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Cleaner production practices towards circular economy implementation at the micro-level: an empirical investigation of a home appliance manufacturer

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Academic Work

Agenda

- Context and objectives
- Research design
- Analysis of a PSS as a circular business model
  - PSS business model structure and elements
  - CP practices and CE issues adopted by the company
- Summary and future research
- Acknowledgements

Context and objectives (1/2)

- The concept of circular economy (CE) has been discussed as an effective strategy towards sustainable socio-technical systems
  - The core of CE is the closed flow of materials and the use of raw materials and energy through multiple phases (Yuan et al., 2006)
- Implementation of CE around the world is still restricted, especially at the micro-level (Ghisellini et al., 2016)
  - There is still limited adoption of circular economy issues in the industry
  - New collaborative business models and different strategies are necessary for CE implementation in industry

Context and objectives (2/2)

- Cleaner production (CP) is one of the main strategies to be considered as preparatory towards CE
  - The waste and pollution prevention (the main important objectives of CE) can only be achieved by a change to CP principles
  - Few studies deal with the diffusion, adoption, and effects of CP in promoting CE (Ghisellini et al., 2016)
  - More extensive work in new business models as triggers for CE implementation should be conducted (Lieder and Rashid, 2016)
- ***Paper's objective:*** *to explore how CP practices may contribute to CE implementation at the micro-level by investigating the implementation of a product-service system (PSS) business model in a manufacturing company located in Brazil*

Research design (1/3)

- Case-based research with the aim of exploring how CP may contribute to CE implementation
- Step 1: development of a conceptual framework
  - Analysis of CE and CP literature to establish a suitable lens for the analysis (CP practices, principles, indicators/CE requirements)
- Step 2: case study design
  - Selection of the unit of analysis based on the expectations for the information content
  - Focus on manufacturing companies with innovative business models
  - Selection of primary and secondary data sources

Research design (2/3)

- Step 3: data collection

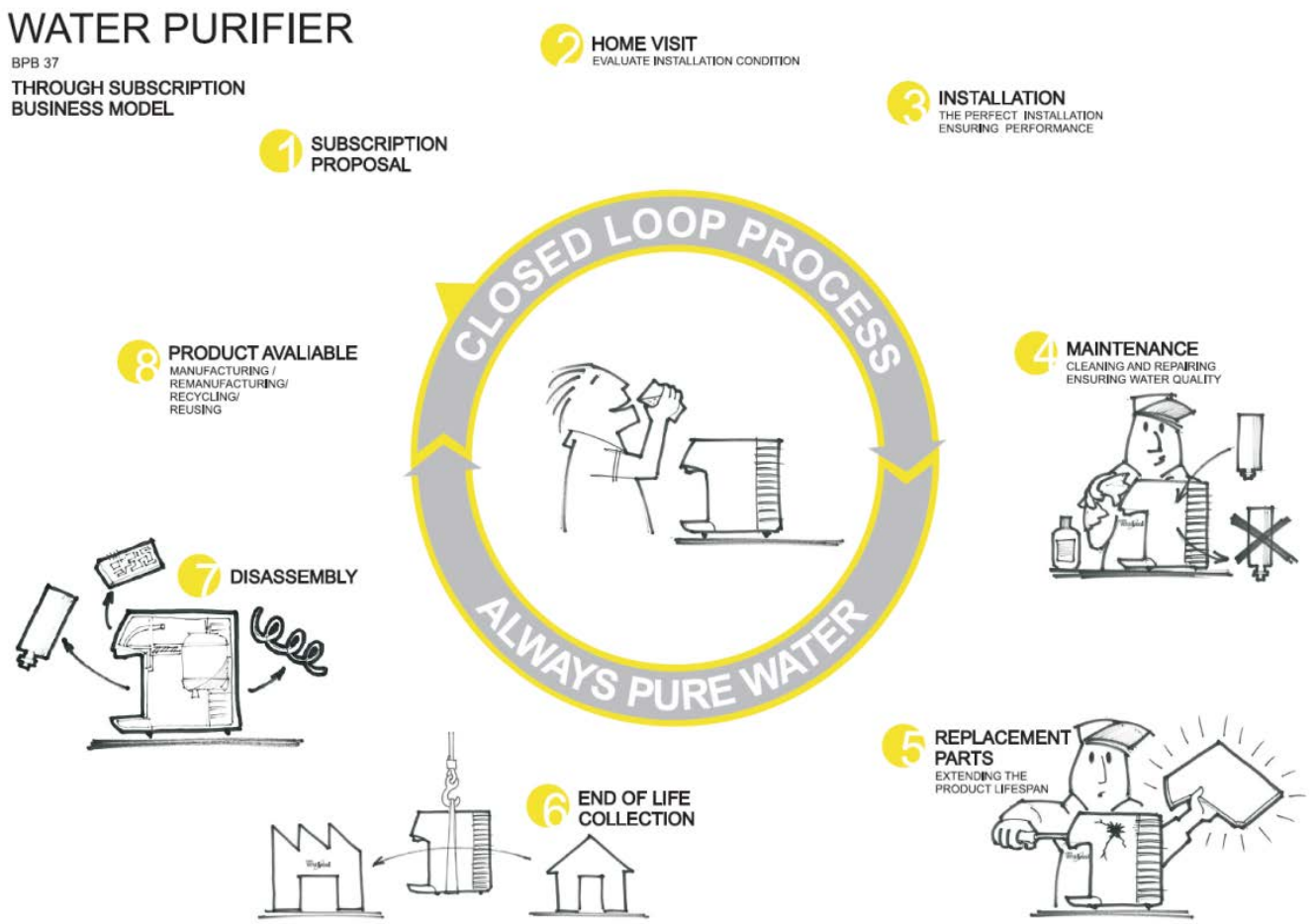
Function	Key information gathered	Information gathered by
Project manager	- Context of the business	Onsite visit (production)
Lead product engineer	Product life cycle aspects	document analysis
Marketing manager	- Context of the business	Onsite visit (marketing sector)
	- Business model development process	document analysis
Service & Operations manager	- Overall service structure	Interview , document analysis
	- Overall manufacturing process	
Operations manager (EoL services supplier)	- Partnership structure	Interview by phone, company website
	- Overall process of receiving, inspecting, disassembling and recycling products	
	- Legal and contracts practices	
	- Incentives and profit-share structure	
Sustainability manager	- Sustainability plan and key actions	onsite visit (production), document analysis (e.g. sustainability practices report)
	- Zero waste program structure	
	Water and energy efficiency programs	
	- Sustainability practices adopted	
	- Governmental and third parties relations	
	- Suppliers certification practices	

Research design (3/3)

- Step 4: data analysis
  - Case description (PSS business model elements)
  - Inductive approach: analysis based on working on the data from the ground up (Yin, 2014) with the propositions emerging by examining the data
    - ➢ Content analysis to map the data and group the concepts in the same phenomenon (related to the same CP principle/practice and CE requirements to be measured in the paradigm shift)
    - ➢ Identification of some propositions that can be subject to further testing in levering on other research designs, as suggested by Meredith (1998)

PSS business model structure (1/2)

- Use-oriented solution, focused on the delivery of 'purified water' in a leasing scheme



PSS business model structure (2/2)

- Value proposition
  - Provision of “safe drinking water”
  - The business model is structured to maximize product use, contributing to the reduction of bottled water consumption
  - Use oriented solution that potentially intensify the use of material and hence could reduce the need for materials (Tukker, 2015)
- Value creation
  - Integrated collaboration among the service provider, other stakeholders (e.g. the NGO), and consumers
- Value capture
  - Structured to afford customers access to the service provided
  - It is not oriented towards product ownership

CP practices and CE issues in the company (1/6)

- Identification of CP practices that contribute to CE implementation

CP practice performance indicator	CE requirements contribution
Increase the durability of the products	Increasing the value durability of products
Implementation of waste minimization programs	Reducing valuable materials losses
Optimization the recyclability in product design	Increasing the value durability of products
Integration in environmental issues in process and innovation	Increasing the value durability of products
Optimization of environmental issues in supplier selection	Increasing share of renewable and recyclable resources
Reduction of the use of raw materials and resources	Reducing input and use of natural resources
Simplification of the product installation process	Increasing the value durability of products
Efficient use of chemicals in manufacturing processes	Reducing emissions levels, reducing valuable materials losses
Integration of environmental issues in the logistical design	Reducing valuable materials losses

CP practices and CE issues in the company (2/6)

- Identification of CP practices that contribute to CE implementation

CP practice performance indicator	CE requirements contribution
Reduction in the use of natural resources in manufacturing processes	Reducing input and use of natural resources
Evaluation of the replacement of materials with non-toxic and non-polluting products	Reducing emission levels, increasing share of renewable and recyclable resources
Improving in the recyclability in operational activities	Increasing the value durability of products, reducing valuable materials losses
Evaluation of the possibility of changing the material composition of products	Reducing input and use of natural resources
Share information about recycling programs and standard practice with stakeholders	Reducing valuable materials losses, reducing input and use of natural resources
Optimization of recycling, remanufacturing and reuse in product design	Increasing the value durability of products
Use energy-saving equipment	Reducing input and use of natural resources, reducing emissions level

CP practices and CE issues in the company (3/6)

- CP principle of product optimization
  - Implementation of new capabilities, new design strategies for slowing resources loops aligned with CE principles
  - Optimization of the recyclability in product design, improvement of recyclability in operational activities, simplification of the product installation process
  - ***Proposition 1:*** *CP practices for product optimization are valuable to CE implementation regarding circular product design strategies as well as to increase the value durability of products*

CP practices and CE issues in the company (4/6)

- CP principle of input substitution – critical material management/suppliers certification program
  - Relevant CP identified practices: (i) evaluation of the possibility of changing the material composition of products, (ii) reduction of the use of raw materials and resources, (iii) reduction in the use of natural resources in manufacturing processes
  - Those are important to reduce input and use of natural resources
  - ***Proposition 2:*** *the CP principle of input substitution is valuable to reduce input and use of natural resources and to increase the share of renewable and recyclable resources*

CP practices and CE issues in the company (5/6)

- CP principles of increasing the efficiency of material and energy use in processes and reduce losses due to leakage (good housekeeping), and internal recycling
  - Implementation of a ‘zero waste’ program (a specific indicator called ‘total waste’ was set up (kg/unit)) - total waste material generated to produce one appliance
  - Implementation of a closed loop model to recover and recycle products through reverse flows at the end of life allows preventing waste production and decrease material losses
  - ***Proposition 3:*** *good housekeeping and internal recycling may allow reducing valuable materials losses*

CP practices and CE issues in the company (6/6)

- CP principle of technological optimization
  - Implementation of an energy efficiency program
  - Products are developed in other to consume less energy during the use phase
  - ***Proposition 4:*** *technological optimization can contribute to reduce emissions level*
- CP practices of the operational areas are connected
  - ***Proposition 5:*** *CP practices at the production area enable CE practices implementation at the micro-level and are connected to other CE areas (i.e. waste management, and support)*

Summary and future research

- CP practices and principles were enablers to CE implementation in the company regarding the new business strategy
- Main contributions so far
  - Development of theoretical propositions that can be explored by further studies
  - Insights to practitioners regarding CP practices that may be valuable to support CE issues implementation in industry
- Future research
  - Analysis of the developed propositions in other manufacturing contexts and identification of cause-effect relationships

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