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Publication date
2019

Document Version
Final published version

Published in
3rd Product Lifetime and the Environment (PLATE) 2019

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Design competencies for a circular economy

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Keywords: circular economy; product design; design competencies.

Abstract: Limited research has been done on design competencies for a circular economy in practice. Yet, an overview of design competencies for a circular economy would be useful to understand which topics should be emphasized in both education and practice. This paper focuses on deriving circular economy competencies for product designers working in industry. The study consisted of three focus groups with twelve designers that are actively exploring circular economy opportunities in an industrial product design context. We derived six design competencies for a circular economy: (1) circular economy understanding, (2) circular economy storytelling (3) setting circular criteria, (4) assessing circular solutions, (5) connecting reverse logistics with users, and (6) design for multiple use cycles. These six competencies are presented and reflected upon by comparing them to competencies found in literature. Two of the competencies found (i.e., circular economy understanding and storytelling) are new compared to those mentioned in literature. The other four competencies found in this study overlap or further specify competencies mentioned in literature. Ultimately, the relevancy of each of the six competencies for an individual designer is determined by the role this designer has in a company.

Introduction

The increasing pressure on resources has become a growing concern. The circular economy, which is propagated by the Ellen McArthur Foundation (2013) as “restorative and regenerative by design”, offers a compelling alternative to our current resource intensive systems. The proposal to cycle material resources is not new, but because the circular economy makes it operationalizable (Ghisellini et al., 2016; Kirchherr et al., 2017; Murray et al., 2017) the concept has gained traction among companies that want to contribute to sustainable development (Kirchherr et al., 2017). Circular economy emphasizes high value and high-quality cycling of materials. By advocating sharing and reusing it also connects sustainable production and consumption (Korhonen et al., 2018). Product designers are seen as potential facilitators and even leaders of the transition towards a circular economy (Andrews, 2015, p.305), because they can design products and services that fit multiple lifecycles. While design for a circular economy can be seen as part of the larger design for sustainability landscape, its aims are more explicit. Design for sustainability is aimed at the broad concept of reducing environmental impact. The aim of design for a circular economy, based on its focus on resource efficiency and economically viable closed-loop systems, is more focused and aims to maintain product integrity as long as possible over multiple lifecycles (den Hollander, 2018).

Research has also suggested that the transition towards a circular economy requires acquiring new competencies and knowledge (EEA, 2016). This reflects the notion that the competencies designers need to operate in the sustainability landscape are changing. Yet, there is a lack of understanding regarding these changing competencies (de los Rios & Charnley, 2016; Sumter et al., 2018). Although limited, some research has been done specifically on design competencies for a circular economy. Often, these competencies are derived from case studies with companies that are exploring circular economy opportunities. They are related to “understanding product and service aspects of the circular offering” (de los Rios & Charnley, 2016), “assessing environmental impact of the circular solution”, “facilitating collaboration”, “anticipating how the circular offering will evolve”, and “integrating business model and product’s design” (Sumter, 2018). In addition, earlier research suggests that the role designers have in companies determines which

"circular" design competencies are relevant (Sumter et al., 2017b; Sumter, 2018).

This paper derives circular economy competencies for product designers working in industry through a series of three focus groups. We use the following definition of a competency: "a functionally linked complex of knowledge, skills, and attitudes that enables successful task performance and problem solving" (Wiek et al., 2011, p.204). The focus is on those designers that work for medium and large companies. These are believed to have a wider reach than small companies when pursuing their sustainable or social activities goals (Hockerts & Wüstenhagen, 2010).

Methods

This study is part of a wider collaborative project (hereafter: co-project) titled *Circular Business Competencies Building: Business function specific knowledge and competencies for a circular economy*. This co-project was initiated by Philips and the University of Exeter and facilitated by the Ellen MacArthur Foundation. While the co-project focused on deriving wider competencies for a circular economy, this paper only presents and discusses the circular economy competencies relevant for product designers working in industry. The co-project offered the opportunity to gather perspectives from multiple designers who have a wide range of roles in companies that are actively exploring circular opportunities, and identify and validate gaps in the design competencies for a circular economy.

Data Collection

The full co-project ran from November 2018 until May 2019. Data was collected in three focus group calls and two surveys between March and April 2019. Table 1 shows the topics and the number of participants who took part in each step of the process. The principal researcher of this study facilitated the calls with the design practitioners in the co-project. A note taker from the Ellen MacArthur Foundation was present during each of the focus group calls to make minutes.

Data collection method (number of participants)	**Topics**
Survey 1: (8)	- Barriers and drivers in exploring circular opportunities
Call 1: (8)	- Barriers in exploring circular opportunities and design challenges - Enabling conditions
Call 2: (11)	- Challenges for product creation - Collaboration - Communication
Survey 2: (-)	- Company culture: supporting/hampering circular economy
Call 3: (7)	- Design for circular economy competencies - Resources needed to address identified competencies

Table 1. Data Collection Process and Participant.

Participant selection

Companies selected employees with circular economy knowledge and/or who were actively exploring circular economy opportunities in their daily work. The selected employees took part in a kick of call, which each of the participating companies organized separately. During these calls the co-project was introduced. Each of the five companies then put forward two or three employees who took part in the focus group calls. Table 2 gives an overview of the participants and their job titles.

Company	Job title
H&M Group	Team Responsible for Engineers
COS Brand	Product Architect
Tarkett	Design Manager
Tarkett	Senior Design Manager
Tarkett	Project Manager Sustainability
Tarkett	Team Manager Design
Essity	Global Brand Innovation Manager
Essity	Global Brand Innovation Manager
Essity	Regional Brand Director
Philips	Senior Product Manager
Philips	Product Designer
Coty	Manager R&D Packaging

Table 2. Participants Data.

Data Analysis

The first survey and call were used to explore the context the participants worked in. This resulted in a wide array of barriers and drivers. We used Covey's "concern-circle of influence model" (Covey, 2004) to separate the challenges that were within their circle of concern (e.g., key performance indicators that are hindering the implementation of circular initiatives) from the challenges that were within their circle of influence (e.g., how to determine the useful lifetime of components after take back). The challenges that were within the participants' circle of influence were the focus point in the second call. In the second analysis round, based on challenges that were discussed in the second call, we derived and formulated design competencies for circular economy competencies. These identified competencies were then validated in the third call, by asking the participants to comment on the importance of the competencies that were formulated.

Results

Based on the collected data six design competencies for a circular economy were derived from the calls with the product designers working in industry (see table 3).

1.	Circular economy understanding
2.	Circular economy storytelling
3.	Setting circular criteria
4.	Assessing circular solutions
5.	Connecting reverse logistics with users
6.	Designing for multiple use cycles

Table 3. Six design for circular economy competencies (validation).

1. Circular economy understanding

"Circular economy understanding" is about having a clear understanding of the circular economy concept as well as mastering the vocabulary to be able to communicate with others. This competency was classified as foundational. It was seen as a more general competency that forms the basis for further actions. A participant remarked: "circular economy is often equated with recycling, while this is the least preferred solution". In order to tackle the challenge of getting to higher order circular concepts, such as reuse, refurbishment and prolonged life, it is vital one masters the ideas behind the circular economy and is able to verbalize those.

2. Circular economy storytelling

To master "circular economy storytelling" means being able to engage internal and external stakeholders (e.g., consumers, suppliers and partners) in the circular story. Product designer should be able to interpret what the benefits of a circular economy are and what the consequences of "going circular" are for the company and for the department they are working in, and "sell" this to others in an engaging way. This reflects the need to create involvement and get commitment, which was mainly expressed by the design managers.

3. *Setting circular criteria*

Setting circular economy criteria relates to being able to determine the circularity of products. This competency is based on the challenge the participants faced when it comes to checking whether products under development are circular. They indicated that they were struggling to determine what they should consider and whether they were on the right track when they were developing circular solutions. Setting circular criteria could be useful in guiding the design process: participants working as design managers mentioned that they were implementing criteria in the form of 'circularity' checklists and product scores (e.g., modularity, ease of disassembly and recyclability of material) to transform the design process. In addition, the criteria for circular materials can also be used as a standard in procurement when searching for and buying materials.

4. *Assessing circular solutions*

"Assessing circular solutions", is about being able to make financial and environmental assessments of the circular products over multiple use cycles. This competency is required as it can help to assess the viability of proposed circular solutions for the company. Participants mentioned that being able to make a financial assessment is necessary, and should be a starting point, as it helps designers to estimate whether developing a circular solution makes business sense. The environmental component of this competency entails being able to estimate what the impact is over multiple use cycles. A design manager mentioned that current environmental assessment methods, such as Life Cycle Assessment, did not align with the circular solutions they were trying to assess.

5. *Connecting reverse logistics with users*

To master the competency "connecting reverse logistics with users" entails being able to engage users to participate in the reverse logistics that have to be set up to facilitate the take-back of circular products. Essentially this competency connects two topics: customer engagement and reverse logistics. Creating customer engagement is connected with the ability to determine what the implications are for reverse logistics (e.g., which logistics channels should be in place to facilitate, for example, take back?). Participants stated that consumers should be engaged to participate in circular business models: "for the consumer it should be very clear how to use the product, how to give it back, how it is designed […] what his benefits are and what environmental benefits are".

6. *Designing for multiple use cycles*

Being able to "design for multiple use-cycles", entails designing product-service systems that can serve multiple use cycles and/or users. In addition, it includes being able to set up a monitoring and tracking system to have an overview of where company resources are and the ability to determine in which state the products are upon take back. Participants found it important to be able to determine the remaining useful life of particular components upon takeback and to determine how often they could be reused.

Role dependency of competencies

During the validation call, participants emphasized that not all competencies were applicable to them because they were not involved in all phases of the design process. For example, a product engineer mentioned that he was not involved in initiating new product development. Therefore, it was less relevant for him to be able to do financial assessments of circular solution. Instead, it was important that he could "design for multiple use cycles". He added that product designers are not always in the "driver's seat" when it comes to initiating the development of new circular products or services. The business model is often set by marketing. Design choices then have to align with the scope of the business model as determined by marketing: "if it is a business model only relating to recycled contents, then you only focus on that, if it is refurbished content, then you focus on that."

Discussion

The six identified design competencies for a circular economy as indicated by the product designers working in industry range from being new to partially overlapping and further specifying competencies found in literature.

First, "circular economy understanding" was found to be a core competency that could serve as a foundation to develop other competencies such as "circular economy storytelling". Circular

Economy understanding and storytelling are highly connected competencies and were not earlier mentioned in literature. When previous research mentioned management buy-in and support as important driver for implementing circular solutions (Sumter et al., 2018, p.12) it was seen as a general requirement for introducing change in companies. Yet, the industrial design practitioners who participated in this study shared that they struggled with engaging stakeholders inter alia due to the fact that they insufficiently mastered the circular economy vocabulary. Hence, these competencies were derived and formulated.

Second, within this study, it appeared that there is a need to develop a competency in doing financial and environmental assessments over multiple use cycles for circular solutions. When it comes to environmental assessment a related competency was mentioned in literature: “estimating the environmental impact on a systems level over multiple life cycles” (Sumter et al., 2018, p.12). Yet, while relevant according to industry when it comes to financial assessment literature does not mention related competencies. While both competencies reflect a need to be able to also “anticipate how the circular offering will evolve over multiple lifecycles” (Sumter et al., 2018, p.12), financial assessment is done on company level while the environmental assessment is done on system level.

Third, “connecting reverse logistics with users” reflects the expanding design domain in which customers should be engaged to participate in circular business models. Literature shows that this competency also means there is a need to understand that in the context of access-based models consumers are framed as users (de los Rios & Charnley, 2016) as they temporarily get access to products. Within this context, literature furthermore mentions the following competencies: “understanding factors of the use experience”, “understanding processes for reverse and re-manufacturing” and “understanding logistics and distribution processes” (de los Rios & Charnley, 2016, p. 118). This reflects an emphasis on the user within circular economy literature. Yet, industry is more concerned with how to set up of the (physical) reverse logistics system and connect it with the users

Fourth, the identified competency “designing for multiple use cycles” corresponds strongly to three competencies mentioned in literature that are all related to understanding product and service aspects of the circular offering: “understanding the service experience and how to design services”, “understanding product wear by use”, and “understand failure mode and maintenance procedures” (De los Rios & Charnley, 2016, p.). Further, this competency relates to the competency to “anticipate how the circular offering will evolve over multiple life cycles” (Sumter et al., 2018, p.12). This challenges the current mindset of designers as it requires them to look further ahead predict how the product will be used, what the potential useful lifetime of product is and which value recovery strategy to apply.

Last, while the participants recognized the importance of certain competencies, they did not feel the need to acquire all the identified competencies. The perceived relevance seems to be dependent on the position that they are working in. For example, “setting circular criteria”, was a competency that was mainly reflected by the participants working in more strategic roles as they felt responsible for guiding colleagues in the design process. There is a need to keep exploring circular design competencies, as they help to understand how organizations learn and how design roles evolve in the context of a circular economy. Further research should lead to a comprehensive framework in which design competencies for a circular economy are allocated to the roles designers could have in sustainability transitions.

Conclusion

In this study we derived six design circular economy competencies for product designers working in industry: (1) circular economy understanding, (2) circular economy storytelling (3) setting circular criteria, (4) assessing circular solutions, (5) connecting reverse logistics with users, and (6) design for multiple use cycles. "Circular economy understanding” and “circular storytelling” are new compared to those mentioned in literature. In addition, when it comes to the competency “assessing circular solutions”, financial assessment was not mentioned before within literature. Furthermore, while literature focused on topics related to the changing role of consumers in circular economy, industry practitioners are more concerned in acquiring competencies that help them determine the implications for

customer engagement on reverse logistics. This reflects that industry puts more emphasis on competencies to tackle short term barriers. The six competencies reflect the expanding role of product design needed to contribute to circular activities. Yet, the role designers have in these settings determines the relevancy of acquiring one of the six competencies. The insights following from these explorations can be used to shape and keep design education up to date.

Acknowledgments

This work was conducted as part of a collaborative project (co-project) *Circular Business Competencies Building: Business function specific knowledge and competencies for a circular economy* that was initiated at the Acceleration Workshop in November 2018 in Lisbon by Philips and the University of Exeter. The project was facilitated by the Ellen MacArthur Foundation. The authors would like to thank the participating organizations for their openness, and the designers for their participation in the focus group calls.

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