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Systems Thinking in Practice in a Circular Economy

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ABSTRACT

The Circular Economy (CE) is frequently touted as important for building sustainability. Despite growing interest in CE, few theories have provided effective on-the-ground tools for building circularity. This case study of an agricultural organization in Western Canada illustrates how the logic of complexity helps frame and sustain a CE. Interviewees embraced complexity to manage the messy, unpredictable work of CE. Although preliminary, this suggests the possibility that circular economy-like behaviour may be more complex than currently understood. Interviewees represented complex systems thinkers in the wild and could help others seeking to build their own CE initiatives.

RÉSUMÉ

L'économie circulaire (EC) est souvent présentée comme étant importante pour construire la durabilité. Malgré l'intérêt croissant pour l'EC, les nouvelles théories n'ont pas encore permis de créer de nombreux outils efficaces sur le terrain pour construire la circularité. Cependant, grâce à une étude de cas descriptive d'une multi-organisation dans l'agriculture de l'Ouest canadien, nous avons constaté que la logique de la complexité a aidé à encadrer et à soutenir leur travail de construction et de maintien d'une EC. Les personnes interrogées ont adopté la complexité dans le but de gérer le travail compliqué et imprévisible du CE. Bien que préliminaire, cela suggère la possibilité que les comportements de type économie circulaire soient plus tenaces qu'on ne le pense actuellement. Les personnes interrogées étaient de purs penseurs de systèmes complexes et pouvaient aider d'autres personnes cherchant à mettre en place leurs propres initiatives d'EC.

Keywords / Mots clés : circular economy, social economy, complexity / économie circulaire, économie sociale

INTRODUCTION

The circular economy (CE) necessitates a wide range of actions, decisions, and structures at the firm level to achieve economic models that seek utility and value in waste products. Circular economy approaches shift us from a linear, one-use production line toward production loops, where we

both reduce the amount of farming/mining/felling and maximize the value we derive from the goods we use already (Korhonen, Honkasalo, & Seppälä, 2016). Because CE behaviours reduce and reuse what we need to keep economic activity going, CE is often associated with sustainability efforts across a wide range of industries; if we use less and reuse, we can help protect the planet's limited resources.

Despite the hope CE can help build sustainability and prosperity (Winans, Kendall, & Deng, 2017; Coscieme, Manshoven, Gillabel, Grossi, & Mortensen, 2022; Springle, Li, Soma, & Shulman, 2022), many practical obstacles remain, including the lack of consensus in defining and generally understanding CE and the development of robust networks/supply chains to support looping waste into value (Bressanelli, Perona, & Saccani, 2019).

On paper, successful CE relies on navigating complex adaptive systems, but does this work in practice or present another barrier? This student-led study explored if those working in CE engage with complexity, and whether we can bridge the divide between theory and on-the-ground practice. The authors wanted to understand if those currently working in CE employed a complex systems-informed approach, and what these practitioners could teach us about how to train the next generation of changemakers.

APPROACHES TO THE CIRCULAR ECONOMY

Circular economy requires a range of considerations, from the energy used (the quantity and sustainability of the source), to the materials used in production (types, amounts, and life cycles), with the goal of improving sustainability and reducing needless waste (Korhonen et al., 2016). One of the more important considerations is how to shift from using materials in a one-off, linear production process to repurposing, revaluing, and reusing materials; hence, a circular rather than linear process (Korhonen et al., 2016).

Factors such as conscientious consumerism, stricter legislation, environmental concerns, and technological innovations are driving interest in CE (Antikainen & Valkokari, 2016; Korhonen et al., 2016; Pieroni, McAloone, & Pigosso, 2019; Boons, Montavlo, Quist, & Wagner, 2013). However, Hvass and Pedersen (2019) explore the CE-based "take-back" initiative, which promotes circular sustainability practices among consumers, and conclude there are numerous challenges for brands considering CE, including "diverging perspectives of value, unclear success criteria, poor alignment with existing strategy, limited internal skills and competencies, and limited consumer interest" (p. 346). Bressanelli, Perona, and Saccani (2019) argue significant uncertainties in the quality, quantity, and timing of product outputs in circular supply chains undermine CE efforts. There are major discrepancies between the expected and actual outcomes of CE.

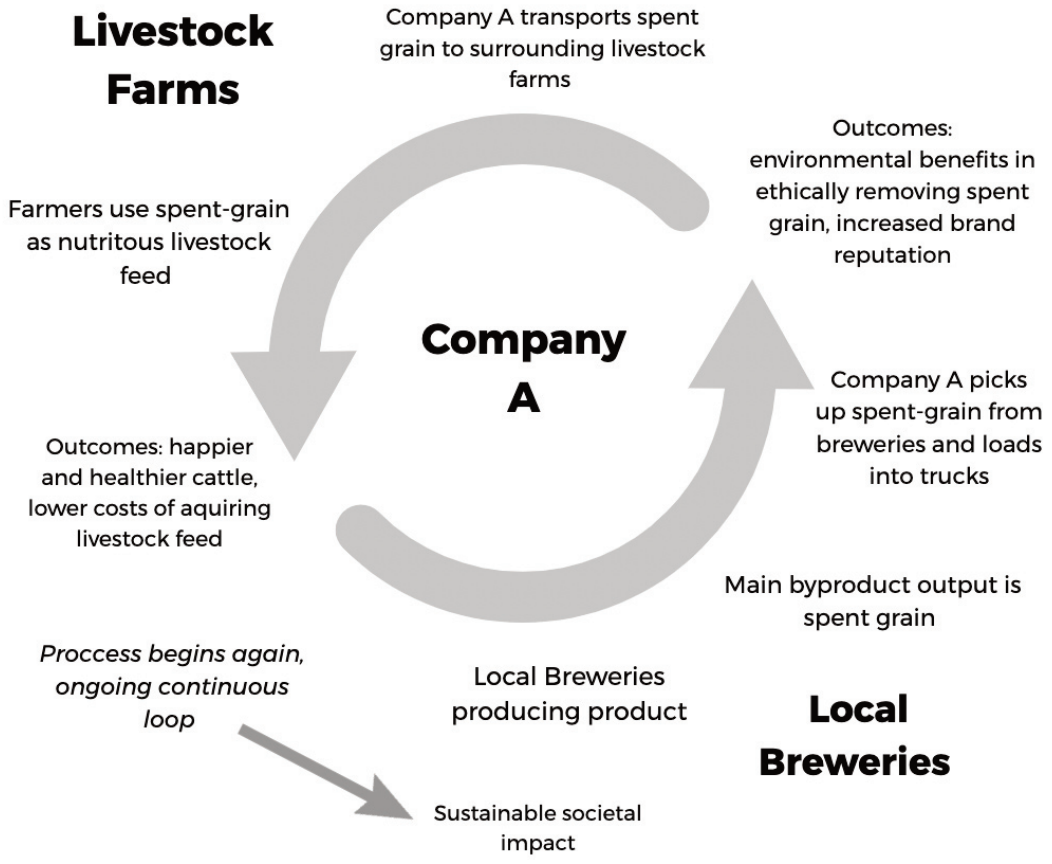
We see parallels between CE and discussions on complexity and complex systems, from the Club of Rome's emphasis on shifting away from linear consumption (Winans et al., 2017; Such, Fernandes, Kraus, Filter, & Sjorgren, 2021), to the World Economic Forum's definition of CE as a designed system that maximizes the value of inputs (as cited in Springle et al., 2022). Complex adaptive systems and CE share common language and concepts (McGowan et al, 2024; Choi, Dooley, & Rungtusanatham, 2001). The most prominent shared concepts are feedback loops, which basically

describes the circular quality of CE (Charter, 2018), and the interdependency and connection between seemingly disparate sectors and businesses (De Angelis, 2022; Springle et al., 2022; Such et al., 2021). Both areas explore the "wicked" problems (intractable, messy problems) and the adjacent possible (little changes that could lead to bigger ones) (Tsui, Chan, Harfitt, & Leung, 2020). Springle, Soma, and Schulman (2022) explicitly used systems thinking in their CE-focused social innovation lab (Laban et al., 2015, as cited in Springle et al., 2022). Yet labs, while useful, are contained spaces, suggesting the need to explore complexity in a more real-world context.

SITE OF EXPLORATION

To capture a real-world example of CE, the authors engaged in a descriptive case study of a Western Canadian social enterprise (Company A) that operates as a regenerative research ranch using a closed-loop business model (Figure 1). This article aims to answer the following question: how can CE be a critical component of an industry that is a core part of Western Canadian identity? Company A has three initiatives: 1) offering farm fresh foods to small local businesses, 2) removing brewers' spent grain (BSG) from local breweries, distilleries, and food processors, and 3) transforming BSG into livestock feed. Brewers' spent grain is a brewery by-product consisting of barley grain husks and seed coat layers, and accounts for 85 percent of total brewery waste, but is a significant source of nutrients for livestock (Sganzerla, Ampese, Mussatto, & Forster-Carniero, 2021). Brewers' spent grain can replace or supplement livestock feed for farmers (Sousa, Gil, & Calisto, 2020).

Figure 1: Company A's closed-loop system



METHODOLOGY

The authors performed five semi-structured interviews with six stakeholders of Company A in October 2022. The interview questions explored Company A's structure, supply chains, and closed-loop production. Interviewees received interview transcripts for review and approval prior to analysis. The interview responses were manually analyzed for emergent trends/themes independently and triangulated to check assumptions and develop themes. The themes are discussed below.

TRUST AND THINKING IN SYSTEMS

Interviewees discussed unpredictability and uncertainty in building a circular process and emphasized the need for strong trust in relationships and communication. But which comes first? Do you build trust via an effective circular supply chain or build a circular supply chain from a foundation of trust? A more careful reading of the interviews reveals that farmers' needs and rhythms are hard to predict outside broad parameters, presenting a significant obstacle to building a reliable supply chain. Yet, the trust between brewers and farmers, and the trust they both have in the process, increases predictability in the outcome. Understanding what others need and the externalities that may affect them can create flexibility.

The importance of trust suggests Company A's method of CE in practice may not appeal to other organizations especially because building relationships takes time. Yet interviewees appreciated the tensions they constantly manage, and the need to learn and be open to how the system moves around them; they are complex systems thinkers in the wild, engaged in real-time analysis and adjustments to feedback loops and information flows.

Interviewees acknowledged the farmers' wicked problems, and financial burdens that limit productivity and prosperity. Brewery waste presented an opportunity to collaborate. Company A explored the adjacent possible during its brainstorming pre-foundation period, questioning the current system's structure with a closed-loop network to repurpose Brewers' spent grain by-product into livestock feed for cattle calf farms. This navigation relied on rejecting/shifting the status quo. Interviewees acknowledged that this shift was particularly difficult for farmers considering the cultural and technical barriers to innovative agricultural practices (Vetroni Barros, Salvador, de Francisco, & Piekarski, 2020). Interviewees saw moving into this adjacent possible as more desirable than standing still, from business and sustainability perspectives. What is not immediately clear, however, is whether this perspective was a precursor to work in the CE, or a consequence of it.

IMPLICATIONS FOR THE FIELD

Company A is acting as a systems thinker in the wild. While this approach is consistent with the literature, we did not expect to see it this explicitly and comfortably used, which was an important lesson. Interviewees' use of complexity suggests a promising future for CE. While this may be a strategically beneficial partnership, members understood interdependence, exploring the adjacent possible and embracing emergence as a way of doing business.

What can we learn from Company A? First, exploring the adjacent possible does not need to mean reinventing the wheel or imagining a wholly new form of transportation. It is about exploring those

options one degree removed from what organizations are doing today—most of the tools or pieces already exist. Thinking across sectors rather than well into the future may be more important; similarly, learning from others can be an effective way to explore the adjacent possible. Using BSG for feedstock was not a novel choice, but it was novel for Company A, and it meant challenging cultures and practices. This is likely necessary in shifting production to greater sustainability and circularity, but it can be done by exploring the next step—not the next whole system.

Second, trust was the foundation for navigating the challenges of small-scale circularity. Trust helps prepare for surprising outcomes. It needs to be built and it needs to be based on communication. But Company A is one small organization; can trust survive growth or scaling? Only time will tell.

Last, understanding complexity has played a role in Company A's success. Those interested in CE may want to explore systems thinking as a set of tools to embrace the messiness, not to get rid of it. Similarly, emerging social entrepreneurs and those teaching them should explore how to see systems in the wild—and out of the classroom.

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