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Whole Systems Thinking for Circular Economy Design Practice

- Mindsets - Design of behaviours; tools, frameworks and experiences to enable and support collaboration, mindset change and improve decision making.
- b. Pioneering and enabling the changing role of the designer in a circular economy

Sara Li-Chou Han, Nick Hall, David Tyler, Phoebe Apeagyei

To develop the role of designers in the context of the circular economy, this paper investigated the concept of whole systems thinking in design practice. Designers' practices were examined not just from the product orientated perspective, but by taking a more holistic systems thinking approach. This addressed a combination of the market, consumers and communication, plus design and production processes, supply chain and end-of-life considerations. The paper presents individual case studies of environmentally motivated fashion design that displayed differing levels of positive impact based on their breadth of design activity, and whether a wider systems-based design approach was successfully incorporated.

The methodology employed a review of literature relating to circular systems and design approaches, and combined this with primary data from semi-structured interviews. Interview data from ethical fashion brands and designers identified barriers to the wider adoption of circular economy fashion strategies. Core competencies required to handle the complex technical issues related to whole system design were analysed in terms of the options available to support designers. Current techniques employed to bring products to market and effectively communicate their wider features and benefits to consumers were interrogated and modelled to establish where knowledge gaps lay.

The paper concludes that the designers taking a systems based approach are more congruent with the circular economy model and the wider skills and attributes that enable such approaches, such as research skills and entrepreneurial methods. Findings on the effectiveness of current circular design systems offer key industry insights on the changing role of designers and the necessary mindset for systemic change. Academic implications of the research include the establishment of whole systems thinking in the training and development of a new generation of designers, to improve and enable positive design decisions. Originality lies in developing circular fashion approaches that draw from and improve upon existing strategies to create sustainable innovation.

Keywords

Whole Systems Thinking; Design; Fashion; Sustainability; Circular Economy; Mindset.

The concept of the Circular Economy requires the re-engineering of how we value products, components and materials; thereby introducing sustainable patterns of consumption through responsible production and sustainable re-industrialisation that builds resilient infrastructure (United Nations, 2016). Underpinning the establishment of the Circular Economy is the need for on-going innovation that can design and transition entire sectors in a 'continuous positive development cycle'. Outlined is an interconnected system that optimises the way we consume products and services; reverse engineering the production of products and services and moving away from the current system of take, make, use and dispose. (Ellen MacArthur Foundation, 2015a). Current design thinking focuses on incremental improvements to existing designs for the purposes of added-value consumption, and is dictated by the limits of existing production systems and profitability through cheap, high turnover goods. Designing for the Circular Economy must go beyond this towards a switching process where the objectives of products and services are evaluated for efficiency, functionality, longevity; a systemic change geared toward greater social and environmental responsibility and reliance a finite materials economy. (Ellen MacArthur Foundation, 2015b).

We must rethink how we design, to deal with far more complex, system-wide relationships using innovation in terms of the function, use-phase and life-cycle of created objects (Charnley, Lemon, & Evans, 2011). The design process must consider and map system-wide technical and biological impacts, examine alternatives that enhance performance, optimise yields and create renewable resource flows that close the loop and install the circular economy as the new market paradigm (Stasinopoulos, 2008). To do this requires consideration of the methods that are used; to re-learn how to design is to innovate in the context of the Circular Economy. Designers need to apply tools that can help them deal with re-engineering complex systems and the products and services therein, changing what they do from the inside out. One such approach, strongly connected to the Circular Economy is Whole System Thinking (WST) (Charnley et al., 2011). This approach to design is a method of navigating and considering the interrelatedness of problems and solutions to create more sustainable designs. WST is about taking a holistic, multi-perspective approach to designing, exploring and evaluating the components of the system in which product or services are produced and used in much more detail. Understanding the interconnectedness of the many different components, how they interact and the problems embedded within these connections enable designers to optimise each of these processes into a single solution. This approach means solving multiple problems simultaneously and taking a collaborative, iterative approach to developing innovative solutions that address problems identified as barriers to sustainable design (Blizzard & Klotz, 2012).

The issues of WST concern how it is best applied to approach, manage and deliver sustainable outcomes. Sustainability has to be a desired outcome of using WST frameworks, as applying WST methods does not guarantee sustainable product systems (Charnley et al., 2011). What WST provides are guiding processes, principles and methods that can enhance designers thinking on a systems based scale and introduce them to a broader set of problems that need to be considered in the context of establishing more circular methods of designing (Blizzard & Klotz, 2012). By using WST methods, designers innovate not just in sustainable design, but in the processes, research, business models and life-cycle interventions needed to make a product or service less negatively impactful by design. The focus is shifted away from retro fitted 'greening' and towards preconceived, objective sustainability, designed in from the very beginning. To enable this requires collaborative approaches to understanding systems, and accessing the most appropriate expertise to further the learning process. For example, the likely introduction of Extended Producer Responsibility (EPR) (Lenzen, Murray, Sack, & Wiedmann, 2007) will require designers to consider end-of-life valorisation of waste textiles and drive requirements for such design thinking.

Though there is a trend toward upcycling, little is currently done with low-grade textiles or textile based items with multiple components and how these are recycled into feedstock for textile manufacturing. A WST approach to developing a response to this idea would include developing a team of experts or a network that collaborate to evaluate low-grade textile waste from a variety of perspectives, thereby discovering new ways of addressing the problems of certain textile waste streams that have the potential for innovation, such as end-of-life mattresses and how these could be re-designed for disassembly, enabling easier deconstruction and reuse of components.. This is linked to the principles of developing a WST approach, briefly summarised in the following points:

Focus on Outcomes:

WST is a method that is applied to a situation. Thus, generating a series of operational principles and applying these to the project in hand is of utmost importance. The result of the project must meet the specific requirements of Circular Economy design, such as closed loop production and recyclability. The principles defined and applied will then depend on the context of the sector and type of product. In order to achieve the desired outcomes, these principles are key to accessing the most relevant collaborators and expertise, and forging strategic alliances which contribute to a wider knowledge network. The alignment of interests between actors in a network then establishes roles and responsibilities to take the project

forward, prioritising design elements which are most purposeful and contribute to the greater whole. (Blizzard & Klotz, 2012).

Open Innovation Networks:

Open Innovation is the paradigm of seeking and collaborating with a range external organisations and find opportunities for innovation through new partnerships; forming networks that share knowledge and research as well as market risks and rewards. The advantages are reduced costs of research and development, improved productivity, broader access to user needs and wider market potential. Managing such networks and the intellectual capital generated can be problematic. Formal and informal agreements in terms of the nature of ownership and sharing of information should be agreed early in the project when discussing outcomes. Matching specific information with appropriate expertise is key to creating synergies between actors. In this way a network can generate the perspectives and knowledge required for WST more rapidly, resulting in faster identification of problems, opportunities and solutions. (Chesbrough, 2003).

Find New Solutions:

Existing design solutions include the preconceptions, processes and systems that limit innovative thinking. WST requires that designers start with a 'clean sheet' and build ideas over time without returning to previous assumptions before generating new concepts. (Blizzard & Klotz, 2012). Designers should establish methods of exploring and capturing new user-needs, examine processes being used throughout the product life cycle, including first and second tier supply routes, and map processes that include the environmental impacts and how they can be reduced or eliminated altogether. Circular Economy alternatives of regenerating, virtualising or exchanging should be considered. Analysis of the interrelatedness of problems identified should lead designers to seek alternative solutions, such as materials that can be replaced to form technical or biological nutrients. This process should create a product story that is both transparent and traceable. (Braungart & McDonough, 2002).

Close the Loop:

Valuing waste and repurposing discarded textiles is a key opportunity for innovative thinking towards the Circular Economy. Whilst upcycling is one solution for higher grade waste, the need to evaluate how products are designed for the environment through pre-development techniques that mitigate or eliminate waste issues and impacts is more broadly effective to reducing the environmental and social impacts of the fashion industry. The need for more robust forms of value analysis, cleaner production techniques and the elevation of

sustainable value is required (Catarino et al., 2011). This includes design for deconstruction; the use of renewable energy; non-hazardous material inputs and avoidance of toxic chemicals such as those found in some dye stuffs and waterproof finishes. The development of EPR programmes aim to establish robust policy around such design efforts and move waste streams out of disposal and back into supply.

Establish Standards and Share Knowledge:

Finally, cooperation and establishment of knowledge networks is the key to developing guidance, training and policy around WST approaches to circular design. Sharing information in this way serves to formalise more independently governed ways of increasing the levels of truly sustainable products that meet the requirements of the Circular Economy value circle. Preserving and enhancing natural capital through control of natural stocks and establishing renewable resource flows is key to the survival of the global fashion industry, an industry that is currently underpinned by issues such as perceived obsolescence and unsustainable material supply, amongst many other factors. (Ellen MacArthur Foundation, 2015b).

Methodology

In order to investigate the role of designers in the context of the circular economy, semi-structured interviews were carried out with eight fashion brands with experience of designing, producing or retailing upcycled or ethical fashion. Questions centred on key points in the circular fashion system; from consumers and communication, to design and production, plus wider considerations of the fashion industry and sustainability, and how to create meaningful change. The identification of current techniques used to bring products to market and communicate with consumers established the core competencies required to deal with the complexities of whole system design. Determining where gaps in knowledge lay and where barriers existed to the wider adoption of circular economy and closed-loop strategies enabled recommendations on the integration of a systems based approach in fashion design.

Selection of Participants

Using purposive sampling eight ethical fashion brands were selected to represent the range of market levels present in the fashion industry. The brands range from higher profile labels that show regularly on and off schedule at London Fashion week, to medium sized enterprises with their own bricks and mortar premises, smaller labels and start-ups,

producing limited collections for loyal customer bases, mainly reached through social media. Designers and brand owners were contacted to be interviewed as part of this study.

Brand 1

Brand 1 was a well-established Berlin based business that displayed and retailed upcycled fashion and jewellery from all over Europe and provided a network hub for the local sustainable design community.

Brand 2

Brand 2 was a micro sized ethical cycle wear enterprise based in London. The owner and director of this brand had previously held roles designing collections for two different London based upcycled fashion brands.

Brand 3

Brand 3 was an upcycled fashion label of a UK based charity raising money for vulnerable children in Romania. Both the head designer and creative director were interviewed.

Brand 4

Brand 4 was a well-established organic clothing line from London, produced under ethical conditions in China and printed in the UK. The brand specialised in printed organic cotton and hemp t-shirts.

Brand 5

Brand 5 was a high profile upcycled fashion brand based in Spain and the UK, with production in Bulgaria. The brand also functions as a consultant and facilitator for outsourced ethical and upcycled production in Bulgaria.

Brand 6

Brand 6 is a collaborative studio shop in London that is used to design, showcase and sell sustainable and ethical fashion and accessories, focusing on high quality handmade craftsmanship, fair trade, and transparency of production.

Brand 7

Brand 7 was a well-established micro-enterprise upcycling brand based in Bristol with a background in academic research informing sourcing decisions. This brand manufactured and produced through a network of local UK makers and artisans.

Brand 8

Brand 8 was a high profile upcycling brand, known for campaigning and public engagement, and pioneering collaborations between educational institutions and upcycling innovators. Based in London with production in Italy.

Semi-Structured Interviews

Semi-structured interviews were carried out with key informants on design and production, how their brands currently communicated their ethos to their consumers, what information it was important to know about consumers and areas in which they felt more understanding was needed. In flexible semi-structured interviewing style, questions varied between respondents to reflect what data could most appropriately be collected from each specific informant and how interviewees were directing the flow and emphasis of the data gathering. (Bryman, 2012; Jankowicz, 1995; Lindlof & Taylor, 2011).

Interview schedules provided a flexible guide to the order and flow of questioning for each interview. A mixture of different kinds of questions allowed for the understanding of the way interviewees understood issues related to the research topics but still allowed for the flexibility in following alternative areas of enquiry during the course of the interviews. (Bryman, 2012).

Results

Presented in this section are the results of the key informant interviews, in which the strategies currently used by designers and brand owners to communicate with their consumers and bring products to market are established. These findings provide vital information regarding present-day techniques for circular economy fashion, gaps in knowledge and the identification of barriers to wider adoption. Key themes emerging from the interviews were:

- 1. Consumers**
- 2. Communication**
- 3. Design and production**
- 4. The fashion industry and sustainability**
- 5. Creating change**

Presented are the key points summarising informants views on each theme:

Theme 1: Consumers

Informants were of the opinion that consumers were often unaware of how their consumption behaviour had contributed to wider problems in the fashion industry, and those that were

aware were unwilling to change their behaviour. It was felt that the most important factors for consumers were price and design. Ethics were not a key consideration for consumers and would only be viewed as a bonus feature at best. The nature of remanufactured and upcycled garments created exclusivity for consumers through limited editions and unique styles, however the social stigma many consumers attached to second hand clothing presented a problem to designers using post-consumer textiles as a source material in designs. Informants identified requirements for more knowledge in the following key areas regarding consumers:

- Price expectations
- Style and design requirements
- Lifestyle preferences
- Importance of quality, longevity and ethics to consumers
- Communication preferences
- Receptiveness to environmental and ethical messages
- Motivations to follow through on expressed good intentions
- Motivations to cease continued irresponsible consumption

Theme 2: Communication strategies

Social media was the most widely used communication strategy for all informants. Sharing of related content and stories communicated the ethos of brands and designers through non-product or sales related posts. This strategy also had the benefit of targeting an audience that had expressed a prior interest in issues of sustainability, allowing audience feedback, questions and participation. A market research opportunity was also presented through this medium. In-store and face-to-face dialogue was also favoured by informants. This enabled a direct connection with consumers to share stories of how products were made and to provide information about the fashion industry in an engaging and non-confrontational manner. This approach provided a unique, service led shopping experience and enabled brand owners to receive feedback, providing an additional market research opportunity.

PR agencies and editorial were also used by some brands to reach more mainstream publications. Despite this, many informants felt that the mainstream media coverage was lacking in provision. Not enough was being done to highlight responsible alternatives to continued fashion consumption or to show sustainable style as being equally desirable as high street fashion. Informants were often frustrated that sustainable fashion was often shown as a novelty. Informants were unanimous in their opinion that style and design were the most effective ways to appeal to consumers, who would only regard ethics as a bonus addition. Connecting with consumers through aesthetics was vitally important in order to be

create a platform on which to engage individuals on the sustainable credentials and human stories regarding garment workers and the fashion industry.

Theme 3: Design and production

Circular economy fashion often eschews the traditional fashion seasons of Spring/Summer and Autumn/Winter and pursues a slow fashion course, gradually adapting classic designs according to available source materials, current trends and direct feedback from customers. The design brief for circular economy fashion is to produce sustainably, by considering all lifecycle stages, from material considerations, to use-phase and end-of-life responsibilities. The brief is the key opportunity for integrating sustainability into the entire design and production process, setting out how to incorporate these considerations along the whole supply chain. Seven out of the eight designers interviewed had utilised upcycling as a form of circular economy fashion design, in order to divert, utilise and revalue discarded materials.

For those utilising remanufacturing and upcycling strategies, sourcing occurred near to the very beginning of the design and production process. This stage used only what was available at the time of sourcing in the form of post-consumer or post-production textile waste, instead of requiring newly made materials, and necessitated designers to spend significant amounts of time researching where materials would be available, how suitable would be for designs and how much was available.

Upcycling also required a flexible design formula. This method utilised the same techniques of standard fashion design such as mood boards, sketches and toiles, however a noticeable departure from traditional processes could be observed in the pattern cutting and fabric combinations. A flexible design formula allowed for fabric substitutions, taking into account the changeable nature of fabric supply. Often panelling and a structured 'patchwork' style of pattern cutting made best use of limited and changing material sources. Interchangeable pattern pieces could be substituted at design level or at manufacturing level to make best use of available resources.

Extra work in sourcing materials for reuse, and smaller production runs often led to higher prices for upcycled garments. Successfully communicating the wider global benefits of producing in this way to consumers was key to generating sales of products and services for circular economy brands. The strongest results reported in gaining this level of understanding and acceptance, including sales and repeat custom, were through online interactions and in-store dialogue in dedicated ethical fashion stores. Providing enough information about the products ethical credentials and origin of the source materials needed to be carefully balanced against showing garments for their aesthetic appeal.

Identifying the most effective retail strategy for sustainable fashion has been an on-going challenge to the industry. Barriers include sourcing solely from one stream, such as post-consumer textiles. Brands utilising a variety of sources such as pre- and post-consumer textiles, recycled textiles and sustainably sourced fabrics have shown more success in scaling up their operations for wholesale supply. Limited understanding from UK based retail buyers regarding the variability of upcycled stock and fears of inconsistency and poor quality have also presented barriers to wider acceptance.

Theme 4: The Fashion Industry and Sustainability

Informants discussed a lack of industry acceptance of sustainable brands and ethical practices. Despite growing consumer awareness, the fashion industry showed a marked reluctance towards transparency. Leadership and support from larger well-established brands in the industry was felt to be vital to instigate any sort of change. Informants felt that the fashion industry could be doing more to promote sustainability, by allowing designers, product developers and buyers to make use of sustainable options. For the larger well-established brands, it will be necessary to equip their designers with the necessary skills, knowledge and agency to make decisions affecting production, labour and materials, as well as the use phase and end-of-life considerations to truly implement a circular economy fashion system.

Theme 5: Creating Change

Creating change in the fashion industry was felt to encompass many aspects, from changing attitudes and behaviours of individuals, to changing design and production techniques and addressing the damage already done. It was made clear by informants that there was no easy solution to the many difficult challenges presented. Risks are presented if consumer understanding for upcycled products does not fully extend to the entire lifecycle of the garment. If upcycled garments are valued in the same way as low cost fashion with a high rate of consumption, there is every danger that they will be disposed of in the same way. Some informants described upcycling as functioning as an end-of-pipe solution, which was only a slight deviation from the linear model of consumption. For a fully functioning circular fashion system to be in place, understanding of the entire lifecycle by all participants is required. Informants also felt that feelings of guilt would not be helpful in changing consumer attitudes. Converting the way individuals think about consumption is balanced very finely between communicating the right message and going too far, making individuals feel judged and guilty for their consumption behaviour.

Increased availability of information online has resulted in individuals being more informed

than in the past, and it is through these channels of online and social engagement that consumers seem most ready to receive these messages. Using social comparison and peer to peer exchange may also provide a platform to engage individuals through more positive messages of social change and clean technologies than in guilt inducing judgements of previous behaviour, as well as offering fresh opportunities for individuals to make the right decisions going forward. Additional actions taken by informants to create change in the industry include involvement in academic research projects looking into sustainability in the fashion industry, and involvement with upcycling projects with local charities. Informants also felt that further actions could be taken by larger brands and governments to create change, by giving designers more agency to implement good practice along the supply chain, and government penalties for bad practice to highlight those acting most irresponsibly.

Analysis and Discussion

Using the principles of WST outlined in the review of literature, the results of the key informant interviews were analysed using cross-case synthesis in Tables 1 and 2, outlining how each brand's strategy aligned with WST. Table 3 outlines the main barriers to adoption of WST, as identified by the key informants.

Table 1. Whole Systems Thinking - analysis

	Focus on Outcomes	Open Innovation Networks	Find New Solutions
Brand 1	Revalue reused and unused raw materials into new products	An overall ethos to inform, inspire and educate consumers about upcycled fashion, and the consequences of over production and fast-paced consumption	Flexible design formula
Brand 2	Create non-toxic and recyclable waterproof clothing.		Emphasis on style and design
Brand 3	Transform charity donations of clothing and textile through upcycling.	Designer-makers given the opportunity to develop skills.	Flexible design formula
Brand 4	Producing ethical, eco-friendly and politically conscious street wear		Focus on t-shirts and street wear combining design and politics
Brand 5	Policy of using reclaimed materials wherever possible, and combining these with sustainable and recycled fabrics to create high-end, fashion-forward collections	Collaborations with mainstream clothing brands	Emphasis on style and design
Brand 6	A studio, shop and workshop space, the aim of the brand was to connect customers to the process of production, including the materials, skills and time required to create unique products by hand	Collaborations with makers and artisans	Focus on artisans
Brand 7	To combine fashion forward shapes with reclaimed materials and heritage craft, through sustainable and ethical design	Collaborations with makers and artisans	Slow fashion emphasis
Brand 8	Upcycling as a design solution to the environmental problem of textile waste	Collaborations with mainstream clothing brands	Flexible design formula

Table 2. Whole Systems Thinking - analysis continued

	Close the Loop	Establish Standards and Share Information
Brand 1	Reuse waste and operate a shop space which functions as a hub for the local sustainable fashion network	Create upcycled fashion designs using fair trade and transparent production methods
Brand 2	Use of low carbon recyclable, waterproof, breathable membrane fabric, produced in Europe in waterproof tailoring	Materials and certification information available on company website
Brand 3	Upcycled clothing designed, made and sold as part of the FARA charity.	Open plan workshop enables customers to see makers and production
Brand 4	Hemp, carbon-neutral organic cotton, and recycled salvage plastic fibres used in clothing, printed with designs created by artists with a political message.	Information on awards and accreditation available on company website, as well as materials used.
Brand 5	Design informed by recycled fabrics	
Brand 6	Shop space provides a platform from which to inform customers on the production and materials used in the showcased items	
Brand 7	Slow fashion collections created using upcycled, sustainable and local materials	An ethos of contributing to the knowledge and understanding around sustainable fashion design through consultancy, education, research, curation and community projects
Brand 8	Sourcing policy was to reuse the textile waste from high end garment factories in Italy	The brand also endeavoured to do as much as possible concerning education and advocacy in ethical fashion, speaking at and working with educational institutions, and becoming leading campaigners in the Fashion Revolution organisation.

Table 3. System Barriers

Consumer Barriers	<p>Lack of consumer awareness of the impact of consumption behaviours</p> <p>A lack of information provided to consumers on responsible alternatives to high street fashion</p> <p>Consumer resistance to behaviour change</p> <p>Ethics a low priority for the majority of consumers</p> <p>Consumers regard ethical credential of products as a bonus feature at best.</p> <p>Social stigma of second hand clothes / textiles for consumers</p> <p>Risk of upcycled and sustainable products being disposed of irresponsibly by consumers</p> <p>Risk that feelings of guilt and judgement are off putting for consumers</p>
Communication barriers	<p>A lack of mainstream media coverage</p> <p>Identifying how to successfully communicate the wider benefits of sustainable production to consumers</p> <p>More consumer knowledge needed regarding:</p> <ul data-bbox="651 1182 1337 1601" style="list-style-type: none">• Communication preferences• Price expectations• Style and design requirements• Lifestyle preferences• Importance of quality, longevity and ethics to consumers• Receptiveness to environmental and ethical messages• Motivations to follow through on expressed good intentions• Motivations to cease continued irresponsible consumption
Design and production barriers	<p>Designers are required to spend significant amounts of time researching sourcing options</p> <p>Uncertain supply through reliance on only one sourcing stream (e.g. post-consumer textiles).</p> <p>Lack sustainable options presented to designers and product developers in larger organisations</p> <p>Lack of skills, knowledge and agency for designers and product developers to make sustainability decisions</p>

<p>Retail barriers</p>	<p>Identifying the most effective retail strategy for sustainable fashion</p> <p>Limited understanding from UK retail buyers regarding stock variability and product quality</p> <p>Retail buyers prejudge upcycled stock to be inconsistent in supply, quality and consistency</p> <p>Unwillingness of retail buyers to place orders leads to a lack of wider acceptance</p> <p>Extra time on sourcing and smaller production runs lead to higher prices for consumers</p>
<p>Industry barriers</p>	<p>A lack of integration of sustainable fashion into the mainstream – sustainable fashion shown as a novelty.</p> <p>Lack of fashion industry acceptance of sustainable brands and practices</p> <p>Lack of wide spread fashion industry transparency</p>

Conclusions

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