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Business Models and Ecosystems in the Circular Economy Using the Example of Battery Second Use Storage Systems

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Abstract: The battery electric drive is an important component of sustainable mobility. However, this is associated with energy-intensive battery production and high demand for raw materials. The circular economy can be used to overcome these barriers. In particular, the secondary use of batteries in stationary energy storage systems (B2U storage systems) has been proposed for the circularity of electromobility. To implement such systems, a circular business model and a cross-industry ecosystem are required. However, the meaning, scope, and structure of these concepts have received little research to date. To close this gap, a theoretical construct for a circular business model based on the theory of business model, sustainability, circular economy, and ecosystem must be developed. On this basis, 16 expert interviews were conducted and analyzed using qualitative content analysis. Numerous challenges resulted from the analysis. The willingness to pay for B2U storage systems is limited, the availability of second-life batteries is restricted, and dismantling as well as testing the batteries is time-consuming. Product-service systems help to increase the willingness to pay and expand the value proposition and value capture, digital technologies realize cost-efficient value creation, and an effective ecosystem enables the expansion of battery procurement.

Keywords: second life; B2U; circular business model; ecosystem; circular economy; sustainability

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1. Introduction

The United Nations Climate Change Conference in Dubai emphasized the importance of global climate protection and the significance of the 1.5-degree target. This needs to be translated into effective measures at the national level [1]. In Germany, transport is the third largest source of CO_2 emissions, contributing to 20% of emissions. The transport sector is the only sector that has not been able to reduce greenhouse gas emissions in recent decades. This is why it is the primary targeted area for the reduction of emissions [2]. In Germany and other countries around the world, battery electric drive is being promoted as the most attractive solution for limiting emissions [3]. However, there are other challenges associated with this technology and the use of batteries that limit sustainability [4]. Cell production is energy-intensive and requires critical raw materials such as lithium or cobalt [5]. At the same time, social acceptability is limited by the high costs of battery electric vehicles (BEV) to date [6]. To fulfill the limited dimensions of sustainability, the circular economy should be emphasized [7]. In contrast to the linear economy, this tries to keep the raw materials in a closed cycle [8]. This maximizes the value of resources and minimizes emissions as well as waste [9]. At the end of the batteries' first life, it is possible to reuse them in the same application, to repurpose them for another application, or to recover secondary raw materials [10]. Repurposing batteries for battery second use (B2U) storage systems is becoming increasingly relevant due to the high demand for storage in the energy sector [3]. However, a circular business model is required to realize circular strategies [11]. The traditional business model must be supplemented by the principles of sustainability and the circular economy [12]. In addition, the circular economy operates in cross-industry ecosystems, meaning that this theory must also be implemented [13]. In order to develop a holistic circular business model, the business model, sustainability, circular economy, and ecosystem must therefore be combined [11]. In these ecosystems, the orchestrator and its business model play a central role [14]. Regarding research on B2U storage systems, there is still a lack of a holistic circular business model for the manufacturer of those B2U storage systems [15] as well as an ecosystem [16]. The following research question therefore arises in the context of this article:

RQ: *What are the success factors in the business model components of a B2U manufacturer in a circular ecosystem?*

This article is structured as follows: In Section 2, a circular business model construct is developed based on the definitions of a business model, sustainability, circular economy, and ecosystem, which will be used as the basis for this article. It also emphasizes the importance of B2U storage as one of the circular strategies for traction batteries. Furthermore, the research gap for a holistic circular business model of B2U storage is identified with the help of a systematic literature analysis and a concept matrix. Section 3 presents the methodology, 16 expert interviews, and a qualitative content analysis according to Kuckartz [17]. The research results are then presented and discussed within the framework of the theoretically derived business model construct. This article ends with the limitations of this analysis and the need for future research and a conclusion.

2. Foundations

2.1. Circular Business Model

The realization of the circular economy requires new business models with minimum resource consumption and maximum added value. For these so-called circular business models, a standardized conceptual framework for implementing and realizing circular business models in practice is still lacking [12]. The previous definitions of the circular business model (e.g., refs. [18–20]) combine the conventional business model, which is based on linear approaches [13], with sustainability and circular economy. A circular business model must include the characteristics of both sustainability and circular economy [11,21,22]. It is also no longer sufficient to look at companies in isolation as circular business models operate in cross-market and cross-segment business networks [11,23,24]. The ecosystem is therefore becoming increasingly relevant for a circular business model. This is rarely discussed in the literature [12]. Although there are initial approaches to integrating ecosystem theory (e.g., refs. [11,23]), there is no conceptual, practice-orientated business model framework that seamlessly connects to the widely used business models.

Even the traditional business model does not have a standardized definition [25,26]. In principle, a business model attempts to combine various elements into an overall system [27] so that a component-orientated perspective with individual sub-aspects appears to be useful. However, the definitions vary in terms of the number and names of the components [28]. One widely used model is based on three components: value proposition, value creation/delivery, and value capture [29,30]. The three-component business model should serve as the basis for the circular business model. In the context of this article, the traditional business model is thus defined as a *combination of the three components value proposition, value creation/delivery, and value capture* [31].

Nowadays, the term sustainability is used in an inflationary manner without a standardized definitional basis [32]. The most common definition is a three-dimensional model, which has its origins in the German Bundestag's Enquete Commission "Protection of People and the Environment" [33,34]. Sustainability is only referred to when the economic, social, and ecological dimensions overlap [35]. In the context of this article, sustainability is therefore understood as a *balanced integration of the economic, social, and ecological dimensions* [7].

The circular economy is becoming increasingly important alongside sustainability [36] and is seen as a requirement for enabling sustainability [7]. The definition of the circular economy often leads to three strategies. Energy and material flows can be narrowed (reduction of resources), slowed down (longer product use), or closed (reuse of resources after utilization) [9]. These are also summarized as the 3R principles: reduce, reuse, and recycle [37]. However, the narrowing of flows is already regarded as a strategy of the linear system and is therefore sometimes not categorized as part of the circular economy [18]. For thematic reasons, the focus is limited to the technical cycle with synthetic materials [11]. There are various options for realizing the two strategies [38]. The end-of-life strategies are the focus of this article. To maintain the product value in the second life, a distinction is made between reuse in the original application and repurposing for a different application to slow down the flow of resources. Recycling can be used to close the flow and thus maintain the material value [13]. This article will focus on repurposing. The circular economy is described as a *sustainable model in which the resource input is minimized by closing and slowing down resource flows, and the value is preserved for as long as possible* [7,9].

In an increasingly digital and uncertain world, the ecosystem and thus, the interaction in business organizations, is becoming more and more relevant [39]. In addition to the innovation and platform ecosystem, the business ecosystem should also be mentioned [40]. This serves as the basis for the literature on circular ecosystems [11]. The structural ecosystem according to Adner (2017) [14,40] is chosen as a subdivision of the business ecosystem as an alternative to the ecosystem-as-affiliation according to Moore (1993) [41]. In this model, the value proposition and the constellation of actors take center stage. This is preferable for analyzing business models [14]. While Adner (2017) refers to the central value proposition, the common alignment structure, and the multilateral relationships of a defined group of partners, Jacobides et al. (2018) [40] also highlight the importance of unique, non-generic services of the actors in a structural ecosystem. In the context of this article, an ecosystem is understood as a *multilateral group of partners with unique complementarities that creates a central value proposition through a common alignment structure* [14,40].

To realize a circular business model, the four concepts are merged. The value network is added as a fourth component alongside value proposition, value creation/delivery, and value capture as the ecosystem plays a central role in the circular economy and should not only be listed under value creation [11]. In the circular business model, there is a central value proposition that is supported by all actors [42], which creates sustainable value [43] and is simultaneously "extended" [44] (p. 3), i.e., the flow must be slowed down or closed. Value creation is realized jointly by all actors in the ecosystem [45], whereby additional activities, such as reverse logistics, are required in circular business models [46]. The value capture must be considered individually for each actor [47]. In the circular economy, additional sources of income or cost reduction can become possible [48]. The literature emphasizes the importance of external and internal influences for the circular economy, which affect the operationalization of the business model [49]. External influences include, for example, political drivers, market influences, social impact, and technological developments. Internal influences, such as strategic capabilities, should not be considered separately as they are already part of value creation/delivery [50]. Figure 1 provides an overview of the circular business model construct developed.

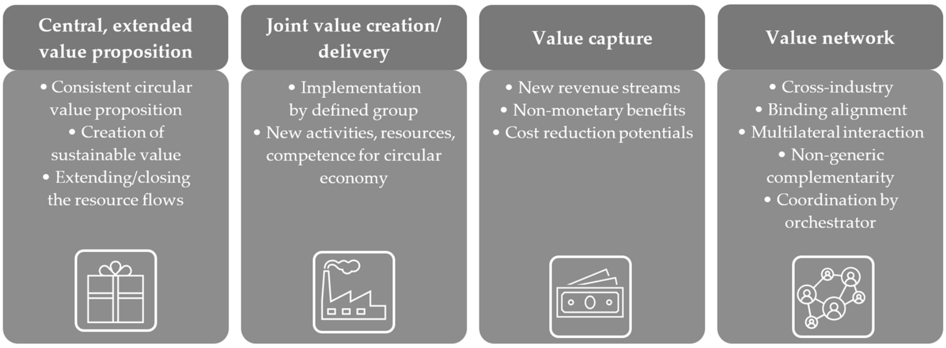

Figure 1. Circular business model framework [11,13,14,40,48,49,51–55].

2.2. B2U Storage Systems

According to the definition of sustainability in this article, the production of traction batteries for BEVs is not sustainable. Most of these are lithium-ion batteries [56], the production of which is associated with high energy requirements [56], critical raw material extraction [57], and high costs [6]. The circular economy is cited in the literature as a solution for increasing sustainability [7], which is being focused on, in particular by the EU Battery Regulation, which has been gradually coming into force since 2023 [58]. The EU Battery Regulation represents an important milestone and replaces the previous EU Directive on batteries 2006/66/EC (see Supplementary Materials Table S1). The end-of-life strategies (see Figure 2) are particularly relevant here as many batteries will be retired in the coming years due to battery degradation. These no longer meet customer requirements in terms of performance and capacity [59].

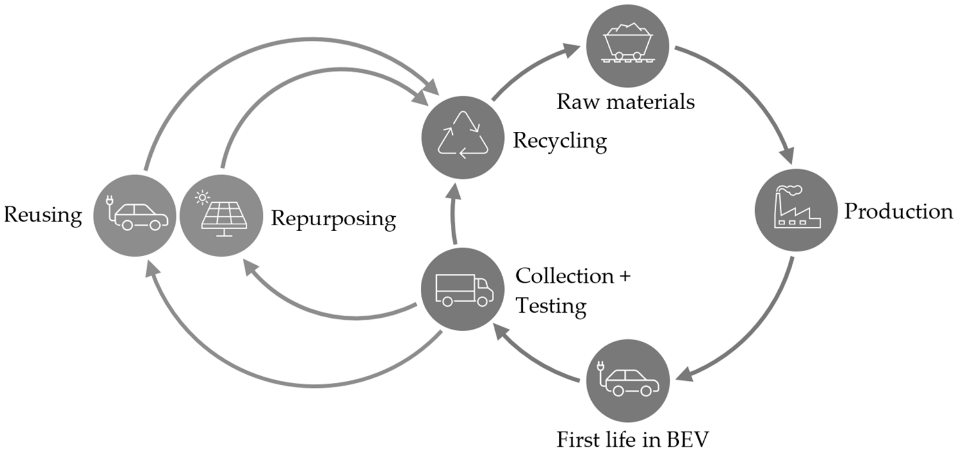

Figure 2. End-of-life strategies for traction batteries [3,60].

A state of health (SoH) of 70 to 80% is usually specified as the end of initial use in the BEV [61]. This is in line with the warranty conditions of various vehicle manufacturers (OEM/Original Equipment Manufacturer), which provide for a free battery replacement at SoH = 70%. First-life utilization corresponds to a period of around eight to twelve years [62]. Due to the often high residual capacity, a second use of the battery appears to be advisable [63]. Recycling is another way of recovering valuable raw materials, such as lithium, cobalt, nickel, and manganese, with the focus so far being on pyro- and hydrometallurgical processes [64]. However, the recycling of lithium-ion batteries has to date only been economically viable for large proportions of metals in the batteries [65] as the recycling processes have so far been labor- and energy-intensive [15]. Using secondary utilization, recycling can be postponed until recycling efficiency is increased [66]. With regard to secondary use, a distinction is made between reuse in BEVs or repurposing for a different application [50]. Due to limited compatibility and reliability, reuse is rarely used [66]. In view of the economic and ecological potential, further use, e.g., in stationary applications, should be favored [10]. Stationary use has a lower requirement [67] and the demand for battery storage is constantly increasing in view of the energy transition [68]. Applications with low load levels are particularly suitable for B2U storage systems to keep the lifetime as long as possible and avoid premature failure. Due to the significantly lower load in stationary use compared to use in BEVs, a large number of stationary applications are generally suitable [69]. A distinction must be made between use as home storage to optimize self-consumption, commercial storage, e.g., for peak shaving, and grid storage, e.g., for primary control power [59,70]. The end of secondary use results from the degradation process of lithium-ion batteries (see Figure 3) [71]. Secondary use should be stopped before the sharp drop in capacity at around SoH = 40%. This results in a lifetime for secondary use of six to 30 years, depending on the application and load profile [72].

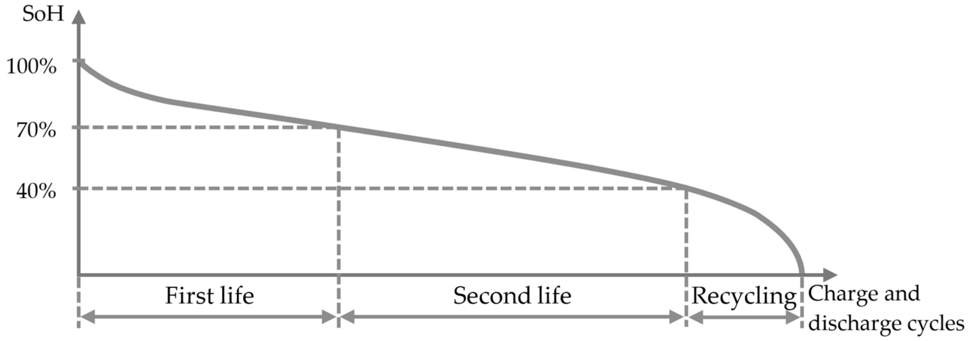

Figure 3. Aging process of a lithium-ion battery [73,74].

2.3. Literature Review

Various databases were searched using the terms "circular economy battery/second-life battery" and "business model" to examine the current state of research into the business models of B2U storage systems. In view of the limited data available, further papers were identified using a backward search. The systematic literature search resulted in 14 relevant articles, which were differentiated using a concept matrix regarding the four essential elements of a circular business model (business model, sustainability, circular economy, and ecosystem) (see Appendix A).

A research gap was recognized in the lack of a holistic, circular view of the business model for B2U storage. As a result, the business model components, such as the central value proposition or joint value creation, remain unclear. The design of the value network for B2U storage as the fourth component of the business model construct is also uncertain and has only been analyzed partially. So far, research has been limited to individual relationships, e.g., refs. [75–77]. It is therefore necessary to develop a holistic ecosystem with all the actors involved [78].

In practice, the use of B2U storage systems has not reached an industrial scale. To date, there have been individual projects consisting of cross-industry joint ventures between OEMs, energy suppliers, or first-life storage manufacturers (see Supplementary Materials Table S2). These are limited to industrial or grid storage systems and are used for research purposes. However, some projects are already aiming to commercialize the storage capacity [79]. There are also start-ups that are beginning to market B2U storage systems for commercial or industrial applications [80].

3. Methodology

The circular business model construct developed in Section 2.1 is to be used within the scope of this study to close the research gap identified in Section 2.3 and answer the research question "*What are the success factors in the business model components of a manufacturer of B2U storage systems in a circular ecosystem?*" formulated in Section 1.

A qualitative method was used as the research methodology in order to understand the complex, causal context [81,82]. Systematizing expert interviews were used to collect data as the research basis and the current state of research are limited [83]. Expert interviews are characterized by the fact that they are more structured and supported by guidelines. Therefore, semi-standardized interviews with pre-structured questions were selected [84]. It was thus necessary to develop a guideline that was orientated towards the four components of the developed circular business model and the external influences. The quality of this research was determined by the selected experts [84]. Experts have extensive knowledge in the area under investigation and could share this during the interviews [85]. To obtain a complete view of the previously separate automotive and energy markets [78], different stakeholders, e.g., OEMs, B2U manufacturers, external specialists, or component suppliers, were interviewed. Potential interview partners were experts who dealt with B2U storage in their professional environment. After contacting 65 experts via the social network "LinkedIn", 16 interviews of 30 to 60 min were conducted with the experts who agreed to be interviewed. A separate interview with an expert on B2U storage systems was conducted beforehand to guarantee the quality of the survey [83]. All interviews were converted into written form by content-related semantic transcription [86] and sent to the interview partners for preparation beforehand [83]. To ensure data protection, all interviews were anonymized [81]. Finally, the interviews were analyzed using qualitative content analysis according to Kuckartz [17] and the MAXQDA 2022 analysis software. The quality criteria according to Mayring [87] were used to assess the research quality of the qualitative study.

4. Results and Discussion

In this section, the results of this study are presented and discussed based on the four business model components. The external influences on the business model are included directly in the individual subsection.

4.1. Circular Value Proposition and Product-Service Systems

The joint value proposition has to be at the center of the circular business model [88]. This study shows that the central value proposition of B2U storage systems is the slowing down of resource flows and thus the maintenance of the product value as the battery is used over a longer period. This is therefore an "extended" [44] (p. 3) value proposition. According to the definitional basis, the value proposition must be sustainable and thus include the three dimensions, i.e., ecological, economic, and social, equally. In addition to the central value proposition, Figure 4 lists all identified sub-propositions, which are broken down into the three sustainability dimensions.

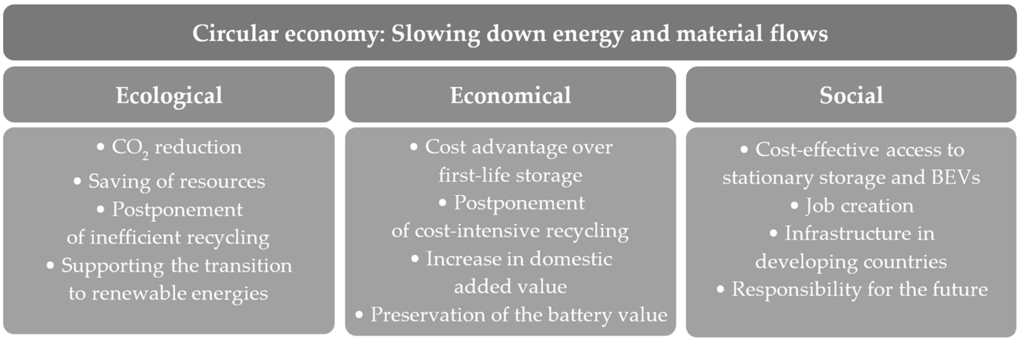

Figure 4. Value propositions of B2U storage systems.

This study shows that the ecological dimension is much more important than the economic or social dimension. Instead, the social dimension is merely seen as an image-promoting tool.

Due to this imbalance, it is not possible to clearly assume a sustainable value proposition. A reduction in CO_2 emissions is most frequently cited as a value proposition in this study. The energy requirements for the new production of a first-life battery and the repurposing of a second-life battery were used for quantification. Despite the smaller usage window of a second-life battery compared to a first-life battery, there is a CO_2 saving of around 100 kg/kWh as the emission-intensive extraction of raw materials and cell production are eliminated (see Appendix B). The ecological value proposition is clearly confirmed. The cost advantage in favor of the B2U storage system is the most significant economic value proposition observed in this study. Some publications on the circular economy assume that customers of circular products have an ecological focus and are therefore willing to pay a higher price [13,89]. This does not apply to B2U storage systems. Used batteries are categorized as critical, meaning that the willingness to pay is reduced by 30 to 50% compared to a new storage system [50] ("*As a customer [. . .] you don't want to pay the same for used as for new*"). The results of this study demonstrate potential sale prices of 450 to 550 €/kWh for B2U commercial storage systems with a capacity of up to 500 kWh. The current mean price for similarly sized first-life storage systems, however, is 600 €/kWh [90]. This results in a cost reduction of 8.33 to 25%. This means there is a financial advantage. However, the required savings are not achieved, and customer acceptance is reduced consequently. The literature has shown that the social component of sustainability is only sporadically taken into account [91]. This is confirmed by this study for B2U storage systems. Possible opportunities to strengthen this dimension include the creation of local jobs through a further value-added process or the use of storage systems in developing countries, such as Audi AG in India [92].

The value proposition also includes the application areas of B2U storage systems, although there are contradictory statements in the literature on this subject [3]. Figure 5 provides a comparison of the three application areas of B2U storage systems. The empirical study shows that the home storage market is excluded due to the high security concerns, the many small-scale projects, and the intensive customer support ("*There is a fear of batteries, especially in the home segment and especially when they are used.*"). Great potential is seen in commercial or grid storage systems due to higher economies of scale and simpler customer interaction. Commercial storage systems still represent a niche market [68] but offer a wide range of applications, such as peak shaving. Although grid storage systems will be able to process the high return volumes in the future, they will also require more monitoring and certification. This means that grid storage systems will only become attractive in the medium term. Primary control power as an application for these storage systems is becoming increasingly less attractive due to market oversaturation and will be replaced by energy trading in the future. Overall, it will be essential to apply multi-use applications to increase the efficiency and utilization of the storage systems.

Home storage	**Commercial and industrial** storage	**Grid** storage
+ Higher willingness to pay + High demand - Increased security concerns - Small-scale projects - Costly customer support - Strong first-life competition	+ High economies of scale + Wide range of applications + Growing niche market + Rising demand with volatile energy prices	+ Many batteries can be integrated + High economies of scale - Low return quantities - High certification and monitoring effort - Complex integration

Figure 5. Comparison of the fields of applications of B2U storage systems.

The importance of product-service systems (PSS) for the circular economy is often emphasized in the literature [93]. All levels of the PSS (product-, usage-, and result-orientated) are relevant for B2U storage (see Figure 6). For example, warranty or maintenance packages, leasing or rental models, or even pay-per-use systems are possible ("*Product-service systems are definitely a topic that will and must come*"). These PSS can overcome the lack of customer acceptance and the lack of trust in the quality of repurposed products [94]. Customers' safety concerns and fears of fire or cost-intensive defects can be allayed if the risk or ownership of the B2U storage system remains with the manufacturer. With increasing integration of the service level, the switch to a new technology and the willingness to pay can be increased [95]. At the same time, circularity and sustainability are promoted as the return of the storage system is made easier [96]. The addition of digital technologies enables "smart" [97] (p. 2) or "upgradable" [98] (p. 540) PSS, e.g., by offering predictive maintenance. The integration of PSS must be realized during the entire product life cycle of the storage system [99].

The differentiation from a first-life storage system can be realized by offering specific functionality, such as peak shaving. Furthermore, the customer should not realize whether it is a first-life or a second-life battery in terms of performance and reliability so that the supposed inferiority of a used battery is overcome [98] ("*Our batteries should be positioned as if they were first-life batteries*"). Finally, the sustainability of B2U storage systems, which is increasingly demanded by society [100], must be emphasized in marketing. In view of the high level of trust required, a stronger focus on service and the lack of expertise and a close relationship with the customer should be sought.

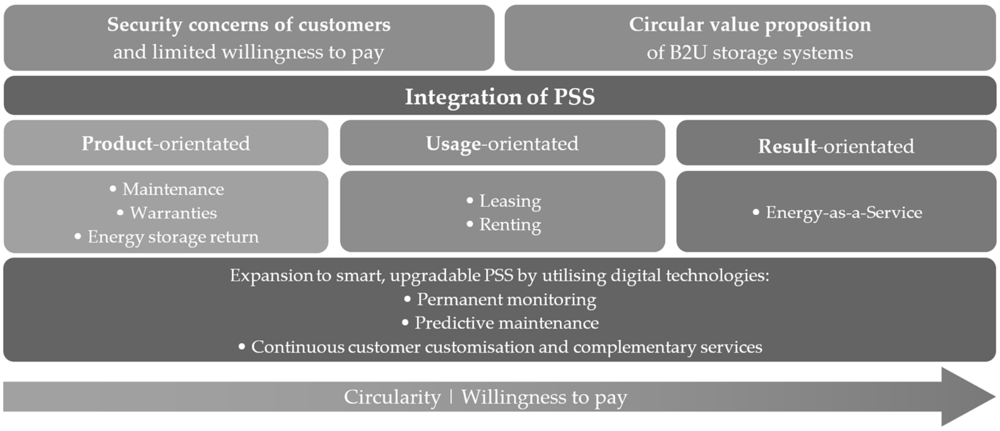

Figure 6. Integration of PSS for B2U storage systems.

4.2. Value Creation and Digital Technology

The value creation of B2U storage systems consists of a variety of activities, whereby the procurement, dismantling, and testing of the used battery modules must be explained as these activities differ significantly from first-life storage systems.

In a circular economy, return quantities are often unreliable and difficult to predict. The quality of the used products is often uncertain [19]. These challenges are also the limiting factor for the B2U manufacturer's business model ("*The bottleneck is actually the availability of modules*"). There is a direct correlation between the new registrations of BEVs and the return quantities of second-life batteries. A period of eight to twelve years is expected for first-life utilization [62]. The problem is that a larger number of BEVs were only registered in Germany from 2017 onwards, meaning that a larger quantity of second-life batteries will enter the market at the end of the decade. Meanwhile, the predictability of the return is limited due to the uncertain aging behavior. Studies also point to a longer utilization of batteries in BEVs [101]. In view of the limited quantities, further procurement sources need to be identified. The use of batteries from commercial vehicles is feasible in view of large battery capacities and a stronger focus on longevity. Although test or press vehicles are used, they will be insignificant in the future due to the small quantities involved. Production rejects or overhangs, so-called zero-life batteries, which have often only been regarded as waste in the industry to date [102], represent great potential ("*This is by far the largest market*"). According to one expert, up to 20% of current battery production is not used in BEVs for various reasons. Production rejects result from the currently limited battery production yield of 85 to 90%, which is expected to increase to 90 to 95% by 2040 [103]. Depending on the defect, these are often still suitable for stationary use but do not fulfill the high automotive standards. Production overhangs occur, for example, due to exceeding the battery storage period, incorrect scheduling, or a vehicle model change and have so far been recycled inefficiently. Despite more efficient production and logistics processes, according to one interviewee, a proportion of 5% of the total battery production of BEVs can be expected in the future. Based on this assumption, the capacity of these zero-life batteries will be 143.5 GWh in 2030, which is 80% of the total stationary storage requirement [104]. The positive aspect is that these batteries are produced in large quantities at a defined location and have a high SoH.

In addition to procurement, the dismantling of the batteries at the cell, module, or pack level must be analyzed. In principle, a smaller dismantling unit increases costs, but also flexibility. The literature states that dismantling at the module level increases costs by 28 €/kWh and at the cell level by 44 €/kWh compared to the pack level [105]. The cell level can be excluded for use in the B2U storage system due to the high cost ("*So then dismantling the modules again at the cell level and then building new modules here. That will never work*").

The levels above this can both be used and depend on the application. The module level is preferable for commercial storage systems due to its greater variability and flexibility, while the pack level should be used for grid storage systems with high battery capacities to limit the effort involved. Although the pack level allows the continued use of individual components, such as the cooling system, it has the disadvantage that the replacement of individual defective modules is associated with high costs. The high divergence between the modules is problematic ("*Every battery module is different*"). This results in a large number of manual processes in value creation and complex integration of the modules into the storage system [16,70,106,107]. An intelligent battery management system (BMS) or innovative interconnection systems are required. Due to increasing return volumes, it is feasible that more batteries with the same characteristics will be available [108]. At the same time, standardization remains unavoidable [15]. This can reduce the time required for value creation from four hours to less than five minutes [109]. The term "Design for X" [12] (p. 19) should also be mentioned in this context. This utilizes a modular product design that can be used in all phases of the circular economy. However, there is often a discrepancy with the first life in the BEV [56]. The trend towards cell-to-pack technology ensures optimized use in the BEV due to a higher energy density but excludes the use of modules in the second life [110].

The safety of B2U storage systems must be at the center of value creation. This is based on customer concerns, the risk of a battery storage system, and the danger of a damaged image for the manufacturer of the B2U storage system in the event of a safety-critical incident. A key role is played by testing the batteries after their first-life use. The lack of access to historical battery data is a cause for concern [56] ("*As far as we know, the OEM does not generally give out battery data*"). The OEM often does not provide any battery data, which increases the testing effort and requires test procedures such as impedance spectroscopy, voltage, or internal resistance measurement. Albertsen et al. emphasized the speed of testing as a key factor influencing the success of the business model [50]. Artificial intelligence can help to speed up this process. However, some interviewees are skeptical about testing without access to the battery history and, therefore, prefer a combination of testing and historical battery information.

In value creation, digital technologies are "a driving force for the implementation of circular business models" [111] (p. 1175). Figure 7 provides an overview of the use of digital technologies in value creation. Data collection in the first life is already important for the business model to increase the predictability of return quantities. It is essential that these data are shared within the cross-industry ecosystem in order to enable data consistency and a simple transition between the phases of the circular economy [53,112]. As of 2027, the battery passport in accordance with the EU Battery Regulation will require the sharing of important battery information, such as the chemical composition or usage parameters ("*It will make our work much easier if we already have a basic set of information about the battery pass from the OEM*"). However, not all important parameters, e.g., battery history, will be disclosed [58]. A standardized data interface must be made possible on the basis of the battery passport, as is the aim of the Catena-X network [113]. However, digital technologies are also required during the utilization of the B2U storage system. With the help of a digital twin, permanent status monitoring is possible and the high security requirements are guaranteed [114]. Regular updates can not only ensure iterative product improvement, but also safety optimization [98]. Predictive data analysis can forecast future events and thus enable smart, upgradable PSS [115]. Finally, by sharing battery data, e.g., on battery design, recycling can be optimized [114].

4.3. *Value Capture and Comparison to First-Life Storage*

According to the literature, the financial dimension is the biggest barrier for B2U manufacturers [116]. The economic attractiveness of B2U storage systems compared to first-life storage systems is decisive for their success [108] ("*It is always possible that a new battery is cheaper than a second-life battery at today's market prices*"). There are uncertainties in the literature regarding revenues and costs [56,70]. For example, the purchase prices of second-life batteries vary widely [61,117,118]. The results of this study showed that the average price of second-life batteries was 52.50 €/kWh. The exact price depends on the contract and the quantity purchased. Currently, second-life batteries are sometimes offered free of charge as recycling is associated with high costs for the OEM. A price of 150 €/kWh is quoted for zero-life batteries, i.e., production rejects or overhangs.

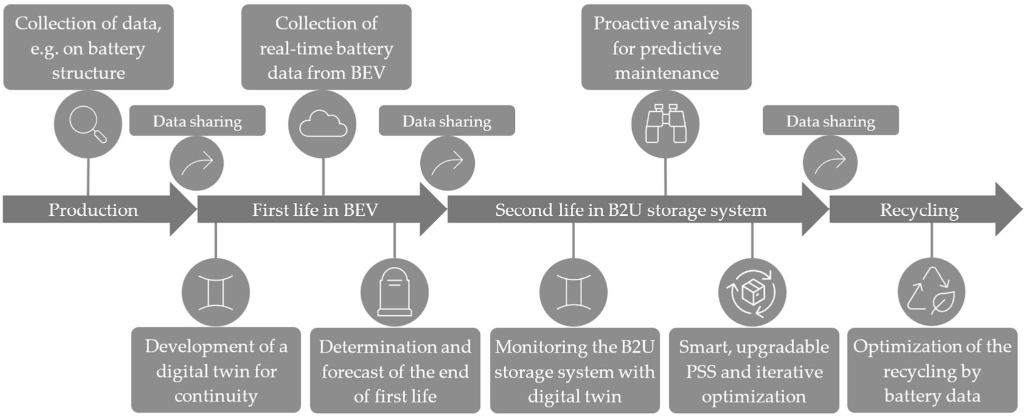

Figure 7. Use of digital technologies in value creation of B2U storage systems.

In addition to procurement, dismantling and testing are necessary for a B2U storage system. These activities must be added to the purchase prices in order to compare first- and second-life batteries [3]. Various differing costs are cited in the literature [61,109,119]. In this study, one expert quotes costs of 10 to 15 €/kWh for dismantling and 50 to 60 €/kWh for testing, resulting in total costs of around 120 €/kWh. For an OEM, the costs are somewhat lower as the internal module prices are lower, and random testing based on available battery history is sufficient. Only around a third of the costs are incurred by the converted module. Further costs are associated with the power electronics and the BMS as the largest cost drivers. However, these costs should be regarded as equivalent. Module prices are therefore a key factor. With a current market price for first-life modules in stationary applications of 190 €/kWh [120], the second-life modules save 70 €/kWh. At the same time, the revenues according to Section 4.1 are 100 €/kWh lower. This limits the attractiveness of a B2U storage system compared to a first-life storage system. Table 1 provides an overview of the costs and revenues of first-life and B2U storage systems.

Table 1. Comparison of costs and revenues of first-life and B2U storage systems.

Price [€/kWh]	Purchasing	Disassembling	Testing	Module Costs	Total Revenue
First-life	190.00	0	0	**190.00**	**600.00**
Second-life	52.50	12.50	55.00	**120.00**	**500.00**
Difference	137.50	−12.50	−55.00	**70.00**	**100.00**

The price development of first-life modules is important. New cell chemistries, such as lithium iron phosphate (LFP), are making batteries more cost-effective. First-life modules are aiming for a limit value of 100 €/kWh in the future [120] ("*This would offer a certain risk, because it would no longer be financially worthwhile to get second-life*"). Another advantage is the increased safety, availability, and modularity. The price development of second-life modules is uncertain. According to this study, if prices for first-life modules fall, second-life modules must become cheaper to ensure demand. Increasing return quantities and continued high recycling costs also mean that a battery surplus and, therefore, price reduction, is possible. One expert therefore expects prices of less than 50 €/kWh. The prices of second-life batteries are dependent on future recycling costs. However, the economic viability of recycling is also uncertain. Raw material prices are expected to rise in the future due to the high demand for raw materials. Revenues will tend to fall due to lower proportions of valuable raw materials in the new cell chemistries. Process costs are expected to fall due to economies of scale. Recycling is expected to be profitable from 2026 [60].

To improve the profitability of B2U storage systems, revenue increases and cost reductions are required. The first step is to raise the willingness to pay [50], which has so far been limited by 30 to 50% (see Figure 8). Close customer loyalty, highlighting sustainability, offering PSS, and smart customizable functionalities are important in this context.

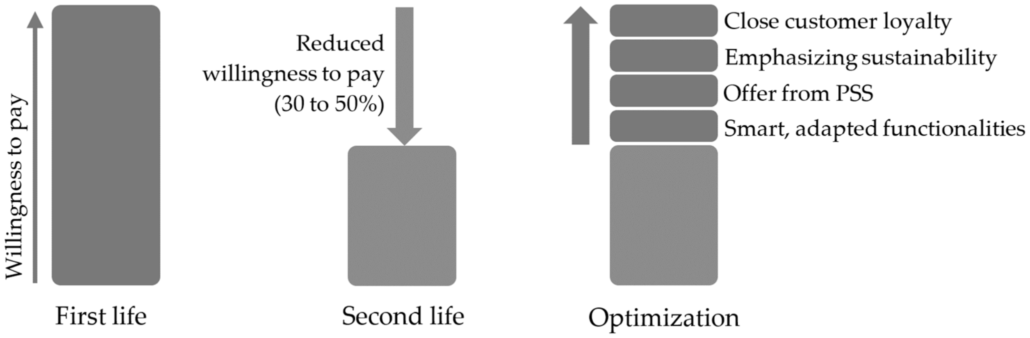

Figure 8. Increasing the willingness to pay.

PSS also provides an extended, long-term source of income for the B2U manufacturer [24,121]. Modules with a high proportion of raw materials can be remarketed by simplifying the return flow of the storage units after use. Furthermore, B2U storage units can be used within the company, e.g., for energy trading, thus eliminating transaction costs due to customer interactions. The use of new batteries from OEMs is exciting in this context. Spare parts are kept for 10 to 15 years [122], whereby batteries must be charged during this storage period to prevent deep discharge. This can result in double revenue for the B2U manufacturer from storage and the energy market ("*They are placed in the stationary storage system and used for the energy market at moderate power levels and retrieved in a usable state when the customer needs them*"). Finally, valuable battery knowledge can be built up with the help of B2U storage units.

To reduce costs, economies of scale and thus, high return quantities, are required in order to limit the previously high value creation costs [123]. A prerequisite is modularity so that different procurement sources and heterogeneous modules can be used. In this way, the tension between efficiency and adaptability can be resolved [124]. To reduce the high development costs, scalable product solutions should be targeted to realize different storage sizes with minimal effort. Cost-intensive testing and disassembly are considered the most critical activities and should therefore be minimized [16]. One expert suggests eliminating disassembly and testing in favor of using battery packs that are continuously monitored ("*The platform in which the battery continues to be used must be so good that it takes over the testing and determines the lifetime*"). However, this may conflict with customers' safety concerns or the disadvantages of the pack level. The uncertain degradation behavior poses a risk to the business model and thus, applications with low charging or discharging rates should be selected to ensure a long lifetime [125]. Close and long-term partnerships with procurement sources can also support standardized, consistent battery quantities or access to historical battery data. Digital technologies (see Section 4.2) can help to optimize value creation and thus reduce costs. Costs can be saved in battery purchasing by working with recycling companies, which often receive money from the OEM for taking second-life batteries. Finally, one expert adds the importance of transaction costs, which are estimated at around 30 to 40% of the total costs. In transaction cost theory, a distinction is made between ex ante (before the transaction) and ex post (after the transaction) [126]. The use of zero-life batteries can reduce both segments due to their as-new condition, centralized collection location, and high quantities of the same type. Figure 9 provides an overview of the measures described for optimizing value capture.

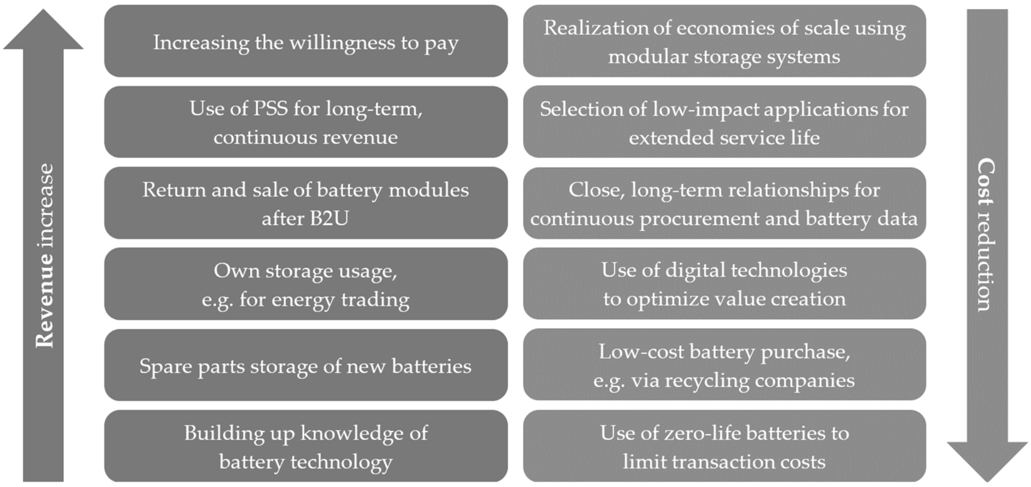

Figure 9. Optimization of value capture for B2U storage systems.

4.4. Circular Ecosystem

The ecosystem is important for the circular economy [127]. A circular ecosystem must describe the relationships between the actors as value creation is characterized by collaboration and cooperation [128]. The results of the empirical study are used to develop an ecosystem that was previously missing from the literature (see Figure 10).

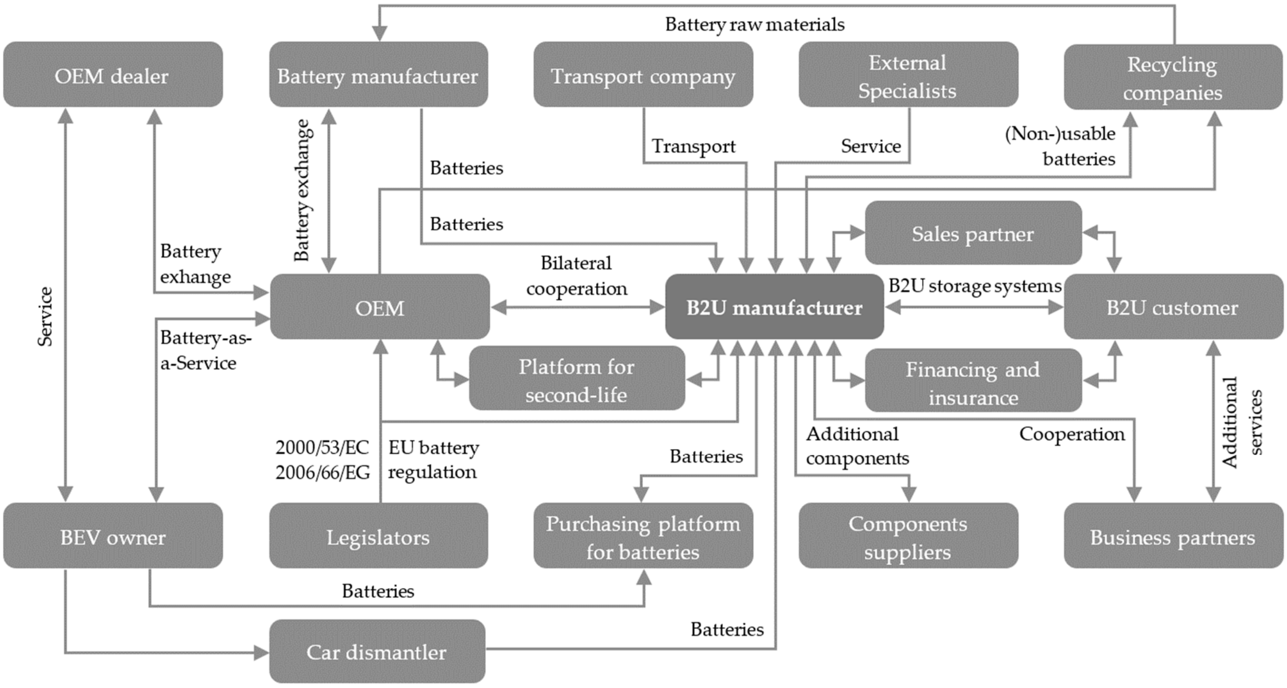

Figure 10. Circular ecosystem for B2U storage systems.

The central players in a circular ecosystem are the suppliers of secondary materials [48] ("*The most important relationship is the supply, so you get the battery modules*"). In the literature, procurement is often limited to the OEM [3,75,76,129]. Upstream of the OEM are their dealers, who interact directly with the owner of the BEVs. Direct relationships between OEMs and BEV owners are increasingly possible, e.g., within a battery-as-a-service model, as implemented by the Chinese OEM NIO [130]. The recycling company is often only seen as the end collector to close the resource flow after B2U utilization [78]. However, a large proportion of batteries are sent directly from the OEM to the recycling company, regardless of their condition ("*These unusable batteries, even completely new ones in large quantities, go directly from the OEM to the recycler*"). In the commercial vehicle segment, some batteries are returned to the battery manufacturer after use. Recycling companies or battery manufacturers can therefore act as a connection between the OEM and the B2U manufacturer. There are also opportunities to reach BEV owners independently of the OEM. One important partner is car dismantlers who collect BEVs after their first-life use. Direct purchase of the batteries from the BEV owner by the B2U manufacturer, e.g., via a platform, is also desirable. According to the experts, the way in which the batteries are returned depends on the timing. Within the warranty period of the battery, which is limited to eight years, the return will be through the OEM as the customer will receive a free battery replacement ("*Currently, the replacement activities of vehicle batteries are still primarily covered by the entire warranty conditions*"). After the warranty period, the path of the battery will depend on the buy-in price and the effort involved in returning it as BEV owners increasingly recognize the value of the battery. Competition for second-life batteries may arise, potentially forcing OEMs into battery-as-a-service models. The specific process and timing of the return remain uncertain. A low SoH does not necessarily lead to the return of the battery, especially with increasing battery capacities.

At present, there is a relationship of dependency between the OEM and the B2U manufacturer as the zero-life batteries and a large proportion of the second-life batteries are returned to the OEM under warranty ("*If the OEMs cut off access to the battery modules, then they are out of business*"). To simplify battery testing and ensure standardized, consistent battery quantities, close and long-term cooperation with the OEM should be targeted. The circular economy already emphasizes that communication between the players is limited [15]. This can also be confirmed for B2U storage systems. Only in rare cases, e.g., in pilot projects with a higher willingness to cooperate, are battery data shared. These hidden characteristics lead to an information asymmetry between the OEM and the B2U manufacturer. Thus, the principal–agent theory can be cited (see Figure 11) [16]. This theory analyses the relationship between a principal and an agent [131]. For example, the OEM has battery information that the B2U manufacturer does not have ex ante. The additional testing effort increases the ex post transaction costs. To overcome this asymmetry, signaling should be targeted, in which the OEM signals the battery quality via data transfer or guarantees [16]. Information asymmetry also exists in the current direction due to hidden actions [132]. The specific use of the second-life batteries by the B2U manufacturer remains unknown to the OEM. According to the interviewees, there is a fear of reputational damage for the OEM if the batteries are used improperly in the storage systems ("*I want to make sure that my name, which may be linked to this module, is not associated with technically inexpert storage systems*"). The OEM is therefore interested in controlling usage by prescribing usage parameters (bonding) or carefully selecting B2U manufacturers (screening). The principal–agent theory can also be applied between B2U manufacturers and B2U customers. The customer usually does not have in-depth battery knowledge and thus has concerns about the opportunistic behavior of the B2U manufacturer. The B2U manufacturer could, for example, forgo quality assurance measures. The relevance of PSS for realizing signaling by the B2U manufacturer is therefore confirmed. In the other direction, there is a risk of hidden actions by the customer [16]. The risk of opportunistic behavior increases with rising service levels as the customer is no longer the owner of the product. Possible solutions are guarantee conditions (bonding) or the monitoring of customer behavior (monitoring) [133].

Sales partners can help to limit the high ex ante transaction costs due to the lack of customer knowledge. The selection of qualified players is important to ensure customer confidence. Complementary solutions, such as PV systems or charging infrastructure, which are provided by partner companies, can further differentiate them from a first-life storage system. The financial industry is important in the circular ecosystem of B2U storage as usage- or result-orientated PSS in particular lead to high upfront investments [134]. In addition, the insurance industry is involved due to the increased financial risk if a B2U storage system fails.

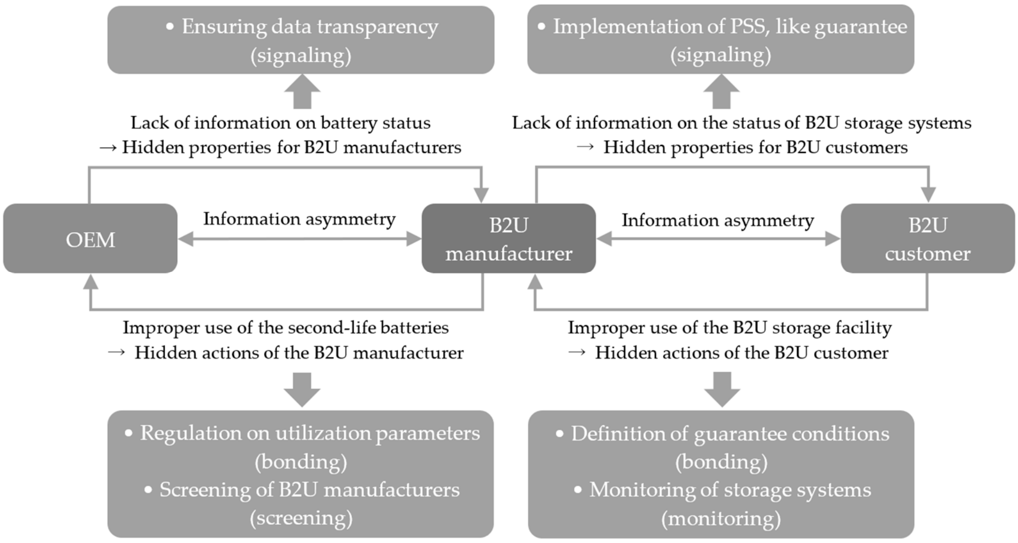

Figure 11. Analysis of the central relationships in the circular ecosystem [16].

According to the literature, OEM interest in second-life batteries is low [63]. However, this study shows that OEMs increasingly prefer to retain battery ownership. This may lead to the batteries not being sold or a battery return after B2U is desired ("*The OEMs will realize more and more what value the batteries have*"). This is due to insecure supply chains, rising raw material prices, and the EU Battery Regulation. The recyclate rate in the EU Battery Regulation prescribes a certain proportion of recycled materials in new batteries, increasing the importance of direct recycling. The influence of this recyclate rate on the B2U sector has not been researched. Studies show that the supply and demand for B2U storage could match by 2030 [135]. This means that, theoretically, no batteries would be recycled. However, the amount of waste to be directly recycled worldwide in 2030 will be 300 GWh, or 10% of total battery production [136]. In addition, the proportion of returned batteries compared to new production will be 7% in 2030, rising to 43% by 2050 [60]. Battery production for BEVs will significantly exceed the demand for stationary storage in the long term, meaning that a large proportion of the cells will be recycled directly [56]. While recycling and B2U are often separated, they should be seen as converging strategies. The OEM can receive the batteries back after B2U via contractual arrangements, e.g., by using buy-back rights or leasing. The OEM thus receives remuneration for the second-life battery and revenue for recycling as recycling efficiency and profitability will increase in the coming years. Non-European OEMs offer great potential for B2U manufacturers as they have no capacity for battery return in Europe. This means that the B2U manufacturer can act as a service provider for the entire process and become less dependent on European OEMs.

To date, the interaction between OEMs and B2U manufacturers has been limited to a bilateral relationship [3]. One expert mentions a sales platform for second-life batteries. This creates transparency and limits the need for close relationships, thereby limiting transaction costs [137]. The survey emphasized that the provision of data should ensure added value compared to known sales platforms. Bilateral, long-term relationships remain important to obtain large, standardized battery volumes ("*But if you really want to scale as a second-life company, then you need direct contracts with the OEMs*"). OEMs will favor bilateral relationships in the future to avoid the hidden actions of principal–agent theory. Similarly, trading of production rejects or overhangs will only be performed bilaterally to avoid publicity. The entire return process of second-life batteries after B2U is facilitated by bilaterality.

Due to the large number of actors within the ecosystem, the question remains as to whether vertical integration or outsourcing of activities is preferable. In the literature on the circular economy, vertical integration is favored due to the greater control over the circular process [138]. Similarly, interactions within an ecosystem become essential due to the multi-layered competencies [139]. When building the business, collaboration with component suppliers and external specialists is important to overcome knowledge barriers [140]. The experts see a switch to vertical integration by building up competencies internally. Activities with a specific focus on B2U storage, such as battery testing or storage monitoring, should be vertically integrated to realize synergy effects ("*Of course, this is all data that is very useful*"). Due to low factor specificity and low transaction costs, simple control cabinets or terminals should be outsourced in accordance with transaction cost theory [141].

The B2U manufacturer has not yet been specified in more detail. It remains unclear in the literature who will take on this role [16]. This study does not provide a clear result either. In the interviews, contrary to the literature, the OEM is often expected to take on this role. The OEM has access to the batteries and their data and can minimize transaction costs and the sale price ("*The OEMs probably have the best prerequisites because they know the batteries best*"). The integration of the entire battery value chain, from cell production to battery-as-a-service and recycling, appears attractive. By diversifying [142] into a new market with new products, the OEM can use B2U storage systems to counteract the loss of jobs due to electromobility. The monitoring of B2U storage systems and the observation of batteries in BEVs can generate valuable synergy effects. The discrepancy between the automotive and energy markets is problematic ("*So the energy sector and the automotive sector simply work completely differently. They have completely different approaches*"). The energy market is highly dynamic, strongly cost-driven, and a B2B market. Additionally, the processes and competencies within the automotive and energy markets are different. To compensate for the lack of expertise, pilot projects with partners from the energy sector or consolidation are feasible. Due to the divergence from the core business, subsidiaries of the OEMs may become important, offering the same advantages but being more flexible in terms of processes. Whether the OEM or its subsidiary will interact as a B2U manufacturer cannot be answered universally and depends on the individual company strategy. In principle, external B2U manufacturers have higher transaction costs due to procurement and testing. Smaller companies, such as start-ups, have further disadvantages due to the lack of reference projects and the risk of hidden actions from the OEM's perspective. Existing first-life storage manufacturers do not usually have these problems as their expertise is backed up by the company's history. However, it is conceivable that the existing product portfolio could be cannibalized by B2U storage systems [102]. Energy companies can act as large-scale customers using grid storage and have expertise in storage technology and grid integration. One expert suggests battery manufacturers or financial investors as a central player offering battery-as-a-service over the entire battery life cycle. Overall, it remains unclear who will take on the role of the B2U manufacturer. Some interviewees notice a decreasing transfer of batteries from the OEM to external companies. External companies, such as start-ups or first-life storage manufacturers, could possibly only act as service providers. However, as batteries are usually returned outside the OEM after the warranty period, external companies may become more relevant.

In ecosystem theory, the orchestrator plays an important role [143]. This study shows that the B2U manufacturer fulfills this role. The OEM can also take on this role, even if it is not a B2U manufacturer itself as it has the batteries and can select the partners ("*OEMs will play an increasingly important role, [. . .] they will take more and more control of second-life and will become the orchestrator*"). For the orchestrator in the circular ecosystem of B2U storage, it is important to find trusted partners to fulfill the high safety requirements of customers. The orchestrator must also communicate with the players to ensure that the ecosystem is aligned with the joint value proposition (see Section 4.1). Knowledge sharing in the ecosystem can realize an innovative B2U storage system [144]. A platform that connects not only OEMs and B2U manufacturers, but all players, can help to organize the ecosystem. This can facilitate multi-layered multilateral relationships and limit transaction costs [123].

4.5. Limitations and Future Research

This article is subject to limitations that indicate a need for further research. For example, this study is not comprehensive as only the key players in the ecosystem were surveyed. A further customer survey may be useful in order to sharpen the value proposition and increase the willingness to pay and user acceptance (e.g., [145–147]). The potential of production rejects or overhangs, so-called zero-life batteries, or spare parts storage should be further quantified in future research. In addition, the topic of "B2U storage" should be expanded and not just limited to batteries after use in BEVs. This study shows a correlation between recycling and B2U industries. This influence, also considering the recyclate rate of the EU Battery Regulation, needs to be investigated in more detail. It remains unclear in this study who takes on the role of the B2U manufacturer. The missing battery return processes and the strategies of OEMs should be investigated further. In general, the topic is volatile and characterized by uncertainties such as the EU Battery Regulation or battery return volumes. Progressive validation and adaptation of the developed business model and ecosystem are therefore essential.

5. Conclusions

To answer the research question "*What are the success factors in the business model components of a manufacturer of B2U storage systems in a circular ecosystem?*", the success factors for the B2U manufacturer's business model are finally highlighted based on the four components. Appendix C provides an overview of the challenges and success factors for future business models.

The core value proposition of slowing down the flow of resources must be at the center of the business model. It is important to consider the three dimensions of sustainability as the economic and social segments are neglected. To date, customer confidence and, therefore, the willingness to pay for B2U storage, has been limited. This needs to be overcome with the help of PSS and a close customer relationship. The combination of PSS and digital technologies enables smart, upgradable PSS and improves the customer relationship. In addition, it is important to offer an advanced overall solution to differentiate it from a first-life storage system. In terms of customer segments, the focus should be on commercial and grid storage as the home storage market involves high security concerns and intensive support. A multi-use application will be favored due to economic efficiency.

The procurement of second-life batteries is central to value creation, which has so far been hindered by limited, inconsistent quantities. An expansion of procurement is possible through as-new zero-life batteries or the commercial vehicle segment. Modular, scalable B2U storage systems must be developed to manage battery diversity. In terms of dismantling, the module level is suitable as this represents a compromise between flexibility and effort. Due to the great importance of safety and the lack of historical battery data, intelligent battery testing and storage monitoring using digital technologies is essential. The aim is to achieve data continuity throughout the entire life cycle of the battery to minimize transaction costs. The battery passport, as part of the EU Battery Regulation, can support this data transfer in the future.

Concerning value capture, the comparison to first-life storage is significant. Revenues have so far been limited due to restricted willingness to pay and the costs are characterized by expensive value creation. PSS, the sale of raw materials after B2U, or the storage of new spare part batteries can help to increase revenue. Modular, scalable storage systems or as-new zero-life batteries reduce the value creation costs.

The value network must be a central component of the B2U manufacturer's business model. Close, long-term, bilateral relationships with the procurement sources are important for data exchange and constant, standardized battery quantities. The current dependency on the OEM and the limited supply of batches, e.g., due to the recyclate rate, must be avoided by expanding procurement sources. Non-European OEMs or purchasing platforms, as well as car dismantlers after the warranty, are relevant in this context. The vertical integration of B2U-specific activities helps to increase synergies, while components with low-factor specificity can be acquired within the network.

Finally, three key overarching elements of the business model are highlighted: PSS, digital technologies, and an effective ecosystem (see Figure 12). PSS expands the value proposition and optimizes value capture. Digital technologies simplify the often multi-layered value creation, and an effective ecosystem reduces the complexity of a circular solution.

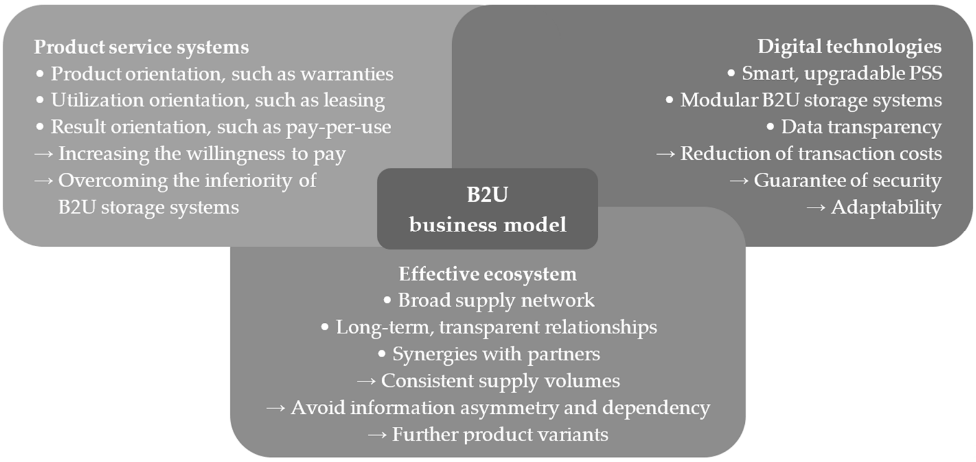

Figure 12. Key elements in the B2U business model.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16051906/s1, Table S1. Legal guidelines on end-of-life strategies for batteries. Table S2: Current B2U projects. References [58,148–162] are cited in the Supplementary Materials.

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Appendix A

Table A1. Literature Review on B2U storage systems.

Author (Year)	Business Model	Sustainability	Circular Economy	Ecosystem
Albertsen et al. (2021) [50]	✓	✓	✓	
Bonsu (2020) [15]	✓	✓	✓	
Bräuer et al. (2019) [16]				(✓)

Table A1. *Cont.*

Author (Year)	Business Model	Sustainability	Circular Economy	Ecosystem
Chirumalla et al. (2022) [70]	(✓)	✓	✓	✓
Jiao; Evans (2018) [77]	✓	✓		
Klör et al. (2015) [75]				(✓)
Olsson et al. (2018) [63]	✓	✓	✓	
Reinhardt et al. (2019) [3]	✓	✓		
Reinhardt et al. (2020) [78]	✓	✓		
Richter et al. (2016) [76]				(✓)
Rufino Júnior et al. (2023) [163]	✓			(✓)
Schulz-Mönninghoff et al. (2020) [164]				(✓)
Schulz-Mönninghoff; Evans (2023) [165]	✓	✓	✓	
Wralsen et al. (2021) [116]	✓	✓	✓	

✓ = Direct component of the investigation, (✓) = Indirect component of the investigation.

Appendix B

Table A2. Parameters for ecological assessment of first-life and second-life batteries.

Parameter	Assumption	Notes/Source
$\text{SoH}_{\text{Begin second-life}}$	SoH = 0.7	[61]
$\text{SoH}_{\text{End second-life}}$	SoH = 0.4	[72]
$\text{Emission factor}_{\text{Germany}}$	434 g/kWh	[166]
$\text{Energy density}_{\text{Lithium-ion battery}}$	200 Wh/kg	[167]
$\text{Energy capacity}_{\text{Example}}$	1 kWh	Example
$\text{Weight}_{\text{Example}}$	5 kg	Energy capacity/Energy density

Table A3. Energy demand for the production of a first-life battery.

Parameter	Assumption	Notes/Source
$\text{Energy demand}_{\text{Raw material extraction}}$	36 kWh/kg	[168]
+ $\text{Energy demand}_{\text{Manufacturing}}$	19 kWh/kg	[168]
= $\text{Energy demand}_{\text{First-life}}$	55 kWh/kg	Addition

Table A4. Energy demand for repurposing a second-life battery.

Parameter	Assumption	Notes/Source
$\text{Energy demand}_{\text{Disassembly}}$	0.05 kWh/kg	[168]
+ $\text{Energy demand}_{\text{Test}}$	0.60 kWh/kg	[168]
+ $\text{Energy demand}_{\text{Inspection/replacement}}$	3.60 kWh/kg	[168]
+ $\text{Energy demand}_{\text{Final inspection}}$	0.60 kWh/kg	[168]
= $\text{Energy demand}_{\text{Second-life}}$	4.85 kWh/kg	Addition
$\text{Energy demand}_{\text{Second-life (reduced)}}$	9.70 kWh/kg	Consideration of the reduced lifetime of the second-life battery

Table A5. Comparison of energy demands for a first-life and second-life battery.

Parameter	Assumption	Notes/Source
Δ $\text{Energy demand}_{\text{Saving}}$	45.30 kWh/kg	Difference
Δ $\text{Energy}_{\text{Saving}}$	226.50 kWh	Multiplication by weight
CO_2 $\text{emission}_{\text{Saving}}$	**98.30 kg**	Multiplication by emission factor

Notes: Battery production is omitted for second-life batteries, as the batteries are not explicitly manufactured for second-life use.

Appendix C

Table A6. Recommendations for B2U storage systems.

	Challenges	**Success Factors**
Value proposition	• Lack of social sustainability of the value proposition • Lack of customer confidence in repurposed products • Limited willingness to pay • Limited cost advantage of B2U storage systems and lack of added value • Large number of possible areas of use and applications	• Realization of the defined value proposition including the three sustainability dimensions • Use of product-, usage-, or result-orientated PSS • Implementing smart, upgradable PSS with digital technologies • Building close customer loyalty • Demonstrate irrelevance of battery age • Focus on commercial, industrial, and grid storage systems • Emphasize sustainability • Create advanced applications, e.g., charging infrastructure • Multi-use application
Value creation/delivery	• Return rates that are limited, discontinuous, and not plannable • High diversity of modules makes storage integration difficult • High effort required to dismantle and test the battery • Lack of data consistency in the battery circuit • Ensuring the safety of the B2U storage system in the event of missing battery data	• Recourse to other sources of procurement, such as the commercial vehicle sector or zero-life batteries • Scalable, modular B2U storage systems • Dismantling at the module or pack level depending on storage size • Digital technologies for optimizing battery testing, permanent condition monitoring, update capability, and data consistency • Mandatory introduction of the battery passport through the EU Battery Regulation enables data transparency
Value capture	• Limited revenue due to low willingness to pay • High costs for battery purchasing, testing, and dismantling • Competition from safer and cheaper first-life batteries with new cell chemistries • Uncertain price development and lifetime of second-life batteries	• Increased willingness to pay, e.g., through close customer loyalty • Additional income through PSS, own storage utilization, or spare part storage • Expansion of battery knowledge through data synergy • Purchase of low-cost second-life batteries • Zero-life batteries without the need for testing • Realization of economies of scale • Ensuring modularity • Selection of careful application
Value network	• Unsteady and unpredictable procurement sources with high module diversity • Dependence on OEM procurement during battery warranty • OEMs with limited battery output, e.g., due to recyclate rate or risk of hidden actions • Information asymmetry on both sides with OEM and B2U customers • Broad network required due to a large number of activities and competencies • Unclear role of the B2U manufacturer and the orchestrator	• Close and long-term contracts with the procurement source • Consideration of non-European OEMs • Battery procurement independent of the OEM, e.g., recycler or platform • Focus on second-life batteries after the warranty ends • Direct contact with B2U customers and customer trust through PSS • Limit vertical integration to specific B2U activities • Collaboration with partners for advanced product solutions • Orchestration of the ecosystem by B2U manufacturers

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