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Solutions for More Sustainable Distribution in the Short Food Supply Chains

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Received: 11 September 2018; Accepted: 26 September 2018; Published: 28 September 2018

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Abstract: The largest part of food sales is managed by large food supply chains. However, an alternative system of food distribution focuses on locally produced and sold food that has gotten great attention in the last two decades. The challenges of those new systems, called short food supply chains (SFSC), represent tough market competitions, high distribution and logistics costs, small shipment sizes and so forth. Hence, the SFSC requires corresponding solutions in food distribution that are aligned with the contemporary logistics trends, sustainability and aspects of the new digital era. Using specially developed methodology, based on two different conceptual models, we showed how the SFSC could be designed from the aspects of innovative logistics modes and contemporary information and communication technologies, with the final aim to outline and evaluate different food distribution scenarios towards greater sustainability. The first conceptual model was aimed at the creation of innovative forms of SFSC, in which business process modelling was used in order to design and explore the given situation more thoroughly. For the purposes of conducting a comparative assessment of the distribution models developed in the previous part, the second conceptual model is developed. By using a qualitative approach, this is how the major advantages and challenges of practical implementations in creating sustainable distribution solutions are stated for each scenario.

Keywords: short food supply chain; distribution; sustainability; information and communication technology; business process modelling; home delivery services

1. Introduction

In a world with an ever-growing population, creating efficient, sustainable, safe and healthy food provisioning systems has become more vital, due to the fact that, besides fresh water, food is the most important natural resource in the world [1]. The largest part of food sales and distribution is done by large conventional food supply chains that represent a network of food-related organizations within which products move from the producers to the end customers. However, because of this, food systems organized in a way which 'disconnects' producers from consumers [2], may cause problems such as: extensive food waste, food security, environmental damage, unfair distribution of added value and profits among chain members and so forth, as well as provide reasons for an increasing interest in the quality of food, locally produced food and food producing practices [3]; consequently, the interest in food supply chains different from the conventional ones has increased rapidly. New food chains in which shortening the food chain and emphasizing the relationship between producer and consumer are key elements have been established [4]. From the agricultural market's point of view, those so-called short food supply chains (SFSC) are an alternative to traditional supply chains [5], having only a few intermediaries between the producer and the consumer and/or a short distance, geographically, between the two [6]. As such, SFSC fully respects the principles of sustainability (economic, environmental and social) and provides progressive opportunities for the aforementioned. Firstly, it participates in the economic reinforcement of a country by advocating the boost of food producer's incomes (sustaining small farms and business). An SFSC represents a network, throughout which products move from production to consumer point, where the number of middlemen is minimal (in direct contact between producers and consumers there are no intermediaries). That way, SFSC makes a contribution by setting up the selling price competitive with the price in a global food supply chain market (middlemen's fee is excluded and selling price is easier to control). For example, in a global conventional food supply chain, consumers are buying food at a three to four times higher price than the price paid to producers [7]. Next, it is proved that SFSC has a positive impact on the employment rate. Furthermore, an SFSC reinforces a sense of the prevalence for the agricultural sector towards a sustainable society and impacts the social development of a region (more specifically rural territory) by preserving local communities and social justice (strengthening local economies). Finally, environmental criteria are also influenced by SFSC. Since producers have a greater number of interactions with final consumers, they can adopt more reasonable agricultural methods, by reducing the use of chemical products in this field for example, upon the request of the end users [8].

Although SFSCs are of recent date, they have been widely studied [4]. Aspects such as the role of producers/farmers in SFSC [5,9], the type, characteristics, structure and business models of SFSC [10–13], the SFSC potential impact on society, economy and environment [14,15], the customer expectations of and their preference towards SFSC [16], have been studied in detail. Also, SFSCs have been studied by many research programs [2,17], which give us a broad overview of realized SFSC case studies. However, the literature written from a distribution and logistics operations point of view is not as available, although this is something which is becoming increasingly applicable and important in agriculture [18] and it is one of the main challenges of setting up an efficient and sustainable SFSC. Actually, there has been a number of papers written in recent years which provide a description and optimization of food supply chain operations (a very systematic literature review of such kind of papers is done in Reference [19]) but not in the context of SFSC. According to analyzed case studies provided in Reference [17], the main barriers facing SFSC from the operating/process aspect are 'lack of specialized knowledge such as IT, logistics and accountancy skills' and from the sales aspect 'poor Internet service and unreliable distribution'. Hence, as they conclude in Reference [18], 'recognition of logistics and distribution as a separate service within the food chain' represents the basic factor of SFSC success. As the same authors further stated that 'distribution and logistics for SFSC have to be smart, simple, quick, flexible, cheap, transparent and reliable', we have added one more word in our paper—'sustainable'.

Conceptually, an SFSC represents a (direct) connection between individuals that 'yield crops' and communities that consume goods. Thereupon, the key point here is: how to connect those two types (and their motives) so that the appropriate food reaches the right place at a suitable time, having acceptable quality, quantity and price [20]? The problem is that SFSC implies fewer middlemen. Hence, producers have to pay much more attention to marketing and distribution of their products, which is not at the core of their business. As it was stated in Reference [8], this approach is feasible, in certain ways, for direct sales, while for indirect sales volumes are more significant, considering that a supply chain has to be properly designed in order to organize the flow of goods and minimize transportation costs so one can become competitive with the global supply chain. Thus, the 'challenges regarding the distribution of food in SFSC are related to the issue of cost related justification towards the realization of logistics activities' [20], due to the lack of a suitable logistical delivery infrastructure. In addition, the fact that the food is perishable and that the transport and management of it are regulated by complicated legal provisions, makes the issue more complex. Therefore, SFSCs require corresponding innovative logistics solutions within food delivery systems that follow the contemporary logistics trends (digitalization, reducing costs, sustainability, improving flexibility and responsiveness to customer demand, etc.), while appreciating the specificities of distribution context of locally produced food.

The basic motivation for this study was to recognize the need to find the effective solution for a more sustainable and efficient distribution system in SFSC. As it was previously stated, we could find opinions in literature about the significance of a SFSC concept but there is no shared opinion on an appropriate operations model of the physical distribution of the food, which is the main challenge of SFSC. Distribution models are very expensive, especially in cases of delivery to less populated places, long transport distances and when "cold chain" conditions are required [21]. Also, as it is stated in Reference [17] very little research has been done to develop tools and data for understanding the effects of SFSC taking into account the economic, environmental, social and health aspects. Therefore, the purpose of this paper is to describe several different operational models for food delivery in SFSC, based on innovative solutions and approaches, using business process modelling (BPM) tool and then explore their features in more detail from several different aspects with the main focus on sustainability. In order to achieve this purpose, the following objectives were devised:

- to develop the operational models and organizing formats of distribution of locally produced food within SFSC. Therefore, by using business process modelling (BPM) we showed how SFSCs could be designed from aspects of innovative ICT and contemporary logistics approaches (third party logistics, home delivery services). Created business process models that depict the sequence and interactions of control and coordination activities among different distribution scenarios could be used as a base for further development of business models.
- to conduct a comparative assessment of the distribution models detailed in the first task, in order to evaluate them from the aspect of sustainability. Sustainability assessment and comparison followed the specially developed framework, based on a similar framework found in literature, which makes the dimensions, inputs and possibilities of different distribution solutions in SFSCs visible.

The ultimate aim of this paper is to provide a qualitative analysis of the fit among locally produced food delivery innovative services, requirements and issues that users of service providers might have. The analysis result could help the decision-makers in SFSC choose an appropriate concept of SFSC development, especially in regions with a low level of SFSC concept maturity.

The remainder of this paper is organized as follows. The next section describes applied research methodology. First, it briefly reviews the related literature about the key concepts of the chosen topic: SFSC, logistics innovation, logistics distribution sustainability, logistics service providers and BPM. After that, we generated a problem statement with a conceptual definition of a modeling object and developed a conceptual model for sustainability assessment. The third section illustrates the application of BPM in the modeling of different food distribution scenarios and determines a qualitative analysis regarding sustainability. The fourth section discusses the results. Finally, concluding remarks are made in the last section.

2. Methodology

The research is based on methodology whose schematization framework is described in Figure 1, (based on the framework in Reference [22]). With the aim of understanding how distribution processes in SFSC could be set up and organized and of assessing their sustainability features, the following approach is used. Firstly, the scope of evaluation was defined. This step first included a literature review regarding the main key words and concept surrounding the stated research problem (literature review on SFSC, sustainable freight distribution, innovative logistics approaches, digitalization, logistics service providers and BPM). After that, solutions to distribution processes in SFSC were conceptually defined and appropriate operating models were created using the BPM tool. For this first part of the research, the used research methodology is design-oriented [23,24], which typically involves "how" questions, that is, how to design a model or a system that solves a certain problem. The research here applied a conceptual design and modelling approach, in which a theoretically-based conceptual model (or domain model) of the possible solution is developed first and after that, the applicability of the designed conceptual model is tested through detail modelling of possible solutions through BPM (Figure 1).

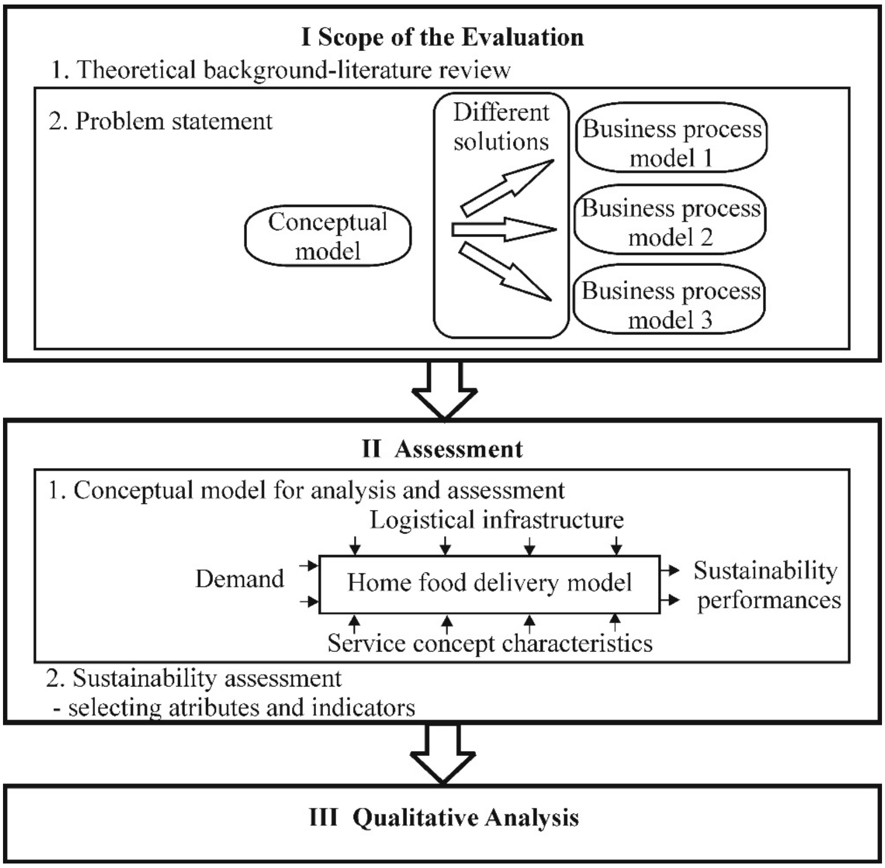

Figure 1. Schematization of the research methodology (based on [21]).

For the second step—the assessment of proposed solutions to food distribution with the emphasis on sustainability—one more conceptual model is developed. Based on models in Reference [25,26] we create a conceptual model primarily to analyze basic features of different distribution model scenarios and then to access their sustainability performances. For sustainability assessment, a set of attributes and indicators of performance were selected, derived from the literature [7,22]. A complete model description is given in Section 2.3. Hence, the second part of the research is conducted by using a qualitative approach where a specially developed framework is applied in order to analyze and assess features of the proposed distribution models from several different aspects with the main focus on sustainability.

2.1. Theoretical Background

2.1.1. Short Food Supply Chain

Short food supply chain, also commonly termed in literature as direct or local food supply chain, can be identified by two basic characteristics: 'food production, processing, sales and consumption that are carried out in a relatively small geographic area (territory) and the number of mediators (or middlemen) in the chain which is minimal' [2,20]. Thus, based on [2,6], the food supply chain can be defined as "short" when there are distinguished short distances (the distance as a physical dimension that covers a range in which a product passes between the starting and ending point in the chain), or only a few (or zero) intermediaries between producers and consumers (the distance as the social dimension, which involves direct interaction and exchange of information between producers and end users).

SFSC was originally identified as an example of "resistance" of farmers to modernize their system of production and distribution of food, characterized by the development of global retail chains. The resistance reflected in the fact that direct sales to consumers bypass intermediaries, thereby creating the possibility for the increase of profits for producers, creating better visibility and identifying new niche markets. Based on wide literature review, the authors in paper [4] derived four prevalent characteristics of SFSC:

- geographical proximity, which refers to a geographical area in which food is produced and/or distributed;
- economic viability of included actors, mainly from the primary producers' point of view;
- social interaction, which refers to the producer-consumer relationship and interaction within communities;
- environmental sustainability.

Taking into account both geographical proximity and social characteristics, there are three basic types of SFSC that are suggested in Reference [4,20,27]:

- SFSC which implies direct contact between the producers and the consumers and sells on a face-to-face basis (direct marketing).
- SFSC which assumes selling local products through local market channels such as farm retail markets, food service outlets, local food retailers and supermarkets (proximate instead of direct relationship between producers and consumers).
- SFSC which presumes selling local food products not only to local consumers but also to all others (extended relationships).

The focus on alternative food systems in scientific literature very often hides a larger reality concerning local food networks [12]. The tradition of selling and consuming local foods is long-standing in Europe but its role decreased with the industrialization and technical/technological innovations. One of the first countries which renewed the interest in developing such kind of food systems through the creation of a formal definition, public affirmative initiatives and acknowledgement by policy-makers was France. They officially defined SFSCs as 'selling systems involving no more than one intermediary' [12]. Other industrialized nations have applied similar initiatives. However, no universal definition of what constitutes an SFSC exists [28] but it could be claimed that its structure depends on provided answers for several basic questions: how, where and by whom the food is produced; in what way and who is responsible for food distribution; who are the consumers and what are their expectations; what are the organizational forms of the actors in the chain; and how significant is the influence of new (digital) technologies? By providing answers to those questions, one can figure out how SFSCs are "built, shaped and reproduced over time and space" [29]. According to this, a general scheme of SFSC structure could be formed, as it is shown in Figure 2, where a slight difference between terms "short" or "direct", on the one hand and "local" food supply chain, on the other, has been made. The term "local" is focused on distance (locally produced foods are sold to local consumers). The term "short" concentrates on the reduction of the number of middlemen and it implies a more "direct" route [29]. Hence, "short" or "direct" food supply chain may involve the sale and distribution of locally produced foods on long distances (spatially extended).

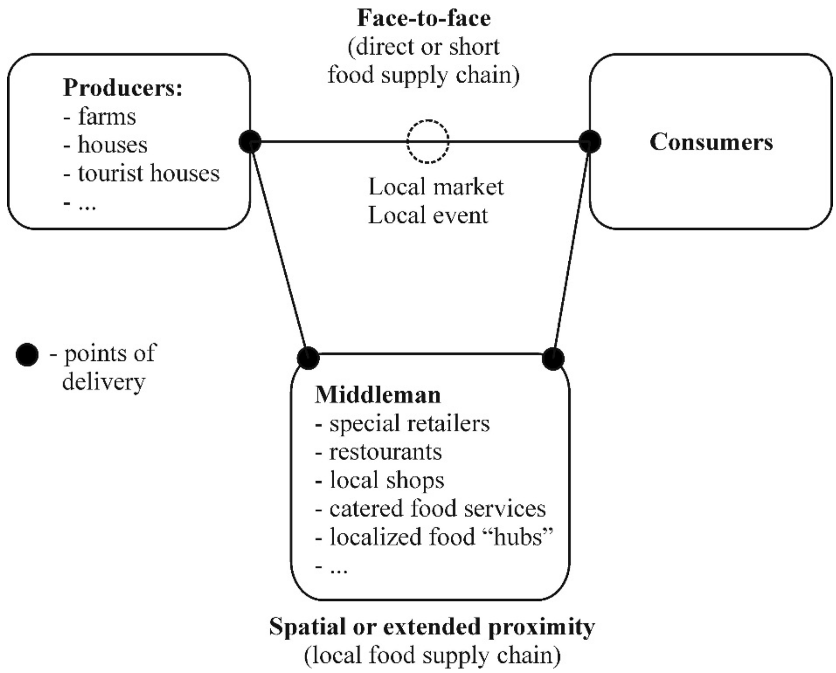

Figure 2. Short food supply chains schematic.

SFSCs were for the most part developed in specific regions and in specific sectors (for example honey, fruit, vegetables, etc.) [12], so it could be claimed that SFSC operates in a specific business environment, where food producers need to be more dynamic and active in cooperation with other firms within the supply chain network and to create a stronger relationship with the customer [20]. It is particularly important to achieve the closest possible cooperation among different small food producers, especially in the field of logistics activities and their realization. That way, logistics cost reduction, better utilization of the resources, improved reliability and efficiency of the deliveries can be obtained [10] (issue of economic and environmental sustainability).

Generally, producers of local foods use two main forms of distribution channels to reach their customers: direct distribution and the use of intermediaries. As it is stated in Reference [28], both of those forms can be organized in a myriad of ways. In the case of direct distribution, sales could be realized directly at points of food production (farms, houses, etc.), or through local markets, localized exhibition events and so forth (Figure 2). The middleman in SFSC makes a bridge between producers and consumers in terms of marketing, selling and delivering [11]. The food producers could supply their products directly to the middleman or could just prepare them to be picked up by the middleman (special retailers, local shops, catering food services, localized food hubs). The middleman is in charge of marketing and sale of goods, or even of direct delivery to the consumer's door. The main issues of such systems are related to the problem of the organization and realization of logistics and distributive activities in a cost effective and sustainable way [10]. In relation to logistics, the basic question includes how to plan, organize and realize activities such as storing, transporting and handling food within its flows from producers to consumers. Generally, particular logistics or supply chain management (SCM) strategy, which defines the ways of how goods are moved, stored and handled, depends on wide range of factors [30]. The basic objective of SCM strategy is to establish new and cutting-edge methods and techniques for the improvement of logistics efficiency, competitiveness and sustainability.

2.1.2. Sustainable Freight Distribution

Sustainable development, generally, has to meet the needs of the present generation without claiming to have the ability to meet the needs of future generations [31]. As it is stated in the same paper, this definition of sustainable development could be divided into three dimensions: economic affordability, social acceptability and environmental efficiency. 'Sustainable development requires radical and systemic innovations' [32]. According to the same authors, such innovations could be more effectively created and studied when building on the business models' concept, so we adopted this argument in our paper. Sustainability has also become an arena of competition among firms [33]. The increase of the consumers demanding care for the environmental, social, ethical and health attributes, influences companies to respond appropriately.

Freight or logistics distribution assumes a number of different types of goods flows (raw materials, semi-finished products and manufactured goods) that should be realized (moved) in an appropriate manner through distribution channels. Therefore, freight distribution represents the term for the range of activities (transportation, handling, warehousing, packaging, etc.) involved in the movement of goods from the very beginning (point of production) to the point of consumption. The main challenge in freight distribution is to organize distribution activities as efficiently as possible, while taking into consideration requirements from both supply and demand sides, with regard to sustainability as well. The nature of the freight distribution systems is switching from the more traditional (simply holding the inventory) towards a business model that relies on stronger information relationships with customers and suppliers. Structural changes in distribution channels currently taking place are accelerating deliveries to customers [34], so it could be said that they are becoming increasingly demand driven [35]. As it is noticed in Reference [34], these contemporary distribution channel structures have proved to be both extremely cost efficient and effective in improving customer services. Distribution channels could be organized in particular ways which then could be compared and analyzed by various approaches. In our paper, an integrated performance assessment across four dimensions (environmental, social, economic and health) is provided in order to explore and compare different delivery solutions.

2.1.3. Innovative Logistics Solutions

When defining the acknowledgeable Logistics and Supply Chain Management (SCM) strategies, companies face a number of limiting factors which are the consequences of the changes which occurred in the global economic surroundings [30]. Those changes, in the form of new trends, affect the business strategy on which the choice of logistics strategy and the operative solutions derived from it are directly dependent.

External forces of change (such as changing customer requirements, increased competition, government regulatory changes, technological advancements, increased emphasis on efficiency and on sustainability, security and resilience, etc.), drive the business strategy while strategies of competitiveness are shaped by the business strategy [30]. This means that external force of change impacts the changes in business and strategies of competitiveness, which in the end cause changes in SCM strategy in the form of new and innovative logistics approaches and methods based primarily on modern digital technologies. Such an innovative logistics solution enables business development to ensure flexibility and prompt market response in an increasing competitive environment. According to [36], this is particularly interesting to small and medium enterprises (such as for example local food producers) that are required to be flexible, adaptive, innovative and sustainable organizations. Those digital-based innovations may also improve the seller-buyer relationship in both directions. The sellers could be able to offer their products to a larger number of customers than with traditional marketing and distribution channels, with higher possibilities to improve their performance (reduce inventory). On the other hand, the customers could have possibilities to choose among a wider range of product options [36,37].

In forthcoming years, business strategies will become more customer-oriented, reflecting the shift in the forces of changes towards meeting customer requirements. However, customer requirements are no longer based only on the speed and cost of services but also on their sustainability. Therefore, there is a demand for a "logistics transformation", which includes changing the context of "product" of logistics industry in terms of end-users [20]. The change of the context of "logistics services outcomes" affects adjustments in the sense of logistics processes realization, which are usually based on the use of modern ICT (business digitalization) [20]. Thus, the reported “logistics transformation” will fundamentally be implemented in the forms:

- of “digitalization” of basic logistics processes (realized through Internet-based solutions), and
- of innovative logistics paradigms, which are completely information-based. From the distribution activities point of view, the paradigms such as 3PL (third party logistics), home delivery services and crowdsourcing have the highest potential importance.

Maybe the key word of this century is digitalization, which is present in all spheres of human activities [38]. When it comes to logistics activities, then digitalization is a personification of the digitizing core logistics processes and virtualization of supply chains [24] as well as using the Internet-based solutions (such as Internet of Things) for ensuring better flexibility, productivity, cost efficiency and better levels of logistics activity control. Digital technologies could bring completely new capabilities for better planning, designing, realizing and controlling the flows of goods, information and values across an extended logistics chain. That is, the improvements mainly accomplished by non-Internet technologies, such as mechanization and automation of logistics operation [39], are no longer sufficient, so a “new” form of logistics reality is needed. When it comes to the innovations in the food supply chain industry, it assumes the use of new ICT which has to provide better cooperation and collaboration among all food supply chain partners such as producers, distributors, retail and logistics service providers. In the food sector, ICT technologies could be crucial elements for meeting the challenges of sustainable farming and food processing, food logistics and food selling. A broad application of future Internet applications is expected to change the way food supply chains are operated in unprecedented ways [24]. Indeed, a lot of ICT research and innovation in farming (Farming 4.0) and food traceability is happening nowadays [1]. The claim that ‘the Internet helps to reintroduce old services’ [40], could be very helpful for improvement of the local food supply chains and SFSC due to increased access and speed of purchase of local products at traditional markets. However, not only do the Internet based services have an impact on the way in which customers order and purchase food but they also have a significant impact on the business models and physical distribution network structure. Digitalization of the food sector is dependent on a number of enabling technologies covering hardware, software, network/cloud/communication technologies and services for providing the functionalities needed by the sector [1].

Logistics service provider or third-party logistics (3PL) provider is an external provider who manages, controls and delivers logistics activity on behalf of the shipper [41,42]. Indeed, a 3PL provider denotes a specific outsourcing activity related to logistics and distribution. A 3PL provider collects outbound shipments from shippers and consolidates them in their distribution centers, after which it distributes them to the receivers [41]. The literature review showed us the existence of three stages, or waves of logistics service provider development, as it was stated in Reference [43]: the first wave assumes increased usage, mostly transport and warehouse services, the second one is related to rapidly increased 3PL popularity and diversification of their services and the third one represents an increased interest in integrated outsourcing logistics functions [20]. A 3PL provider could be categorized as one of four types according to their general problem-solving ability and customer adaptation: service developer, customer developer, standard 3PL provider and customer adapter [10]. In the area of SFSC, a 3PL provider could be of crucial importance due to the fact that development of efficient SFSC is very sensitive regarding the strategies for realization logistics and distribution activities. Challenges regarding distribution of locally produced food are related to cost justification of ‘in-house’ logistics. Therefore, SFSCs could require logistics solutions which can be offered by specialized 3PL providers [20]. However, selecting the appropriate 3PL providers for partners could be very challenging for food producers, due to both feasibility and viability of such logistics services capable of satisfying low-volume supply chain needs and uncertain business potential for SFSC intermediary businesses [3].

The third stream of relevant logistics innovation concept review focuses on home delivery services, which is tightly connected with the 3PL concept. The term *home delivery* 'represents all goods that are consigned to customers' homes or another site designated by customers rather than situations where customers have to personally pick up the goods or ship them in person' [40]. According to the same authors, functionality of home delivery is important for online shopping business models and hence it could be a crucial factor in success of online-based fulfillment and delivery processes in SFSCs. Hence, home delivery is considered a vital component mainly in the area of e-commerce, as a value-added service provided by sellers [40]. As a matter of fact, developing the appropriate operation models of distribution of locally produced food in SFSCs, as one of the objectives in our paper, could be categorized into home delivery service problems which have been widely researched by both academies and industries for over three decades. In the academic world, the first published paper exploring the home delivery services was in 1996 and the first industry patent about the same concept was even earlier, in 1993 [44], after which this concept has attracted great interest in the following years [25,26,40,45–47]. Generally, the home delivery concept has been studied by two different points of view: the seller's and the consumer's point of view [45]. Some of those papers investigated existing home delivery services from different angles and perspectives (investigation of the success factors) but as concluded in Reference [26] there is no shared opinion on the most successful and applicable operations model of the home delivery concept. In Reference [25] the appropriate framework and computer model to analyze the home delivery concepts was built, which will be used in building our conceptual model for assessment of proposed distribution models. In our paper, the objective will be definition and identification of the main value proposition, as well as the addressed issues that characterize proposed home food delivery service models, from both the consumer's and producer's point of view. More concretely, we analyze proposed models from the customer's point of view (value proposition of developed models) and also from the seller's point of view with regard to answering the question of what the issues in delivering those customer value propositions profitably are.

Crowdsourcing leverages technology to employ hundreds or thousands of individuals to perform tasks or help solve problems, thus increasing efficiency by taking advantage of underutilized assets and people [48]. In the transport and logistics area, crowdsource assumes sharing assets and people in realization of personal travel or freight distribution activities (last mile delivery) using smart applications. The well-known service for ride-sharing is Uber, which matches people's need to travel with excess car and driver capacity. In Reference [49] a growing popularity of crowdsourced delivery over the past few years, with a number of online platforms, is noted. According to the same authors, the dominant business model for such kind of delivery is business-to-customer, where a parcel is picked up directly from a fixed point by a crowdsource and delivered to the customer. From the SFSC perspective, by using the crowdsourced delivery, local producers get a cheaper option for sending food bought online and private citizens increase possibilities of extra income [44]. Crowdsourced delivery has already occurred due to the fact that consolidated companies like Amazon are testing delivery by leveraging a crowdsourced solution.

2.1.4. Business Process Modelling

As it is noticed in Reference [50], technological advancements in ICT should be followed by appropriate business models as a reflection of innovative logistics strategy and changes in the supply chain management paradigm. Hence, utilization of innovative logistics solution based on digital technologies has to be explored in detail, in order to provide a clear picture of company's business and logistics operating processes. An appropriate way of showing how business components are related to each other and how they operate is business process modelling.

According to [51], a business model, or how to organize a business, is one of the five types of potential areas for industrial innovations (the business model innovation represents the changes in the logic of how firms do business). From a supply chain perspective, examples of new business models are the design of a joint distribution service, the usage of a common category warehouse, the establishment of the new forms of distribution channels and so forth [52]. A business process is a set of logically related tasks performed to achieve defined business outcomes [53], previously formed through a business model. It implies strong emphasis on how the work is done within an organization, thus it represents a specific order of work activities across time and place, with a beginning, an end, a clearly defined goal and inputs and outputs: a structure for action [54].

A business process model is an abstraction of real business processes with the ultimate purpose to provide a clear picture of the enterprise's current state and to determine its vision for the future [50]. Hence, Business Process Modelling (BPM) is an important part of understanding and restructuring the activities and information which is a typical firm used to achieve its business goals. It is also a powerful method used for better understanding of business concerns and communication between stakeholders, allowing every interested party to be actively involved in these activities [55]. BPM is implemented to improve existing business processes, by reorganizing the existing ways of functioning and operating certain elements which form an integral part of the business model, or to establish a new business system on certain principles which the company's management deems necessary. The development of methods of BPM results in unifying methodology in recognized standards such as Business Process Modeling Notation (BPMN). Therefore, BPM does not represent classical programming but could be seen as programming in which a programmed language outlines a graphical notation of BPMN.

Synthesis of all these literature insights results in a theoretical framework which connects the previously discussed theories in such a way that a conceptual understanding of possible distribution models in SFSC could be obtained. Hence, using this theoretical framework, the conceptual model and various detailed scenarios of food distribution processes in SFSC could be further specified, enabling us to explore distribution activities in SFSC from different aspects.

2.2. Problem Statement and Conceptualization of Problem Solving

The involvement of SFSC implies that the farmer is not just a producer any more but also responsible for sales and marketing [56]. Hence, producers are obliged to manage several additional activities that may come before actions which are related to the producer's core business. One of those added activities, or the most challenging one, is logistics (transportation and distribution). As we have already stated in the introductory section, the main challenges regarding the distribution of locally produced food are connected to feasibility of the logistics activities realization in the producer's own organization. The main concerns related to this [20] state the following: the small shipment size and production capacities, limited technical and financial resources, high logistics costs which assume relatively high product prices. To sum up, SFSCs require contemporary and sustainable solutions in the field of food distribution, which should be based on innovative logistics approaches and new information and communication technologies. One of the ways in which this issue can be overcome is in application of digital technologies through Internet-based solutions and innovative supply chain paradigms (which are completely information-based), such as using 3PL, home delivery services and crowdsourcing in distribution activities. As it has been already mentioned, the basic motivation of this paper is to emphasize the need to find the sustainable solution for the distribution system in SFSC and the basic objective is to offer a concept for exploring and analyzing the practical ways of improving economic and ecological sustainability, as well as efficiency and competitiveness of small food producers and their supply chains, based on new ICT (cloud, web and android applications) and innovative logistics solution. That way, through the definition of appropriate business models, which should follow the application of the above-mentioned technical and technological innovations, an adequate theoretical base for the development of SFSCs with sustainable distribution based on digitization of food markets could be created.

The problem statement has stemmed from local food consumers' dilemmas while facing a choice: whether to go and buy food themselves or buy food using some kind of home delivery services? Depending on the chosen option, among others, the volume of realized transport and associated Greenhouse Gas (GHG) emissions is different. For example, the supply of food through retail chains accounts for approximately one third of the UK's total GHG emissions, with transport estimated to account for 1.8% of the total emissions [19]. Based on the established theoretical framework we adopted conceptual understanding of possible solutions which are home delivery service based, due to the assumption that these kinds of solutions are more sustainable.

The conceptualization of the stated distribution problem solving, given through an appropriate conceptual model as a solution-independent description of the stated problem domain, is shown in Figure 3. The proposed conceptual model includes the development of SFSC platform based on the principles of digitalization of business processes in the food market and the application of innovative logistics solutions and strategies. More specifically, the innovation of the proposed concept is based on the reengineering of the business process of local food distribution systems that would involve the usage of smart applications and devices (that enables online order placement, inventory control, dispatching and receiving management [36]) and application of modern logistics strategies in the field of distribution that involves the existence of home delivery services provided by specialized logistics service providers or a crowdsourcing solution (with support of technology and solution providers).

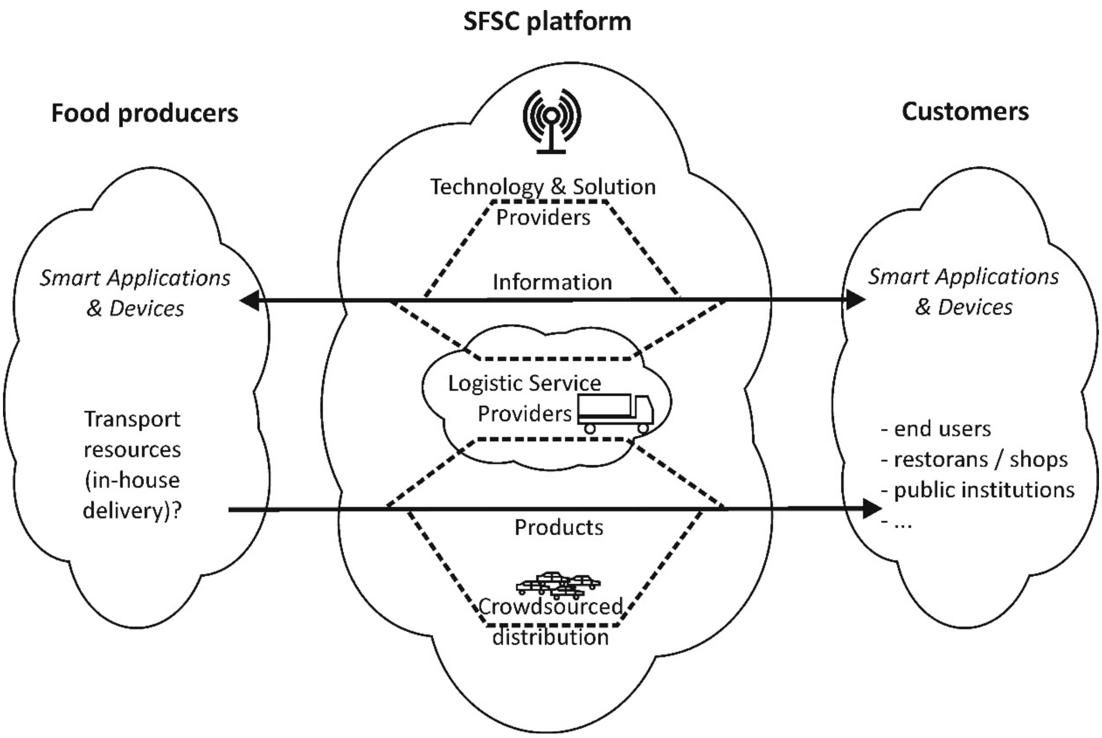

Figure 3. Conceptualization of distribution problem solving in the SFSCs.

The proposed conceptual model is solution-independent in the sense that it is not concerned with making any business process design choices or with other designs or planning issues. Instead, it focuses on the general challenges and solutions to the problem under consideration. In the business process models design phase, three business process models are developed. The basic building blocks in those process models are activities adopted from the two types of SFSCs: direct distribution and distribution with the use of intermediaries. The business process models are modelled in the BPMN.

2.3. Conceptual Model for Assessment

The second developed conceptual model is aimed at analysis and final assessment of the proposed food distribution solutions represented through three business process models. Based on the models introduced in Reference [25,26] we create a conceptual model to first analyze basic features of different distribution model scenarios and then to access their sustainability performances (Figure 4). The proposed model examines different distribution scenarios which are defined by:

- customers' demand, characterized by broadness of their category (i.e., citizens, restaurants, shops, hotels) and location (coverage of the customers base) and variation in delivery on daily basis;
- offered service concept, characterized by the product range, the type of reception, the delivery hours (and time window), the delivery lead time and minimum order;
- logistics infrastructure, characterized by equipment and resources necessary for planning, realization and control of goods (i.e., transport fleet, storage space, staff), information and financial flows (i.e., real time tracking of delivery, order processing infrastructure, web design architecture, cash flow function and methods of payment, management of customer's personal information).

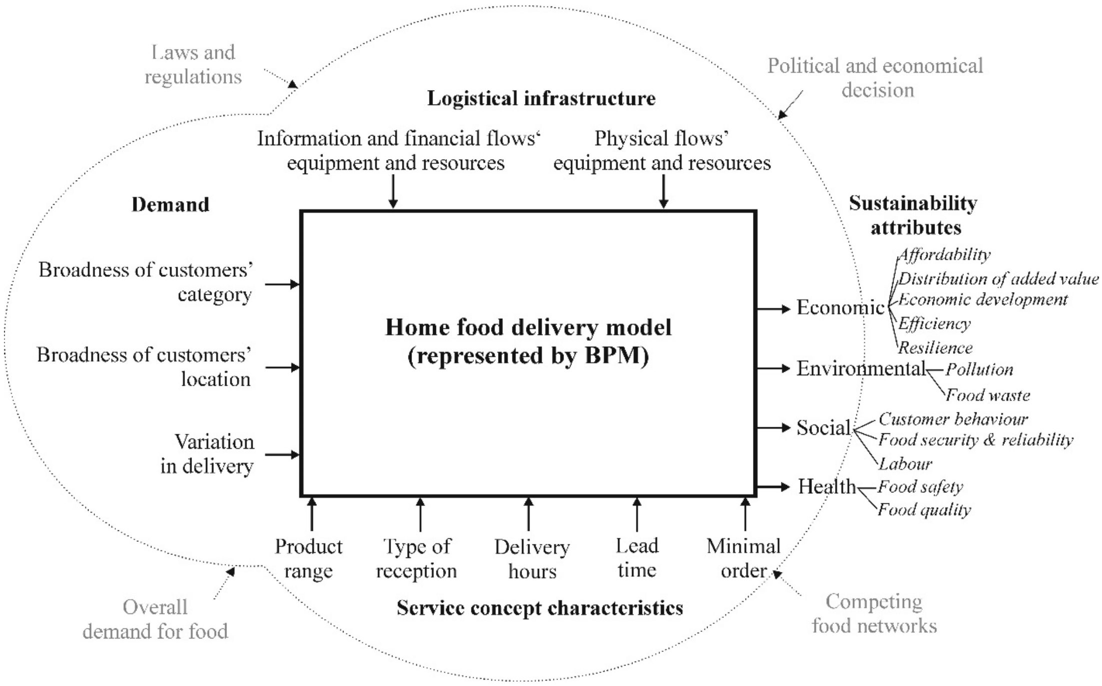

Figure 4. Conceptual model for food distribution scenarios analyses and assessment (based on [25,26]).

Therefore, each distribution scenario could be described in more detail and analyzed within three stated segments, whereas the fourth segment of the given model is used for the assessment of distribution models' sustainability performances. The model's segment 'service concept characteristics' covers the way in which the value for customers is created by helping them solve a specific problem (customer value proposition). In other words, it covers the way in which the proposed solution helps customers get an important 'job' done [57], which alternative offerings do not address [21]. The model's segment 'demand' is a customer segment through which identification of all kinds of customers characterized by specific demand and locations is possible. The third segment 'logistical infrastructure' covers key resources (people, technology, facilities, equipment, channels) and key activities (operational and managerial) required to deliver the value proposition to the targeted customer [57]. This is how the proposed assessment model covers several key aspects from the "Canvas business model", proposed by [58], as well as the key segments that make up a business model according to [57]. This fact could be very important and helpful in defining an appropriate business model, which should follow the definition of customer value proposition and organizational patterns, as the last step towards implementation of the selected distribution model.

As could be noticed from Figure 4, the abovementioned three segments represent the basic descriptive aspects of a food distribution system in the SFSC context. However, there are also descriptive aspects of the environment in which SFSC operates and of which understanding is very important in the process of analyzing SFSC. In a developed conceptual model, the environment, which refers to factors that influence the distribution system but cannot be influenced from the inside of the system [59], could be represented by four aspects: laws and regulation, political and economic decisions, overall demand for food and competing food networks. Maybe the key aspects are governmental and public initiatives, represented through appropriate legislation tools and political decisions. The institutional support for SFSCs makes it possible to solve some of the main obstacles in their setting up, such as regulatory barriers (regulations and tax systems), access to finance and skills issues [17]. However, all stated SFSC's environmental aspects are more oriented towards strategic decision-making in developing SFSC and they define the framework within which more operational issues are considered, such as the issue of food distribution. Therefore, these aspects will not be given much attention in the rest of the paper (reason why they are marked with a gray color in the Figure 4).

For sustainability assessment, a set of attributes and indicators of performance were selected, derived from the pertinent literature. Based on [7,22] we selected twelve attributes in total from four well know sustainability categories: economic, environmental, social and health (Figure 4 and Table 1). We set our list of attributes, as an adequate narrow version of the list of 24 attributes basically proposed in Reference [7] (similar to the approach presented in Reference [32]), to be sufficiently relevant as a conceptual and practical tool for assessment of the proposed distribution models (home food delivery models). In the economic dimension, five attributes are defined: "*affordability*" as the price offered to consumers; "*distribution of added value*" as the feature which concerns the contribution of the SFSC to the local economy as the means of fair distribution of added value and profits between SFSC members; "*economic development*" as a measure of SFSC has an impact on strengthening local economies and employment rate; "*efficiency*" represented by delivery costs and "*resilience*" to the infrastructure disruption, demand disturbance, price deviation and so forth.

Table 1. Overview of attributes and performance indicators for the sustainability assessment (based on [22]).

Category	Attributes	Indicators Description
Economic	Affordability	Ability to provide food at acceptable prices (consumers sales price)
	Distribution of added value	Price obtained by producers/price paid by customer
	Economic development	Contribution to economic (local) development (new hired labor)
	Efficiency	Cost efficiency of delivery (€/order)
	Resilience	Resiliency to delivery disruption, disturbance and deviation
Environmental	Pollution	GHG emissions per order delivered
	Food waste	Food waste in distribution processes
	Customer behavior	Willingness to pay such kind of service
Social	Food security and reliability	Accuracy and quality of the delivery service avoiding receiving broken package or foods
	Labor	Number of people who can get financial benefit from SFSC
Health	Food safety	Following standards for food safety and control during delivery
	Food quality	Potential for food traceability and level of trust-based relations between SFSC actors

The environmental category is covered by the attributes "*pollution*" and "*food waste*". The distance driven per order has a strong impact on GHG emissions, so possible effects of various distribution scenarios will be estimated on the basis of the potentially driven distance by using the emission factors defined by relevant literature. A sustainable food system should be based on resource use efficiency in order to minimize its impact on the environment, where the waste has a crucial role [60]. Food waste in context of SFSC distribution refers to edible food losses and could be defined as food lost at any stage of the SFSC (decrease in food quantity or quality). Reducing food waste in distribution processes could be achieved by using technical innovations and knowledge.

In the social category, the identified attributes are: "*customer behavior*", defined by customers' willingness to pay for such kind of services and their interest in establishing direct connections with the producers; "*food security and reliability*" defined by accuracy and quality of the delivery services avoiding to receive broken food packages or food; and "*labor*", which is already stated as some kind of feature from the economic category but it also concerns the social category regarding all persons who can get the financial benefit from establishing SFSC.

The health dimension is covered by attributes "*food safety*" and "*food quality*". Food safety and food quality are two terms which describe aspects of food products and the reputations of the producers [61], as well as the potential delivery service. Food safety generally could be defined as an 'assurance that the food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use' [61,62]. In the context of distribution, food safety assumes maintaining the right conditions for food during delivery and timely processing of problems and their control based on respecting appropriate standards. Food quality can be defined as 'fitness for consumption' and it is linked to trust/confidence [61], which could be based on face-to-face relationships or on formal and codified rules with a third-party guarantee [61]. Hence, food quality in SFSC could be estimated through potential for food traceability and level of trust-based relations between SFSC actors in food quality targeting.

The applied sustainability assessment concept could be categorized as one from integrated assessment group, which are used for supporting decisions related to a policy or a project in a specific region. In the context of sustainability assessment this integrated assessment concepts have an ex-ante focus and often are carried out in the form of scenarios [63]. The selection of these attributes and indicators was made by the authors, according to the analysis of relevant literature and their own perceptions and experiences, taking into account attributes' applicability to the researching problem. Further researching steps could be realized towards their confirmation and justification by the stakeholders involved in the examined real SFSC case studies.

3. Results

3.1. Business Process Models

Towards the exploration of the potentiality and applicability of innovative ICT and logistics solutions in creating sustainable SFSCs in detail, a business process model that depicts the operational models and organizing formats among three distribution scenarios has been developed: *digitized "face-to-face" SFSC*; *digitized SFSC with specialized logistics service providers (LSP)*; and *digitized SFSC with crowdsourced distribution*.

3.1.1. Solution 1: Digitized "Face-To-Face" SFSC

The first business process model (BPM_1) assumes a direct connection between producers and consumers through an intelligent cloud ecosystem linking other producers, payment services providers and consumers. This form involves developing information systems that interlink the local food with the customer. Hence, it could be said that this form of SFSC assumes the forming of the digital market which could be administrated by a single producer or, what is more appropriate, by a cluster of producers. The transportation method is mainly self-transport, which gives the local food producers flexibility and full control.

The description of the process is as follows: a customer checks product availability on the digital market through the web or smart application. In case of a positive outcome, the customer forwards the request to the producer who after validation checks the ability of aggregation of similar orders and their common delivery in order to achieve sustainability goals. The producer defines the final delivery conditions (time, cost), which include the booking of goods in stock and passes it on to the customer in the form of the final offer. After accepting the offer, the customer makes an electronic payment and as the next step, we have the application of orders under defined conditions. Payment service providers are integrated into the form of the digital market. The producer prepares the products for delivery and automatically updates the new state of stock on the digital market. In accordance with other requirements, which he bears in mind when planning delivery, the producer selects the best transportation routes and schedule of stopping at delivery. According to that, producers are responsible for simple packaging, warehousing and transportation. The inventory management system is very "home-built" [64] and mostly involves the push type of inventory strategy (make a product for the store, not for immediate distribution). It should be noted that through ICT application messages can be posted to the customer on the delivery status. After the shipment arrival, received shipments are collected and checked by the customer. Activities 'receiving and verifying of products' assumes possibilities of a product return, which is realized by the producer. At the end of the process, the customer and the producer have the possibility of mutual evaluation. Based on the process described above, a BPM_1 is developed, as shown in Figure 5.

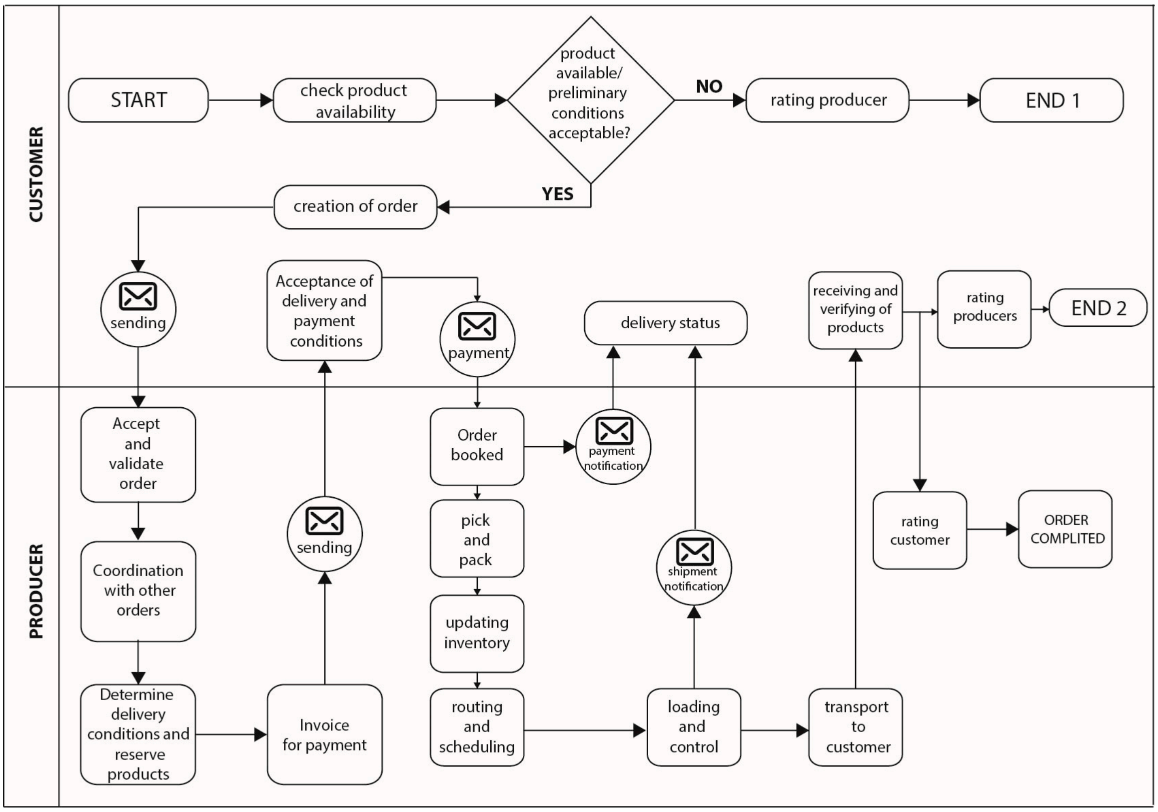

Figure 5. Business process model of digitized "face-to-face" SFSC (BPM_1).

3.1.2. Solution 2: Digitized SFSC Using Specialized Logistics Service Providers

The second form of the innovative SFSC includes engagement of corresponding LSP, which will deal with the information, physical and business resources that are required for the realization of the proposed conceptual model. In this case, there are information and logistics intermediaries who are merged into the integrated function of LSP. This means that the LSP controls the information system that covers all ICT solutions necessary for the operation of the digital market but also it manages all logistics activities that follow the route of the product from the producer to the customer, as well as reverse flows in case of product return. In doing so, LSP may have storage facilities for temporary storage of goods, to supply customers (products previously shipped from the manufacturer) or the delivery will be made directly from the manufacturer. The business process model related to this form of SFSC is shown in Figure 6 (BPM_2 model).

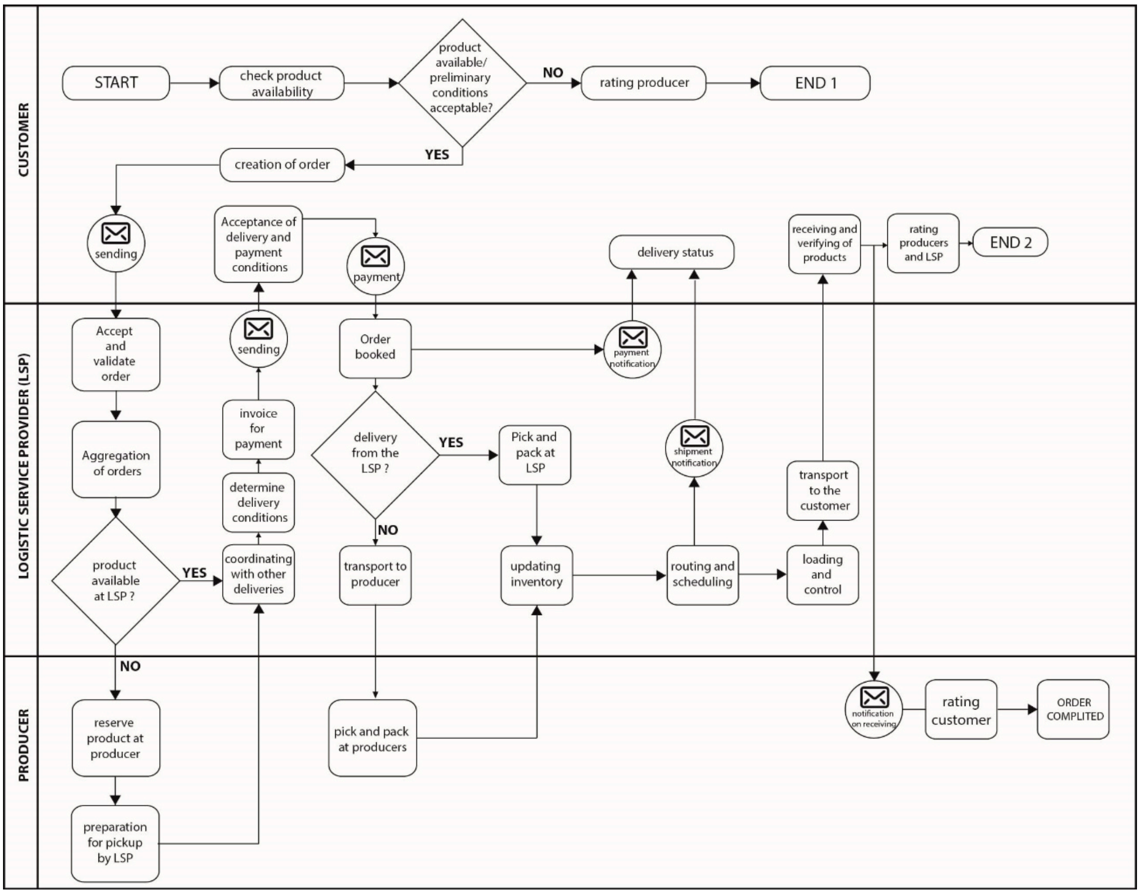

Figure 6. Business process model of digitized SFSC with specialized LSP (BPM_2).

The difference compared to BPM_1 is just in the sense of the utilization of logistics activities (storage and transport) and the method of information flow. This business process model assumes that the processes in the whole SFSC are integrated and that LSP takes responsibility for the whole distribution process (including the collection and transport of returned products from the customers to storage facilities or producers). The LSP can also take over the strategic role due to the possibility to manage the producer's inventory. LSP makes all the important decisions regarding orders and thereupon, the role of an adequate IT in all decisions is crucial.

3.1.3. Solution 3: Digitized SFSC with Crowdsourced Distribution

The last proposed solution assumed that the function of information intermediary is decoupled from the function of logistics intermediary. Upon that, the information intermediary provides information to the consumer by accessing the data owned by the producer and other members in the distribution process. In this case, those other members equate a private person who realizes logistics activities (mainly transport) on the basis of crowdsourcing (similar to the well-known Uber transportation system). The suggested model (BPM_3) is shown in Figure 7.

The difference of this model compared to BPM_1 is that the function of information intermediary is differentiated from the producer and its function is to strategically control the entire process of food distribution, not only to serve as an information support in the process of distribution controlled by the producer (case BPM_1). The implementation of transportation activities is left to the private individuals who are interested in providing such services. This is the main difference compared to BPM_2 where the implementation of logistics activities is given to the specialized companies. As in the previous solutions, there is also the possibility of the product return (recognized by the model under the activity 'receiving and verifying of products'). Naturally, in this case the task of collecting return products is also crowdsourced (realized by the same or different individuals in comparison with crowdsourced delivery).

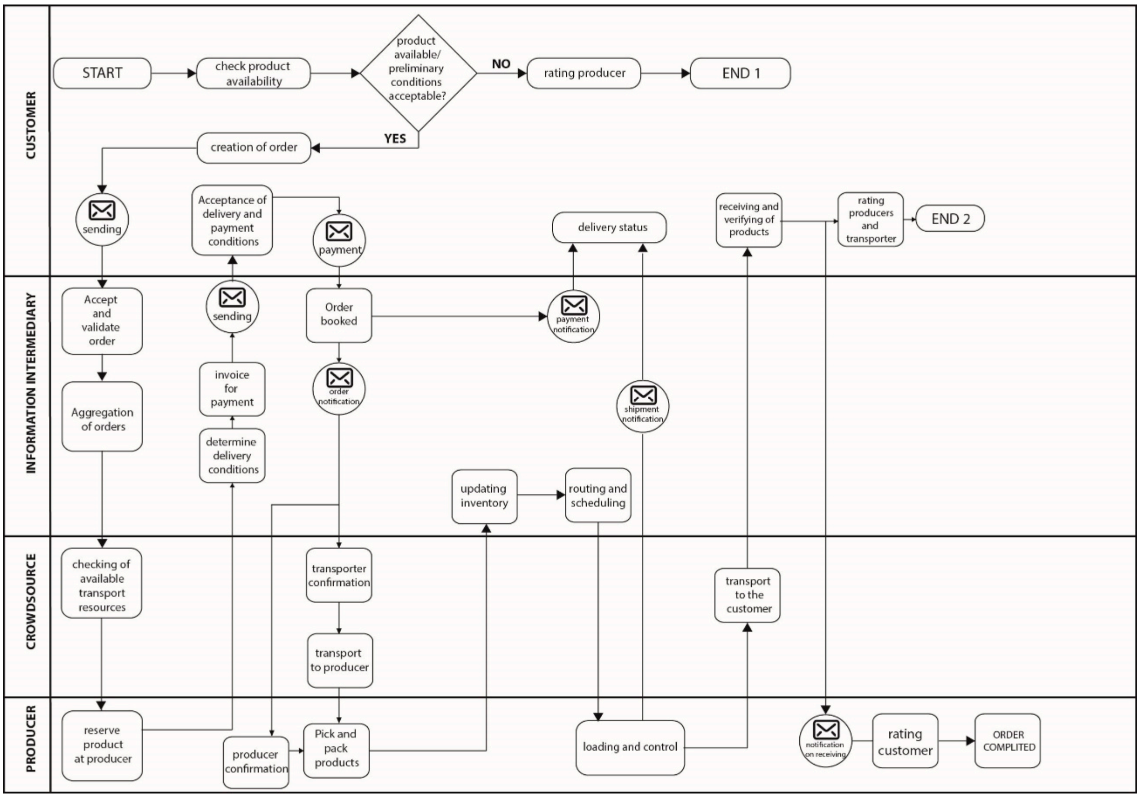

Figure 7. Business process model of digitized SFSC with crowdsourced distribution (BPM_3).

3.2. Comparative Analysis and Sustainability Assessment

As previously stated, using a qualitative approach, a comparative analysis (exploring features from several different aspects) and a sustainability assessment of the proposed food distribution models is conducted according to the conceptual framework represented by Figure 4. Each of the described solutions is analyzed first from the aspects of service concept characteristics, demand characteristics and logistics infrastructure, which is then followed by a sustainability assessment.

From the perspective of service concept characteristics it could be claimed that Solution 2 is generally the best performing due to the existence of a specialized LSP which could ensure optimal realization of logistics operations. Offering a large variety of products impacts those logistics requirements (transport, handling and packaging) which are extremely intensive and varied. This could be very problematic from the operational aspects of the self-logistics method (Solution 1) or crowdsourced logistics (Solution 3) because a wide range of products of different characteristics and different requirements increase the complexity of logistics resources and methods. In terms of reception types (attended reception at home or at another predefined location) and delivery hours (defined range of hours for delivery-in food sector defined at around 2 h slots [46]), Solution 2 gives the highest possibility of choosing delivery location and/or delivery time, due to the flexibility of logistics planning. Lead time per delivery is generally longer with attended reception—as a reception type is assumed in all our proposed solutions—than in unattended cases such as box reception. To ensure reasonable delivery lead time, each customer must be within a fixed distance of the point that supplies it [65] and which is very hard to accomplish with Solution 1. Home delivery services provided by LSP, which has a wide and flexible distribution network capable of improved speed of their supply chain, are able to offer such service. In crowdsourced distribution, the carriers are occasional and/or non-professional drivers [66] which could lead to issues of reliability and disability in certain traffic conditions. This can cause a longer lead time at the end. Such problems could be compensated for by offering rating systems. Small minimal order and shipment size, as one of the main challenges in SFSC, can cause the biggest problems in the setting up of the first Solution, especially in a situation with producer's independent realization of logistics activities (without producers clusterization). On the other hand, crowdsourced distribution could be a very suitable solution for delivering small packages on local scale shipment distances.

The market penetration within specific areas and the related market densities in these regions are of significant importance for the introduction of new products and/or services [47]. The covered geographical area and market penetration could be characterized by the density of the customer base which could be defined by the broadness of customer category and customer location. Regarding the customer category and location, it could be stated that Solution 2 covers a broad customers base from both points of view, while Solution 1 is more oriented to SFSC developed for specific customers and for specific products (for example, honey, fruit, vegetable), located in a smaller region because greater location coverage raises the issue of delivery cost justifiability. The third solution, based on crowdsourced delivery, might offer a smaller coverage of different customer categories due to their potential ordering of products where cold chain requirements, as regards logistics activities, is necessary. On the other side, the third solution could offer very good coverage from the customer location point of view. Variation in delivery, depending on customer needs, can cause certain vulnerabilities, mostly in Solution 2, due to the fact that its efficiency depends on the appropriate shipment size and economies of scale, as well as the capability of LSP to react on low-volume issues.

A third set of features centers on the logistics infrastructure which is characterized by logistics assets and resources and the applied type of ICT. The value invested in different types of logistics assets and resources plays an important role in a cost-benefit analysis. Solution 1 assumes 'in-house' logistics with own transport fleet and without sophisticated storage and handling capacity. Vehicles could be shared between producers in the case of forming a producer's cluster. Producers are expected to act as delivery staff who are non-professional drivers but with basic experience in transporting and delivering foods. Solution 2 is based on outsourced logistics realized by LSP with specialized logistics resources and trained staff. LSP act as an intermediary, which offers different kinds of transportation, distribution and information services and as such they participate in the final product price paid by customers with the price of their services. Since the crowdsourced delivery assumes service that is 'outsourced to occasional carriers drawn from the public or private travelers [66], Solution 3 refers to the leveraging of owned assets across individuals. Therefore, this solution does not require existence of owned logistics resources but sharing personal or company's assets and staff in realization distribution activities. The second type of logistics infrastructure is connected with the ICT used for planning, realization and control of information and financial flows. The quality of used ICT could be rated with regards to the capability of management and protection of customer's personal information, the accuracy of order processing, web design architecture, cash flow function, offered methods of payment and related security systems, real time tracking possibilities and so forth [40]. According to this, it could be concluded the ICT platform applied in Solution 1 is less professional than ICT platforms applied in the other two solutions, in terms of being realized on a web application for smart devices as an interface that connects users and central information systems administrated by a producer (or by a cluster of producers) and not by a professional technology provider company. Such an ICT platform could offer a broad range of previously stated services but with lower performance than the platforms managed by specialized information intermediaries (Solution 2 and 3).

A synthesis of our sustainability assessment is reported in Table 2, which provides general representations of the estimated impacts on the sustainability value proposition of the proposed food distribution solution. The indicators, as a measurable parameter [67], which provides information on sustainability value proposition are, generally, quantitative (such as '*ability to provide food at acceptable prices*', '*price obtained by producers/price paid by customer*', '*contribution to economic development*', '*cost efficiency*', '*GHG emission*', '*food waste*', '*accuracy and quality of delivery service*' and '*number of people who* *can get financial benefit*') and qualitative (such as '*resiliency*', '*willingness to pay*', '*respecting standards*' and '*potential for food traceability*'). However, due to the unavailability of real data and a generally qualitative nature of research, linguistic assessments are used for further analysis.

Table 2. Sustainability performances of the proposed home food delivery models.

Indicators	Estimated Impact to the Sustainability Value Proposition		
	Digitized "Face-To-Face" SFSC	**Digitized SFSC with LSP**	**Digitized SFSC-Crowdsourced**
Ability to provide food at acceptable prices (consumer's sales price)	Low	Medium	High
Price obtained by producers/price paid by customer	High	Low	Medium
Contribution to economic (local) development (new hired labor)	Medium	High	Low
Cost efficiency of delivery (€/order) [1]	Low	Medium	High
Resiliency on delivery disruption, disturbance and deviation	High	Medium	Low
GHG emissions per order delivered [1]	Low	Medium	High
Food waste in distribution processes	Medium	High	Low
Willingness to pay such kind of service	Medium	High	Low
Accuracy and quality of the delivery service avoiding receiving broken package or foods	Medium	High	Low
Number of people who can get financial benefit from SFSC	Low	Medium	High
Following standards for food safety and control during delivery	Medium	High	Low
Potential for food traceability and level of trust-based relations between SFSC actors	Medium	High	Low

[1] Detailed results are shown in Appendix A.

That is, during the assessment step, the potential effect of each attribute (represented through appropriate indicators) on sustainability value proposition is considered and aggregated into qualitative results for each distribution model. The potential effects, represented throughout linguistic term-based qualitative judgments: 'low', 'medium' and 'high', were defined based on the information obtained from the literature, authors' experience and knowledge, as well as discussions with experts. Table 2 shows that it is difficult to conclude at first glance which solution is best regarding sustainability performing. Some of the analyzed solutions perform better for some indicators, whereas for other indicators they perform worse. This could mean that the final sustainability assessment of the real SFSC will be highly dependent of the context.

Affordability expressed throughout the ability to provide food at acceptable consumer sales prices, depends on quality and costs of logistics and distribution activities which impact on food price competitiveness. Hence, Solution 1 could be the worse solution due to the potential large share of transport costs in the final product price. On the other hand, the crowdsourced solution could provide the best costs competitiveness. From the aspect of fair distribution of added value, solutions without intermediaries could offer better performance, whereby Solution 3 is better than Solution 2 because it is not based on professional service. The greatest contribution to local economy development, expressed by new hired labor with full time jobs, is provided by Solution 2 (hired labor in intermediary companies). Solution 2 could impose new hired labor in producing and delivering activities in case of increase in the business volume. Solution 3 does not assume new hired labor in delivering activities but only individuals with extra income, while it could impact on hiring new labor in ICT solution providers company. Different food delivery solutions have different operation efficiencies, represented through average delivery costs per order. The operation efficiency of Solution 1 is the lowest due to the lack of professional logistics infrastructure. Solution 3 could offer the lower operating costs compared to traditional logistics operators (Solution 2), due to increased flexibility of assets [66]. Detailed calculation of cost efficiency based on a hypothetical case study is provided in Appendix A. In contrast to the operation efficiency, Solution 1 has the best performance regarding resilience to different types of delivery disruption, disturbance and deviation because of their redundancy capability and self-controlled logistics operations. Concerning GHG emission per delivery, the Solution 2 and 3 seems to be characterized by a smaller volume than Solution 1 due to the fact that the proposed professional logistics services and crowdsourced solutions has the potential (with better route planning, higher load rates and efficiently use of vehicles) to reduce energy and carbon-footprints of deliveries. In our considerations, GHG emissions are directly connected to the traveled transportation distance (the 'food miles' concept), as it is shown in Appendix A. As Table 2 shows, the second environmental attributes-food waste has the lowest value and hence the biggest impact on sustainability performances for Solutions 2. This is connected with the quality of offered service concept based on existence of specialized LSP. The inability to provide fulfillment of all food distribution requirements (such as cold chain requirement) is the reason why Solution 3 provides the lowest performance.

Generally, [2] states that consumers like to buy locally produced food for a range of reasons (such as environmental concerns, health reasons, quality of food, to support local farmers and economies). When it comes to the proposed home food delivery models, as well as the stated customer buying behavior, our estimation is that they are potentially most willing to pay for delivery service offered by Solution 2 due to ensured quality and safety of food, good environmental performances and the general customer service level. The low impact on the sustainability performance for Solution 3 is based on low level of trust. The second social attribute-food security and reliability, expressed throughout accuracy and quality of the delivery service avoiding receiving broken package or foods, is estimated identically like the previous one, mostly due to the quality of the offered service concept (ensuring timely processing of all kind of quality problems, handling capacity for customer complains). According to the overall number of people who can potentially get financial benefit from the implementation of SFSC, Solution 3 provides the best results due to the number of people who can get extra income. The indicators for the two attributes from the health category are estimated identically. The customer's attitude towards food labeling as a standard of food control and safety is more developed [2]. Customers are very interested in the maintenance of right conditions for products during delivery, as an aspect of the quality and reputations of food delivery services. According to that, Solution 2 represents their first choice. Although Solution 3 offers the best potential for food traceability (as an indicator of food quality), the identified challenges related to trust and liability issues could significantly contribute to the reduction of customer's interest for this type of delivery services.

4. Discussion

Forming a model of an efficient logistics system is crucial for the development of a sustainable SFSC. In this paper, the abovementioned models include advancement and improvement of logistics resources and competence of producers, using logistic capacities of specialized logistics service providers, or the use of crowdsourcing. Each of those solutions is based on the usage of modern ICT and each of those solutions has its own advantages and disadvantages from the operation and sustainability point of view. The proper design of SFSC should not only involve improved logistics operability but also the satisfactory performance of sustainability [68]. Hence, the proposed solution that offers the best balance between the value created for the customer, the value captured by the involved companies and the value for the environmental sustainability, will be the most attractive one.

Findings in this study are aligned with literature regarding identification of the main operational problem in the establishment of the first model in the functioning SFSC (Solution 1). That is, a small concentration of cargo flows (small size delivery and small minimal order), could reduce the efficiency in terms of transportation [8]. As concluded in Reference [69], this is an expensive mode of delivery, both in terms of time and money, especially in situations of delivery to less populated places, long transportation distances and when specific transportation conditions are required [21]. On the other hand, this model allows producers greater flexibility and freedom during the transportation process since they can perform other activities (e.g., grocery shopping, having meetings, performing other tasks, etc.). This statement could be confirmed by [70], where analyzed case study has shown that food deliveries are usually made by own account transport by the food suppliers or producers. Problems of the operational efficiency of the distribution can be solved by forming clusters of producers to share information and knowledge among the members (information integration), to coordinate and share their transport resources, to create joint distribution facilities and joint distribution planning processes (trend towards centralization). Low operational efficiency of Solution 1 impacted on its very low sustainability performances measured by GHG emissions (as proved in Reference [69]), food waste and ability to provide food at acceptable price for customers. However, as a solution based on zero intermediaries, it has the fairest added value distribution.

Solution 2 implies leaving distribution to specialized logistics providers. In this way, the full integration, coordination and optimization of logistics activities are achieved and manufacturers are focused on their core activities. It is believed that the overall operational efficiency in this model, represented by costs, the service level and user-friendliness of the service will be the best compared to other solutions, as proven in some other cases [18]. Generally, it could be claimed that the obtained value of cost efficiency for Solution 2, as well as for two other solutions (Appendix A), are highly realistic in comparison with the values from other research [25,71]. In addition, LSP provides full quality of delivery in terms of respect of the conditions in which food is stored and transported. The main disadvantage here is the sustainability and business success dependence on the quality, organization and price of LSP services. Besides this sustainability disadvantage, represented throughout the low value of attribute 'distribution of added value', the indicators of all other sustainability attributes have high or medium estimated impact on the sustainability value proposition.

In line with previous literature [49,72], third solution is eco- and social-friendly, because it is characterized by a smaller volume of GHG emission per delivery and it gives chances to individuals for extra income. In Solution 3, LSP is excluded, which can have positive financial effects (reducing the costs of delivery). Crowdsourced distribution, if properly implemented, could be a very suitable solution for delivering small packages over short distances. On the other hand, disadvantages of this model are related to the inability of the full flow control of the products, primarily in the context of sanitary and health conditions. Using non-professional staff could lead to the problems of reliability as well as to the problems of trust and liability. However, the implementation of SFSC member rating system could be a very effective solution to these issues.

Selection and implementation of some of those solutions will depend upon an individual case and business conditions. Nevertheless, the results of this research provide a detailed insight for all stakeholders interested in the development of such delivery based SFSCs. It makes food producers aware of various food distribution options and their advantages and disadvantages from the producer's point of view. For each proposed service, we identify the value propositions and the issues the service aims to address. Regards LSPs, as SFSC operators, it can be inferred that these results could serve for evaluating the new market potential, as well as for evaluating the feasibility of creating appropriate business models. The paper result could help in government's policy-making in choosing affirmative initiatives and appropriate concept of SFSC development, especially in regions with a low level of SFSC concept maturity.

5. Conclusions

Globalization of food production influences the structure of food supply chains. This impact is mainly reflected in the increasing complexity of food supply chains and in raising distance to which food is transported on its way to consumers, which has a negative impact on the environment, food quality and sustainability of food production. Hence, systems of local food production and distribution have gotten great attention in the last two decades, mostly for the reasons of consumers' growing motivation to purchase locally produced food, as it is more in line with domestic quality and health standards. However, local food producers cannot be competitive enough with large food supply chains due to low economy of scale and relatively high logistics costs. Because of that, supply chains of the local food products (or short food supply chains) require a corresponding solution in food distribution, which follows modern logistics strategies and approaches in combination with a contemporary ICT solution, with the final aim to ensure their sustainability and to improve overall competitiveness of local food producers. In this paper, several solutions for the improvement of distribution in SFSCs are explored. All of the analyzed solutions are based on digitization of business and logistics processes and involve existence of ICT which would ensure efficient coordination and collaboration of all members of SFSC throughout the development of a form of "digital local food market". In addition to solving the problems of efficient and sustainable food distribution in SFSCs, the proposed solutions also obey the principle of food identifiability which enables consumers to ensure quality of delivered products. Close to modelling and exploring the proposed solutions in detail, three business process models, which render the sequence and interaction of activities among diversified food distribution scenarios, have been ensued. For each operational scenario, the major advantages and challenges of its practical implementation are revealed. After that, based on the created conceptual framework and selected set of attributes and indicators, a sustainability assessment of the proposed solutions has been accomplished. In the context of sustainability assessment, the applied integrated assessment tool is based on qualitative approach with an ex-ante focus.

Developed business process models could serve as a base for possible development of the appropriate simulation models, as well as business models, that could be identified as the next step, towards further research in this area. Those simulation models, based on real data, could be used for further estimation of delivery operation efficiency and costs for each distribution scenarios, with the final aim of selecting the most sustainable food distribution mode from the economic point of view. The selection and implementation of some of these solutions will depend on the specific case and business factors such are: lot size, lead time, assortment, the risk of purchase error, transaction cost, service support, customization and so forth. Also, the developed framework for sustainability assessment, with proposed attributes and indicators, could serve as a base for development of a robust multi-criteria analysis, which will have the advantage of incorporating both qualitative and quantitative data into the process of sustainability assessment of the proposed solutions in the context of real SFSC.

In this paper, we focused on SFSC which are delivery based, hence distribution and logistics are crucial for producers. Taking this fact into account we have explored and analyzed several potential solutions for SFSC improvement from the aspect of logistics. The obtained analyses results could contribute to better understanding of the issues and challenges in establishing digitized home delivery services and could serve as a help in decision-making for food producers and other involved stakeholders. However, we do not provide a general solution because entering such kind of delivery services is challenging and there is no 'one size fits all' approach.

Author Contributions: Conceptualization, S.B. and M.M.; Data curation, V.T., D.M. and S.N.; Methodology, S.B., M.M., V.T., M.J. and D.M.; Supervision, S.B.; Validation, S.N.; Writing–original draft, S.B. and M.M.; Writing–review & editing, M.M. and M.J.

Funding: This research received no external funding.

Acknowledgments: The realization of this paper has been supported by the Serbian Ministry of Education, Science and Technological Development program through projects TR 36007 and TR 36030, as well as through project DTP1-050-3.1: "Regional and Transport Development in the Danube-Black Sea Region towards the Transnational Multiport Gateway Region (DBS Gateway Region) supported by Danube Transnational Programme".

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Hypothetical Case Study for Cost and Environmental Efficiency Estimation

The hypothetical case study is designed based on the case study presented in Reference [25]. The service area is a circle with 10 km radius, which is in range with the area covered by an average municipality in Serbia. The size of the customer base in this case is 725 households, which is 1% of the families living in the projected area and can be assumed as potential penetration for the service (this assumption is highly realistic according to some other research where that estimation is up to 7% [25]). If we assume 1 deliver a week per customer, it results in 145 daily orders (with a stabile daily demand and no weekend deliveries). Next, the assumed time needed for delivery at the customer's site (duration of the stop at the customer) is 5 min. We assume 2 delivery windows with 5 h duration each (from 9 a.m. to 2 p.m. and from 4 p.m. to 9 p.m.). In the scenario where distribution activities are centralized (according to the LSP proposed in our Solution 2), as shown in Figure A1a and following the outcomes given in Reference [47], the average number of kilometers per customer is 4.8 km. This value is obtained for assumptions that are similar to this one in our hypothetical case study regarding potential customer orders density and length of delivery windows.

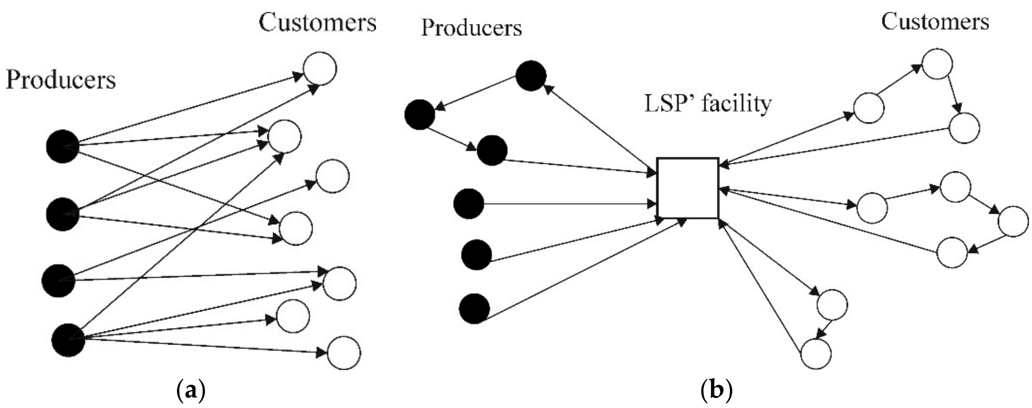

Figure A1. Scenarios in performing distribution activities: (**a**) centralized; (**b**) non-centralized.

Therefore, the total number of kilometers for deliveries of all 145 orders is 696 km (145 orders × 4.8 km). Average time needed for 1 delivery could be calculated as: 5 min + 4.8 km/40 km/h = 12.2 min (40 km/h is average vehicle speed during delivery). For realization of all 145 orders the time needed is 1769 min, or 29.5 h. In case of 10 h of working per vehicle (2 delivery windows per 5 h), we need 3 vehicles (29.5 h/10 h per vehicle = 2.95 vehicle). Each vehicle traveled distance per working day is 232 km. Fixed and variable costs per vehicle per month could be calculated as follows [73]: vehicle fuel, oil and tires expenses-€680; vehicle maintenance-€150; vehicle amortization-€150; license fees-€25; vehicle insurance-€25; driver's salary-€500. Total costs per month associated with distribution are €1530. According to the assumptions regarding working days per month (22 days), the cost of a vehicle-day is €70. If one vehicle performs 49 orders per day (145 orders/3 vehicles), then the costs per order could be calculated as €70/49 orders = €1.43 per order. It could be claimed that the obtained value of cost efficiency for our Solution 2 is highly realistic in comparison with the values from other research (values from €2.1 per order [25] to €3.87 per order [71]). Delivery costs in our case are lower mainly due to lower wages of drivers in Serbia than in the EU countries where other research was performed.

In scenario where all deliveries are undertaken with own transport by producers (non-centralized distribution activities), which is the situation in our Solution 1, the average number of kilometers per order increases (Figure A1b). According to [74], this increase in distance per order is about 60%. Hence, the average distance per order in our case study for Solution 1 could be estimated as 7.68 km and the total numbers of kilometers for all 145 deliveries is 1113.6 km. Average time needed for 1 delivery could be calculated as: 5 min + 7.68 km/40 km/h = 16.5 min. For realization of all 145 orders the time needed is 2395.4 min, or about 40 h. In case of 10 h of working per vehicle (2 delivery windows per

5 h), 4 vehicles are necessary. However, because distribution is not centralized and if we assume that 20 producers were undertake delivery with their own vehicle, the average daily distance per producers is 55.68 km (1113.6 km/20). It could be concluded that in that way we have 5 times more vehicles than necessary. As in the previous scenario, fixed and variable costs per vehicle per month could be calculated as follows: vehicle fuel, oil and tires expenses-€159; vehicle maintenance-€100; vehicle amortization-€100; license fees-€25; vehicle insurance-€5. Total costs per month are €389 and they are associated with the producer's self-distribution without taking into account the costs of their own work (driver's salary is €0). According to the assumptions regarding working days per month (22 days), the cost of a producers' vehicle-day is €17.68 and daily costs for all 20 producers are €353.6. Due to the fact that the total daily number of orders is 145, a cost per order could be calculated as €353.6/145 orders = €2.44 per order. Solution 3 assumes crowdsourced based delivery and according to [49], in such a case cost per delivery and associated distance, could be a decrease up to 25% in comparison to the traditional centralized distribution realized with LSP (our Solution 2). Hence, delivery cost per order for Solution 3 could be estimated as €1.1 per order.

Traveled distance, types of vehicles and fuels used have a strong impact on GHG emissions [69]. Possible GHG emissions effects have been calculated on the basis of the calculation given in Reference [69]. Here we assumed that the vehicles used for Solution 1 and 2 are vans equipped with diesel engines and for Solution 3 are cars equipped with gasoline engines. The used emission factors are shown in Table A1. The results show that the proposed Solution 3 has a significant potential for GHG emissions reduction in comparison with Solution 1 and 2.

Table A1. GHG emission results [1].

Solution	Vehicle	Emission Factor, CO_2/g/km	Distance Driven (km) per 145 Orders	GHG Emissions, kg CO_2
1	Van, diesel	297	1113.6	330.7
2	Van, diesel	297	696	206.7
3	Car, gasoline	159	522	83

[1] Based on [69].

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