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RESEARCH ARTICLE

Designing a circular business strategy: 7 years of evolution at a large washing machine manufacturer

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Abstract

This paper discusses the development of circular business models for a large white goods manufacturer. A 7-year journey in designing, discussing, adapting, and finally finding a potentially profitable circular offer is summarized, and the barriers that had to be overcome in this process are highlighted. The shift from selling washing machines to repeated leases with remanufacturing steps in-between turned out to be very challenging. Despite the numerous claims in the consulting world that both manufacturers and consumers can benefit from the transition to a circular economy, it took multiple iterations to find a business model with the potential of being economically attractive to both the company and the client. The transformation process of shifting to a circular business model tends to be highly underestimated by companies and involves many issues beyond product design such as customer relationships, return logistics, remanufacturing operations, and service contracts. Researchers will need to work with companies to address the transition issues and to increase the relevance of circular economy research.

KEYWORDS

barriers, business model innovation, circular business models, circular economy, circularity strategy, sustainable development

1 | INTRODUCTION

While the circular economy has gained traction with industry, governments, and academia, there is limited research on the barriers and obstacles companies face in the transition towards a circular business model. The global economy is only 8.6% circular (Circle Economy, 2021) and while several companies have implemented at least some form of reduce, reuse, remanufacture, or recycle, almost 24% of the European companies use none of these (Barreiro-Gen & Lozano, 2020). The circular economy efforts so far are mainly limited to small-scale initiatives (Lacy et al., 2020) and systematic evidence on how circular models affect profitability and growth for individual businesses is lacking (Demirel & Danisman, 2019). If the economic benefits of transitioning towards a circular business model were as evident

and accessible as often stated, companies would have jumped on this opportunity long time ago. The slow adaptation indicates that companies are facing implementation hurdles.

Research that closes the gap between academic endeavor and real industrial problems is highly needed within circular economy to increase the relevance of academic output by studying real problems faced by companies trying to transition to a circular business model (Agrawal et al., 2019; Atasu et al., 2008; Guide & van Wassenhove, 2007, 2009; Reefke & Sundaram, 2017) and to provide a balanced view of both opportunities and challenges (Baines et al., 2017). Several claims made about the circular economy, including the benefits for companies on microlevel, lack rigorous verification (Agrawal et al., 2019). Context-dependent evidence-based theory on how companies can transition to a feasible, profitable circular business

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model is urgently needed (Van Wassenhove, 2019). This requires multiple case studies from different sectors to study how circular economy barriers can be overcome (Bhatia & Srivastava, 2019; Garcia-Quevedo et al., 2020; Govindan & Hasanagic, 2018). Case descriptions are also most effective for disseminating the knowledge and being impactful (Pfeffer & Sutton, 2006; Rousseau, 2006).

This paper contributes to literature by discussing the circular economy transition attempts, including how certain barriers were overcome, of a large manufacturer in one sector. Gorenje is one of the larger European manufacturers of white goods currently operating in an almost linear take-make-use-dispose system. Over the past 7 years, they explored how to develop circular business models to replace their current sales models. There are many issues that need to be thought through in such process, including the offer to consumers and related consumer behavior, service and maintenance of the products, return logistics, product design, financial model, legal issues, marketing, relationships with supply chain partners, etc. Each of these circular economy issues needs to be carefully analyzed. This paper describes real industry transition challenges by providing a rich description of a 7-year longitudinal development in close collaboration with a manufacturer. To the best knowledge of the authors, this has not been done before, despite its importance.

The next section reviews literature on barriers and obstacles for manufacturing firms transitioning towards circular business models and discusses knowledge gaps. The longitudinal case study method applied in this research is outlined in Section 3. In Section 4, Gorenje's story and evolution in their thinking are described. The paper first frames the circular economy ideas and goals of Gorenje and the industry it is in. The iterations for several circular business model designs and their respective benefits and challenges are discussed thereafter. Both successful and unsuccessful ideas are discussed to illustrate the learning. The findings are then generalized in Section 5. Potential tools and models required to guide companies in their transition to the circular economy are discussed. The paper is concluded in Section 6.

2 | BACKGROUND LITERATURE

Circular economy, where products are returned to the manufacturer for reuse, refurbishment, remanufacturing, or recycling, is billed as the main strategy to reduce resource consumption (EC, 2020; EMF, 2013a, 2013b, 2014; McKinsey, 2016). By taking control over the products during and after usage, companies would be able to capture the value that remains in many products currently being discarded and thereby increase their profitability (EMF, 2015). It seeks to provide a better balance between economy, environment, and human well-being (Gonzalez et al., 2019; Murray et al., 2017). However, as discussed above, it is unclear how individual companies can realize this transition.

Govindan and Hasanagic (2018) conducted a literature review on barriers, drivers, and practices of implementing circular economy and identified 39 barriers, including lack of clear policies promoting circular economy, ownership issues, lack of enthusiasm towards circular

solutions, design issues, and profitability issues. In a similar study, Bressanelli et al. (2019) identified 24 challenges that hamper the implementation of circular economy. Little is known about how these barriers interact in practice. Kirchherr et al. (2018) conducted a survey among European practitioners and found that the low levels of circular models in today's world can be explained from a lack of consumer interest and awareness as well as hesitant company cultures to business models whose profitability is not immediately apparent. Unfortunately, little knowledge exists on how individual companies can overcome a combination of these obstacles in their transition towards a circular business model (Bressanelli et al., 2019). Our in-depth analysis of 7 years of transition at Gorenje attempts to close this gap.

Given the importance of profitability for the transition towards circular economy (Chen et al., 2020; Kirchherr et al., 2018), studies exploring circular business models and challenges for existing companies from an economic point of view are urgently needed. Several papers indicate that there might be economic challenges that prevent the realization of circular business models without additional incentives from government (Genovese et al., 2017) and call for more case studies to establish empirical evidence on how companies can close the loop in a profitable and competitive way (Agrawal et al., 2019; Ferasso et al., 2020; van Loon & van Wassenhove, 2020). While many papers have discussed tools and methods to analyze the profitability of circular business models (for an overview see Souza, 2013 or Govindan et al., 2015), very few combine profitability with an assessment of value for consumers. The consumer perspective is often ignored, assuming they have a strong preference for circular solutions. This combination of economic attractiveness to the producer as well as the consumer is crucial to determine the viability of circular business models (Matschewsky et al., 2017; van Loon et al., 2018). While our earlier papers focused on discussing tools and methods for assessing profitability and value for consumers (e.g., van Loon et al., 2018, 2020), this paper discusses how a company develops a profitable and attractive circular business model over time through trial and error and highlights economic challenges along the way which need to be addressed by practitioners and researchers. Our paper contributes to academic research by providing an in-depth longitudinal case study discussing the economic challenges of a real company trying to close the loop and highlights urgent research questions around economic viability of circular business models.

3 | METHOD

This paper reports the findings of a 7-year period during which Gorenje tried to develop a profitable and feasible circular business model for their consumer washing machines. A case study approach is considered a suitable method for studying complex phenomena in real-world settings (Eisenhardt, 1989). It gives insights into how and why certain things are done (Yin, 1994). Within management science, it is recognized that single-case studies are a useful method to increase our understanding of the world (Siggelkow, 2007). When studying transition challenges, the longitudinal nature of the study

becomes important. Over the course of 7 years, multiple workshops were held at Gorenje's headquarters and online. Participants in the workshops consisted of experts and managers from various departments at Gorenje, including business strategy, R&D, marketing, aftersales services, and product design. Meetings took place between May 2014 and December 2020 (see Table 1). The first meeting between Gorenje and the research team consisted of a multiple day visit to Gorenje's plant and office in Slovenia to acquire a detailed understanding of their current business and environment, the challenges, and circular business ideas. The meeting provided a sketch of a potential circular business model that was then carefully analyzed for its expected profitability and feasibility. For this purpose, we developed a simple analytical excel-based model to assess the costs and profit of leasing washing machines compared to selling, as well as to evaluate the total cost for consumers (a complete description of the model can be found in van Loon et al., 2020). Results were discussed in the next meeting after which potential adjustments were proposed, data were collected, and new profit calculations were made. This cycle was repeated several times. Important meetings were recorded and transcribed to provide a collection of field notes for analysis (Stuart et al., 2002; Voss et al., 2002). Minutes were checked by two to three persons to ensure accuracy (McCutcheon & Meredith, 1993) and the analysis as described in this paper is checked by the co-author working at Gorenje. The case study is presented as narrative supported with quotations and theory (Eisenhardt & Graebner, 2007; Yin, 1994).

4 | TRANSITIONING TOWARDS A CIRCULAR BUSINESS MODEL

Gorenje is one of the leading European manufacturers of household appliances, producing ovens, hobs, washing machines, dryers, dishwashers, etc. (Gorenje, 2021). Their white goods are produced across three factories in Slovenia, Czech Republic, and Serbia reaching a volume of around 19,000 units a day. Washing machines, the case product in this study, are produced at various quality levels and sold under

different brand names such as Mora and Körting for the low-end consumer segment, Gorenje and Pelgrim for the medium segment, and ASKO and Atag for the high-end segment. The washing machines are produced in Slovenia and sold throughout Europe.

Gorenje decided to explore circular business models to transition towards a more sustainable but equally profitable business model to replace the linear sales model tagged as unsustainable by the circular economy reports (e.g., EMF, 2013a, 2013b, 2014; McKinsey, 2016). Gorenje joined the European project ResCoM (ResCoM, 2013) to collaborate with researchers and other pilot companies on this quest. At the start of the project, in late 2013, Gorenje was remanufacturing used machines on a small scale, mainly for sales to employees. Due to this, they realized that the value of end-of-use white goods is relatively high. Used machines could be upgraded for another use cycle with a different customer with relatively simple operations and replacements of some components. Some people at Gorenje became convinced that a business model extending the life of washing machines by one or more use cycles might save resources required in the production of new machines, reducing both costs and impact on the environment.

Gorenje is already involved in the remanufacturing business, however, it's a very small part of the business activity. Gorenje will be interested in exploring how the ResCoM ideas can be implemented to expand this business for a sustainable development and growth of the company. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, November 2013)

Several companies have explored circular business models for washing machines in the past. Electrolux trialed pay per wash 15 years ago (McAloone & Andreasen, 2004) and ISE sold refurbished professional washing machines to households in the United Kingdom between 2005 and 2014 (Anonymous, 2016; EMF, 2013a). Some third parties are offering washing machines on a pay-per-use basis, e.g., Bundles (2020) and Homie (2020) in the Netherlands. Many of these practices were terminated or operate on a very small scale, sometimes using crowdfunding to overcome financial and economic viability issues (Bressanelli et al., 2019). Nevertheless, the Ellen MacArthur Foundation argues that circular business models are economically viable for the mainstream market (EMF, 2013a). More specifically, they claim it would be economically attractive for both manufacturer and consumer to lease high-end washing machines rather than selling low-end ones (EMF, 2013a, p. 47).

These contrasting elements provided a great starting point to test the viability of alternative business models compared to the traditional take, make, and dispose one from an academic point of view. At the company, a similar discussion was ongoing. Some managers, influenced by the circular economy proponents, were keen to develop and implement circular offers. Top management on the other hand was skeptical. Leasing had been tried in the past and failed. Suggestions for circular models would have to be carefully examined for expected profitability. As one of Gorenje's managers phrased it:

TABLE 1 Meetings between research team and Gorenje

Plenary workshop at Gorenje's headquarter	Physical meetings research team and Gorenje	Online meetings core research team and Gorenje
6–8 May 2014	June 2014	July 2015
	December 2014	October 2015
	June 2015	January 2016
	November 2015	
9–11 March 2016	June 2016	February 2017
	December 2016	April 2017
	May 2017	May 2017
	October 2017	December 2018
		November 2019
		October 2020
		December 2020

If we have a great idea which is not economically feasible, then we will stop here. (Tea Dovšak, Project Manager R&D Competence Centre Laundry Care, May 2014)

The company's initial idea of the circular business model for washing machines is described in the next section followed by the subsequent iterations attempting to develop a circular business model that would be economically viable.

4.1 | The initial idea

Gorenje's initial idea was to repeatedly lease high-end existing washing machine models to consumers in different segments, i.e., to use a cascade model with a remanufacturing step between each lease. Since brand new washing machines are perceived differently from 5- or even 10-year-old machines according to the marketing department, the company wanted to make alternatively priced offers to consumers leasing machines for the first, second, and third time, targeting premium consumers for the first lease, economy consumers for the second lease, and budget consumers for the third lease. Actual knowledge on how customers perceive leased washing machines of different ages and related willingness to pay in the different segments was lacking at this stage. Instead, the proposed targeted consumer segments mimicked the existing premium, economy, and budget new machine types the company had been offering for years, keeping relatively close to their linear business with the only difference that consumers would now lease for 5 years in a segment rather than purchase a machine. The machine to be used for leasing would be the currently used premium model, i.e., the high-end machine which Gorenje thought could be remanufactured twice so that it would last for 15 years or three 5-year lease periods before being recycled. It was assumed that consumers would choose between buying or leasing washing machines in their specific segment, i.e., a lease to a

premium, economy, or budget consumer would replace the sale of a new premium, economy, or budget washing machine, respectively (Figure 1).

Because the circular business model was nothing more than a rough idea at this stage, deep knowledge and reliable input data were missing. Cost structures of circular business models are often unclear in the beginning, and with leasing and remanufacturing, it takes more time, maybe years, to verify the initial cost estimations (Linder & Williander, 2017). Consequently, simplifying and largely untested assumptions were made. For example, the company made rough estimations about lease prices that could be charged for the different segments and simply assumed that demand in the different segments would be perfectly balanced. There is no reason to assume this would hold true and it was unclear how the company would deal with imbalances; e.g., what to do if consumers would request mostly budget-type leases? Other simplifying assumptions were that all washing machines would be returned to Gorenje at the end of the leasing period, all consumers would duly pay their leasing fees on time and in full, and all washing machines would be returned in a state where they could be successfully remanufactured at reasonable cost to be leased to the next segment. It was very likely that in actual business practice, one or more of these ideal conditions would not be met and hence the real profit of the leasing option would be lower than estimated at this stage, i.e., the estimate would be an upper bound, assuming all would go well. The required input data, including anticipated leasing fees for each segment and costs for each step during remanufacturing and leasing, e.g., logistics costs, were based on best estimates provided by two experts from Gorenje and were inserted into the analytical model developed for this assessment (see van Loon et al., 2020). Assessing the envisioned circular business models using the outputs of simulations led the company to realize that their views were too optimistic and perhaps even naïve and that they needed to go deeper in their search for a potentially profitable circular business model. These learnings are described in more detail below.

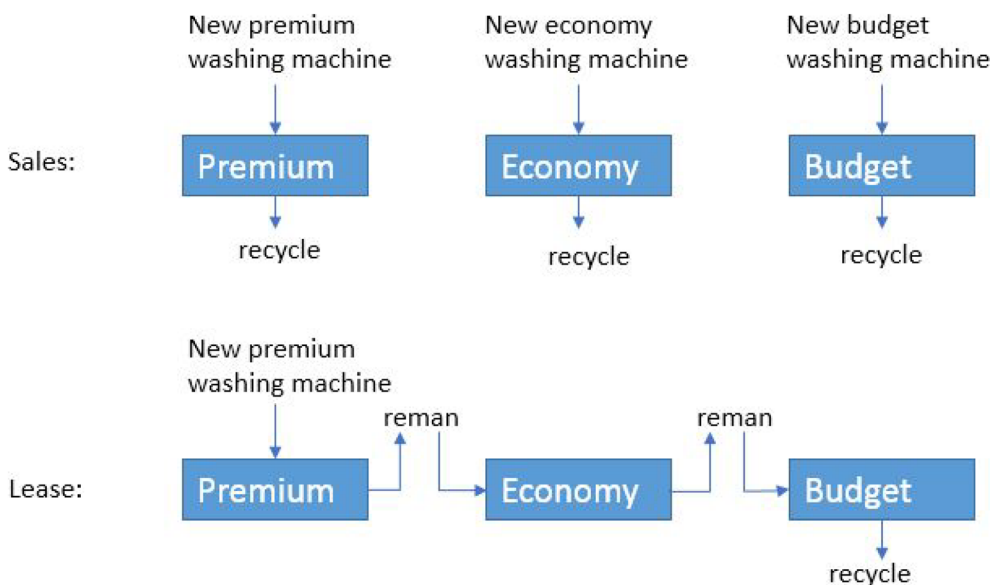


FIGURE 1 Flow of washing machines in premium, economy, and budget market in sales and lease system (van Loon et al., 2020) [Colour figure can be viewed at wileyonlinelibrary.com]

4.2 | Setting reasonable leasing fees

The profit and cost estimations of the envisioned circular business model were presented in a second 2-day workshop at Gorenje. Participants in the workshop involved business strategy, R&D, marketing, aftersales services, and product design experts, providing an interdisciplinary view on the proposed solution. At this point, the room was filled with strong circular economy proponents as well as skeptics. The presentation spurred discussion on the feasibility of the offer. While the lease offer appeared to be attractive and led to enthusiasm with the circular economy proponents on the management team, it was based on highly optimistic lease fees. The initial leasing fees for the three offers, which were merely set based on gut feeling, proved to be too high. The Total Cost of Ownership (TCO) calculations showed a TCO of leasing about twice the TCO of buying a washing machine. While leasing generally increases consumer willingness to pay (Waldman, 2003), its convenience and lower risk (since machine failures are covered by the lease), are insufficient to justify twice the price of buying. The marketing department also argued that the additional convenience of leasing is strongly linked to the quality of service. Fast response to failures by service technicians would perhaps justify larger leasing fees but, as the after-sales department argued, it would also significantly increase the repair costs assumed in the initial model scenarios. The marketing and aftersales department concluded that providing high aftersales service at low cost is a pie in the sky.

In addition, for the economy and budget leases, remanufactured machines are used. It is well known that consumers are less eager to pay for remanufactured products than for newly manufactured ones in a sales system (Abbey et al., 2015; Atasu et al., 2010; Guide & Li, 2010; Kleber et al., 2018; Souza, 2013), mainly due to the lower perceived quality of remanufactured products (Abbey et al., 2017; Abbey & Guide, 2016). Prices drive customer preferences to the greatest extent (Hunka et al., 2021). The willingness to pay for remanufactured products in a lease system, where consumers incur no risk for expensive repairs, might have a lower discount rate (Gulserliler et al., 2021). Unfortunately, empirical evidence on the willingness to pay for remanufactured products in a lease system is lacking. Because it is argued that circular economy should lead to financial benefits for both manufacturers and consumers (EMF, 2013a), the total cost for consumers in the lease system should not be (much) higher than in the sales system. Based on these arguments, the decision was made that the TCO in the sales system would be used as an upper bound in the next iterations.

4.3 | No budget leases

We subsequently analyzed the situation where consumers would not be willing to pay a premium for leasing; i.e., what happens when the TCO in both business models is the same? The profitability calculations showed a reduction in profit and even a loss in one segment compared to selling. Leasing and remanufacturing washing machines lead to additional costs to remove, transport, and remanufacture the

machines, which are easily ignored in profit calculations (Agrawal et al., 2019; van Loon & van Wassenhove, 2020). The remanufacturing costs, although significantly lower than producing new machines, in combination with additional administration and maintenance costs in the leasing scheme, were higher than the revenue that could reasonably be generated from leasing fees in the budget offer. The initial plan to simply lease an existing model from the sales market, i.e., the premium consumer washing machine, would therefore not work. The company had been way too optimistic at first. Overall costs in the leasing model, requiring additional steps compared to the sales model, were much higher than expected.

The need to monitor lease payments and answer customer queries leads to administration costs. Product failures need to be handled during the whole leasing period leading to higher repair and maintenance costs. Remanufacturing washing machines adds further costs that are difficult to recover if no substantial product life extension is achieved. Taking the same washing machine and leasing instead of selling it were clearly not a profitable proposition. From a marketing perspective, leasing 10-year-old washing machines to budget consumers is also difficult due to competition with lower quality brand-new low-end washing machines. The visualization of the costs of leasing washing machines in the various segments and the limited feasible leasing fees for budget washing machines due to competition with lower quality machines made it apparent that leasing to the budget segment would not be feasible. Hence, the decision was made to focus on the premium and economy segments instead.

4.4 | Leasing sturdy washing machines

A discussion on expected maintenance and repair costs in the leasing schemes led to the consideration of a different type of machine for the leasing business model. The current consumer premium machine would be too expensive in maintenance and repairs in its second lease period to make the lease offer sufficiently profitable. Gorenje's maintenance engineers suggested to use a professional B2B washing machine from their product portfolio for leasing purposes since the model, although a bit more expensive to produce, had a much stronger quality record so that expected repair costs would be much lower.

Gorenje has two ASKO lines, i.e. professional and classic line. Professional is designed for 15000 washing cycles, classical for 4000 washing cycles. Design for number of washing cycles means that repair needed in this period is below 1%. Regarding the ageing of material everything can withstand at least 15 years, so the main limiting factor is wear connected to washing cycles. It will be probably useful from Gorenje point of view to offer customer professional or classic regarding to projected annual use in the leasing consumer market. (Simon Kotnik, Project Manager Common R&D, December 2015)

To make a business model in which products go through several use cycles feasible, a durable and high-quality product is needed (Agrawal et al., 2019). Quality of the returned product can affect the remanufacturing success rate (Mutha et al., 2016) as well as the remanufacturing costs (Galbreth & Blackburn, 2006; Guide et al., 2003). It further has a positive effect on costs of collection, transportation, storage, and sorting (Guide & van Wassenhove, 2001). The possibility to extend the product's life in a lease system compared to the conventional sales system is important for profitability. The need to design durable products is often discussed within the circular economy community, though it needs to be linked to predicted usage duration (Akturk et al., 2017; Geyer et al., 2007; Guide & van Wassenhove, 2009; van Loon et al., 2018; van Loon & van Wassenhove, 2018). The decision was made to drop the idea of leasing high-end consumer washing machines and instead opt for professional washing machines which are more durable and require fewer repairs. However, professional washing machines are also more expensive to manufacture since more material is used in the design to make them long-lasting.

Unfortunately, extensive simulations of alternative scenarios showed that leasing was still less profitable than selling. To create the same level of profit, consumers would have to be willing to accept a TCO exceeding that of buying by about 40%. The higher costs were due to higher manufacturing expenses and because administration, transport, and repair costs were still higher than in the sales model. When leasing, repairs after warranty are incurred by Gorenje, while it generates additional revenues in the sales system since consumers pay for repairs after the initial warranty period. This made Gorenje realize that the circular economy not only substantially changes the revenue model, but it also requires a completely different perspective on product design. Repairs and obsolescence are no longer sources of potential income but deep concerns. When leased products break down and need to be repaired or replaced, profit quickly melts down. While maintenance managers and designers were aware of this in the company, they had little or no hard evidence to show the effects to change the minds of the proponents of the circular models. This is where our simple models and scenario analyses added real value in building joint understanding of the obstacles of moving into the completely new territory of circular business models.

From the company's point of view, the spare parts in normal economy represent a different amount of earnings. In the circular economy, when we as a company own the products, the repairs are a cost and we need to optimize the costs. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, September 2017)

The possibility of designing a new washing machine, specifically for the leasing program, was discussed in the next workshop. A product designed for remanufacturing can lower the operations costs substantially (Guide, 2000). An even sturdier washing machine lasting longer and needing fewer repairs than the current professional ASKO washing machine was envisioned.

Washing machine that will last for 25000 cycles without any repairs needed. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, March 2017)

There is a huge difference in making the products and repairing the products. You can make products very cheaply, in the majority of cases with very low-skilled labor forces, but if you want to repair this product, suddenly you need skilled labor force which is not so cheap as it is for the virgin product. And this makes the circular economy not so interesting. So, we had to find different ways how to get around this. One of the ways was to begin with designing a product which will last. We as a company know how to build the product with around couple of 1000 cycles, but we also know how to build the product which lasts couple of 10000 cycles. And the price difference between these two models is not 10 times bigger, it is much lower. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, September 2017)

The above quotes illustrate the profound learning process company managers traversed, especially enthusiastic circular economy proponents like Ales Mihelic. Enthusiasm is necessary, but knowledge and fact-based decision making should be the basis of any substantial business model transition. Companies carry strong beliefs in different departments, sometimes based on myths rather than facts, especially when it comes down to how consumers perceive their products. Our models provided strong evidence that exposed some of these myths and allowed for more neutral fact-based decision making.

4.5 | Optimizing the circular business model

Other possibilities to reduce the costs of leasing washing machines were debated. One potential cost reduction was found in administration. Quarterly billing replaced monthly lease fees to reduce transaction costs. However, such business model with specially designed professional washing machines and quarterly billing might be more suitable for businesses than private households. This realization led to B2B customers being targeted in the next iteration.

Gorenje again moved further away from their initial envisioned circular business model in which existing consumer washing machines would be leased to the same segment as the current sales business. After realizing that repairs are a bigger issue in circular economy since they create costs instead of revenues, new opportunities in terms of optimized product designs for circular economy were explored. One example concerned the design of a durable non-breakable washing machine minimizing maintenance and repair costs. Other ideas to reduce costs in the leasing business model, e.g., lease admin costs, led to the realization that perhaps a profitable business model would be more suitable for the B2B market.

This completely changed the perspective and required further analysis about the viability of leasing versus selling washing machines for Gorenje. At present, it was not possible for Gorenje to find a large-scale consumer leasing model that would have the same profitability as the current sales models. This conclusion does not even take into consideration other important elements like risks related to financial and legal conditions, competitor actions, shifts in technology, or lack of sufficiently rapid acceptance by consumers. Consequently, even if circular economy models would be suitable for mass consumer washing machines, Gorenje's experience shows that this transition would be far from easy for the company. While from a macroeconomic perspective the circular economy transition appears to be attractive, research is urgently needed on how to help individual companies engage in a successful transition.

4.6 | Leasing washing machines designed for circular economy to B2B customers

B2B customers like hotels, restaurants, hospitals, ships, etc. are more functionality-oriented and care less about the aesthetics of the washing machine. It was therefore argued that from a customer's perspective, a 5-year-old machine would be as good as a new machine if the same performance was guaranteed. Clearly, individual private consumers would care a lot more about appearance of the machine after 5 years of use. For the B2B market, it would no longer be necessary to distinguish machines according to their age, and a single lease offer could be proposed to the customer. In other words, customers pay the same fee for having access to the washing machine, which can be brand-new or previously used and remanufactured. Since the newly designed circular professional washing machine would be extremely durable, it was projected to have three leases with two remanufacturing operations in between, to provide the reliability and performance required in each subsequent B2B lease. Our model calculations showed that the manufacturer's costs of leasing washing machines were further reduced by the changes made. The previously high burden of repair costs in the lease program was removed because of the new sturdy product design with almost no failures. However, the sturdy washing machine was again slightly more expensive to manufacture. The two remanufacturing steps during the lifespan of the washing machines to keep the machine running without failures added further costs to the leasing program. Together with the more frequent transports to remanufacture the machines and the lower but still significant administration costs, the profitability of the leasing system still appeared to be lower than selling the machines. However, the difference was becoming small, and one could argue the customer would receive higher service and might therefore be willing to pay slightly more than today. Slowly, a business model that could work and would therefore be worthwhile to explore further, was emerging, albeit for the B2B market.

4.7 | Pay per wash

More could be done to support users to become more eco-friendly in their washing behavior. With today's possibilities through digitalization, information on the consumption of water, energy, and detergent could be collected remotely and used to provide feedback to users on their washing behavior compared to others. It was argued that such feedback system provides additional service to customers and warrants therefore a somewhat higher TCO, closing the gap further. Setting the right price for different washing programs such that the right behavior is triggered, customers are willing to pay for it, and the company can make a profit, is nevertheless challenging.

For pay-per-use we are thinking that the price of the programs will differentiate based on the length of the program and the intensity of the spin. If you have a more intense spin, you will pay more. This will force you to use more environmentally friendly programs and put more load in the wash such that people won't wash with practically empty washing machines. This is the first, but probably, what we are thinking now, is that some appliances will be there, and no one is using them. In summer cottage, if you only have 5 washes in the summer months, that is for sure not profitable for us. So, we have a minimum fee that includes a few washes. If you wash less, you need to pay the minimum fee. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, November 2019)

Knowledge about the willingness to pay for such service is almost non-existing. Deeper knowledge on the willingness to pay for remanufactured versus new products in a leasing or pay-per-use system is urgently needed as well as the willingness to pay for feedback on behavior. Gorenje decided to engage in a pilot program to collect data and better understand the market for such services. The pilot is planned in four European countries with a total of 400 washing machines. During this pilot, the normal professional ASKO washing machines will be used instead of the washing machine specifically designed for the circular economy. This leads to higher repair costs, and therefore perhaps an unprofitable pilot business case, but volumes in the pilot are too low to start producing the newly designed washing machine.

We decided to not develop a special washing machines for the pay-per-use business because we are producing in batch, so this means that there needs to be enough demand before we start producing. I am very upset about the repair costs; they are very expensive. But for the beginning, this is what we have. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, November 2019)

The pilot will show whether the circular business model that is designed through a long process of learning about different aspects and reshaping almost all parts of the business model will deliver the anticipated results or whether further adaptations are still needed. Gorenje will have to find out if the proposed leasing offer is attractive to customers and if there will be demand for it. They will need to see what lease conditions customers are ready to accept and what fees can be charged. Customer behavior in the pay per use needs to be examined further; will customers behave properly and what are the costs of delinquent behavior? Assumptions need to be verified through the pilot. The refined data can then be inserted into the analytical model to further analyze the profitability of the offer. Even though the designed circular business model looks very promising, a good understanding of the market and the offer is essential to prevent costly mistakes due to overly optimistic assumptions.

5 | DISCUSSION

Finding a profitable circular business model turned out to be more challenging for Gorenje than initially imagined. The numerous general macroeconomic claims that circular economy is the way forward to reduce resource consumption and at the same time allows for economic growth were less helpful for a specific company trying to find a profitable business model, given all the nitty-gritty details involved in the necessary transformation. It proved to be a difficult exercise, finding the right business models takes time, and so does the required mentality change from the different stakeholders. Multiple iterations and in-depth discussions between departments are needed to identify the issues, explore potential solutions, align the different positions, and change plans accordingly. The final solution can be completely different from the envisioned business model at the start of the process, as illustrated by Gorenje's learning process. The first idea was relatively close to the current linear business: the same washing machine was to be used, leased, and remanufactured instead of sold. The subsequent iterations involved a new washing machine specifically designed for circular economy, an optimized supply chain for leasing to the B2B market and offering additional services. All those changes cumulatively led to a potentially profitable circular business model.

Several papers indicated that top management support is an important success factor for circular business models (Centobelli et al., 2020; Moktadir et al., 2020). While several high-level managers within Gorenje really supported and pushed for the development of circular business models, top management was more skeptical due to earlier failed attempts and required cost-profit calculations that showed a profitable circular business model before larger resources would be made available. Due to the difficulty of designing a promising circular business model which required mentality changes at the different departments involved in this project, it took several years before the company could move to a pilot phase. This is in line with literature stating that a firm established in linear economy requires time to advance towards circular business models because it has to

modify many parts of its business and has to overcome several barriers in this process (Garcia-Quevedo et al., 2020). Circular business models have higher degrees of uncertainty during the development and testing phase than linear business models due to the difficulty of assessing and verifying critical business model assumptions (Linder & Williander, 2017). Both revenue and costs are stretched out over a longer period, and proper field tests or pilots to verify, e.g., remanufacturing costs or leasing revenue in a third use cycle, take therefore years to conduct. Underlying factors on which the costs and revenues depend might also change over time. This uncertainty can lead to reluctance to transition to circular models (Linder & Williander, 2017). Taken together, this makes it really complicated for established manufacturers, like Gorenje, to jump into circular adventures, and time is required to carefully think through various options to transition to circular business models and to carefully plan the road towards a circular model. One could argue that many of the lessons learned have been previously mentioned in literature. For example, we know that leasing or other forms of service-based business models are more expensive than selling due to the increased need of interaction and monitoring (Kindström, 2010; Tukker, 2015), that complex products are more suitable for circular economy due to their higher end-of-life value (Tukker, 2015), and that product design for durability, ease of repair, upgradeability, etc. is needed to keep the costs of remanufacturing reasonably low as well as to enable revenue generation over a longer time period (Agrawal et al., 2019; Guide, 2000). But all these issues are rarely considered together, and the question remains how individual firms can overcome them or how a feasible transition path looks like.

As our case study highlighted, companies will not switch to a circular business model overnight but will start with a pilot and small-scale initiatives that will (hopefully) gradually expand, but do not allow for economies of scale from the outset. The circular offer will exist for a long time in parallel with their linear business. There are obviously many challenges related to not having the economies of scale advantages which large manufacturers are accustomed to, as well as to having to operate two very different business models concurrently. Given the objective of many governments to accelerate circular economy in the relative short term, these transition challenges deserve more attention in literature.

Related to this, we see a need for research on the economic viability, both long-term and during the transition process, of circular business models for different products, especially smaller products with lower end-of-life value. Our case study showed that even though washing machines have a decent end-of-life value after use that can be captured via remanufacturing, this gain appeared insufficient to cover additional expenses in the lease system. The relative gain in manufacturing costs compared to the additional costs of the circular business model is identified as an important contextual factor (van Loon & van Wassenhove, 2020). Will it be possible to find new circular models that are economically attractive for both manufacturer and consumer for all types of products? Are circular models economically viable for the mainstream market, or will it require additional services to increase the willingness to pay like in our case study? There is a

general lack of knowledge on consumer acceptance and behavior in the circular economy (Zhou et al., 2021). Firms tend to ignore the fact that the consumer has alternative competitive offerings, and very little research is done on the willingness-to-pay for remanufactured products, even less in combination with leasing and additional services in different contexts (Gulserliler et al., 2021). Companies typically have little or no market intelligence data on this and often do not know how to research it properly either. Once more knowledge exists on consumer behavior and willingness to pay in a circular business model, the knowledge can be used to refine profitability calculations. Only a few studies have included the consumer perspective in the economic feasibility assessments so far (Ferasso et al., 2020; Gulserliler et al., 2021).

Once a manufacturer finds a potentially profitable circular business model, there are still many issues that need to be overcome in the transition process. Much research is focused on optimal circular end states, while research on the road to be travelled to reach that state is badly needed. Important transition hurdles include competitor and supply chain partner actions, financial (cash flow) issues, and changing legislation, to name but a few. Clearly, the transition is far from easy for an individual company, and research is needed to support these efforts with the tools of our discipline.

You need to be aware what you can do in your design ... to make it more serviceable, more repairable, more long-lasting... And we need to optimize the costs. This is why we need tools. (Ales Mihelic, Innovation leader R&D Competence Centre Laundry Care, September 2017)

Finally, to really help industry with the transition, we need to ensure that the academic knowledge is accessible and understandable for practitioners. The analytical tool that we developed and used in this project (described in van Loon et al., 2020) is basically using the academic knowledge that was developed more than 10 years ago, but suddenly spurred interest of companies and banks when it was integrated in a simple understandable excel model (van Wassenhove, 2019). In our discussions with various manufacturing companies, and in line with the findings of Kirchherr et al. (2018), regardless of how design or sustainability driven these companies were, profitability is always the key issue. Top management looks for promising business avenues, and simple calculations on the profitability of circular business models might be all they need to allow further investigation. Simple analytical tools that require only a few ballpark data points and are easy to understand in their assumptions are essential. Careful visualization and understandable analysis of a large number of scenarios give substance to internal discussions between multiple functional groups in a company. Companies frequently do not fully realize the complexities of the new business model and forget important cost components without those simple tools pointing them out. These circular business models are a big stretch from business as usual and managers typically underestimate the gaps in their skillsets and/or overestimate the value of their product/service offer

(e.g., the customer's willingness to pay or the reaction of competitors). Hence, they require tools to point out obstacles and provide suggestions on how to overcome them in a format and language they can relate to.

6 | CONCLUSIONS

This paper empirically investigated the conditions and mechanisms for transition to a sustainable circular business models at the firm level based on a longitudinal study in close collaboration with a white goods company. Based on the washing machine case study, contextual factors and interventions that determine a successful transformation were outlined. The case study showed that simply changing from selling to leasing products does not work. In general, the transformation process of shifting to a circular business model is highly underestimated by companies. Many more components need to be considered than initially imagined, including return logistics, customer relationships, contracts with dealers and service technicians, remanufacturing processes, and the changing needs and demands of consumers over time. Many of these, when looking into the details, are adding considerable costs to the circular business model and hence need to be optimized for the company to be able to provide a high service at reasonable cost. Cost optimization for a company within a circular economy is different from that in a linear economy. For example, spare parts are no longer a source of revenue. Companies need to learn about these differences, getting into a circular economy mindset in all departments. Tools that highlight these differences and facilitate discussions between different departments/stakeholders are needed. Our simple optimization model turned out to be extremely valuable in supporting interdepartmental discussions at Gorenje by highlighting the impacts of alternative scenarios based on facts rather than opinions.

Finding a circular business model that is profitable, competitive, and attractive to engage in for existing manufacturing firms is not easy in today's mainly linear economy. There are many hurdles to overcome, and some companies might not find a circular business model that really works at all. To allow for a fair discussion about transition to the circular economy, more practice-based (as opposed to conceptual) research is needed towards the barriers of circular business models, for example, by defining contextual factors that can have a determining role. This requires more case studies, like this one, that explore the economic feasibility of circular business models in a variety of industries and show the requirements that make this possible. These exploratory studies can be highly relevant and impactful and should not be put aside as being the role of consulting, since even when they cannot always be perfect from a method perspective, their execution follows academic guidelines, and they inform and inspire follow-up research. This study is unique in that it engaged in multiple iterations in close collaboration with the company over a long period of time. Even though many of the aspects discussed in this longitudinal case have been mentioned in literature, there is a dire need for comprehensive transition cases and tools to support industry. While

the optimistic macroeconomic projections of the benefits of the circular economy may be correct, these ideas may not work for a specific company or, at the very least finding a workable solution and managing the transition may be highly challenging, as this paper illustrates. Companies need better guidance on how they can transition towards a sustainable circular business model. Consequently, researchers need to engage in work with companies to address the issues and to increase the relevance and impact of circular economy research.

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