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Transition towards Sustainable Solutions: Product, Service, Technology, and Business Model

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Received: 5 December 2017; Accepted: 28 January 2018; Published: 30 January 2018

Abstract: Nowadays, the horse industry can be considered as an important industry in European countries and has a major role in agricultural industry throughout the world. Although today the diversity of the horse-related companies provides new markets and business opportunities, there are also some sustainable issues which needs to be addressed. Therefore, this study contributes to this research gap by reviewing the concept of sustainability and existing approaches to find sustainable solutions for companies. These sustainable approaches can be applied to products, services and technologies as well as business models, such as the product-service-system (PSS), circular economy (CE) and industrial symbiosis (IS). Although there seems to be a growing understanding of sustainable approaches and their role in sustainable development, there is a lack of research at the empirical level regarding the types of sustainability approaches (i.e., technologies, services, products and business models) that evolve in specific industries. The empirical data in this research have been collected from a cross-section of Finnish horse industry operators to determine how willing companies are to exploit approaches to sustainable solutions, as well as what the existing sustainable solutions are in this industry. The response rate of this study is approximately 24 percent, including 139 received valid responses among the sample of 580 operators.

Keywords: sustainability; sustainable solutions; agricultural industry; industrial symbiosis; circular economy; product-service-system

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1. Introduction

The horse industry can be recognized as an important industry and plays a key role in the agricultural industry around the world [1]. Since activities of horse-related companies have changed over time and in the future, new markets and business opportunities will increase even more. Even though today the horse industry provides new opportunities and possibilities for alternative land use and nutrient recycling and new business models for horse companies, it also has some environmental challenges. Currently, the main concern in the horse industry is related to the large portion of manure produced in stables, and there is a need to find solutions to overcome these issues in a sustainable way [1]. Besides, according to an assessment report of an intergovernmental panel in 2014, the existing toxic emissions generated by agriculture, forestry and land usage comprise 25 percent of anthropogenic greenhouse gases (GHG) emission [2]. Therefore, using sustainable solutions for the agriculture industry is necessary in order to enable productivity, economic growth, an environmentally-friendlier environment, and reduced toxic emissions. Thus, this makes the horse industry a very fruitful context to study sustainable solutions in the agricultural industry.

On the other hand, in recent years, sustainability has become an essential issue for companies, primarily because of the pressure applied by stakeholders and society to transition into sustainability as a way of thinking. Hence, the motivation of academics, organizations, and business practitioners to achieve sustainability is highly related to the economic goals of organizations to become market leaders, gaining a competitive advantage, and creating fewer negative effects on society [3–6]. Bebbington et al. [7] refer to the needs of companies, organizations, and individuals to find relevant approaches related to sustainable activities [7]. Additionally, there is an essential need for innovative approaches to attain sustainability in various business domains [8]. Therefore, technologies, services, products, and business models (i.e., product-service-system (PSS), circular economy (CE), and industrial symbiosis (IS)) are among the approaches proposed in this study to achieve sustainability.

To the authors' knowledge, there is a lack of empirical studies about existing sustainable solutions in this specific industry. Therefore, finding appropriate solutions for achieving sustainability is the main concern for most of the companies which involved in this industry with a high environmental impact. Moreover, Shrivastava et al. [9] identified the need for more studies on sustainability in the field of water and soil [9]. Therefore, it is required to concentrate more on the achievement of sustainability in the agriculture industry [10].

This research sets the objective to review the concept of sustainability and to find approaches for companies to achieve sustainable solutions. To reach this goal, two different research questions must be answered. First, what kind of approaches to sustainable solutions exist? Second, how willing are companies to exploit sustainable solutions? Additionally, in this article, empirical data have been gathered from a cross-section of Finnish horse industry operators to study companies' willingness to explore sustainable solutions in their business. To summary all the findings, the results are presented in a form of a conceptual framework.

The remainder of this research is structured as follows. After the introduction, the literature review follows, which investigates the concept of sustainability and its dimensions as well as possible solutions for achieving sustainability in business. The third section describes the research methodology, including the empirical setting, samples, data collection, and measurements. The results obtained from a cross-section of the Finnish horse industry can be found in the fourth section. Then, the discussion and conclusion are presented.

2. Literature Review

2.1. Sustainability

The importance of sustainability cannot be ignored because of the environmental problems faced by contemporary society. Such ecological issues are related to the shortage of virgin resources, the existence of industrial emissions, and the lack of raw materials [5,11–16].

The term sustainability was first introduced by Hans Carl von Carlowitz in 1713. The main research concentration of this author was on the finite nature of wood as a resource [17]. In 1987, the definition of sustainability changed, based on the Brundtland Report, to "Economic development that meets the needs of the present generation without compromising the ability of future generation to meet their own needs" [18] (p. 586) [19] (p. 84) [20] (p. 43). This definition is still valid because the main focus is on the integration of the environmental, social, and economic dimensions of sustainability, which is called the triple bottom line (TBL) [19,21,22].

The environmental dimension of sustainability dates back to the growth of ecological issues, such as acid rain, global warming, droughts, increases in sea level, and habitat destruction [23]. Environmental sustainability concerns also include waste reduction, toxic emissions, pollution, and the consumption of energy resources and toxic materials [21,24].

Next, the social dimension of sustainability traces its origins back to the Middle Ages a time when lumber was utilized as a primary source for economic processes. As lumber has been used as a main source of construction and energy production during periods of population growth, such uses lead people to think about the finite nature of the forest, which is related to the concept of sustainable forestry [25]. Research on the social aspect of sustainability focuses on improvements in quality of life and well-being, such as job opportunities, the enhancement of relationships inside and outside of an organization, democratic activities and the responsibility of governments and citizens to do sustainable activities [21,26]. Finding a balance between personal and social needs and improving nature's capacity to support both individuals and the environment are among the issues in this dimension [23].

Previous studies on this topic have shown that the advantages of sustainability are not limited to social and environmental dimensions. Sustainability also contributes to economic development by creating value for organizations [27]. The economic failure of Wall Street, for instance, has shifted researchers' attention to the economic dimension of sustainability since 2008. The worldwide economic recession was a cause of concern in terms of unemployment, job security, and financial risks to governments and public programs. Economic sustainability has been considered from two perspectives [28]: ordinary financial performance, including the costs of production and manufacturing [24,29], and the economic interests of external stakeholders, such as the broad range of developments in economic well-being and living standards. It is worth mentioning that creating economic development without considering the social and environmental aspects is impossible. Hence, creating a balance between each dimension of sustainability can be considered the main aim to attain sustainability in business [30].

To evaluate sustainability in a firm's activities, there is an essential need to find comprehensive structures and mechanisms in each governance system [31,32]. So, an institutional dimension has been defined to complete the TBL framework [33]. The institutional dimension of sustainability can be seen as a cross-sectional dimension related to all three other dimensions of sustainability. It includes governmental aspects of sustainable development, for example, elements of pertinent legislation, policies enacted at the community level, and political support for development [34,35].

The main point of sustainability is related to achieving a balance among its various dimensions [22,24,26,36,37]. Consequently, it would become possible to achieve sustainability at a global scale if changes were made in our way of thinking and if new activities were adopted [38,39]. For instance, innovative products, services, technologies and sustainable business models could be created in a way that not only meets social and environmental attractions, but also satisfies economic and institutional requirements.

2.2. Approaches to Sustainable Solutions

During the last two decades, crisis in economic, financial, environmental, and institutional dimensions have raised questions about appropriate approaches for sustainable solutions in the future. It is common knowledge that transitions are required at individual, organizational, and societal levels to overcome these issues [40].

There are a variety of ways to incorporate the principles of sustainability into an organization's activities [36]. Some of these methods include considering sustainability at the beginning phase of business strategies (i.e., preparation and the reviewing process); providing supportive approaches for new arrangements and negotiations, which enhance sustainable practices in business; developing new projects with consideration of sustainable principles; and expanding the vision of sustainability in a company's restrictions [21].

In regard to business activities, sustainability refers to "the adaption of business strategies and activities that meet the needs of the enterprise and its stakeholders today, while protecting, sustaining, and enhancing the human and natural resources that will be needed in the future" [41]. The relevant sustainability strategies described in this study include the creation of sustainable products, services, technologies, and business models with the aim of satisfying current needs without compromising the requirements of the future generation. Accordingly, to reach sustainability, a search must be done to find sustainable solutions. Next, sustainable solutions in terms of products, services, and technologies, as well as business models such as PSS, CE and IS are reviewed as follow.

2.2.1. Products, Services, and Technologies

According to Sadovnikova and Pujari [42], green strategic partnerships can be defined as an agreement among different organizations on a voluntary basis. The aim of such a partnership is to share, exchange, and co-develop sustainable products, technologies, and services to achieve sustainable goals and address vital business requirements [42]. Partnership in sustainable technology includes cooperation among different companies with the aim of the development as well as implementation of novel sustainable technology to produce green products and offer sustainable services [43,44]. Therefore, different sustainable solutions in terms of technology, services, products, as well as a business model are required to face the profound impact of sustainability in society [45].

Novelty in technology, business models, as well as lifestyle models are three important factors related to the achievement of sustainability around the world [19]. Sustainability in manufacturing contains that all the processes of manufacturing, such as customer, service, production process activities and so on, are done in a sustainable way. Compared to traditional manufacturing, advanced manufacturing can be considered an important factor in the development of sustainability and enhancing the quality and flexibility of the manufacturing process, while decreasing costs [46]. Technology can be defined as an influential item to achieve sustainability in advanced manufacturing. The reason is that technology provides the occurrence of radical transitions during the manufacturing process, which enables the reduction of energy, material consumption, and toxic emissions [47,48].

Additionally, providing both physical products and services is another sustainable solution that supports the development of value networks [49–51]. Green products are sustainable solution that enhances the quality of life of individuals and development rates of companies [52]. In addition to producing sustainable products, the creation of service, especially in a saturated market that changes quickly, provides sustainable competitive advantages [53]. Moreover, to enhance human well-being, which is related to the social dimension of sustainability, technology is needed for sustainable development in different domains, such as healthcare, energy, and the agriculture industry [10].

A vast number of authors have mentioned technology as one of the important solutions that can provide sustainability [9,54–61]. Technology encompasses a set of devices, methods, processes, as well as practices [10]. Technology can provide economic, social, and environmental sustainability, due to its nature to enhance positive relationships between human requirements and environmental restrictions [62]. Improvements in information and communication technologies (ICT) provide sustainability in work and lifestyle, which leads to both economic and social sustainability. Technology will support the smart consumption of energy resources, which leads to achieving a sustainable environment [19].

On the other hand, technology can be considered as the parameters leading to sustainability by concentrating on the consumption of renewable energy, the preservation of resources, new methods of pollution control, and waste management technology [9]. Therefore, new technologies are required to overcome with the challenges of sustainable development [63]. Clean technology, end-of-pipe technology, environmental technology, and eco-technology are among the technologies used for the efficient use of energy, water and land, as well as the reduction of waste, air pollution, noise and vibrations, leading to sustainable development [9,64]. Unfortunately, currently the main focus of sustainability is limited to energy resources, emissions and waste reduction, while water and soil are still ignored in the sustainability domain. Therefore, there is a need to focus on all these issues to achieve a sustainable society [9].

2.2.2. Sustainable Business Models

New technology, services, and products are among the sustainable solutions and achieve commercial viability for business, but only when they paired with appropriate business models [8,65]. Therefore, a new business model could be another possible solution for sustainability [19]. PSS [66], closed-loop models [67], IS [68] are among the business models that have a wide range of sustainability characteristics and help to achieve sustainability in business [8].

Product-Service-System (PSS)

In recent years, the need for eco-designs as well as sustainable production and consumption methods has arisen [69–71]. Changing the way of business to be more service-oriented will improve sustainability in production and consumption. In this regard, the concept of PSS refers to sustainable production and consumption [72]. Making the transition from cars to mobility, washing powders to cleaning services, and videocassettes to movies are among the examples demonstrating purchasing services instead of products [70]. Additionally, according to Goedkoop et al. [73], the main concentration of PSS is the reduction of the environmental impact, which leads to sustainability by providing effective services or product consumption.

The concept of PSS offers new model of business that satisfies customer demands by offering a combination of both products and services. In this method, the fulfilment of customer demands is based on innovative and sustainable solutions among all the manufacturing process [74]. The aim of PSS is to reduce the consumption of resources and the creation of products and services with fewer resources, less waste, and less pollution. For instance, periodic maintenance enables less waste and more effective use of natural resources [75]. Therefore, many different authors believe that the concept of PSS can be recognized as a sustainable business model [75–77].

There are vast numbers of companies that create sustainable solutions for their business. For instance, ZETA is a construction company that enables the design and manufacturing of the whole building by the use of sustainable green technology. IBM deals with financing, which fosters more sustainable use of current products by creating a new business model based on lease financing and asset recovery. Better Place is another company that works with electric vehicle technology, using the provision of service as a sustainable solution for its business. These companies do not just create novel technologies, but they create products and services by efficiently using current technology [65].

Circular Economy (CE)

There is an essential need to make the transition in business models from linear to circular systems [78]. Sustainable development—in terms of environmental, social, economic, and institutional aspects—can be achieved with the concept of CE, which is a novel business model [79]. The main purpose of CE is to provide opportunities and create competitive value for advanced well-being in society while considering the utilization of fewer materials, energy resources, and ecological charges [79].

All three dimensions of sustainability have been considered in the concept of CE. Referring to economics, CE focuses on the development of resource distribution as well as the consumption of energy and resources in an efficient manner. These sustainable activities in CE result in the promotion of competitive benefits at both local and national levels. In terms of the environmental dimension, CE is an eco-friendly business model, which changes the structure of industries to promote the use of sustainable methods with fewer negative effects on environment. With respect to social sustainability, CE enables new employment opportunities, allocates economic developments fairly and global contributes to the overall well-being of the society [80].

The concept of CE, which concentrates on waste recycling, was introduced to industry in the mid-2000s [81]. Geissdoerfer et al. [82] have defined CE in a way that cover various contributions as a "regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling" [82] (p. 759). The necessity of the CE cannot be ignored for sustainable agricultural development. Vast numbers of examples exist in the agriculture industry in which the main focus is to exchange wastes as the resource between different levels of the industry. For instance, fish feed on weeds, insects and their waste manure fields which decrease the consumption of chemical fertilizers and toxic material and manage the origins of pollution better in the agriculture industry [83]. Furthermore, the application of CE can support resource reuse, for instance in tanneries [84]. Additionally, in China, Jilin, studies on the animal-husbandry breeding make progress in pharmaceutical, fertilizer and agricultural industry in reuse and recycle of materials with the aim of minimize and manage waste and rise in the level of income yearly [85].

Industrial Symbiosis (IS)

IS, eco-industrial networks and sustainable development are different concepts that are closely related to the concept of CE [86–89]. Moreover, IS and eco-industrial parks are among the essential concepts used in industrial ecology [90]. All these concepts are in the same line and can be used interchangeably [89].

Industrial ecology can be defined as a policy with the aim of reducing the amount of waste creation by imitating natural ecosystems in industrial systems [54]. Frosch and Gallopoulos [91] refer to "Industrial ecology" for the first time by utilizing an analogy between natural and industrial ecosystems [91,92]. Subsequently, Allenby defined the term as "a systems-based, multidisciplinary discourse that seeks to understand emergent behavior of complex integrated human/natural systems" [92–94]. The central focus of industrial ecology is to make the transition from a linear to a circular nature of industrial systems. In a circular system, waste and by-products can be reused as energy sources or raw materials for another product or process [95]. The development in industrial ecosystems can be classified into three different groups [96]. The first is undeveloped systems, which focus on a linear economy and do not have feedback flows. The second group has a limited number of feedback flows. The last type concludes the cyclical material flows, meaning that waste can be used as a resource for the other system, which leads to waste reduction among all the systems [97,98]. This research concentrates on the third group, which is closely related to the concept of CE.

IS is a subset of industrial ecology with the main focus on the integration of local industries and exchange of energy, water, waste and by-products among the local companies, societies, and industries [54,87,99–102]. As suggested by Mirata and Emtairah [103], IS networks create ecological and competitive advantages by incorporating a set of similar approaches, such as the continuous and symbiotic relationships involved in local activities, in which various resources, materials, energy and knowledge are exchanged [103] (p. 994). As the concept of IS leads to the creation of economic growth for local companies' involvement and decreases the environmental impact due to the efficient consumption of energy, it is a win-win situation and provides both economic and environmental sustainability. Karlsson and Wolf [104] refer to the application of IS in the forest industry, noting that extra heat and waste can be utilized in different industries or processes. The exchange of information, services including logistics, training and system planning are activities involved in IS [103].

Kalundborg is the most well-known example in IS [105,106]. Kalundborg utilized industrial gypsum, produced in the process of desulfurization instead of natural gypsum in the production of plasterboard. The main focus is the exchange of material among co-located factories [105,106]. UPM-Kymmene Corporation's Kymi plant is the pulp and paper mill in Kouvola, Finland is another example which utilized IS in their activities. This pulp and paper mill utilizes IS in its different units, e.g., three chemical plants, a power plant, energy distributor, water purification unit, waste water treatment plant and landfill. In the power plant, they utilize the wastes of the pulp and paper mill, which are wood residues and sludge, as fuel or input for providing their own heat and electricity needs. Moreover, they deliver electricity and heating to the close town of Kouvola [90]. "Palopuro Agro ecological Symbiosis" is the name of the project that is currently in process in Hyvinkää, Finland. Knehtilä is the name of a farm that utilized IS with its main activities on the cooperative food production system based on energy and nutrient self-sufficiency. The aim of this farm is producing organic and local food using the nearest resources and recycled nutrients. They utilized both the manure of the hens and horses in local places as the input for biogas energy. They utilized biogas in many different places, including grain drying, bakery ovens, cars and farming machines [107].

IS concentrates on material flows in both industrial clusters and industrial parks [95]. The eco-industrial park model was developed in China in the late 1990s [81]. It is worth noting that eco-industrial networks, IS networks and eco-industrial parks are in the same line and can be used interchangeably, while the latter one covers a wider scope in terms of geographical places [89]. The concept of eco-industrial parks is based on the exchange of resources including water, energy and materials as well as knowledge and information with the aim of reducing the consumption of these resources as well as wastes and fostering a sustainable society [89,92].

Mol and Dieu [108] have evaluated the potential of an eco-industrial network in Tapioca Industry in Vietnam, focusing on waste reduction and shape the industry by utilizing an eco-industrial network. According to Jacobsen [106], Kalundborg can be used as an example of an eco-industrial park, reporting both direct as well as indirect effects of this approach in terms of economic growth for companies' cooperation. Reductions in disposal costs and the prevention of discharge fees are among the direct economic advantages achieved through the exchange of higher value by-products. He also mentioned the indirect business benefits, including improvements in the operational capacity and supply security, as well as flexibility and innovation [106]. The exchange of the materials in an eco-industrial park can be used both in by-products [101] and waste or real-value products. Waste is considered food, which means that the waste of one company can be used as the feedstock for another company [92].

The example of the eco-industrial park which is about the exchange of resources, materials and waste has used for the first time in Kalundborg, Denmark in the 1960s [106]. The vast number of eco-industrial parks can be found in different countries, such as India, Australia, Korea, Japan, Canada, the United States and Europe. Most of these developments of eco-industrial parks are endorsed by the exchange of material and information among different companies or industries [109,110]. Another example of an eco-industrial park is in Sweden, Oster Gotland, which is related to the material flows and linkage between a sawmill, a pellet production plant, a pulp mill and many different municipality actors with the aim of reusing and cutting CO2, heat and power waste with biofuel applications [111]. The exchange of waste or by-products is the main activity that is implemented or planned in eco-industrial parks, as it is quite economical to utilize waste especially for metal scraps, waste plastics, paper or wood scraps, ash and sludge [112].

Due to the presented literature review, there is a lack of empirical studies to find the status of horse industries in terms of sustainability. Besides, there is a need to empirically conducting research in this specific industry to determine how willing companies are to exploit approaches to sustainable solutions, as well as finding the existing sustainable solutions in this industry. Consequently, next section concentrates on empirical study in the context of Finnish horse industry.

3. Methods

3.1. Empirical Setting

The horse industry in the EU today is of increasing economic importance to all countries and still plays an important role in agriculture in many countries [1]. Further, Liljenstolpe [1] indicates that the diversity of horse-related companies has increased over time and in the future, new markets and business opportunities will increase even more. Even though the horse industry today provides new opportunities and possibilities for alternative land use and nutrient recycling, and new business models for horse companies, it also has some environmental challenges. The location of horses during the past two decades has shifted from the countryside closer to urban areas, causing more sustainability and environmental challenges. One of the greatest challenges is related to manure horses' produce. A horse produces about 20 kg of manure every day, which may cause problems in terms of nutrients [1]. Currently, only a small part of that manure can be used as fertilizer especially in urban areas due to harden environmental acts. Therefore, to develop an environmentally sustainable horse industry, the problem related to the handling and utilization of horse manure needs to be solved. Thus, new sustainable solutions, for example technologies, services, business models and other innovations, seem promising or even necessary. As the economic importance of the horse industry is not expected to diminish in the future, solutions for more sustainable future are required and providing interesting challenges for both academics and practitioners.

3.2. Sample and Data Collection

The dataset was gathered from a cross-section of horse industry companies in Finland. The initial survey was sent to 631 companies, of which 580 were reached. Two rounds of reminders were sent, each a week after the previous round. Thus, the response rate of this study is approximately 24 percent, including 139 received valid responses among the sample of 580 operators. To check the non-response bias, the respondents were divided into three groups: the first respondents, the first follow-ups and the second follow-ups. The results of the statistical tests revealed that there was no significant difference (at the 5 percent significance level) between the four groups regarding study variables. Therefore, it can be assumed that the responses reflect the whole sample well.

The background information of the respondents is presented in Table 1. Approximately 49 percent of the respondents represented small companies with less than 20 horses; 44.6 percent of the responses came from medium-sized companies and 2.9 percent from large companies. The majority of the respondents were from horse-riding companies, whereas horserace companies represented 18.7 percent of the respondents, as presented in Table 1.

Table 1. Background information of the respondents.

		No	%
Size	Less than 20 horses	68	48.9
	20–50 horses	62	44.6
	Over 50 horses	4	2.9
	No answer	5	3.6
Type of operation	Horserace	26	18.7
	Horse-riding	98	70.5
	Other	13	9.4
	No answer	2	1.4

3.3. Measures

The items utilized in the survey were constructed based on previously utilized scales. The items and their references are presented in Table 2. The variables of the study were environmental sustainability, social sustainability, institutional sustainability and economic sustainability. Each of the variables was measured using 3–5 items. For each of the items, the respondents were asked to indicate their opinion on a scale ranging from 1 to 7 (from not important to extremely important). The measures used in the survey also included 4 items that describe the horse industry operators' willingness to utilise sustainable solutions. The items were as follows: willingness to exploit technology, willingness to invest in technology, willingness to exploit services, and willingness to do business. These sustainable solutions were identified from the literature and modified to items by the authors. Each of the items were measured on a 1 to 7 scale (ranging from no willingness to extremely willing). Two control variables—size and type of operation—were also entered in the survey.

Table 2. Survey items of sustainability.

Dimensions	Aspects	References
Environmental sustainability	Nutrient cycling, Commitment to environmental cause, Waste management, Hygienic factors, Land occupied	[113,114]
Social sustainability	Social recognition, Human capital development, Job creation, Health and safety	[113,114]
Institutional sustainability	Incomes, Indirect jobs, New business	[35,113]
Economic sustainability	Ease of material handling, Energy consumption, Cost reduction	[113,115]

4. Results

4.1. Quantitative Analysis of the Survey

In this section, a description of the valuation of sustainability among industry companies is presented. Regarding the results of different dimensions of sustainability presented in Figure 1, the valuation of sustainability seemed to be high among the horse industry. The means of all studied dimensions, the economic dimension (means 6.11–6.33), the institutional dimension (means 5.58–6.33), the social dimension (means 5.74–6.06) and the environmental dimension (means 5.20–5.68), indicated a high valuation of sustainability.

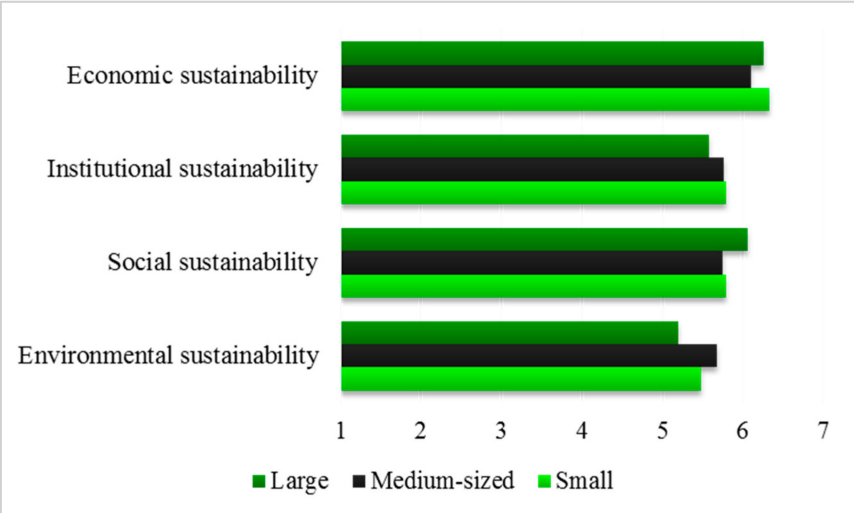

Figure 1. Companies' valuation of different sustainability dimensions.

When the differences between companies with different sizes were analysed, the following was observed. The medium-sized companies seem to valuate environmental sustainability more than small and large companies. Economic sustainability was most valued by small and large companies. Large companies valued social sustainability more than smaller companies. Small and medium-sized companies valued institutional sustainability slightly more than larger companies. However, the differences were not statistically significant. Generally, it can be stated that the size of the company does not significantly affect the valuation of sustainability in the horse industry.

Regarding the results of different sustainable solutions (Figure 2), it can be stated that the willingness to exploit technology (means 4.25–4.05) and the willingness to exploit services were relatively high (means 4.87–5.11) among companies. The willingness to do business with sustainable solutions was also satisfactory (means 4.32–4.61), but the willingness to invest in technology was relatively low (means 3.00–3.78). However, in small companies, the willingness to exploit and invest in sustainable technologies was relatively high when compared to larger companies. What it comes to the willingness to exploit services and to do business related to sustainability, the size of a company did not play a major role in the companies' willingness to exploit such solutions.

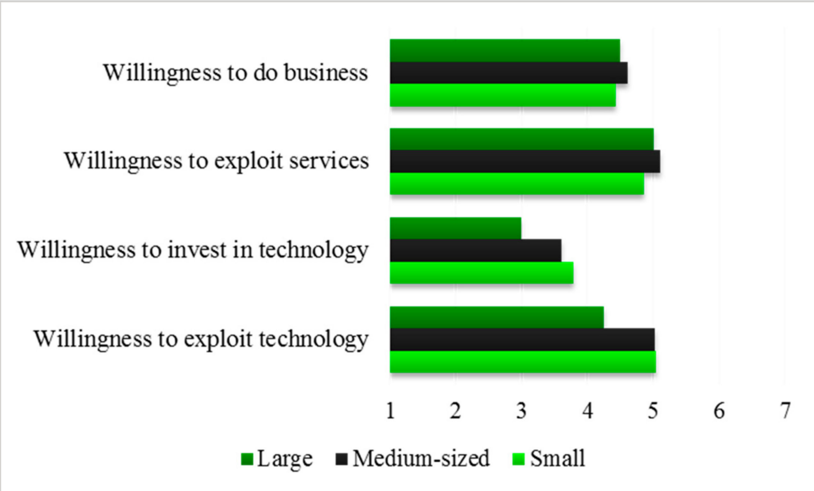

Figure 2. Companies' willingness to exploit sustainable solutions.

4.2. Qualitative Analysis of the Survey

In this section, the sustainable solutions are presented separately for small, medium and large operators and summarised in Table 3.

Table 3. Summary of the sustainable solutions of horse industry.

Sustainable Solutions	Willingness to Adopt	Examples	Focus/Motivation
Product e.g., [49–52]	High	Making fuel out of the manure, such as pellets, biogas.	Energy production, Reducing energy consumption
Service e.g., [49–51,53]	High	Collecting manure from the farms and stables by a service provider Delivering the litters in exchange	Ease, Cost-effectiveness (especially small sized operators)
Technology e.g., [9,54,56–61]	High (to exploit), Low (to invest)	Utilizing manure as a fuel Burning manure in small-level units (Incinerators, Drum composters, Added heat recovery ventilation)	Energy production, Reducing energy consumption (small sized, medium sized and large operators)
Business model e.g., [8,19,66–68]	High	Collecting manure from multiple operators and burning it in shared facilities (such as incinerators and bigger-scale drum composting units) Returning the horse manure back to fields. Turning current landfills into gas recovery activities and utilizing manure as a part of the process	Energy production (especially in urban areas) Improving of the land use, Supporting farming (especially in countryside)

4.2.1. Small Operators

The small-sized horse industry operators' responses, at the general level, can be divided into two perspectives. First, the focus of the horse manure utilisation should be on improving the land use and supporting farming. Based on the opinions of these operators, the horse manure and its nutrients should be returned to fields. The other perspective in horse manure utilisation highlights its potential for energy production or energy consumption. These small operators currently hope that in the future, horse manure could be utilised as a fuel in small stables and farms and manure could be burnt in small-level units and incinerators. One technology to support energy production was suggested to be the possibility to make pellets out of manure. However, currently the operators wished the technology were cheaper to be able to invest in it. From the service point of view, the small stable keepers and operators are currently asking for a service in which manure is collected from the farms and stables by a service provider and the litters are delivered in exchange. In these services, the operators highlighted the ease and cost-effectiveness of the service. Most mentioned that it would be best to use the collected manure in energy production, and only some noted that the service provider could return the manure back to fields (supporting the land use and farming).

4.2.2. Medium Operators

The responses of the medium-sized operators can also be divided into two different perspectives. At the general level, it was mentioned that the main focus of the horse manure utilisation in the future should be:

In the countryside, manure should be utilised in land use and farming activities and nutrients should be recycled.

In urban areas, the main aim of the manure utilisation should be on energy production and consumption.

Although the land use and nutrient recycling in the countryside was mentioned as important, energy consumption was not totally excluded. Drum composting was mentioned as a technology that could be utilised to support both these actions (land use and energy consumption). With added heat recovery ventilation, it could be more effectively used to support the energy consumption of stables and farms, and composting output would be better in land use and farming (compared to raw manure). In addition to drum composting, medium-sized operators also wished that small-level incinerators were possible. They hoped that in the future, burning would not be allowed only in large-scale units. However, some of the operators thought that it may take time before the technology makes it possible for small-scale burning and even then, it might be too expensive to invest in one. For that reason, they mentioned that it would make sense to build incinerators (and also bigger-scale drum composting units) close to large operators, for example racetracks. It was also suggested that current landfills could be turned to or utilised in gas recovery activities and horse manure could be utilised as a part of these processes.

4.2.3. Large Operators

The large horse industry operators and stable keepers' interest in horse manure utilisation seems to be strongly focused on energy production and consumption. They currently see manure as a potential fuel to be used in incinerators. Many large operators have buildings and other structures where produced heat can be utilised. Based on the opinions of these operators, the burning of manure seems to be the most potential and attractive option for manure utilisation in the future. The possibilities for biogas production were mentioned as another option, but currently burning seems to be the most attractive technology.

5. Discussion

Many prior studies suggest that sustainability and sustainable development can be achieved through the integration of environmental, social, institutional and economic objectives (e.g., [21,22,24,36,37]). The findings support these statements by highlighting the holistic valuation of sustainability among the studied companies. The economic, institutional, social and environmental dimensions were all highly esteemed, which in turn indicates the capacity for sustainable development in the horse industry.

This readiness for sustainability was realized especially in terms of the willingness to exploit both new services and technologies. The findings are supported by previous studies, which emphasized services [70,72,75] and technologies [9,54–61] as an important solutions for the achievement of sustainability. However, the willingness to invest in new technologies was considered low, especially among the large companies.

One reason for the reluctance to invest may be that it is considered to be done by a single company. This means that a single company carries all the risks without the possibility of combining different solutions. Therefore, the willingness to exploit services and technologies may indicate the willingness of companies to be involved in green strategic partnerships, as presented by Sadovnikova and Pujari [42]. According to them, this voluntary-based partnership aims to share, exchange and co-develop sustainable products, technologies and services to achieve sustainable goals and address vital business requirements. This partnership may also refer to the willingness to participate in IS, which provides ecological benefits as well as competitive advantages by incorporating similar things together, such as the continuous and symbiotic relationships that are involved in the exchange of resources, materials, energy and knowledge in local activities [54,87,99–103]. This allows a combination of opportunities in which some of the horse manure and its nutrients can, for example, be returned to fields and some are used for energy or pellet production (cf. [107]). In IS, the risks and costs can also be shared, which is important in the era of uncertain environmental regulations.

On the other hand, it is worth noting that the results from open respondents show that all types of operators, including small, medium and large operators, are interested in using horse manure to improve land use, support farming and produce energy. The point is that utilizing horse manure by exploiting business and services can be possible when changing the business model from a linear to a circular system. This is in line with Edbring et al. [78], who stressed the necessity of a circular system to achieve sustainability in business. There are different reasons for these results. The first is a reduction in the cost of transportation. As the main concern of the horse industry is the large portion of manure production, moving this huge volume of horse manure will be very expensive. Via CE methods including IS, it is possible to exchange information, materials and services including logistics, training and system planning among local industry [54,87,99–103]. Therefore, the transportation cost will decrease by sharing and providing services in this way.

The second reason involves the achievement of economic growth by producing their own energy or heat from horse manure. As the concept of IS leads to the creation of economic growth for local companies' involvement and decreases the environmental impact due to the efficient consumption of energy, it is a win-win situation and provides both economical as well as environmental sustainability [104]. The third reason is related to the possibility of making manure usable in other industries, e.g., using horse manure as the fertilizer in gardening. Many examples exist in the agriculture industry in which wastes are exchanged as resources in other parts for fertilizing or land use [83–85,95]. Accordingly, wastes are utilized as resources locally or in other places and consequently it is possible to produce less waste.

Less use of energy resources is the fourth reason for the willingness of all operators to utilize horse manure. Instead of using gas and oil as the source of energy, horse manure can be used as a fuel. Therefore, by producing heat or electronic energy from horse manure, the need for energy resources might decrease. In Finland, UPM utilizes the wastes of pulp and paper mills, which are wood residues and sludge as fuel or input for providing their own heat and electricity needs [90]. Moreover, there is an ongoing project using the manure of hens and horses as resources to produce biogas, and it is used in many different local places including grain drying, bakery ovens, cars and farming machines [107].

6. Conclusions

The aim of this research was to review the concept of sustainability and find approaches for companies to achieve sustainable solutions. The results have been collected from a cross-section of Finnish horse industry operators to discover companies' willingness to exploit or invest sustainable solutions in this specific industry. The findings from empirical studies show that the activities of horse industries are sustainable. A literature review indicates that the main aim of sustainability is to make balance between all dimensions of sustainability, and the results demonstrate that all dimensions of sustainability are at a high level and there is not too much distance between them (see Figure 1). Moreover, this research has contributed to the literature by linking the current literature review on existing approaches for sustainable solutions to empirical research. In Figure 3, the sustainable solutions have been posed against three dimensions that, based on the empirical results, can be seen as fundamental determining factors in a big picture. The dimensions are entitled as willingness to utilize, challenge to utilize, and need for partnership. Focusing on these dimensions is a one way to reflect the sustainable solutions of a company. The theoretical and practical implications are presented below.

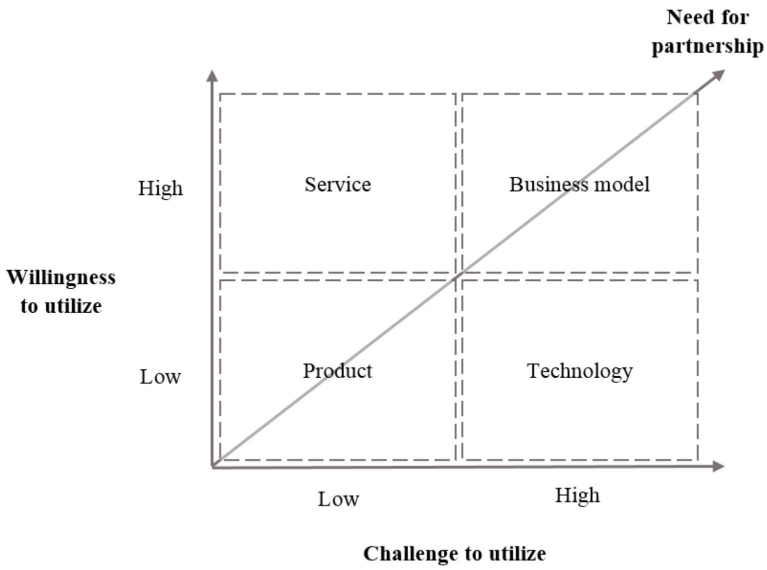

Figure 3. Conceptual framework regarding the transitions towards sustainable solutions.

6.1. Theoretical Implications

The current study enriches sustainability research by examining approaches for companies to achieve sustainable solutions. Two different research questions were examined in this research. First, to answer the question—what kind of approaches to sustainable solution exist?—Four different approaches have been identified for sustainable solutions. Products, services and technologies as well as business models including PSS, CE and IS are among these four approaches—each of which has an option for exploitation or investment, e.g., exploiting technology to make pellets, providing services to collect manure and utilizing wastes as energy production, fertilizer and in land use. Our study argues that the immediate motivation for adopting sustainable solutions stems from increasing energy production, reducing energy consumption, ease of solutions, ensuring cost-effectiveness, and improving of the land use. Additionally, to answer the question of how much willing are companies to exploit sustainable solutions, the results show that the vast number of Finnish horse industry operators, irrespective of the size of the companies, are willing to exploit new services and technologies. However, the willingness to invest was not considered as an attractive alternative (see Figure 2). Besides, operators are more willing to utilize sustainable solutions together with others, which can be linked with IS. As such, our findings shed new light on the role of partnerships in achieving sustainable solutions. Our findings open new avenues for research focusing on how sustainability initiatives may differ when conducted outside the focal company.

6.2. Practical Implications

Regarding managerial implications, this study increases understanding of the approaches for companies to achieve sustainable solutions. In practice, the study suggests that, each sustainability dimension drive companies toward sustainable solutions. Therefore, policymakers and government decision makers should be aware of this. Instead of more and tighter regulations, more sustainable policy schemes should be developed to support companies' activities toward adopting sustainable solutions. Solution developers (i.e., technological, service, and business) can also utilize the results of the study to develop more suitable and attractive solutions for the horse industry.

Acknowledgments: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions: All the authors contributed to the conception of the study and the development of methodology. Mina Nasiri, Tero Rantala, Minna Saunila, and Juhani Ukko wrote the paper. Minna Saunila and Tero Rantala analyzed the data. All the authors have read and approved the manuscript.

Conflicts of Interest: There is no conflict of interest.

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