

REMANTLE AND MAKE: A CROSS GEOGRAPHICAL STUDY EXPLORING THE ROLE OF MAKERSPACES AND THE CIRCULAR ECONOMY IN SCOTTISH TEXTILES

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This paper draws on primary empirical research carried out in two maker spaces based in geographically different sites, one urban based in the central belt of Scotland and one rural based in the Scottish Highlands. It reflects on the ReMantle and Make project, an EPSRC feasibility study exploring the role of maker spaces for the circular economy in the Scottish textiles industry. This research presents an analysis of the project, drawing on methods of visual mapping and Situational Analysis to critically examine the relational and democratic factors for maker spaces in knowledge production.

Keywords: circular economy, makerspaces, textiles, situational analysis

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INTRODUCTION

Realising a circular economy requires consultation and collaboration with a broad spectrum of stakeholders if we aim to develop robust, sustainable solutions to issues of global waste. In the context of the textiles sector particularly this includes manufacturers, designers, higher-education institutions, small to medium enterprises, policy makers, and citizens, all of which are necessary to explore sustainable, circular material futures. The complexities of the material waste issue itself, and the many actors needed to develop responses to it, results in tensions and conflicts when faced with developing practical solutions. Rather than repress ideological collisions and tensions faced in taking theory into practice from multiple perspectives, the research discussed in this paper aims to bring them out in a democratic forum based on practical and theoretical knowledge.

The research presented here explores design innovation approaches, in collaboration with academics, designers, manufacturers and policy

makers, to tackling the issue of material waste. In two cross discipline 'Re-Make-a-Thon' workshops, it explored different notions of value in material waste and strategies for implementing a circular economy approach from multiple perspectives. The workshops applied theory in practice using waste textile material from local manufacturers and the tools and resources in a maker space to uncover practical issues to implementing circular practices through hands on experiments, live design briefs and multi stakeholder debate. A Showcase exhibition and Roundtable discussion of the project at its end widened participation further to include citizens and opened up the research to deeper discussions around the social and policy implications of circular practices, and more focused, systemic issues in implementing closed loop practice. The project was part of a bigger research project entitled 'Future Makerspaces in Redistributed Manufacturing', a two-year research project based at the Royal College of Art and funded by the Engineering and Physical Sciences Research Council (EPSRC), which explores the role of maker spaces in redistributed manufacturing (RdM). Our study aimed to investigate how we can use maker spaces to cultivate cross-institutional circular thinking and provide resources to develop circular design knowledge and practice. This paper focuses on the

Roundtable discussion at the culmination of the project and aims to uncover the roles of individual actors in the study, their agency, and the role a maker space played in defining and mediating roles.

This paper begins with a summary overview to the circular economy, the maker space movement, and democracy in design. We go on to discuss the methodological approach taken to construct our research, describing the key methods and mode of analysis. Following this, we present the project's participants, activities and outcomes as a narrative case study. The context of each of the key participants involved in the project and that contributed to the workshops are introduced, which allows us to explore how the agency of actors and, in some respects, power relations was recalibrated in the context of the project. This is done through examination of participant responses and our own observations, analysing the roles and discourse throughout the final stage of our project, namely the Roundtable discussion.

Our analysis of the project is argued to demonstrate how future maker spaces could be sites for collaborative material experimentation and democratic spaces for peer produced knowledge. Spaces where institutional norms and agendas collide, strategies for addressing complex issues from a multiplicity of perspectives develop, while simultaneously providing educational hubs for experimentation and learning. In summary of the paper we ask: what role did the maker space play in the development of approaches to implementing the circular economy? To what extent did it contribute to a more democratic exchange between the tensions and conflicts of different institutional perspectives?

IMPLEMENTING THE CIRCULAR ECONOMY

Positioning the issue of waste

Across the globe, societies, in the main, live in a 'throwaway and replace' culture. In Scotland alone,

statistics from 2015 show that 46.6% of household waste, equivalent to 1.5million tonnes, went to landfill (SEPA, 2016) with almost half of the non-land filled waste being incinerated. Internationally the issue is even greater with some 10,000 tonnes of solid waste deposited on landfill sites in places such as Laogang in Shanghai, China, and Mexico City's Bordo Poniente (Hornweg et al, 2013). In 2010 global levels of solid waste hovered around 3.5 million tonnes per day and this is predicted to rise to 6 million tonnes per day by 2025 (The World Bank, 2013). Our growing population and demand for new products has placed huge pressures on our planet's resources. The problems associated with the current global trends means we urgently need innovative new ways of thinking about how we make and consume products, and the circular economy has been claimed as one such way.

The Circular Economy

The circular economy is a framework and an alternative way of thinking that can help address complex issues around material waste and linear models of resource use. The term is antonymous to the linear economy, defined as 'converting natural resources into waste, via production' (Murray et al, 2015). A linear system affects natural environment by reducing natural capital through extraction, use and disposal, and degrades remaining natural capital through pollutants. In opposition to this, a circular economy aims to reduce the amount of new natural capital extracted and reduce the impact on remaining natural capital by keeping materials in productive use for longer, thus reducing 'waste' and the need to pollute through industrial processes (The Ellen MacArthur Foundation, 2013). The three Rs of Reduce, Reuse and Recycle have become central to the concept.

In a circular economy the waste from factories would become a valuable input into other processes. Rather than be discarded when they break or fail or become perceptibly obsolete, products could be repaired, reused or upgraded (Preston, 2012). The circular economy is beyond design and waste

management, as it fosters new business models that take account of provenance, longevity, impacts and end of life (RSA, 2013); therefore, partnerships and collaboration in the circular economy will be crucial. In the move towards a more 'circular' future, knowledge exchange will be essential to support joined-up thinking, to connect all stakeholders involved in the lifecycle of material journeys and new supply chain models. Transparent democratic exchanges between all stakeholders will be required if we are to tackle the issue constructively.

Scottish Textiles

Within the UK textile sector, there is increasing awareness of the requirement for new textile initiatives to be linked with the concept of the circular economy (Earley and Goldsworthy, 2015), but there is a lack of innovation tools, practical knowledge and accessible evidence available to provide support. Within Scotland specifically, Scotland's Zero Waste Plan and Circular Economy Strategy set the trajectory for the future of the Scottish economy and environment with a focus on resource efficiency and new innovation. The vision focusses on lower rates of consumption in the economy, less waste, and more value added to resources. In addition, the Scottish Textile Strategy highlights innovation, sustainability and efficient use of resource as key to its ten-year plan. However, the Scottish textile industry, while supportive of the circular economy lacks visible action. Research has found that 'there are few reports related to circular economy innovation in textiles in Scotland and evidence of closed-loop manufacturing' (Wilson, 2015: pg. 1).

Recently, research commissioned by Zero Waste Scotland, Scottish research and policy organisation, investigated innovation in the academic and industrial landscape for Scottish textiles. The research shaped the zero-waste work plan for 2014 to 2016, a plan that foregrounds three key objectives: sustainable fibre processing; showcase and pilot CE models and resource efficient good practice; and seek greater engagement of industry

with academia.

With the Scottish textile sector estimated to be worth £956 million to the Scottish economy, and with an ambition to grow by 50% by 2020, there is a significant drive to invest in the circular economy in Scotland as a growing industry, and a substantial opportunity for intervention to help support the transition.

MAKER SPACES

Definition of a Maker Space

Maker spaces are open access workshops that transfer knowledge and technology to citizens. They play a part in establishing social and ethical actions, they can be places where ideas can find a place to experiment and explore alternative ways of doing things. Maker spaces, far from being places of just developing innovative products, are places where design and material engagement play a role in ethical and social interventions, and where alternative thinking propagates (Shea, 2016). The spaces allow academics and citizens (including entrepreneurs) to network, exchange ideas, and learn. Maker spaces are typically independent, community-based efforts. They are responsive to local issues and can exist to provide support for innovation and enquiry where there is no current local provision. Within these physical hubs, technology, skills, ideology and education can come together to explore and experiment with new ideas and possible futures. Maker spaces are 'socially shaped' entities, reflecting their time and place in both technological and human terms (Kohtala & Bosqué, 2014). For our study we were interested in the role these spaces of experimentation, education and democratic production could play in furthering a circular economy.

Politics of Maker Spaces: Activities and Ideologies

Maker spaces often build strong associations with different communities and organisations. These

associations 'flavour' the spaces, which can guide and influence the type of activities and ideas that occur and propagate. A brief review of some of the types of maker spaces currently in operation gives a feeling of how these spaces differentiate from one another, their associations, and the politics at play across the global network of open access spaces. Some maker spaces have developed to respond to specific interests, movements and theories or to fill a gap or niche. Feminist maker spaces, for example, are for some seen as a counter culture to the traditional form of maker space ideology of openness, to one of boundary and safety (Toupin, 2014).

A common view of maker spaces is one of inclusivity, democracy, openness, and sharing, yet a brief exploration shows them to be highly diverse political entities. Social barriers can disrupt open sharing and normative behaviours, which have prevented some groups from engaging with social groups outside their own. Sharing is an almost universal virtue of maker spaces, considered part of the complete ideology of maker spaces and related to open availability of technology, information and the distribution of agency. Research has shown however that knowledge forms in small groups and is normatively shared locally in maker spaces, yet 'lateral' knowledge sharing has been exceptional (Wolf et al, 2014). People who engage with maker spaces are less likely to openly share what they are doing with those outside of their local group. This social barrier to sharing is a characteristic of maker spaces that conflicts with the open sharing ideology that is supposed to fundamentally underpin all their activities. In some cases they have become places for like-mindedness to propagate where similar views circulate and strengthen a particular position. In this social act the people of maker spaces can shy away from conflicting views, instead becoming niche and narrow.

For our study it was important to recognize the politics at play within the spaces we ultimately created as part of the project; the time and place of the project, and the way this influenced the

outcomes. By purposefully inviting different perspectives and conflicting views into our project, and by siting it in a maker space, we hoped to allow relative 'strangers' to share and exchange their views and democratically create new knowledge.

DEMOCRATIZATION THROUGH DESIGN

When considering the complex implications of establishing a circular economy, this raises the challenge of assembling multiple actors, and aligning their interests, to collaborate and cooperate in very particular ways for very particular values. This requires a broad cultural shift towards circular thinking that is difficult to expect through enterprise and innovation alone. Therefore, we argue that any consensus on values of eliminating unnecessary waste is not done just through collaboration, but a democratic process.

There has been growing recognition of design innovation having the capacity to deliver constructive and creative democratic processes. Von Hippel (2005) recognises the 'democratization of innovation' to mean 'that users of products and services [...] are increasingly able to innovate for themselves.' Such principles have long been recognised through Participatory Design, which 'started from the simple standpoint that those affected by a design should have a say in the design process.' Such a process was strategically guided by 'the consideration of conditions that enable proper and legitimate user participation' as well as 'making the participants tacit knowledge come into play in the design process' (Simonsen and Hertzum, 2012:103). In this way, the process of constructing the problem with participants is as important as the production of an artefact (Bredies, Chow and Joost, 2010:164). Such 'democratization' of the design process has only recently been folded into the wider discourse of co-design as its principles sat in contrast to the 'existing power structures' of most organisations (Sanders and Stappers, 2008).

It is the implications of existing power structures that this paper, through analysis of our project,

sought to investigate through a Foucauldian relation of power to discourse. Foucault (1980) presents power as ‘the total structure of actions’ bearing on the actions of individuals who are free (Foucault, 1980:220). Hindess (1996) interprets this freedom as ‘those individuals whose own behaviour is not wholly determined by physical constraints [...] those who are in a position to choose, and [exercising this power] aims to influence what their choices will be’ (Hindess, 1996:99). Foucault relates the exercise of power to ‘the instruments, techniques and procedures that may be brought to bear on the actions of others’ (Foucault, 1980). Hindess suggests that ‘the forms of power may be remarkably heterogeneous’, and that some will be concentrated and hierarchically organised, while others will be socially dispersed (Hindess, 1996:100). He summarises how, from this perspective, ‘power is everywhere and it is available to anyone’ and as a result ‘its use may be analysed in terms of the most varied instrumental and evaluative considerations’ (Hindess, 1996:100).

From the perspective of collaboration, part of the ‘instrumental and evaluative considerations’ is through the things representative of discourse used to enact the will of institutional actors. For manufacturers, usually these are implemented for the purpose of achieving efficiency or administering quality control. For leaders, this focuses on the capacity to motivate action in alignment with a wider strategic plan. Discourse represents these instruments or procedures as *ways of speaking*, proliferated and repeated across networks of actors to bring about action, which inform the models by which we work and become *ways of infrastructuring* (Simonsen and Hertzum, 2012). As Hayes describes, we develop our own conceptual models about how organisations function, and use these models to guide us, interpret what we see, and decide how to act (Hayes, 2002:72). The challenge we identified for the circular economy was to develop a democratic discourse around a model for circular thinking strong enough to develop and replace existing wasteful modes of production.

Design carries significant potential towards meeting this form of challenge, with a practice that can engage such a discourse, unpacking each actor’s various models and make them an *explicit* part of understanding, debate and decision-making. Of core interest for this paper is when such models become *things*, matters of concern (Latour, 2005), ‘a contested gathering of many conflicting demands; a disputed assemblage that will divide and congregate and will engage new assemblies of humans and non-humans’ (Yaneva 2009, 284). When the knowledge across collaborators in the design situation needs to be gathered and represented, through modelling, a congruence of meaning becomes strained along the associations and implications made. This paper aims to understand these strains by reflecting on the learning developed through the project, and analysing the discourse facilitated with key participants as stakeholders.

METHODOLOGY

The methodology for this paper follows three key stages: presenting the case study of ReMantle and Make through a key narrative of learning; presenting the design and facilitation of the project Roundtable discussion; and the analysis of that discussion using *situational analysis*. Here, we briefly introduce the process of discerning the case study and applying situational analysis, while the Roundtable design and facilitation is presented within the case study and analysis sections.

Case Study

A case study approach is applied to our project as it can deal with multiple causation and complexity (Bell, 2005) and can help critically evaluate design practice for “universal ideas to be extracted” (Breslin and Buchanan, 2008, p.38). For the purposes of this paper, case studies are understood as a key method of empirical inquiry that ‘investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are

not clearly evident' (Yin, 2009:18). The context of maker spaces linking with Scottish textiles manufacture through circular textiles design was highly complex, specialized and uncertain, aligning assiduously with Yin's conditions for case study research.

The presentation of the case study used key narratives extracted across of the chronology of the project in order to foreground learning from key activities in relation to power structures and the role of maker spaces for circular thinking. This draws on exclusively qualitative data accumulated through discussions, interviews and researcher observation and reflections collected throughout the project. The purpose of the deployment of this data is to provide contextual information about the overarching project from which the final Roundtable activity was delivered.

Situational Analysis

The mode of analysis for this paper is adapted from one of the author's PhD thesis developing an *object-oriented approach* to trace and analyse multidisciplinary design work. The Roundtable discussion is analysed using aspects of *actor-network mapping* (Johnson, 2016), which used the Ecology Map of the project's actors and context of development to then apply situational analysis (Clarke, 2005) to interpret the discussion and controversies across the cohort assembled.

Clarke (2005) presents situational analysis as methods of mapping to support grounded theory analysis, the initial form being situational maps, which 'lay out the major human, non-human, discursive, and other elements in the research situation of inquiry and provoke analysis of relations among them' (Clarke, 2005:xxii). In Clarke's method of situational mapping, the question is 'who and what matters in this situation?' calling on the researcher's (or informant's) experience observing (or participating) in the situation under inquiry. Clarke then suggests the analyst performs a *relational analysis*, 'literally centre on one element

and draw lines between it and others and specify the nature of the relationship by describing the nature of that line' (Clarke, 2005:102). This is performed systematically, one selected element at a time.

For the Roundtable discussion, selected lines of discussion would undergo relational analysis drawn on a sheet of tracing paper placed over the Ecology Map, visible underneath. This would all be supported by asking questions on each relation, annotating the stakeholder's interpretations, with the discussion audio-recorded for further analysis. This further analysis would connect related interpretations from the discussion, combined with wider learnings presented from the case study, to produce three key themes on the roles, motivations and power structures influencing stakeholders in circular thinking.

CASE STUDY: REMANTLE AND MAKE

ReMantle and Make conducted practice-led research to produce a small collection of fashion accessories within a circular economy model by prototyping potential future maker spaces for circular textile design. This case study presents the key narratives at each stage of the project to reflect on the barriers and opportunities to implementing closed loop innovation within the textile sector, on what scale it could be possible, and what role maker spaces could have in a sustainable future for manufacture.

Factory Visits

The initial stages of research exploration in our project involved approaching some of the largest textile manufacturing mills and factories in Scotland, such as, Johnsons of Elgin, Begg and Company, MYB Textiles and the Scottish Leather Group. They all supported the research by gifting pre-consumer textile surplus, including leather offcuts, cashmere and woollen selvedge edging, woven fabric, coned yarn and lace.

Key Learning Narrative

While there was an appreciation for the knowledge and quality in the materials each manufacturer produced, there was variation in approaches to waste and reuse. This was observed to depend on how actively they aimed to produce knowledge on their waste, and how ready other stakeholders were to take their waste, often simply for disposal. While the waste outputs were highly varied along the production process, our focus was on high quality surplus textiles in both off cuts and cones of yarn.

Archetypes & Prototypes

Three textiles designers were commissioned to produce what we called circular *archetypes*, which would act as definitive prototypes in response to the design challenge. A selection of the prototype collars developed by participants from the Re-Make-a-Thons were also produced as *archetype* open source garments for exhibition by our project partners, micro-manufacturers Kalopsia, for the Roundtable and Showcase. Our commissioned designers would also develop their own prototypes for exhibition to a highly finished standard.

Key Learning Narrative

This was a vital part of the project, as the experiences of commissioned designers working with the materials alone brought insights into the challenge such materials present for designers. When sharing their experience in the Re-Make-a-Thons, they described the initial frustration of working with surplus materials, needing to deconstruct their traditional way of working through experimentation, and the enjoyment in discovering how to bring such materials to life. Presenting such a mind shift before then asking the Re-Make-a-Thon participants to use the materials was important to enhance the quality of experimentation and prototype outcomes.

Circular Canvas

To explore the circular characteristics of the garments and systems proposed as part of our Re-

Make-a-Thon workshops, we developed a model framing the circular life cycle of textiles, known as the Circular Canvas. The tool breaks down the life of a product into five key stages of *origin*, *material*, *equipment*, *use*, and *post-use* (see fig. 1). The tool challenged us to determine for each stage as much information as was available about the impact of textile products. We focussed on the local conditions around a product during its production and distribution, the material processes involved and the equipment needed to make it. We also explored the product in use looking at the systems in place to take a product to market and the consumer roles. Finally we asked questions about post use, or the future lives of the product and the embedded materials.

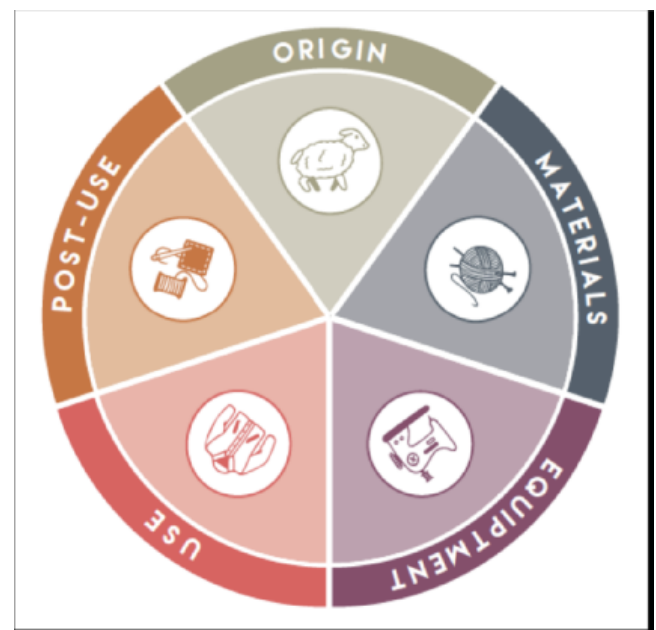


Fig. 1: ReMantle Circular Canvas

Key Learning Narrative

The initial purpose of this model was for it to integrate as an essential part of the prototyping process, to inform the nature of experimentation by participants. However, the reality was that the materials would lead the nature of experimentation; how participants would explore their properties to gain inspiration. It was only once they had gained

enough confidence to fully prototype a selection of collars that the canvas came into play as a framework to present and reflect upon their garments. This felt a more appropriate use for the canvas as it does not inherently contain the knowledge around a garment, it is the site on which knowledge gained can be articulated and shared, often exposing key gaps in knowledge, and therefore offering insight towards further iteration.

The Re-Make-A-Thons

The Re-Make-A-Thon workshops were one-day, rapid, hands-on design events where participants were set the brief of transforming waste material into a prototype collar. The collar needed to be open source, where the original conception can be hacked or modified to produce a hybrid concept.

The first Re-Make-A-Thon, set in Glasgow, focussed on exploring the possibilities with the surplus material and made full use of the technical capability of the Glasgow Maker Space, MakLab, such as 3-D printing, digital textile printing, digital embroidery and laser cutting, alongside more traditional sewing and embroidery equipment. There were sixteen participants in total, including a range of fashion and textile designers, product designers, academics and students.

The second Re-Make-A-Thon was hosted in a temporary 'pop up' maker space in the Glasgow School of Art's Highland and Islands Creative Campus on the Altyre Estate, just outside of Forres. We were joined by some of the participants from the first Re-Make-A-Thon, and additional craft makers, researchers and design students from the region, to total fourteen participants. To build on our findings from the first Re-Make-A-Thon, we challenged participants to not only think of some ideas for open source designs, but to consider the whole lifecycle of their concepts using our circular canvas tool to guide them and build systems level thinking into their designs.

Key Learning Narrative

The Re-Make-a-Thons were at the heart of the experiment, aiming to present a viable process for designers to come together with surplus materials and find value. Among various insights, the provision of space for designers to experiment together, share knowledge, techniques and ideas in a constructive environment were widely commented as building interest and new collaborations. There was also a keen sense of self-awareness and learning energy among the cohorts where technical knowledge was actively sought, gaps exposed, and creative yet considered solutions presented. The gaps reflected, however, were significant in that many participants felt they could only speculate aspects of the circular canvas, and so participants with technical knowledge would have enhanced such discussions.

While the quality of what was produced was always going to be limited, the diversity of prototypes was very encouraging. Due to the participants openly conversing on their ideas this seemed to naturally vary their chosen experimentation and outputs. More crucially, many participants chose to work further on their concepts after the workshops to prepare more finished items for exhibition. This observed motivation and interest in the process exposed how the project was meeting a gap in many participants' work practices to be presented at the final Roundtable and Showcase.

Roundtable & Showcase

The project returned to MakLab to set up a final Showcase exhibition and host a Roundtable discussion with our project stakeholders. The Showcase told the story of the project, exhibiting the raw surplus materials that started it all, through to the hands on experiments and the ideas from both Re-Make-A-Thons, and finally the finished open source garments produced by our project partner, Kalopsia, and our commissioned designers.

Eleven stakeholders took part in the Roundtable with the majority of participants not sharing a

common institution or ‘place of origin’. Two participants were managers of maker spaces from different parts of the UK. There were independent textiles designers, a circular economy policy advisor and sector manager from Zero Waste Scotland, with only the academic research team and two other participants sharing the same institutional place of origin.

After allowing the stakeholders to walk around the showcase, we all sat down for an intensive 90 minute discussion, facilitated by prompt cards, but very much driven by the different perspectives and experiences around the table. We used the Circular Canvas to frame a simple Ecology Map of the project (see figure 2) to guide our conversation through the stages of the circular approach. The Ecology Map helped us to scrutinise current situations for products in textiles and to interrogate any new propositions created as part of the workshops. We used prompt questions derived from our project insights to bring our knowledge to the table and explore where the participants saw themselves in product ecologies, where they could have impact and what that impact might be. The key learning narrative for this process is the focus of this paper, presented within our analysis.

Figure 2. Ecology Map for Roundtable Discussion

ANALYSIS

In this section we present our use of situational analysis: firstly through the mapping of stakeholders who took part in the roundtable element of the research study into the Ecology Map; then secondly, by analysing the major discourses that arose from the roundtable along relational lines, and how they compared to our interpreted findings throughout the project.

Mapping the Participants

We asked participants at the start of the Roundtable to place themselves onto the Ecology Map where they felt they had a role to play in the circular economy and explain their choice as a way of establishing their own view of their role and their institutional background. This began to set out what norms and influences individuals might bring to the discussion. The mapped actors are presented below (see figure 3), referred to by their role and each positioning is annotated with a supporting quote.

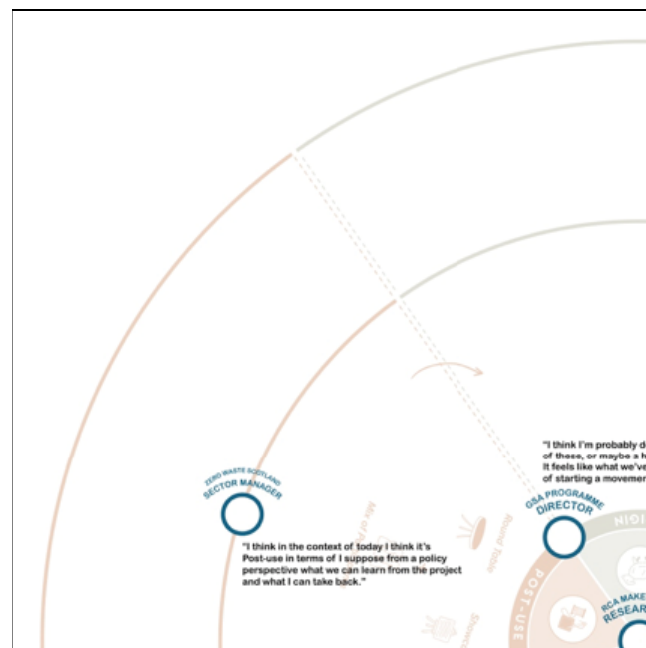


Figure 3: Roundtable Participants Mapped into ReMantle Ecology Map (Johnson, 2017)

Mapping the Discourse

Three prompt questions in particular moved discussion through our circular Ecology Map: Is changing waste to surplus about process or mindsets? Who is best equipped to take on surplus material? Is the circular economy a knowledge economy? Our analysis maps the key points interpreted from across the discussion, how they relate to the stakeholders involved and how these key points relate to each other in producing key themes on the roles and relationships towards developing circular models in Scottish textiles.

The result of our analysis is presented according to three key themes that emerged. Firstly, much of the discussion centred on *the tension of responsibility and change*; secondly, exposing *the challenge of scale and volume*; and thirdly, providing *space for experimentation and communication*. Each theme is presented with a visual mapping of relations, key quotes from participants, and reasoning for how they frame and constitute each theme.

The Tension of Responsibility and Change

The question that opened discussion, 'Is changing waste to surplus about process or mindset?' was initially separated as part of the creative process for artists and designers, and part of marketing strategies for consumers. Strong discussion expressed the difficulty in propagating the circular economy in textiles due to a lack of education and quality information for consumers. The public can't be expected to change their habits when retailers shift the responsibility of waste to consumers, aggressively undercutting more sustainable models, and fashion advertising "really building vulnerabilities in young consumers". This was proposed as defining the mindset shift:

"That is getting away from thinking that these

prices and practices are acceptable and then realising in fact what we're doing is undercutting our own markets and that is again dangerous." - Kalopsia Managing Director

Responsibility across the stakeholders emerged as a key point of discussion (see figure 4), particularly highlighting the tensions of how responsibility is distributed. The ZWS Sector Manager expressed policy changes that would be meaningful to the public as crucial, such as 'if we could knock 40% off our council tax because our public sector does closed loop textiles.' Conversely, consequences of ongoing ignorance in sustainability issues were cautioned as resulting in unwanted taxes, either on consumers, producers or retailers, in order to force behaviour and process change. Where such penalising legislation would fall would depend on who had power to shift the locus of responsibility. Should the responsibility of waste produced after using an item fall with the consumer or the producer?

"What if we're all guerilla returners and every time our item has run out or broke down or we were done with that piece of clothing, we just returned it back to the shop where we bought it from?" - ZWS Sector Manager

The group saw responsibility throughout the whole chain of production and consumption, including the retailer, designer and producer, sharing new frames of reference for the textiles industry. The discussion connected such frames of reference to design education and making informed choices that can instil circular practices. The Textiles Embroiderer shared a simple process of providing bags for her students to collect all their bits of waste according to their colour. The issue of the presentation and quality of surplus would arise across the key themes, and certainly emerged within the project activities. However, the particular issue of 'fast fashion' was raised through an example of a fashion designer advocating smart use of disposable materials designed specifically for a circular

economy.

The tension set out in this theme relates to the notion of shared responsibility across the fashion industry clashing with the locus of leadership, and how good decision-making at the start of a process can integrate sustainable practices and still relate to modern consumption.

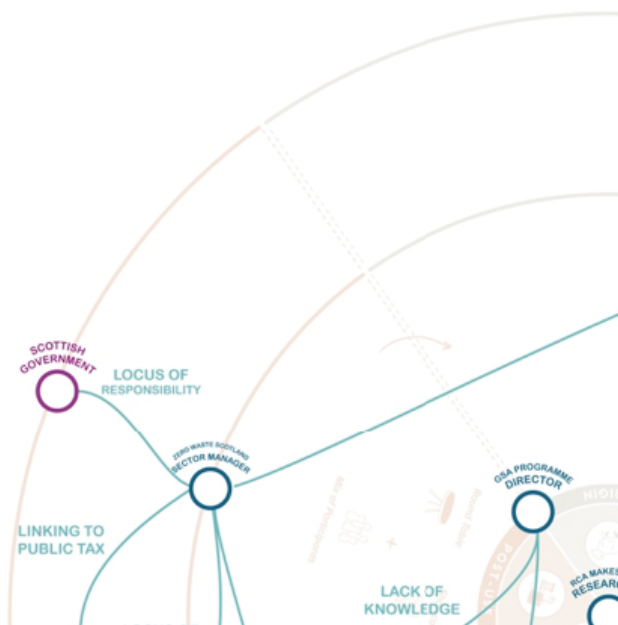


Figure 4: Relational Mapping of 'Tension' Theme, (Johnson, 2017)

The Challenge of Scale and Volume

The second theme exposes the debate expanding on issues around the creation and use of 'waste' or surplus material and how quantity dominates current structures and large-scale thinking, however raising the quality of surplus material was paramount to creative practitioners and seen as a key opportunity. The selection of surplus material for the project seemed to emphasise how surplus waste could be made of interest to designers.

"This surplus, it's what happens then, what

happens next, who's managing that, who's categorising that and cataloguing it. [...] unless there's almost a business structure to underpin it, we're going to really struggle to get this into any sort of use and high volume." – Kalopsia Managing Director

"I do think there's an issue around quantities and experimentation. [...] [Manufacturers I approached] were like, 'We need you to take five tonnes of it at a time.' I'm like, 'I can't take five tonnes. I can take two bags, have a play, and then get back to you with solutions and potentially afterwards look at five tonnes, once I know what I'm doing with it.'" – MakLab Manager

The challenge of scale was firmly set out by the ZWS Sector Manager (see figure 5), that the 'Scottish government has decided textiles is not a priority,' as it's felt 'we're very good at designing out waste from our original methods of production,' while major companies 'will not try a new technology unless you can show us that it will process 50,000 tonnes minimum.' As a result, she felt technology should be the focus of innovation towards the circular economy, as well as designers educating manufacturers globally.

"A garment that Scotland would produce is up to 5% waste. A garment produced in Hong Kong is up to 20% waste. So that's about the industrial process. So what can we as designers and educators, who are going to send out those designers to those industries, what can we impart, teach or learn around that? These are the global challenges." – ZWS Sector Manager

In the context of large British businesses, the Sector Manager asserted 'you will see case study after case study [...] trying to close the loop'. However, she claims a textiles technologist equally will say they're against the boardroom, the design team, or even fashion, where less sustainable materials might dominate the market: 'one year it's polyester. [...] that puts up the carbon. If the next year it's

cotton in fashion that puts up the water usage.” In other words, mainstream fashion is perceived to need to adopt circular thinking, however this would also be subservient to the influences of the market and mindset of consumers. As such, the perceptions of these volumes, and what they mean to the everyday consumer, is expressed as needing to be made more meaningful through design.

The Textiles Manufacturer contributed a story of their waste management as a more flexible, yet systematic exchange. Firstly, what they gave to the project as waste is noted as ‘not actually waste or storage, because we actually sell it back and it gets re-spun until they’re fibres.’ This raises the question of how to make sense of the volumes from a manufacturer’s perspective, where it’s more about ‘bypassing what normal waste routes would be’ and ‘turning it into something better than recycled.’ The challenge for manufacturers is that they can’t guarantee how to use their waste, as ‘the source material from our surplus is not actually always going to be there.’ And so bespoke, creative solutions can play a role, ‘like slippers where you felt the whole thing down’, responding to surplus, or even learning uses of expected surplus, that could be judged as better usage.

The overall challenge set out within this theme is in facilitating the scaling up of knowledge and creative solutions. This particularly includes how policy, both at governmental and organisational levels, is not exclusive to narrow, high volume technological solutions, but encourages a shared curiosity for small-scale solutions.

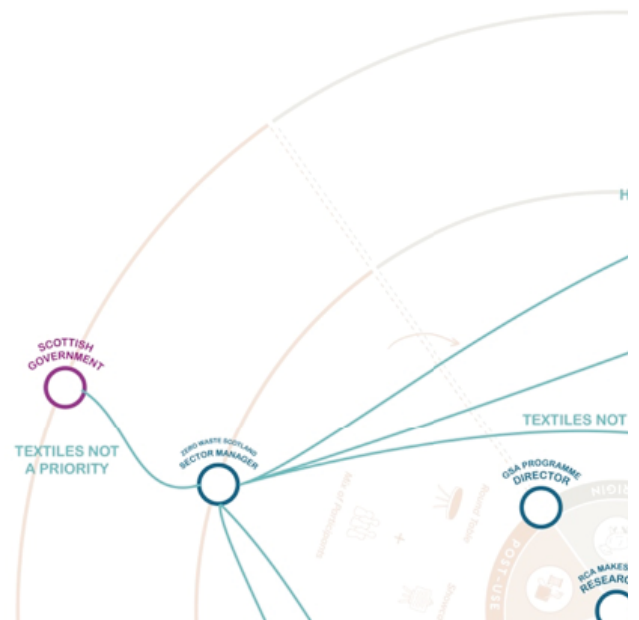


Figure 5: Relational Mapping of ‘Scale’ Theme, (Johnson, 2017)

Space for Experimentation and Communication

The third theme focuses on the enhancement of maker spaces, and their potential role for contributing a shared space for a circular textiles economy in Scotland. As the challenges of technical processes, material quality, cultural norms and market forces were expressed throughout, the MakLab manager often retorted with opportunities they saw for their operation to intervene (see figure 6).

In response to technical processes of dealing with waste materials, she shared recent experiences experimenting with acrylic, a material they use a lot of, which is a form of plastic that doesn’t easily melt down and is difficult to reuse:

“Recently we’ve been looking at how we can turn it back [...] re-granulate it and then turn it into a composite that can be added into something else and turned back into something.

So we have been really pleased with finally finding a solution to this, which is something that we've been thinking about for three years."

This dedicated experimentation towards the reuse of waste material clearly needed time and investment, alongside the wider operations of the maker space, and so this turned her to ask 'where do you find the information?' and 'where do you find people who have already been tackling such problems?' There is a distinct and tangible reason for maker spaces, tackling similar issues of waste that are common between them, to connect and share such knowledge. As part of connecting and sharing such technical knowledge would be another agenda to engage broader communities in contributing, learning and using such knowledge 'at different geographical locations' or 'looking at early years'. Such engagement would ultimately aim 'to change the habits of waste and consumption at the beginning of the process as well.' The uncertainty lies in whether maker spaces could lead this without a consistent approach and systematic sharing of knowledge.

Small exchanges towards changing habits were shared by both the Kalopsia Managing Director and the maker space manager. For Kalopsia, a key policy with their clients is 'when you get products from us, you get the products and the waste, so you're very aware if your pattern is not efficient.' The maker space manager concurs how this is a conversation small makers have all the time, citing how customers request an order without understanding how long it will take and how much it inherently costs. As a result, a major driver towards a circular economy is identified in 'the education of people in terms of much more transparency about how things are made, and about how much they actually cost to make.' Such education is recognised as happening at the point of need, when people make a request for something to be produced, and are confronted, not just with what they value in their modes of production, but what others value as well.

As a result, this theme often overlapped with the

previous themes to propose the concept of a *surplus broker*, as a new potential actor in the circular economy in textiles, emerging through the discussion:

"Ideally what you're looking for is someone to have a large symbiotic business that can take some of these waste streams. If you don't know they're there you don't think about it." - Kalopsia Managing Director.

Kalopsia's Design Director drew on existing examples that take on some of the principles of the surplus broker concept, such as the effectiveness of recycling and reuse in Scandinavian countries, who not only 'have all these stations where you return glass bottles, plastic or fabric and everything is labelled and everything is clean and organised,' but everyone knows that you go to these places to give and receive items. This goes a step beyond charity shops or second hand, which select items suitable for resale and dispose of anything else.

The potential for maker spaces in this theme is for them to become a networked space driven by the notion of circularity, brokering knowledge and generating cost benefits in surplus retaining value. Such brokering then connects various actors as stakeholders gaining awareness of the stake they hold; their relevance and relation to such circularity. This shouldn't need to be limited to select members of the public, especially not if such sites demonstrate capacity for diverse technical processes. They become sites for dynamic projects, both addressing local needs, and sharing in global challenges.



Figure 6: Relational Mapping of 'Space' Theme, (Johnson, 2017)

DISCUSSION

At the outset of this project we asked, what role the maker spaces played in the development of approaches to implementing the circular economy, and to what extent did it contribute to a more democratic exchange between the tensions and conflicts of different institutional perspectives. Reflecting on our analysis of the project roundtable, the participant feedback, and our observations from the workshops, we can begin to assign some meaning to these questions and unpick the role our maker spaces played in democratising the process of new knowledge production. We then make some more general claims about the power of maker spaces to mitigate institutional conflicts outside of the boundaries of the project.

In summary we believe that the maker spaces in this project, although subjective institutions with their own ideas, behaviours and norms, proved themselves to be rich places of open debate, free experimentation with new technologies and,

crucially, ideas. Our study brought together the multiple stakeholder views and opinions that are needed to tackle systemic issues like the circular economy. By creating a safe space for debate, institutional and expert knowledge was brought out in a forum where each viewpoint was given the opportunity to contribute to framing the issue from their perspective and contribute to a shared knowledge. We observed that through engaging with the study, opinions were altered and individuals were able to enhance their own knowledge as well as contribute to a new collective body of knowledge. The Roundtable discussion, especially, was instrumental in building new domain knowledge about the issue of the circular economy in textiles at the systems level. We were able to explore the issue from different scales and perspectives, and exchange and debate ideas with the knowledge and criticality of the partner's expertise to ground our exchanges in the real world context. The practical workshops bridged the gap between industry and academic knowledge. By the act of physically creating artefacts, the theory and practice of circular economy are argued to have been tangibly brought together, stimulating debates on quality, value and sustainability. Practical experimentation also allowed a 'safe' trial and exploration of new business models and sharing of best practice in efficient design and production.

From our observations and reflections on the analysis of the project, the key points that have emerged are: maker spaces can be agile facilitators of creative innovation; they have the power to create and broker knowledge between multiple stakeholders in a transparent and open way; and by connecting viewpoints, ideologies and knowledge, they can play an instrumental role in developing approaches that can help to implement solutions to complex issues like the circular economy. These key insights contribute to our understanding of the power of maker spaces and how they can facilitate equality in debates on complex issues.

Facilitators of Creative Experiment

Firstly, we believe our analysis shows that the maker spaces in our project, when compared with, for example, the small creative enterprises or the large producers, can be 'soft ground' for free expression and experimentation. It was the intent of the project to position them as places to 'play' and develop new innovation and so it is not so surprising that this was the case. However, during the workshops and through the Roundtable discussion the role for maker spaces to facilitate creative experiment did emerge as something all the stakeholders identified as a key strength for them. As places capable of agile innovation at a small scale we observe that concepts can be explored safely, and evidence built that can scale out of the maker space and into the wider world.

Connecting perspectives

Reflecting on the workshops it is clear that the project setting was instrumental in bringing the various stakeholder institutions and their perspectives to the fore and uncovering the potential connections. The maker space managers in our project saw themselves, or at least the maker spaces they represent, as facilitators for exchange and knowledge brokers. Capable of connecting experiences to wider challenges as a form of diffuse knowledge producers, able to bring together shared aims from different perspectives to shape issues and distribute knowledge for debate through a network. Maker spaces have their own agendas and politics and this can be largely a product of staff personal ideology. This naturally influences the activities and therefore any concepts that are explored within. While our maker spaces were set up to tackle specifically the topic of the circular economy through experimentation, the Roundtable left open the opportunity for multiple perspectives to both shape the issue and contribute to responses. In this way the maker space played a significant role in connecting multiple viewpoints to generate new knowledge on a topic and, crucially, it enabled the participants to frame the issue from the start, and respond and debate to new ideas.

A Collective Model

One of the significant outcomes from the study was the framing of a gap in the circularity of textile waste and the conceptualisation of a potential solution. The new model, a collective material brokering model, did not exist before the Roundtable and was enabled by the discussion and expert understanding in our project in the maker space. The model focussed on maker spaces playing the role of broker for surplus material in a surplus market place. The idea was in response to the issue of small unreliable supplies of surplus material from large producers that limits its potential for reuse, either by them or smaller enterprise. The idea of circular matching where material is centrally sorted and graded then made available to designers and makers only emerged after the different stakeholder groups at the Roundtable had the opportunity to discuss their own issue with adopting circular approaches and then collectively conceptualise the material broker idea. Our role as an academic institute providing the project space and design innovation approaches in this process cannot be overlooked, and points toward a vital future role for academic institutions as a key partner in supporting any modelling or validation of such concepts in future.

Framing the study

The significance of this study is that it has shown how maker spaces can play a role in bringing together multiple stakeholder perspectives to create new knowledge about a complex societal issue. The maker spaces in our project facilitated both physical experimentation and debate and both were important actors in the contribution to new domain specific knowledge and open debate. Using the skill and equipment of maker spaces enabled a tangible engagement with the technical challenges of a circular economy in textiles. It played the role of broker by connecting designers, academics and material manufacturers to explore challenges through hands on experimentation. It connected multiple perspectives at the Roundtable that

otherwise would not have had the opportunity to layer their knowledge with the knowledge of others, making a significant difference to the breadth of debate and therefore criticality of the issue and any responses.

CONCLUSION

In conclusion to the study, the situational analysis of the Roundtable discussion has shown how maker spaces can play a role in both democratic knowledge production and democratic validation. They played an important role in exposing power relations between stakeholders and to the systemic challenges of the circular economy in textiles. The combination of physical capability for technical experimentation and their openness in inviting stakeholders in to discuss and debate issues position maker spaces as ideal sites for agile innovation. The approach enabled the necessary engagement between academia and industry that has been identified as crucial, yet a barrier to circular economic development and something that has not previously happened in Scotland.

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