomenon thoroughly to develop an in-depth understanding of the chosen subjects within a short period of time (Bell, 1999; Yin, 2014). Moreover, this approach has proven to be effective in other similar studies exploring soft/intangible aspects of makerspaces, such as social interactions – see Wang et al. (2015) and Taylor et al. (2016) as examples.

PACT Analysis (People, Activities, Context and Technologies) was applied to provide an analysis structure for the case studies using a human centred approach. The analysis framework is commonly used in the fields of interaction design and usability studies (see Konstandinos et al., 2016 for an example). It excels in helping researchers

i   develop an understanding of the current situation of the chosen subject

ii   ensure that all key areas can be properly investigated and brought back together in a meaningful manner (Benyon, 2010).

All case studies involved a site-visit and semi-structured interviews with staff and users. The research covered both small and medium-sized community-based organisations and large-scale well-established ones (see Table 1). Although not all organisations involved in this research described themselves as '*makerspaces*', they all provide making facilities for people and support them in engaging with creative acts. All cases discussed in this paper are based in the UK. For a comparison of makerspaces in different contexts, this research will conduct further case studies in China in the next stage.

Table 1   List of case studies

Community-based Makerspaces	Well-established Makerspaces
• The Remakery, London	• Building BloQs, London
• The She Shed Association, Barnsley	• The Goodlife Centre, London
• The Camden Town Shed, London	• Blackhorse Workshop, London

The interview questions were designed based on the four categories of the PACT Analysis (see Table 2). As the case studies also aimed to gain a better understanding of the design of makerspaces, 10 design themes for exploring the design of community buildings (i.e., Access, Context and Identity) proposed by The Glass-House Community Led Design and partners through the *Empowering Design Practices* project (see Explore Design: Community Buildings: http://explore-design.empoweringdesign.net for more information) were reviewed and selected according to their relevance to the research to guide the development of the sub-categories of interview questions.

The key findings of the literature review, which identified the need to help people appreciate their creativity and gain the confidence to engage with creative activities, were also considered in designing the interview questions, investigating two types of '*empowerment*' occurring in this kind of space:

i   how makerspaces could **empower people to make**

ii   how makerspaces could **empower people through making**.

The former focuses on identifying good practices/strategies that makerspaces have employed to help people develop confidence to engage with creative activities, while the latter concentrates on how engagement in a creative process could impact beyond the outputs of making. This helps the researchers identify the potential social impact of co-design activities and makerspaces in the broader context.

The questions in the Technologies category were designed to explore relationships between physical and digital aspects rather than investigate types of machinery provided in the makerspaces. This is because the research team aimed to explore how makerspaces could empower people beyond the outcomes of making.

All interviews were recorded with permission and participants' consent was sought in advance. Photographs were taken with permission to support the notes taken during site visits. All interview records were transcribed and Thematic Analysis was used due to its appropriateness for qualitative research analysis (Grbich, 2013). The main activity of this method is coding. The procedure used in this research can be divided into four steps as follows. Firstly, the notes and transcripts from the interviews were examined several times to familiarise and further comprehend the responses. For example, highlighting was used for the information that a respondent frequently repeated and emphasised. The second step, coding, broke down the data into small incidents, gave each incident a name (code), and then reviewed each incident to ensure that similar incidents have the same name. Next, the incidents identified were grouped into categories. For instance, the incidents named '*defining user requirement clearly*' and '*defining design approach clearly*' were grouped together, as they all aimed to define the context. The name (theme) that represents the data in the group was chosen – see an example in Table 3.

Table 2   Questions for owners, staff and users of makerspaces

Subjects	Sub-categories	Interview Questions
People	Maker identity	• Please describe key characteristics of current users
	Access/entry barriers	• What might prevent potential users from engaging with this makerspace and how could these barriers be reduced?
	Relationship	• How would you describe the relationship between makerspace and users?
	Perception of social impacts	• What social impacts do you see/expect from engaging with makerspace?
Activities	Desirable value propositions	• What are the core values that may attract people to engage with this makerspace?
	Service design	• Please describe main services provided by this makerspace
	Functionality and Aesthetic value	• To what extend does the design of this makerspace enable and/or hinder the delivery of these services?
	Emotional value	• To what extent does the design of this makerspace enable people to socialise, share ideas or express themselves?
	Encouragement/ Communication	• Please describe how to encourage/communicate with people to get involved in the activities provided by makerspace
Context	Identity	• Please describe how you feel in the makerspace
	Empower to make	• Please describe activities designed to help people gain creative confidence to make things
	Empower through making (impacts)	• Please describe how this makerspace was designed to reflect the characteristics of the surrounding community
		• What role might this makerspace play in fostering creativity of people in local community?
	Partnership/collaboration	• Are there any opportunities for this makerspace to collaborate and/or work in partnership with other organisations? (e.g., pop-up events or co-working)
	Social enterprise	• Please describe the main purpose of engaging with the makerspace and your potential contribution to the community
Technologies	Physical and digital	• Do you have a digital platform? If so, how does it compliment the services you provide physically?
	Facilities	• Please suggest desirable technologies that the makerspace should consider providing

Table 3 Example of themes and codes extracted from the interviews

Theme	Codes	Key words identified from transcripts
Cognitive element of making	Cognitive element, mental side of making	"*We want to be able to not just cater for people with the physical elements of making it, but also the cognitive element, the mental side of things, and the ability to be able to rethink the way they live as consumers of material essentially…*
		"*Because we have actually come to the realization that not everybody is inclined to get their hands dirty. Some people are more cognitively aware that there is something that needs to be done about the environment or they are cognitively attracted to the idea of remaking*".

4 Principal findings from case studies

This section presents the results of six case studies:

i   profiles of all participating organisations– starting with small and medium-sized community-based organisations (Case Studies 1–3), followed by large-scale well-established ones (Case Studies 4-6) respectively,

ii   PACT analysis results

iii   discussion of good practices.

All key issues extracted from different categories are highlighted with bold letters and clustered into key themes.

4.1 Profiles of participating organisations

The Remakery (CS 1): This not-for-profit organisation was founded based on a sustainability ethos. It aims to provide an actionable option for people who want to tackle environmental issues and bring positive changes to their local communities. The main service for the paid members is providing space and a means for making things from waste and reclaimed materials. Another key role is to promote sustainable lifestyle through conversations and events to engage broader audiences beyond their current members. It also supports local social enterprises that share similar interests.

The She Shed Association (CS 2): This not-for-profit organisation was established to reduce loneliness and isolation for older women, by providing a safe space, where they could come together to share skills, tools and conversation. The founders had experience of running a men's shed before and identified the need for organising a shed specifically for women. The aim is to help re-establish and nurture social networks to reduce the risks that loneliness engenders. It offers a wide range of creative activities, including pottery, painting, jewellery making and woodworking. The organisation structure is organic – for example, new types of creative activities were often added as a response to users' suggestions. Membership is not required.

The Camden Town Shed (CS 3): This association claimed to be the first UK Shed, started by its users in 2011. The main aim of this not-for-profit organisation is to reduce social isolation in older people. It is equipped for woodworking, sculpting and hand-

building in clay. Although sustainability is not its main goal, it provides reclaimed materials.

Building BloQs (CS 4): This is a makerspace for professional makers. The main service for paid members is providing space and means for making, such as workbenches, machines, materials and storage spaces. The services could be grouped into three main sections: wood, metal and fashion and textiles. In the near future, the organisation aims to provide an engineering section and diversify its offer further. The organisation has been working with the local authority to support the community of makers in London. It will be part of the Meridian Water (a major £6bn re-development program led by Enfield Council), enabling the organisation to provide more services to local communities, including teaching, manufacturing and retailing.

The Goodlife Centre (CS 5): The organisation has been a self-funded company from day one. The centre's aim has always been to help people who want to make something. The company started with a woodworking training course at a community centre and later expanded into other areas, such as upholstery and sewing. It has successfully helped people build their creative confidence to make things, which has sometimes led to career change.

Blackhorse Workshop (CS 6): The mission of this makerspace is "*to become a socially pioneering world class centre for making*". It was founded by design practitioners, offering various packages for access to the wood and metal workshops with bench space and machinery (e.g., half-day, one day, one month, six months and one year). It also offers training courses in other areas, including leatherwork. Whilst this makerspace is designed primarily for professional makers, it also caters for hobbyists and families. It runs events where artists, designers, expert fabricators and craftsmen from various industries are invited to share their ideas with the general public.

4.2   Key findings under the people category

The research reveals that all organisations have a **clear target audience** and a good understanding of the **users' motivations**.

4.2.1   Target audience of community-based makerspaces

The small and medium-sized community-based organisations appear to focus on a **niche group**. For example, the Remakery focuses on environmentally conscious people with motivations of skill-sharing and peer-learning. For the She Shed Association, the main target group is older women who are vulnerable to loneliness and social isolation, coming to the shed to make new friends and explore their creativity. Users who took part in the interviews described the act of making as "*what we want to do, but never had a chance to do*". Similarly, the Camden Town Shed's main target is older people, but successfully attracts users from diverse backgrounds, e.g., actors, teachers, cameramen and engineers. The primary motivation for joining the shed is for "*fun*". There is a strong sense of belonging, as users reported that the space has "*good banter*" and a "*sense of comradery*". The founder also noted that "*everybody shows interest in what other people are doing*".

4.2.2 Target audience of well-established makerspaces

Large-scale well-established makerspaces seem to target a **wider audience**. For example, the co-founder of Building BloQs described their users as anyone "*who wants to make a living through making*". Their members can be broadly categorised into two groups: freelance professionals and small companies. The vast majority of their time is working on bespoke commissions. The organisation also makes the space and services available to the student community. Whilst most users already have a substantial amount of skill and knowledge in the making, some members chose to join this makerspace to upskill and develop knowledge further. The Goodlife Centre welcomes both adults and children. No prerequisite knowledge is required. Likewise, Blackhorse Workshop welcomes users of all ages and various making skills. For instance, it works with the local council to support youth groups and schools. It also organises events for families and children, e.g., Kids Holiday Club. The members come from diverse backgrounds, e.g., furniture makers, architects and set designers. Whilst many users are professional makers, many members are hobbyists who come to do DIY projects for their houses.

As these organisations have a clear idea of their target groups and their motivations, which informs their business model, they are able to provide suitable activities to suit their needs.

4.3 Key findings under the activities category

The research found that the all makerspaces' main purpose is not about producing artefacts, but **enabling people to achieve their goals**. The staff described their organisations/services as a **platform** for users to realise their aspirations. It is also observed that most co-design activities, e.g., sharing ideas and observing other users, occur in an ad hoc manner.

4.3.1 Co-design activities in community-based makerspaces

Small and medium-sized community-based organisations appear to focus on helping people achieve **personal and/or social goals**. Co-design activities often happen in the form of idea sharing and peer-learning – both in the personal and community projects.

The She Shed Association uses the act of making as a way to help their female users share skills, socialise, re-establish social networks and gain creative confidence. According to the founders, most users, including both young and senior, are not "*social animals*". In some cases, they are on the lower spectrum of autism, which may not have been identified, but has shaped their life. The act of making helps facilitate casual conversation among users, e.g., asking others to pass some materials or tools. The founders pointed out that "*socialising does not mean that you have to talk to someone. Making something next to someone feels nice*".

It was observed that most small and medium-sized community-based organisations help people achieve their goals through **peer-learning** and **co-design**. For instance, resident makers at the Remakery play a key role in helping members develop their skills and creative confidence through mentoring, giving advice, and demonstrating how to operate machines (see Figure 1). Users also get peer support from other members.

Figure 1   A resident maker mentoring a user (The Remakery) (see online version for colours)

The reason that most small and medium-sized community-based organisations focus on personal and/or social goals might be because their members are **not interested in commercial benefits**. For example, the Camden Town Shed founder explained that although some makers had been commissioned to make things for other people, they did it to help clients or found the commissioning jobs interesting – not to make money.

The user interviews confirmed that the act of making has made a positive impact at personal level. It has helped them develop **creativity** and **self-confidence**. This is because making requires users to make decisions and, in some cases, defend decisions. One user commented that rather than buying an off-the-shelf product, she felt that she could make it herself or modify a commercial one to suit her needs. "*That's what makes you creative*" she remarked. Most users are very proud of what they made (see Figure 2). One interviewee described her work as a "*wonderful achievement*". The **sense of achievement** has helped users express themselves freely. The making has also encouraged users to **explore new knowledge** – for example, one user at the Camden Town Shed studied principles of Islamic Art to create a precise drawing of geometric patterns that he wanted to make (see Figure 3).

Most organisations have explored various ways to engage with wider audiences. For instance, the Remakery acknowledges that "*not everyone wants to get their hands dirty*". Thus, it has tried other means of supporting non-members to bring positive changes to their local communities without getting involved in hands-on making activities, e.g., running talks or seminars. Some interviewees mentioned that the makerspace territory might expand from making to **thinking**, i.e., its future roles would go beyond physical elements and include **cognitive** aspects.

4.3.2   *Co-design activities in well-established makerspaces*

Large-scale well-established makerspaces support users on both **personal and work-related goals**, e.g., launching businesses and building careers. Similar to the previous organisations, co-design activities often occur in the form of idea sharing and peer-learning. Co-design activities also take place in collaborative projects.

Figure 2   Artefacts produced by makers (The She Shed Association) (see online version
for colours)

Figure 3   A maker working on Islamic Art patterns (The Camden Town Shed) (see online version
for colours)

The primary purpose of Building BloQs is to provide a "*platform on which people can
create and do business in the making and manufacturing industries*". The co-founder
observed that what attracts the members to join is access to affordable resources, but
what makes them stay is the **knowledge community**, i.e., users want access to other
makers, other businesses and other knowledge that they may not have. Thus, the
organisation has been promoting **peer learning** and **networking**, e.g., creating a café for
socialising, developing an online directory of members and displaying members' work
(see Figure 4) to get them talking to each other and seeing each other's work.

Figure 4   The café decorated with artwork produced by users (Building BloQs) (see online
version for colours)

Blackhorse Workshop also recognises the importance of peer learning and networking, leading to **collaborations** and **business opportunities**. For example, informal networking activities during making enable small business owners to recruit freelance makers for their projects.

Despite a different mission, the Goodlife Centre also aims to help makers achieve their personal and work-related goals. The centre offers a variety of courses for beginners. The founder is keen to help people, especially those in managerial positions who make important design decisions, e.g., product development and marketing campaigns, understand creativity to make better design decisions. One trainee at the centre reported that the act of making could foster creativity. He observed that he has changed his **way of thinking**, with his thinking process becoming **more structured** – as he has to plan things before he starts making.

Clear evidence of **empowerment** was found at the personal level, e.g., self-confidence and changes in ways of thinking. The **impact beyond outputs of making** was also recorded – for example, the Remakery is successful in getting wider audiences involved in making positive changes to their area.

4.4   *Key findings under the context category*

The study identifies contextual factors of

i   locations, e.g., local communities

ii   built environments, e.g., exteriors and interiors.

It was observed that the choices of target audience and main aims often reflect key issues affecting people in the area.

4.4.1 Contextual factors influencing community-based makerspaces

Most community-based organisations are not-for-profit and, hence, are driven by **social causes**. They see the act of making as a **positive response** to local issues.

For example, the Remakery was founded as part of a positive movement initiated by Lambeth Council in response to anti-social problems in the areas and was originally funded by the council. It perceives the act of making as a means of **engaging the public** in conversations about reclaiming and reusing waste. The act of making also offers people an opportunity to play a more active role in transforming their community and tackling environmental issues. The organisation has expanded its role to provide support for social enterprises. One of the resident makers has set up a social enterprise to help people with anxiety and other mental health problems through woodworking. The She Shed Association was set up for a different purpose, reflecting different issues in its area. The founders described the location as a very deprived area, since many industries that used to create jobs had moved out. There is a lack of funding and facilities to support local people. The space was described as a '*safe place*'. In one sense, it is a safe place to explore creative ideas freely. In another sense, it is a physically safe place to discuss personal issues, as some users were victims of domestic violence.

4.4.2 Contextual factors influencing well-established makerspaces

Large-scale well-established makerspaces are often driven by specific **needs** of a **community of interest** that they serve, e.g., professional makers, freelancers and small businesses. Since they provide services to paid customers, the location, quality of space, and facilities are carefully designed to suit their needs.

Blackhorse Workshop location is approximately half an hour from Central London, which puts it in a good position to support creative practitioners in London and surrounding areas. The open-plan nature of the workshop and the courtyard enable people to socialise and share ideas. Its café is open to members and the general public. This has been useful in making local people aware of the workshop facilities, even though they may not need them in the immediate future (see Figure 5). Similarly, Building BloQs provides a large open-plan shared space that all members can use. The open-access nature enables members to pass between spaces and see other makers' work across all three departments. The organisation also provides private working areas, as, in some cases, it is necessary for members to make things privately due to commercial sensitivity of the work or nondisclosure agreements with clients. Users can also store their tools and work in progress in their private areas. The co-founder observed that this aspect of their business is similar to that of a landlord. Members can rent private working areas so other types of business owners would rent their office spaces. It also offers additional storage space for rent outside of the workshop.

4.4.3 Effects of built environments

Staff from both types of makerspaces reported that design of the environments plays a crucial role in creating a warm and welcoming place, encouraging people, especially beginners, to participate in making activities and promote co-design activities. For example, in the case of the Remakery, the space's flexible and informal character enables people to adapt the place to suit their needs and helps facilitate casual conversations. Although most community-based makerspaces have limited space, some organisations,

such as the Camden Town Shed, try to provide dedicated space for each making activity. The Shed also has a kitchen/social space. To make the most of available space, most community-based makerspaces were designed to be multi-purpose.

Figure 5   The café for both members and local residents (Blackhorse Workshop) (see online version for colours)

All large-scale well-established makerspaces take the design of their built environments seriously. This might be because most founders were trained in design or other creative fields. For instance, the Goodlife Centre founder was trained in design and has worked for high-end brands. This helped her learn the importance of experience design and the quality of space. It was observed that the place has a good mixture of men and women compared to other places. The founder mentioned a study conducted a few years ago, aiming to identify why women did not engage with makerspaces. One key factor that affected their decisions was the toilet. Since men generally run makerspaces, they sometimes overlook small details, e.g., cleanliness of the toilet. The attention to detail is one of the critical success factors of the centre (see Figure 6). The welcoming atmosphere is crucial to the centre. The place is described as "*a pub with no beer*" – in other words, people come to enjoy themselves in the company of others.

It can be seen that the **interests of the communities** shaped the purposes and the services of these makerspaces. Contextual factors, e.g., problematic issues, in the neighbourhoods could affect the target audience's choices and their services. Regardless of the types of makerspaces and their target audience, the design of built environments has helped them achieve their goals, such as attracting more members, facilitating casual conversations and promoting collaborations among makers.

4.5   *Key findings under the technologies category*

The question under this category aimed to explore what digital services are currently offered and how they might complement the physical aspects of the makerspaces and

expand the impact beyond the outcomes of making. It was observed that most small and medium-sized community-based organisations have not fully utilised the online channels and virtual communities. Most organisations have websites, but did not fully utilise them. However, they have a plan to redesign their websites and better use the platforms for outreach purposes in the future. Some organisations, e.g., the She Shed Association, use social media to promote their work and attract new users. Some organisations, e.g., the Camden Town Shed, are not active on social media since they are unlikely to attract target audiences through this channel.

Figure 6 Airy atmosphere in the workshop (The Goodlife Centre) (see online version for colours)

The large-scale well-established organisations generally make good use of digital channels. For example, the Goodlife Centre has its website and utilises several social media platforms, e.g., Facebook, Instagram, Twitter and Pinterest, to showcase the work and attract more users. Moreover, the information is regularly updated. Blackhorse Workshop also has a website and uses social media platforms, e.g., Twitter, Instagram and Facebook, to promote their activities and attract more people to join and/or attend their courses/events. Some organisations that serve professional makers also develop an online directory of makers to help members network and attract more users.

It can be concluded that most activities and support for makers are currently provided through physical space. Virtual community and online support may be developed further.

5   Themes emerging from case studies

Many key issues and good practice were extracted from the case studies. They were developed into codes and clustered together to form themes and key themes. Key themes can be summarised, as shown in Table 4.

Table 4   Key themes and examples of sub themes

Key themes	Codes/themes extracted from case studies
Makerspaces as platforms	Launch careers, achieve goals/aspirations
Foster creativity through co-design	Idea sharing, peer learning, mentoring
Empower people to make	Build confidence, advance skills
Empower people through making	Help people think, improve oneself
Socialisation through making	(Re)establishing social connections, networking
Importance of makerspace design	Welcoming space, friendly atmosphere
Social value creation through making	Sense of achievement, belonging and comradery

The core theme that links all findings together is using the act of making as a **platform** to enable people to achieve their goals. Although these makerspaces target different groups and are guided by different philosophies, most of them describe their main purpose as helping people realise their aspirations, which could be personal, social and/or work-related. The role of makerspaces has been expanded to enhance not only peer learning, but also public life, such as supporting wellbeing by fulfilling the needs of the communities and reaching out to excluded groups, e.g., older people vulnerable to loneliness and isolation. The results suggest that makerspaces can contribute to both economic growth (e.g., providing support to social enterprises and small businesses) and social improvement. These findings are similar to the work of Galaleldin et al. (2016).

The second key theme is the notion of how individual creativity could be fostered through **co-design**. The interviews with both staff and users confirmed that co-design activities in the makerspaces, e.g., sharing ideas, can further develop their creativity. This might be because the act of making requires people to think things through before starting. It also encourages people to bring creative and critical thinking to explore new knowledge, make creative decisions, and, in some cases, defend their decisions. These experiences have helped people gain confidence and/or develop their creativity further (Paganelli et al., 2016). While most co-design activities, e.g., observing other users, occur in an ad hoc manner, all the makerspaces recognise the importance of peer learning and collaboration. Therefore, they employ various strategies to promote co-design activities, including displaying works from different members on the walls to facilitate conversations and networking, and taking advantage of open-plan space to encourage people to see each other's work. Many interviewees from community-based makerspaces reported that they would like to encourage users to work together in a large community project rather than concentrate on only their projects so that they could learn more from each other. Moreover, working on a shared project could give users more reasons to remain engaged with the making community rather than leaving after completing their projects.

There is evidence of **empowerment** generated through this type of space. Most users who took part in the interviews reported a certain degree of empowerment through the engagement with making and makerspaces (**empower people to make**). For example, they could make something that they always wanted to or advance their skills and/or expand their networks further. Several users also observed an increase in self-confidence and changes in ways of thinking. Most works carried out in makerspaces can be classified as personal projects. Non-professional makers generally make things for themselves or close friends/families. Since makers in community-based makerspaces are not motivated

by commercial benefits, their decisions are often driven by their desire to help others rather than make money (**empower people through making**). In most cases, the main purposes of makerspaces are not about producing artefacts, but '*making people*' – in other words, helping people with personal development. They want to influence not only those who have engaged with the makerspaces but also the wider audience. These findings are similar to the work of Smith and Iversen (2018) who suggested that co-design can deliver long-lasting impact for the community by shifting the focus from tangible outcomes (e.g., artefacts) to sustainable social changes (e.g., active community engagement). For example, the GoodLife Centre wants to help decision-makers in managerial positions make better decisions, as it may affect large groups of people. Thus, some interviewees noted that the role of makerspaces might shift from providing means of making to helping people think. The types of empowerment vary from one makerspace to another depending on the targets, motivations and contextual issues affecting people in that community, which could be a community of interest or a geographic one.

Socialisation has been identified as a crucial aspect of making and makerspaces. The findings echo the results of previous studies. For example, the survey conducted by Kuznetsov and Paulos (2010) with 2608 makers aged 18–95 with diverse interests revealed that the main motivation for making communities was to get inspiration and new ideas for future projects. Whilst some makerspaces use socialisation to support co-design, others use making to facilitate conversations. Organisations, e.g., the Camden Town Shed and the She Shed Association, use making to help people re-establish social connections among vulnerable groups, e.g., people who suffered from retirement anxiety or being victims of domestic violence. These individuals are often described as shy and not sociable. Thus, it is hard for them to initiate and nurture social networks. For them, making is about sharing and talking to like-minded people, which makes them feel safe and at ease. The notion of "*a problem shared is a problem halved*" was observed by one of the co-founders of community-based makerspaces.

The **design of makerspace** plays a vital role in facilitating socialisation by creating welcoming spaces for people, especially those not trained in design, to engage with co-design activities and making. Flexible, adaptable spaces promote conversations, which is crucial to co-design. Good connections and flow between different spaces (e.g., studios, working areas and socialising areas) facilitate peer learning and networking. Behavioural design has been subtly deployed in many makerspaces to encourage users to tidy up after using shared tools/machines, to instil **respect** among makers and build a friendly atmosphere within the makerspaces. The approach has helped attract new users, promote casual conversations and encourage people to freely experiment with unconventional ideas. Some interviewees compared the atmosphere of makerspaces to that of a pub, which plays an essential role as a public space in the UK.

The last theme is **social value**. It was observed that this kind of work has created social value at the individual level to some extent, e.g., creating a sense of achievement and belonging. In this sense, making and makerspace can benefit people's mental health and wellbeing. At the organisational level, most makerspaces have created social value based on creative activities and making, e.g., providing platforms for practitioners to launch their businesses and introducing creativity and making to the wider audience, such as families, youth groups and schools. In this perspective, making and makerspace have made creative acts accessible and approachable to the general public.

With key themes extracted from the case studies, it can be concluded that co-design activities occurring in makerspaces can help foster creativity and generate social value

and impact through various forms of empowerment. They could contribute economically and socially.

6   Conclusion

This paper has explored how co-designing and making taking place in makerspaces can foster individual creativity and make societal impacts. The study particularly focused on investigating '*empowerment*' occurring in makerspaces through the good practices that makerspaces employed:

i   how makerspaces could empower people to make

ii   how makerspaces could empower a wide audience through making.

The research revealed that current strategies employed by makerspaces, e.g., using open-plan to promote peer-learning, can directly empower makers. Co-design activities help promote the empowerment, such as getting resident makers to work with users with less making experience to help them gain confidence and skills. The study identified practical strategies for empowering a broader audience, e.g., providing co-working space for local businesses, organising public talks, and using social spaces, e.g., café, to attract people from surrounding communities. These activities have made makerspaces, and creative activities feel more accessible and approachable to the public.

In the next stages, all key findings will be compared with those from case studies in China to identify similarities and differences between two nations in terms of engaging people, key approaches/activities, use of technologies and cultural and social aspects of making. Finally, key issues will be extracted to develop suitable strategies for public community makerspaces in China.

Acknowledgement

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