

Design for a Circular Economy: A Paradigm shift

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We are in a paradigm shift. A move from a linear destructive model to a circular and restorative model. This requires radical change in terms of business models, modes of operations and the design methods, tools and techniques used to design with intention. A new methodological framework is proposed and explored that crosses leading behavioural change research with emerging design through action research. It was found that the methodological framework is able to change norms, raise salience and so prime participants for ideation in a circular economy and that while this research is in early days it shows promise as a way to accelerate innovative concepts that can radically change an eco-system for a circular economy.

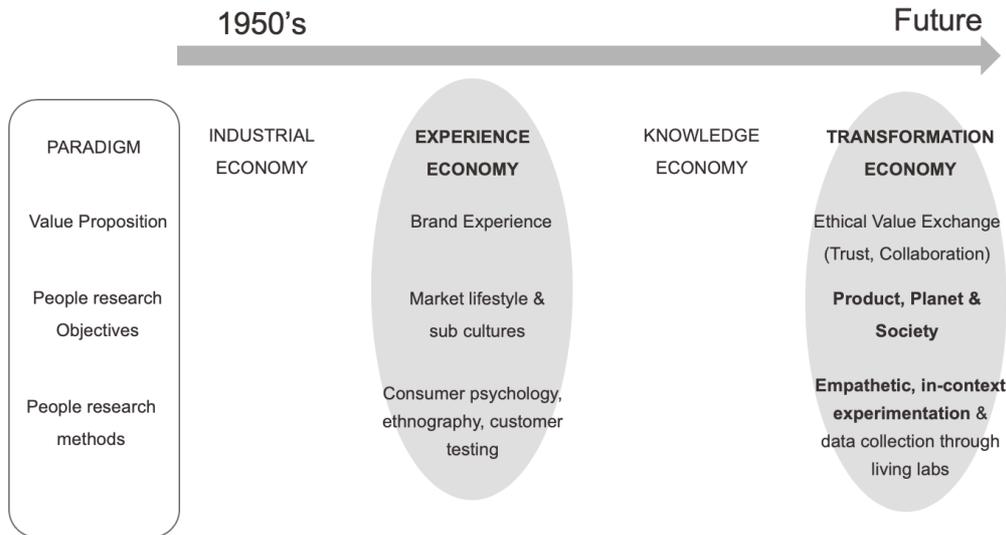
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1 Introduction

We are in a paradigm shift, in the sense of Kuhn (Shapere, 1964) a move beyond, business as usual and linear economies to a circular economy (Stahel and Reday 1981) whereby business models and modes of operation require radical change and designers are progressively drawn into more fundamental phases of product (and system) evolution (Hall, 2011) with greater transdisciplinary collaborations (Stock & Burton 2011) to design for change (Banjeree 2008) with intension and for sustainability (Stegall, 2006) Design requires new methods, tools and techniques (Gardien, Djajadiningrat, Hummels, & Brombacher 2014).

Societal and environmental changes have urged governments to act immediately, to accelerate programs and business using radical changes to address the well-being of people and their environments overall (Paris Agreement cop21 2015, SDG 2016, G20 2018). Accompanied by exponential growth in technology processing power (Moore's Law), enabling distributed processing, has accelerated a paradigm shift through the 'experience economy', a linear business model with focus on the product and brand experience, and into the 'transformation economy' (Brand and Rocci 2011). In this new economy business behaviours and deliverables are valued for their holistic approach; beyond the design of the product or system and inclusive of social and environmental aspects; embedded in digital technologies. See Figure 1. (Gardien et al., 2014); (Bakker, Hollander, Van Hinte & Zijlstra 2014). "Our current consumption and production patterns are unsustainable" (Baldassarre, Calabretta, Bocken, & Jaskiewicz, 2017). There are significant benefits to moving to a circular economy as "regenerative loops aim to create, Innovation opportunity, Job creation, Economic competitiveness, Resource savings, Waste prevention"; and the principles of CE aim to minimize a) inputs in terms of resources and energy and b) outputs as given as waste, emissions and energy loss. (Stahel and Reday 1981).

Paradigm changes



Adapted from Brand, R., and Rocchi, S (2011); Gardien, P., Djajadiningrat, T., Hummels, C., & Brombacher, A. (2014)

Figure 1: Paradigm Changes. Adapted from Brand, R., and Rocchi, S (2011); Gardien, P., Djajadiningrat, T., Hummels, C., & Brombacher, A. (2014)

The European Union, (European Commission (EC) 2016) adopted the Circular Economy model “As part of its continuous effort to transform Europe's economy into a more sustainable one and to implement the ambitious Circular Economy Action Plan”: this continues to evolve as measures for circular economy are added for implementation. The EC believes that change “must involve all sectors of the economy, including industry, transport, building and agriculture”.

Yet only 9% of the planet is circular (PACE, 2019). The linear model continues to be the current norm and given the recent rise in levels of carbon dioxide outputs in 2018 accompanied by the geopolitical withdrawals and denials of climate change there has been a reversal in progress since the United Nations ratification in Paris (2015); (Nature 2018); (PACE 2019). “Next to the implementation of innovative technology, sustainable development based on innovative business models, better understanding of customer needs and behavioural change are crucial” (Baldassarre et al., 2017). This paradigm shift requires intentional design for sustainability that embodies the new purpose across the full ecosystem (Stegall 2006). Intentional design is needed at the front end of the process to “inform and inspire open ended questions” (Sanders & Stappers, 2008); “design out” adverse consequences (Cross 1972): as only designing with intention can designers reach circular economy goals towards sustainability.

For these reasons this study explores through action research a new methodological framework (Seago 1994/5) with motive to explore, support and accelerate the design of novel business concepts for a circular economy using a systems and design thinking approach: in the sector of food and agriculture. Action research is used as it allows the researcher to explore the potential of the methodological framework in context and in this

way, evaluate the concept outcomes in a real world environment. (Frayling (1993); Seago 1994/5))

2 Context

This action research is part of a larger study comprising of a series of six trials, that explore the use of a new methodological framework to create through transdisciplinary dialogues (Banerjee 2008), located at and beyond the leading edge of designing for sustainability (Stegall, 2006) that seek to propose new opportunities that can evolve technologies, markets, user expectations and behaviours (Hall 2011) for a circular economy. This work explores the scenario of the food system, as it is one of the largest contributors to climate change and requires radical transformation (Willet et al., 2019). This work develops use of theory and builds on author learning from previous action research in food and agriculture with intention to innovate radical concepts for a circular food and agriculture economy among a diverse group of system stakeholders. (Evans., Valsecchi., Pollastri., (2012); Evans. (2015); Evans., & Kennedy (2015); Evans., Fassi and Meroni (2016)).

The methodological framework and process remain the same across all six trials. While the specific content is nuanced for the challenge and region. For these reasons, this work will focus on the action research projects conducted at two Food Tech conferences held at University College Davis, 2017 and at the University College Dublin in 2018: content of the conferences was focused on the food and agriculture domain and its relationship with emerging tech and the Internet-of-Things: attracting speakers and participants associated with this domain.

This paper will focus on the 'work' done by the participants in the real-world setting. (Pawson and Tilly 1997, p60).

3 Methodology

Two, three-hour action research studies were conducted one at each of the conferences, respectively, among a diverse group of 30 eco-system stakeholders; including farmers, venture capital fund managers, academics, NGOs, Agricultural regional director, business managers and directors, food scientists and data analytics researchers and developers. The participants actively chose to participate in the study. Data was gathered in different ways by two researchers using individual and team feedback, concept development and outcomes, and participant round table.

The research question proposed to initiate ideation was framed by the goal to create food & Agriculture concepts in a circular economy such that it asked; "How can we innovate by using our knowledge, systems and Internet-Of-Things to better manage food?"

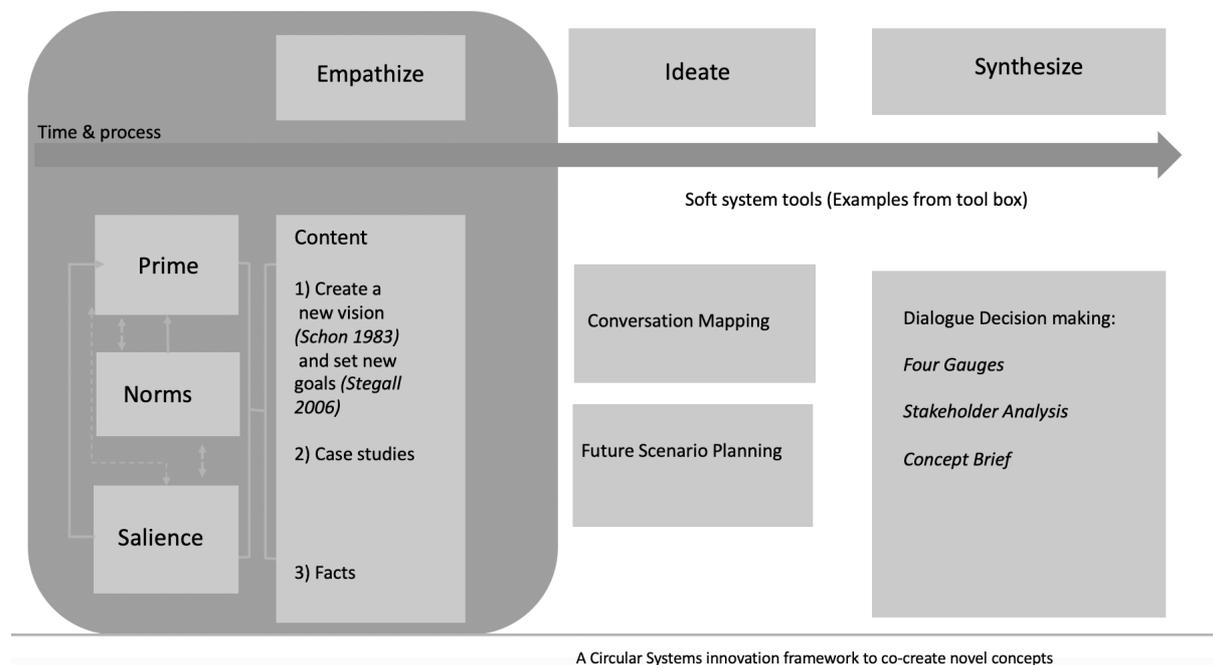
3.1 The new methodological framework

The methodological framework (Figure 2) has been developed with intention to explore, support and accelerate novel business scenarios in a food and Agriculture., circular economy using a systems and design thinking approach. It has been designed to enable quick paced interventions, (Reis 2011) at the start of the design process; enable circular economy concept innovations, over a short time period, among diverse groups of

participants, who may have significantly different knowledge levels and experience in circular economy and sustainability thinking and implementation either from a business, government or individual perspective. The aim is to use this intervention to support both initiation of new ways of doing at the; a) food and Agriculture., eco-systems level and b) business transition for a circular economy (Bocken, Schuit, & Kraaijenhagen 2018).

It draws on the behavioural change work of (Dolan, Hallsworth, Halpern, King, Metcalfe & Vlaev 2012) who discuss the “increasing evidence to suggest that ‘changing contexts’ by influencing the environments within which people act (in largely automatic ways) can have important effects on behavior.”

A New Methodological Framework



A Circular Systems innovation framework to co-create novel concepts

Figure 2. A New Methodological Framework to co-create novel concepts in a circular economy: Adapted from Evans (2019)

The methodological framework aims to change the context from which participants tackle the challenge, to raise automatic behavioural responses from the perspective of a circular economy context by resetting business model norms and raising salience in the potential of the challenge. In this way, specific knowledge is primed in memory to make it more accessible and therefore more influential in processing new stimuli (Richardson-klavehn & Bjork 1988).

The framework consists of three parts, namely, Empathize, Ideate and synthesize. The *Empathize phase* is used with intention to change the context and to shift participants perspective and so their automatic decision-making references. This is achieved through knowledge sharing and takes place prior to ideation phase and aims to shift context from a linear model perspective (the current norm) to a circular model perspective (the intentional norm).

The description of how this change is achieved and then evaluated is the focus of this work.

Evaluation is made to assess the extent and ability of participants to innovate for a circular economy following the emphasize phase and again using final outcomes.

Phase 2: Ideation, captures idea plurality (Fry 2010), enabling all stakeholders to participate and contribute from their personal perspectives and unique context along the eco-system. Themes (Dorst 2011) are created and developed through teamwork and reflected on further using future scenario planning tools.

Phase 3: Synthesis is where teams are encouraged to develop their preferred concept, given the challenge, through further reflection using tools such as the four gauges (Burnett & Evans 2016) and a stakeholder roll-out plan.

In the following sections the empathize phase is explained in greater detail as the first assessment of the methodological framework is to understand if and how the emphasize phase delivers.

During the empathize phase consideration is placed on changing the norm as “the greater the influence and following of a norm in a social group the more likely others will adhere to it” (Burke and Payton-Young 2011); raising salience through the use of “stimuli that are novel, accessible and simple” as these “are more likely to register with people” (Houser, Reiley and Urbancic 2008); and priming as “behaviour is influenced by where we place our attention” (Kahneman and Thaler (2006).

This phase comprises of three parts; 1) an alternative future novel vision (Margolin 2007; Schon 83/84); 2) case studies; and 3) facts and in this way aims to change the ideation context and set the challenge.

3.1.1 An alternative future vision: The work of Schon (1983/4) is leveraged such that an alternative future vision is created based on a paradigm change from linear production processes to circular and, in this way, contributes to changing the established norm. It further helps to set the design intention and sets new goals (Stegall 2006), to encourage participant ideation for a circular economy beyond the established ‘baked in’ linear model norm (PACE 2019). The alternative future vision is created in several steps; the first considers the core principles of the circular economy in line with Stegall’s second philosophy (2006); (Lewandowski 2016); secondly builds on the circular economy through consideration of a reduction of waste. In these trials a focus is also given to by-product production and services through micro localized circular systems (Stahel and Reday 1981); and thirdly introduces the concept of data, data flow, its usage and raises questions as to its potential.

3.1.2 Case study examples were chosen to contribute to resetting norms and raising salience, chosen for their qualities of novel, accessible and simple (Houser et al 2008), and grouped under three types. For this study all examples demonstrated by-product usage with specific emphasis; a) established , long term, by-product success stories, b) Rapid success through Venture Capital funds and c) Regenerative usage (Scott 2015). Regionality was also considered with the thought to increase accessibility of the case study.

3.1.3 Facts were used to emphasize the necessity to reduce waste, including policy decisions, in-line with circular economy principles. To do this by considering the opportunities along the full system and to use product already in the system to extract greater value with the aim to reduce waste output of the system.

Together, the aim of the empathize phase is to change the context (Dolan et al., 2012) and importantly the norms, to an alternative future view (Schon 1983), “that could and should be” (Margolin 2007 p5) of the problem and raise automatic decision making with cause for participants to consider alternative solutions to meet new goals by designing in a circular economy for sustainability.

An evaluative intervention was conducted following the knowledge sharing and before the ideation, to assess what participants found to be new and interesting; concepts, facts or examples that were brought to the foreground during this phase.

4 Findings

These are organised to answer two questions that aim to measure if and how the methodological framework met its goals to innovate radical concepts for a circular economy among a diverse group of Food and Agriculture stakeholders; 1) Did knowledge sharing meet its goals? And in what ways did it change norms from a linear business perception to a circular one; convey circular economy thinking such as to extract more value from the considered materials and energy inputs and therefore reduce: a) energy and materials entering in the system and b) waste leaving the system; 2) How did the concepts created using this methodological framework contribute to a circular economy?

4.1 Knowledge Sharing Evaluation

Knowledge sharing was found to convey a set of key elements that helped to raise automatic decision making in a circular economy among participants. Indication that norms were re-evaluated, examples proved to be salient and the alternative future vision was received as viable albeit with much work to be done and with very different time scales observed between different eco-system stakeholders.

Participants found that the alternative future vision with by-product micro systems was easy to understand and conveyed clearly the concept of a circular production system and economy whereby resources are retained in the system. Further, from this example greater value can be extracted from the resources by considering the by-product opportunities.

On reflection following knowledge sharing participants were motivated by examples of circular economy and discussed the potential of; “micro circular systems (by-products)”; and “circular economy” as opportunities to change the way things are done; Further, dialogue indicated that the “use of data” had not been previously considered from a systems perspective and that by taking an alternative systems view there appear to be many untapped opportunities; In general policy is considered to lag behind innovation so that a conversation on “Policy as accelerator rather than laggard” inspired different ways to approach inclusion of policy makers in the design process; The indication of by-product potential at various points on the food and agriculture chain opened us a great many possibilities for consideration as one participant commented that there is “Potential to remove waste at many points”.

The case study examples were able to establish a wide variety of opportunities that raised curiosity in types of new businesses that might be created. Specifically, a case study example of ‘tomato skins and seeds to pesticide and fertilizer’, was found to highlight an opportunity to use food beyond the direct food chain. This was key to open up imagination about ‘what might be’ and of what might be needed in terms of data, knowledge and technology to be able to make potential concepts more accessible. Highlighted simple facts,

such as the amount of food wasted and how this requires further resources to process and dispose, were found to stimulate the necessity and urgency for system change from linear production to circular economy and in this way better manage the food grown in the system so as to improve the amount of grown food reaching its intended purpose. Examples were able to activate related knowledge and make it more accessible to process the challenge; as the examples demonstrated that a change has already begun.

4.2 Concept Evaluation

In this section the evaluation of output concepts is discussed in terms of method used to measure 'work' done during the process of the methodological framework that led to concept outcomes with the aim to deliver impact for a circular economy. In this way identification can be made of the potential for circular economy contributions through use of the methodological framework. The specific outcomes are not the focus of this research.

An adapted framework from ReSolve (Ellen MacArthur foundation 2013/15) is applied to assess the contribution of the output concepts in a circular economy; this includes opportunities to Regenerate, Share, Optimize, Loop, Virtualize and Exchange; with additional social values included from the work of Laubscher and Merinelli (Lewandowski 2016).

Evaluation was applied to two concepts and found that both concepts could contribute to ReSolve's 'Optimizing' classification for a circular economy: described as 'an Increase in performance and /or efficiency of products and reduce waste in production and supply chains.' That 'can be linked to leveraging big data, automation, remote sensing and steering (not necessary that product is changed or technology)'. In both cases data strategies were applied in new ways which would require technological development. These developments could offer different opportunities for eco-system stakeholders to apply information that could lead to new business models in a CE.

4 Discussion

The action research is located at the initiation of the design process (Harder, Burford & Hoover 2013) with aim to ideate and innovate radical concepts in a circular economy, over a short time frame, three hours, and has demonstrated that in these cases, conducted at a domain specific conference 'Food Tech', it was able to, during this time frame and within these conditions, change the ideation context, using the empathize phase, to shift automatic decision making and reflection toward tackling system challenges and ideating solutions with circular economy goals.

Concepts were evaluated using circular economy frameworks to assess if and how they contribute to a circular economy.

It was found that participants were successfully primed (Dolan et al 2012) to tackle the circular economy challenge by exploring the by-product food opportunities to extract greater value from the products already in the system. Two viable concepts were evaluated that were shown to contribute to a circular economy by setting goals to extract greater value from produce already in the system and in this way reduce waste exiting the system. (Stahel &

Reday 1981; Ellen MacArthur 2013/15). As assessed by Resolve's framework both output concepts could contribute to 'optimize' classification, 'an increase in performance/efficiency of product and reduce waste in production and supply chain'.

Concepts demonstrated that the creative scope of ideas as a result of the methodological process, can be diverse when addressing open ended questions, at the upfront of the design process (Sanders & Stappers 2008). A specific concept might address one defined issue and contribute to a circular economy, yet there can be alternative proposals conveyed with very different interventions to address the same issue. In this study there was diversion on type of resources to get work done, in one case an idea skewed heavily towards human labor resource intended to produce positive community impact and on the other hand a technical solution leveraging emerging tech; AI and robotics. This led to very different impacts beyond the primary goal. Impact could be measured on community, relationships, budget, timing for example. It can be said that the value of this diversity provides flexibility that may help to address regional and local needs and capabilities that may lead to a variety of choices dependent on community, availability of NGO's, type of soil and produce, or technical and robotic services; for example. Each intervention will be locally assessed in terms of its contribution to the circular economy along with, its viability, desirability and feasibility.

As a way to pre-empt an ideation process that aims to innovate in a circular economy the empathy phase was, in these conditions, found to be successful: able to change norms, prime participants and co-create concepts for a circular economy that might radically change the current system.

5 Conclusions

An exploration of a new methodological framework that influences behavior by 'changing context', the environment within which people act (in largely automatic ways), from the field of economics and psychology, crossed with emerging design practices through action research, has shown to be effective, in early trials, as an intervention to innovate concepts for a circular economy; over a short time period, among a diverse group of food and Agriculture stakeholders in a domain specific conference setting. A proposed new methodological framework uses a three-part process whereby phase 1, the empathy stage uses a set of three types of stimuli to change the context, prior to ideation, phase 2; and synthesize phase 3. It was found that the empathize phase was able to change norms, raise salience and so prime participants prior to ideation of concepts for a circular economy. The concept outputs show signs for innovation with contributions to the circular economy, following the design process. This research is in early days yet shows promise as a way for quick intense design interventions that may accelerate innovative concepts with potential to radically change an eco-system and in this way, could transition business for a circular economy.

6 Limitations and directions for future

Action research by its very nature is in context and is not considered rigorous compared with scientific lab experimentation. The work can benefit from understanding the effects of knowledge sharing as presented in Phase 1 in a more controlled environment such that data can be obtained and compared for both in context real world research and in a more

scientific experiment where certain external variables in real world research can be controlled.

There are only two case studies that explore the food and agriculture eco – system. Further research will explore the opportunity for the use of the methodological framework at other interventions along the food chain and in another scenario. In this way generalization of the results can be discussed both across an eco-system and for alternative scenarios.

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