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# Towards a circular economy by leveraging hazardous resources: A case study of Fortum HorsePower

**Abstract:**

The increasingly efficient use of scarce resources is a central theme in the gradual transition towards a circular economy. Hazardous materials represent a category of resources that is often difficult—and potentially risky—to transport, store, or neutralize. As a result, hazardous materials are rarely included in closed material loops. The present paper analyzes HorsePower, a business concept centered around an innovative way of utilizing horse manure. Horse manure is generated in millions of tons in horse-rich countries such as the UK, Germany, and France. It is a hazardous resource, as it may spread diseases, and cannot be disposed of or landfilled economically. The content analysis of 21 semi-structured interviews carried out with different business actors participating in the HorsePower business network reveals that the success of HorsePower stems from its ability to combine the complementary capabilities and material needs of a relatively complex network of business actors including stables, sawmills, logistical service providers, and heat and power plants. Each actor receives added value; the benefits from participation are greater than the sacrifices of participation. Furthermore, the findings show that certain types of hazardous resources, when combined with resources produced by another actor, may be burned efficiently and safely in specific power plants, reducing the need for other types of fuel. The observations imply that novel approaches for effectively sharing ideas and resource needs across organizational boundaries are needed to facilitate the development of additional innovative CE business concepts, leveraging both actor-specific capabilities and intra-actor resource dependencies.

***Keywords:*** Circular economy; business models; hazardous resources; value creation; business networks

## Introduction and the research aim

Both minimizing the creation of waste as well as developing novel ways of re-using waste are central objectives in the transition towards a circular economy (CE), that is gradually replacing the traditional harvest–produce–dispose model followed in the traditional linear economy (Brennan et al., 2015). Business models that leverage waste materials traded on the global marketplace, such as rare metals and paper fiber, have become quite commonplace in many industries and the target of considerable academic interest (Geissdorfer et al., 2017). However, few firms and academics concentrate on business models that create value from waste that is either hazardous to individuals or the environment, or highly difficult to re-use and thus has a negative value on the marketplace (Hsu &

Hu, 2017). Instead of selling waste, producers have to pay significant sums of money to dispose of it. Horse manure serves as an example of waste that has negative value for the farmer or stable owner as it is continuously generated and difficult to process cost-effectively on site (Rynk, 1994). It is rich in nitrogen, meaning that it is harmful for the environment, especially rivers and lakes. In addition, it is, to an extent, hazardous as it may spread diseases (Airaksinen et al., 2001).

This study examines HorsePower, a business concept established in 2015 that aims to create value from horse manure through the innovative combination of the materials, productive capabilities, and resources of multiple business actors including stable owners, forestry companies, logistical service providers, and power plants. Fortum, the firm mainly responsible for the introduction of HorsePower, is an energy company based in Finland with approximately 8,000 employees. Currently, Fortum is the largest electricity retailer in the Nordic countries. It has a strong strategic emphasis on sustainable development and is actively seeking new ways for renewing the energy system and sustainability-oriented innovations.

The underlying innovation in HorsePower is that while horse manure has a negative market value and cannot be used cost-efficiently by any business actor as such, it can be combined with biomass created by the forest industry, allowing it to be efficiently burned for energy at specific types of power plants. While not significantly reducing emissions created by power plants, the need to burn alternative fuels (both fossil and renewable) is reduced. Also the efficiency of logistical service providers' resource usage is increased, as transport vehicles that used to arrive at certain regional areas empty can now be used to transport materials in both directions. As such, by building on the productive use of hazardous waste, HorsePower simultaneously pursues economic benefits and environmental value. In particular, attention is directed towards understanding *how value is created for different actors in the HorsePower business concept.* Based on an empirical study of the HorsePower business network, we show how that while the elements of value are unique and highly actor-specific, each involved actor receives a positive value contribution from the HorsePower concept. Our findings have several implications for academics and practitioners focusing on utilization of hazardous resources as well scholars addressing value creation in networked contexts.

## Literature review

### *Business models for the circular economy*

Circular economy business models are seen to hold a possibility to enhance environmental and social well-being in an economically viable way (Antikainen & Valkokari, 2016). In general, a business model describes a rationale for value creation, delivery, and capture (e.g. Osterwalder & Pigneur, 2010), and at the heart of the business model is a value proposition describing the economic, environmental, and social value of the business solution (Bocken et al., 2013; Boons and Ludeke-Freund, 2013). Value creation and delivery includes the consideration of the activities, resources, channels, partners, and technologies related to a business concept, while value capture means the consideration of the cost structure and ways to earn revenues (e.g. Teece, 2010; Osterwalder & Pigneur, 2010). CE business models can be defined as providing a rationale for how an organization can create, deliver, and capture value through slowing, closing, or narrowing material loops (Bocken et al., 2016; Lewandowski, 2016). *Slowing resource loops* refers to the retention of product value for as long as possible through maintenance, repair, refurbishment, and remanufacturing. *Closing resource loop*s refers to recycling, where value is created from resources classified as waste, while *narrowing resource flows* means paying attention to efficiency improvements (Bocken et al., 2017). Various factors have been found to either accelerate or hinder the development of circular business (Tura et al., 2019). CE business models are linked to new value creation opportunities as they open new business opportunities; can increase cost efficiency, margin, and profits (Ghisellini et al., 2015); and create possibilities for differentiation and improving image (Bocken et al., 2016; Lacy & Rutqvist, 2015). However, they require a new way of thinking and doing business. Especially for established companies, this can be difficult (Teece, 2010), and many companies have been found to be limited in their capability to develop innovative business models (Chesbrough, 2010). Also, high economic, political, and commercial uncertainty hinders the implementation of CE business models (Liu and Bai, 2014). Despite the difficulties, industry boundaries are gradually fading as new models are introduced as a result of cross-sectoral group efforts (see, e.g., Andrews, 2015; Esposito et al., 2015; Linder & Williander, 2015). For example, BMW's IDrive concept for navigating and controlling systems within vehicles leverages technologies developed in the gaming industry. Also, Hilti, a manufacturer of building tools, draws on principles developed in the automotive fleet management context to lease out building equipment to its customers and ensure that they are adequately maintained (Enkel & Gassmann, 2010).

***Business models leveraging hazardous resources***

By reviewing the literature discussing the management of hazardous waste, we were able to identify three alternative approaches for processing hazardous waste: reducing the toxicity of hazardous waste, using hazardous waste as an input in production processes, and extracting valuable components from hazardous waste.

Approaches for reducing the toxicity of hazardous waste aim at processing the waste in a way that is safer for the environment. For example, Heo et al. (2016) discuss how the toxicity of copper slag can be decreased by means of a specialized treatment process. Approaches for using hazardous waste as an input in the production process consider waste as a valuable resource that can be fed into the process in a cost-efficient way. The risks related to the hazardous nature of the waste can often be mitigated by ensuring that the volume of waste material is very low in relation to other non-harmful inputs. Earlier research has discussed technical processes for combining hazardous and non-hazardous inputs in production processes in the production of concrete (Kassem et al., 2018; Paul et al., 2018), asphalt binder (Qurashi and Swamy, 2018), and thermoelectric composites (Jagadish et al., 2016). Approaches for extracting valuable components from hazardous waste typically focus on types of waste that are generated in high volumes. For example, medicine blisters used for storing and transporting doses of medicine contain valuable metals, some of which may be extracted using highly specific solvent-based technologies (Youcef et al., 2018). Finally, in addition to processing hazardous waste, some types of waste may be disposed of in power plants that are capable of burning them cleanly and efficiently (Bhatt et al., 2018).

***The creation of value in multi-actor contexts***

The purpose of any business model is to create value, and a business model can only be profitable in the long run if it is able to create value for all involved actors. Furthermore, value can be created in a dyadic interface between one firm and its client, or in a more complex network including actors playing different roles in it, exchanging both tangible components or materials and intangible elements such as various services. The concept of value is somewhat ambiguous in terms of how it has been used in the literature (Payne and Holt, 2001; Ulaga, 2003). For example, definitions of value have tied the concept to the ability of a firm to exploit opportunities in its environment (Barney 1991), the ability to satisfy customer needs (Bogner and Thomas, 1992), and the cost-efficiency of operations (Peteraf, 1993). In this paper, according to the work of de Chernatony et al. (2000) and Flint and Woodruff (1997), we consider value as the difference between the benefits received and sacrifices made by a specific business actor. Thus, value created for an individual actor in a business network—that is, a set of two or more firms connected by exchange relationships (Emerson, 1981; Miles & Snow, 1992)—may be very different from value created for another actor in the same network. In addition, a resource, such as a flow of waste material that has no value (or even has negative value), for a specific actor may be highly valuable for another actor that can utilize it as raw material in its production process.

To understand how a specific CE business model creates value for involved actors, we need to direct our attention to the benefits (positive value elements) for each individual actor and the sacrifices (negative value elements) made by them. Some of the sacrifices made by an actor, such as the price paid for a specific service, can be easily quantified in monetary terms, while other sacrifices, such as the reduction of customer satisfaction due to quality issues, are much more difficult to estimate. Also, quantifying the benefits that an actor receives from a specific model represents a challenge as well. In the following, the article proceeds to discuss the research approach, analysis, and findings.

## Methodology

This study draws on a qualitative, empirical case study (Yin, 2014) focusing on the Fortum HorsePower concept. The qualitative research approach was selected in order to generate a deep understanding of the observed phenomenon in a real-life setting (Corbin & Strauss, 2015).

The data was collected by conducting 21 explorative, semi-structured interviews with individuals in the HorsePower business network. The interviews involved 26 individuals who represented different business actors including stables (client 1), heat and power plants (client 2), logistic partners (service providers), and Fortum (the implementer) (see table 1 for detailed information). In the selection of interviewees, we relied on snowball sampling, that is, we first selected representatives working with the HorsePower concept at Fortum and, during the interviews, asked these individuals to suggest persons representing other organizations involved in the concept for inclusion. The interviews took on average 46 min and were conducted in 2018. Most of the interviews were conducted face-to-face, but due to significant geographical distances, six of the interviews were conducted by telephone. The interviews were recorded and transcribed.

**Table 1.** Research data information

| **Firm** | **Size of firm** | **Interview type** | **Interviewees' positions** | **Time (min)** |
|---|---|---|---|---|
| Fortum 1 (HorsePower) | Large | Group interview (4persons) | Vice president, R&D manager, sales and marketing manager, salesperson (HorsePower) | 72 |
| Fortum 2 | Large | Individual Interview | Head of engineering & O&M | 52 |
| Fortum 3 | Large | Individual Interview | Marketing manager | 61 |
| Fortum 4 | Large | Group interview (3 persons) | 2 customer solutions managers, development engineer (eNext) | 88 |
| Fortum 5 | Large | Individual Interview | Product manager (eNext) | 78 |

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|---|---|---|---|---|
| Heat and power plant 1 | Medium-sized | Individual Interview | Power and heat plant manager, consulting | 66 |
| Heat and power plant 2 | Large | Telephone interview | Power plant manager | 35 |
| Stable 1, Finland | Very large (multiple stables), Finland | 2 Individual Interviews | 2 employees (trotting stable) | 20<br>25 |
| Stable 2, Finland | Small (9 horses) | Individual Interview | Employee (hobby stable) | 57 |
| Stable 3, Finland | Small (4 horses) | Individual Interview | Employee (hobby stable) | 40 |
| Stable 4, Finland | Small (6 horses) | Individual Interview | Employee (hobby stable) | 34 |
| Stable 5, Finland | Medium (16 horses) | Individual Interview | Employee (trotting stable) | 44 |
| Stable 6, Finland | Medium (19 horses) | Individual Interview | Employee (riding school) | 37 |
| Stable 7, Finland | Large (22 horses) | Individual Interview | Employee (riding school) | 58 |
| Stable 8, Finland | Large (24 horses) | Individual Interview | Employee (boarding stable) | 57 |
| Stable 9, Sweden | Very large (42 horses) | Telephone interview | Employee (boarding stable) | 25 |
| Stable 10, Sweden | Very large (50 horses) | Telephone interview | Employee (boarding stable) | 42 |
| Stable 11, Sweden | Very large (43 horses) | Telephone interview | Employee (boarding stable) | 27 |
| Logistics service provider 1 | Small | Telephone interview | Managing director | 30 |
| Logistics service provider 2 | Small | Telephone interview | Partner | 20 |

The data analysis followed qualitative data analysis guidelines including those related to data reduction, data display, drawing conclusions, and verification (Miles & Huberman, 1994). Textual data was analyzed with the content analysis method (Bazeley & Jackson, 2013). Data reduction was carried out with NVivo 11 software in order to select the key parts of the data and simplify and abstract the meanings (Hsieh & Shannon, 2004). This included the forming of initial categories and writing down notes and thoughts to highlight the core issue. Initial categories were further analyzed in order to highlight the relationships and links between these categories. The reduced data was further organized into tables and figures to allow the drawing of conclusions and verification (Miles and Huberman, 1994).

**Results**

The analysis revealed various benefits (positive value elements) and sacrifices (negative value elements) related to HorsePower that were experienced by different network actors. These elements are summarized in Figure 1. The following subchapters discuss in more detail the material and information flows across the network of Fortum HorsePower, as well as the findings regarding the identified key themes of value elements. (Italics are used in the text to identify the key themes.)

| | Benefits (positive value elements) | Sacrifices (negative value elements) |
|---|---|---|
| Fortum | • Additional revenues<br>• Image benefits<br>• Opportunities for new market entries | • Low profitability of operations<br>• Additional work in coordinating logistics<br>• Varying political requirements slowing the implementation speed |
| Stables | • A solution to the manure problem<br>• Reliable waste management service<br>• Time and effort savings<br>• Access to higher quality bedding material | • High cost of waste management service |
| Heat and power plants | • Cost savings<br>• Image benefits | • Additional work requirements for environmental management<br>• Technical challenges<br>• Safety concerns |
| Logistic service providers | • Additional revenues<br>• Increased capacity utilization<br>• Alignment with personal values | • Varying stock sizes<br>• High technical and cleanliness requirements for equipment |

**Figure 1.** Summary of key findings

***Material and information flows across the HorsePower network***

HorsePower is based on the idea of utilizing waste material flows across industries. There are around six to seven million horses in Europe (Arnet, 2015; World Horse Welfare & Eurogroup for Animals), each producing manure of up to 10 t/a (e.g. Kusch, 2013). Options to utilize or get rid of horse manure are very limited and costly. Horse manure is categorized as a hazardous waste; it is not allowed to be landfilled, and it has limited suitability for other uses, for example, as fertilizer. Stables have limited possibilities for using significant amounts of manure themselves, which is why horse stables across Europe are facing major challenges. The HorsePower concept is based on the centralized management of services for manure and bedding material pick-up and delivery. First, by-products from the forest industry are delivered for stables to use as bedding material. Used bedding material, mixed with manure, is picked-up regularly from stables (there is no need for long-time storage in the stables) and delivered to a heat and power plant. This manure is used as a low-cost bio-material to produce electricity and district heating to end-users. Finally, the combustion ashes (by-products from energy production) are utilized, for example, in civil engineering, as well as being used as forest fertilizer.

The HorsePower business network consists of multiple actors. Fortum HorsePower (the implementer) is the main solution provider running the business. They work as the platform for information sharing and communication. There are two types of customers: stables (client 1), and heat and power plants (client 2). Stables purchase the waste management service, including the delivery of bedding material and pick-up of horse manure. Power and heat plants purchase biofuel; that is, horse manure mixed with bedding material, to be used in energy production. In addition, the network also includes logistic service providers who collect and deliver the bedding material and horse manure. The role of forest industry actors (e.g., sawmills) (suppliers) is to sell material to be used as bedding materials. In the network, end-users for heat and electricity also exist. Additionally, authorities have a role as regulators, setting the laws, standards, and rules for the utilization of horse manure in power and heat production. Figure 2 illustrates the HorsePower business network, as well as the material and information flows between actors.

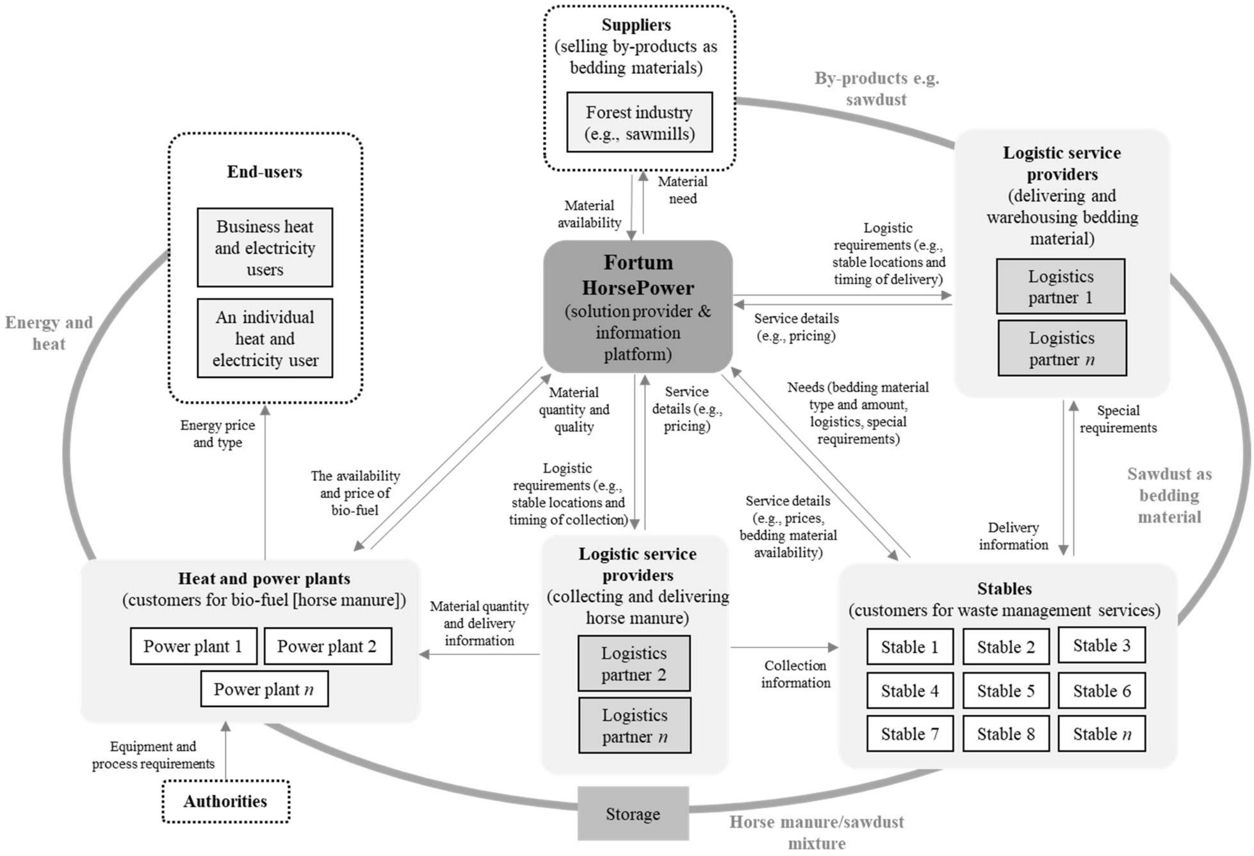


**Figure 2.** The HorsePower business network

***Value creation for different actors in the HorsePower business concept***

In the following, the findings are discussed highlighting the perspectives of the different network actors. After presenting each perspective, the identified categories are summarized in tables 2–4 with illustrative quotes from the data.

*Value creation for Fortum*

The main motivation for Fortum is the ability to create additional *revenues.* HorsePower provides new market opportunities and possibilities to expand into entirely new business areas, industries, regions, and nations. In addition, HorsePower supports the development of a greener and more environmentally friendly image for Fortum. As the business concept is based on solving the waste management problem (horse manure) in a sustainable way, Fortum receives *image benefits* of utilizing HorsePower in marketing. However, as the concept is relatively new, Fortum has experienced difficulties related to the *low profitability of operations.* This is largely due to the challenges in managing various logistical flows as well as determining optimal pricing levels. The organization of two-way logistics (e.g., material flowing to stables and from stables) was found to incur unexpected additional work as well as costs. Furthermore, contradictory and varying political regulations on regional and national levels were found to hinder the rate with which the concept can be made available to business actors in different European countries.

**Table 2.** Value creation for Fortum with empirical illustrations from data

| | Benefits (positive value elements) | Sacrifices (negative value elements) |
|---|---|---|
| **Fortum HorsePower** | **Additional revenues**<br>*"Now we have found the balance where the service is not too costly for the customer and it is also economically reasonable." (Fortum 1)*<br>**Image benefits**<br>*"In marketing, I like to tell customers [the end-users of energy] about HorsePower as horses generate a lot of goodwill. This is a concrete example of how a small thing can develop into innovation and how animals can benefit society." (Fortum 3)*<br>**Opportunities for new market entries**<br>*"In central Europe there is high future potential. Especially in Germany, certain old-school laws and regulations are slowly exiting." (Fortum 2)* | **Low profitability of operations**<br>*"As the business is relatively new, it has been challenging to find the balance between the price for the customer and profitable business" (Fortum 1)*<br>**Additional work in coordinating logistics**<br>*"We still have much to do in this logistics puzzle."*<br>*"In the beginning it was difficult to understand the amounts and ways for reasonable transportation. This was linked to the difficulties in finding the balance from an economic perspective." (Fortum 1)*<br>**Varying political requirements slowing the implementation speed**<br>*"Power plant regulations are developing very slowly … also, many regulations and the perspectives of different ministries in the EU overlap, which is painful." (Fortum 2)* |

*Value creation for stables*

The value for stables is mainly created by providing solutions to their waste management problems. As horse manure is categorized as a hazardous waste, it cannot be landfilled. Larger stables are frequently located near cities and have limited manure facilities or fields where manure can be used as a fertilizer. Before manure can legally be used as a fertilizer in Nordic climates, it needs to be combusted or stored up to nine months (e.g. Airaksinen et al., 2001; Eriksson et al., 2016) or, according an interviewee, even a year. This creates a storage problem and increases costs. Stable owners see HorsePower as an efficient and *reliable service for waste management.* Many interviewees emphasized how they value the reliability and security of the service and that the manure management is done according to legal requirements. HorsePower was described as an efficient, easy, fast, and environmentally friendly service. Furthermore, many stable owners emphasized the *time and effort savings* resulting from the service. In contrast to these benefits, the interviewees also highlighted issues that decreased value creation. Especially the *price* of the service was considered to be relatively high. The pricing was considered particularly unattractive for smaller stables due to the proportionally higher logistical costs. Several interviewees mentioned that HorsePower provides them with access to *a bedding material with better attributes* (sawdust instead of peat), helping them to keep their stables clean and to support both horses' and employees' health and well-being.

**Table 3.** Value creation for stables with empirical illustrations from data

| | Benefits (positive value elements) | Sacrifices (negative value elements) |
|---|---|---|
| Client 1<br>(a stable) | **A solution to the manure problem**<br>*"As I am in the middle of city, I don't have fields or so places to put the manure." (stable 4)*<br>*"Horse manure cannot be landfilled"*<br>**Reliable waste management service**<br>*"The reliability and security of waste management ensures that the work is done according to legal requirements and norms" (stable 6)*<br>**Time and effort savings**<br>*"Life is now easier. I don't need to stress about where to put the manure etcetera and the service brings the bedding material to the barn." (stable 8)*<br>**Access to higher quality bedding material** | **High cost of waste management service**<br>*"This is relatively expensive. Thinking that this is only working with manure, it is pretty expensive to live with this amount of manure." (stable 8)*<br>*"Bedding material and manure management is quite a big cost for stables. Offering bedding material in smaller packages and lowering the prices would perhaps bring new customers." (stable 2)* |

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| | *"Sawdust is better alternative as bedding material (compared to peat); the work environment is cleaner, lighter and air quality is better." (stable 1)* | |

*Value creation for heat and power plants*

The mixture of manure and bedding material is sold for power and heat plants as biofuel to be used in energy production. This fuel is attractive due to its low price compared to alternatives as well as its environmentally friendly image. Value is created through *cost savings* in energy production. In addition, although the current heat and power plants had not yet used HorsePower for marketing purposes, the interviewees noted that the use of HorsePower could provide "green" *image benefits*. In addition to benefits, some sacrifices were also acknowledged. As horse manure is categorized as a hazardous waste, utilizing it in energy production is highly regulated, requiring specific permissions. Obtaining such permits require *additional work for environmental management*, including extra effort to convince authorities to use it for this purpose. For example, trial production runs may need to be made to demonstrate that emissions remain below predetermined limits. The regulations and practices of authorities vary between countries and regions, causing challenges in getting premises and understanding the requirements needed. Extra work and effort were also identified to be linked to environmental management. For manure, the nitrogen emission level is lower than it is for conventional fuels, thus power plants need to pay extra attention and make investments to ensure that emission levels remain below the limit. In addition, interviewees mentioned some *technical challenges* at the beginning of the use of HorsePower, as the delivered manure with excessive moisture content was caught in the conveyor belts. Furthermore, possible negative consequences were identified to be linked to the *safety concerns*. As interviewees revealed, in the beginning of the use of HorsePower, employees had some concerns. This was due to the potential risks stemming from working with hazardous materials as well as possible smell and hygiene drawbacks.

**Table 4.** Value creation for heat and power plants with empirical illustrations from data

| | **Benefits (positive value elements)** | **Sacrifices (negative value elements)** |
|---|---|---|
| Client 2 (a power plant, energy producer; internal or external) | **Cost savings**<br>*"The biggest factor in the implementation of HorsePower is the clear cost savings."*<br>*"In relation to energy-related content, HorsePower is half the price of, e.g., the chip price." (heat and power plant 2)*<br>**Image benefits**<br>*"After we get the continuous permission to burn it, we have to see whether it is usable from image promotion." (heat and power plant 2)*<br>*"I think it is great that we try to utilize waste in energy production." (heat and power plant 1)* | **Additional work requirements for environmental management**<br>*"Testing permission ended in last May. … Currently horsepower is not mentioned in our environmental permission, which is why we can't burn it … Among authorities there are not yet uniform practices about these premises." (heat and power plant 2)*<br>*"When we are using HorsePower, we have a little bit higher nitrogen oxide emission level and we need to pay a bit more attention to combustion operations to keep the emissions below the limit. … The nitrogen limit is lower for manure than it is for conventional fuels". (heat and power plant 2)*<br>**Technical challenges**<br>*"At the beginning the manure-mixture grabbed the conveyor belts, which required mechanical cleaning, not being nice work to do." (heat and power plant 2)*<br>**Safety concerns**<br>*"When we started burning it, it caused some negative emotional effects among employees related to burning animal manure. There were worries about its hygiene. However, in practice that did not become a problem." (heat and power plant 1)* |

*Value creation for logistic service partners*

Logistic service providers play an important role in the HorsePower business concept as they transport materials between the involved actors. In addition to additional *revenues*, HorsePower also brought benefits related to more efficient usage of equipment, that is to say, it brought optimization of capacity use, *increasing capacity utilization.* The transportation of bedding material to stables was recognized to be suitable for reverse logistics, that is to say, vehicles that were previously returning empty from their destinations could now create additional value by carrying resources both ways. In addition, interviewees also highlighted that the concept *is aligned with their personal values.* They were motivated and proud to be involved to this new type of business, which utilizes waste material and follows CE ideology. In addition to transport services, logistic service providers also store the bedding material delivered by sawmills. Identified sacrifices related to the concept were linked to seasonal *variations in* bedding material usage that affected the *stock sizes* of logistic service providers that took care of the bedding material storage. Interviewees explained that the bedding material is delivered in a steady stream, but the use of bedding materials in stables varies significantly between summer and winter times (in summer, animals are at pasture and no bedding material is used at all), sometimes resulting in relatively big stocks. Furthermore, HorsePower was described as a complex business system as the stables, their requirements, types, equipment, and facilities vary significantly. Furthermore, interviewees emphasized *high technical and cleanliness requirements for logistic equipment*, as the stables with open manure storages require tailored cranes for moving manure. In addition, the cranes need to be cleaned between each usage to avoid health risks. From logistic service partners this requires rich and ongoing communication with stables as well as an ability to flexibly adapt to different situations.

**Table 5.** Value creation for logistic service partners with empirical illustrations from data

| | **Benefits (positive value elements)** | **Sacrifices (negative value elements)** |
|---|---|---|
| Logistic service partners | **Additional revenues**<br>*"This presents approximately one third of our business." (logistics partner 2)*<br>**Increased capacity utilization**<br>*"We have a pretty strong volume moving from Helsinki and the capital area to Eastern Finland and, from time to time, we have had unused transport capacity moving from Eastern Finland to the capital area. So this solution has suited us pretty well." (logistics partner 1)*<br>**Alignment with personal values**<br>*"This is a great project, part of clean energy economy in which it is nice to be involved. … you can leave your own handprint." (logistics partner 2)* | **Varying stock sizes**<br>*"Sometimes the stocks get quite big. Finland has four seasons that come with seasonal fluctuations." "Bedding material deliveries comes in a steady stream throughout the year, but usage and customer export vary quite a bit." (logistics partner 1)*<br>***High technical and cleanliness requirements for equipment***<br>*"Each crane truck is unique … building a car is very, very challenging. When we looked for the first car, there was only one suitable in Europe." (logistics partner 2)* |

## Discussion

*Implications for theory and practice*

The utilization of hazardous resources is likely to play an important role in the transition towards a CE. Hazardous resources give rise to considerable risks regarding their safe transportation, storage, and neutralization. At the same time, hazardous resources have the potential for utilization as inputs to production processes (see e.g., Youcef et al., 2018; Jagadish et al., 2016). As such, increased utilization of hazardous resources supports the transition towards the CE by forming additional resource loops and increasing the efficiency of resource usage. Both aims are central in achieving long-term ecological as well as economic sustainability.

The observations regarding the HorsePower network open up new avenues regarding the utilization of hazardous materials in productive activities. Based our analysis, it is possible to identify productive uses for hazardous waste flows that have a negative market value (they cannot be sold in the marketplace). The HorsePower business concept was found to be characterized by collaboration within a broad business network of actors with heterogeneous capabilities, resources, and needs. In the network, materials such as horse manure produced at stables, and sawdust produced in sawmills, as well as the transportation capacity that was not being used by logistical service providers, are combined in an innovative way, creating value for all the involved actors, either by reducing their sacrifices (negative value elements) and/or by increasing their benefits (positive value elements). The ability to create value for all the involved actors contributes favorably to economic sustainability of the business concept, whereas ecological value creation is more a question of a technological nature, in other words, it is a question of developing a process through which sawdust and manure can be combined as a fuel that is high in thermal value.

From the perspective of working towards a circular economy, it would be preferable if hazardous waste—horse manure in the studied case—could be processed into resources valued by the market, similarly to the cases of concrete (Kassem et al., 2018; Paul et al., 2018) and asphalt binder (Qurashi & Swamy, 2018) production discussed earlier. However, when the technology for cost-efficiently utilizing horse manure in the production of other types of resources is not yet available, burning it seems justified from a sustainability perspective, as doing so increases the economic effectiveness of operations (e.g. the logistical service providers have higher capacity utilization rates) and as it replaces other fuels (fossil and renewable) that would need to be burnt if manure were not available. In this sense, it was observed that the Horsepower concept contributes to the economic as well as ecological perspectives of sustainability. However, contributions to the societal dimension were not observed, at least other than the positive feelings associated with being part of the concept mentioned by several interviewees.

A salient characteristic of the studied business concept is that the network of involved actors was relatively complex and heterogeneous. From the perspective of developing additional concepts that leverage other hazardous waste flows in a sustainable manner, this complexity poses certain challenges. Specifically, organizations designing business concepts would need to have access to in-depth knowledge regarding the production processes, material flows, and capabilities of potential partner actors. Given the culture of limited openness typical in many industries (Saad et al. 2002; Sako 1992), this information is not likely to be easily available. In addition, for a new business model to succeed, the model needs to be able to deliver value to all involved actors rather than a subset of them. Thus, a systematic analysis of positive and negative value elements, similar to the analysis carried out in the present study, is likely to aid organizations in this task as value analysis can be used to limit involvement to those business network actors that receive more benefits than they have to make sacrifices when participating in the concept.

Based on the literature on innovation in business network contexts (e.g., Pittaway et al., 2004; Gassman, 2006; Powell et al. 1996), the process of developing business models leveraging hazardous resources is likely to be supported by an approach that invites potential collaborating actors to join in the ideation and testing of alternative ideas. As Winans et al. (2017) highlighted, a successful implementation of CE concepts requires that all involved stakeholders have a clear idea of the potential benefits. The case illustrated that the value creation potential of the CE business model in terms of economic gains, also emphasizing positive environmental and social impacts. From the wider societal and environmental perspective, the concept has a positive environmental impact, such as $CO_2$ reduction linked to replacement of fossil fuels and localized energy production, which reduces the extra emissions from logistics (e.g. Lundgren & Petterson, 2004). HorsePower is a positive example of a business that has convinced both regulators and customers of the possibilities of CE business. Such examples are needed to change the mind-sets of decision-makers internationally and to encourage managers to look beyond their traditional organizational and industry boundaries. The establishment of HorsePower is an example of a big, established company's voluntary efforts in expanding its business towards a circular economy and the requirements of sustainable development. Although the academic literature related to CE business models is rising, this study is one of the few empirical illustrations of the topic.

### *Limitations and suggestions for future research*

In this study, the empirical research was limited to different network actors including Fortum, stables, heat and power plants, and logistic service partners, presenting the key business network. The study did not include suppliers from the forest industry as they simply sell the (by-)products to Fortum according to their requests. The concept is currently operational in Finland and being launched in Sweden, which is why the study was also mainly limited to the Finnish context. After the concept has expanded to other European areas, it would be important to study the varying perspectives of end-users (i.e., individual citizens purchasing heat and electricity or business users, e.g., power plants, themselves) toward HorsePower across different nations. This is due to the considerable differences in fuels used in the production of heat and electricity across Europe, as well as opinions of citizens towards the use of manure as a fuel. Indeed, while several of the interviewees mentioned that the HorsePower concept is well-aligned with their personal values, it is not known if this would be the case in all European countries. As the observations highlighted that specific environmental permits were required for each heat and power plant burning manure, further research could also address differences in regulatory environments (at both the regional and national levels) that relate to the utilization of hazardous resources in energy production.

As the present study was qualitative and explorative in nature, we are in no position to make claims regarding relationships between observed variables. For example, based on the inquiry, the value created for involved business actors cannot be linked to economic indicators such as revenues or profitability. In addition, the observed value elements (benefits and sacrifices) were not categorized based on their relative importance. Thus, it is very likely that some of the elements presented in Figure 1 are highly relevant, whereas other elements are more marginal for involved actors. A logical step forward would be to approach value creation in networked contexts following quantitative research approaches. While it would likely be a considerable challenge to identify a sample of multi-actor business networks that are developing and implementing novel CE business concepts, such work would likely yield considerable and generalizable insights.

## Conclusion

This study examined the case of HorsePower, an innovative CE business concept. We observed that HorsePower ties multiple heterogeneous actors together as a complex system that leverages both actor-specific capabilities and inter-actor resource dependencies to create value for all involved. The primary innovation was that horse manure (which is hazardous and has a negative market value), when combined with relatively inexpensive residue produced by the forestry industry, was found to burn efficiently in specialized power plants. Furthermore, the creation of value, that is the benefits as well as sacrifices resulting from participation in the HorsePower concept, was observed to be highly actor-specific. For example, HorsePower enables stables to dispose of horse manure cost-efficiently, enables logistic service providers to increase their capacity utilization, enables energy companies to benefit from inexpensive fuel, and enables forestry companies to gain additional revenues from sales of forestry residue. The main implications of the study are twofold. Firstly, waste flows with no market value (such as horse manure) may become valuable when combined with resource flows (such as forestry residue) produced by another actor. Secondly, the utilization of hazardous waste in production processes may require—instead of simple dyadic arrangements—the development of relatively complex inter-organizational arrangements involving multiple actors. The findings of the present study contribute to the growing streams of literature on CE business models and on the utilization of hazardous waste. In addition, they open up new avenues for qualitatively exploring how complex inter-organizational value-creating systems can be purposefully developed and for quantitatively exploring which of the observed practices may be generally applied to other contextual settings.

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