Perspectives on Requirements of Informational Sustainable Short Food Supply Chain Platform

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Abstract

Sustainable short food supply chains are emerging to provide more control over economic, social, and environmental factors by reducing the number of actors within food supply chains. Both producers and consumers influence this shift in food systems, as both stakeholders have perceived improvements related to sustainability. Producers see improvements in economic return, improved job satisfaction, and improved use of resources. The consumer shift is a result of reduced social and geographical distances between the point of production and consumption. Informational food supply chain platforms are used to improve transparency, stimulate information flow, improve traceability, to provide better control, and to enhance visibility throughout the chain. This paper explores requirements determination for informational sustainable short food supply chain platforms. A literature review is used to determine requirements of current platforms. A expert panel is used to confirm and further elicit requirements. The results show forty requirements for informational short food supply chain platforms. Sustainability indicators, track & trace, supplier information, electronic data interchange and transparency are found to be very relevant. Limitations are highlighted and areas of future work are suggested.

Keywords
Informational Platforms, Supply Chain Management, Sustainability, Short Food Supply Chains.

1. Introduction

Food supply chains take a product from its raw form through a series of processes to provide value added products for consumers. The participants in food supply chains usually consist of producers, processors, traders, wholesalers, distributors, retailers, and catering companies. Conventional food supply chains often face several challenges that include seasonality of supply, fluctuations of demand, health, food safety, quality, and traceability within a supply chain. The conventional food supply chains are often referred to as long food supply chains and they are typified by multiple food miles and nodes. In the global context, conventional food supply chains are often complex networks of actors, products and information that leads to difficulties in diffusing current challenges (Dani 2015), and generally faced with problems in achieving desirable sustainability levels. Long food supply chains incur sustainability challenges in all its dimensions, including a) environmental factors such as CO_2 emissions and exploitation of resources, b) social factors such as poverty and job satisfaction, and c) economic factors such as economic cost of food waste and volatile processes.

A need for food supply chains to become sustainable, reduce distance between supply chain actors while having good control over social, economic, and environmental factors (Forssell and Lankoski, 2015; Brandenburg et al., 2014), amongst others, led to the emergence of sustainable short food supply chains. Benefits of short food supply chains include reduced food miles, closer relationships amongst actors, better financial returns, job creation, stimulation of alternative forms of agricultural production, and provide diversity amongst local food production (Giampietri, et al. 2016). Trends show that consumers are increasingly less attracted to intensive agricultural supply chains and are looking for alternative food systems. This relates to the ability to create significant economic, social, and environmental benefits.

A main challenge within short food supply chains relates to information flow. A lack of appropriate information flow in the chain may lead to a lack of awareness on aspects such the origin of foodstuffs and the value of local products (Kalfagianni and Skordili 2019). Hazen, et al. (2018) suggest this can be overcome through reliable, real-time information within the supply chain. The importance of information flow within sustainable short food supply chain is crucial. Information flow creates transparency, a critical element of short food supply chains. Zhang, et al. (2017) suggest a main driver for informational short food supply chain is sharing information asymmetrically. Information sharing can improve business processes both internally, and throughout the chain. Members of short food supply chains play a critical role in information flow, as equal benefits must be seen to stimulate participation. Information platforms can be used to understand and offset information flow challenges and help improve visibility and transparency within food supply chains (Accorsi, et al. 2018).

Digitalization with informational platforms improves management of business processes for short food supply chains to overcome current challenges. Connectivity through informational platforms can be achieved through trust, collaboration, and sharing information. Current applications of informational food supply chains platforms are related to business transactions, tracking and tracing, sustainability, and improving collaboration. Clarity about the requirements of informational platforms for short food supply chains is crucial.

The aim of this paper is to report on a study that seeks to determine and understand requirements for informational sustainable short food supply chains. The study data is collected through literature review and a panel of experts. The remainder of the paper is structured as follows. Section 2 contains a description of sustainable short food supply chains and related work. This is followed in Section 3 by the research methodology used in the study. Section 4 presents results and the discussion of findings. Section 5 concludes and highlights areas for future work.

2. Sustainable Short Food Supply Chains and Related Work

According to the European Commission (2013), a short food supply chain is a supply chain that reduces the distance between buyers and producers and can confirm traceability to a producer. In terms of supply chain management, Dong et al. (2014) define sustainable food supply chains as those that have good control over economic, social, and environmental aspects. Ilbery and Maybe (2005) state that distance should also include social aspects in short food supply chains.

Sustainable short food supply chains are attracting attention due the perceived benefits on sustainability compared to conventional, long, food systems (Malak-Rawlikowska et al. 2019). Short food supply chains have three categories (Renting et al. 2003): a) face-to-face, the direct interaction between the buyer and the seller, b) proximate, which allows consumers to buy locally through farm shop groups, specialized catering, and consumer cooperatives, and c) extended, which confirms locality through certification and production labels. Sellitto et al. (2018) discuss environmentally friendly operations, the ability to improve cooperation, and locality as key factors in successful short food supply chains.

Sustainable short food supply chains cover the three pillars of sustainability. Consumers can perceive the benefit of environmental sustainability through reduced food miles (Kallas et al., 2019; Kawecka and Gębarowski, 2015; Giampietri et al,. 2016). Charatsari et al. (2018) illustrate social aspects including improved health, improved sense of community, and improved working environments on farms. There are also improved economic aspects including improved business operations within short food supply chains. Jarzebowski et al. (2020) show how short food supply chains influence economic, social, and environmental factors. Economic benefits include less economic uncertainty, improved profitability on small/medium producers, investments in community, job creation, food safety, food quality, and synergy with other sectors. Social benefits are direct relationships, trust, transparency, collaboration, rural development, sense of community, and education. Environmental benefits included better use of resources, less food waste, organic production, reduced emissions, and the reduction of food miles. In order to create value throughout the entire short food supply chain. Faulhaber (2002) discusses the importance of network effect. In the network effect, participants jointly define the elements of the platform. This aspect is important to create sustainable short food supply chains as it is important to consider the perspective of all members involved within different types of networks (Eriksen and Sundbo 2016).

Hazen et al. (2018) highlight the importance of information flow within the supply chain. This relates to the need to create reliable, complete, and consistent information. Current literature shows the application of informational

platforms, highlighting the ability to share real-time data to improve business processes and become more responsive within the supply chain (Bruque-Cámara et al. 2016). Informational platforms are used in food supply chains to enable and create consistent real-time information between functions and applications, and members of a supply chain (Rai et al. 2006). Although research is fairly limited in relation to informational sustainable short food supply chains, the literature does show a range of application for informational platforms in food supply chains. Table 1 provides an overview of examples of current informational food supply chain platforms.

Table 1: An Overview of Examples of Informational Food Supply Chain Platforms and Main Functions

Platform	Key Functions				Source
	Traceability	Operations and Supply Chains Oriented Data Exchange	Visualization and Virtualization	Governance and Auditing	
Horticube		X	X		(Verhoosel et al. 2016)
CyberGIS			X		(Lin et al. 2015)
Tracefood	X			X	(Storøy et al. 2013)
FLspace		X	X		(Verdouw et al. 2016)
E-HUB		X	X		(LU et al. 2013)
Agriplace					(Broersen 2019)
SPACE		X	X		(Hisatomi et al. 2008)
ASPIR				X	(Niya et al. 2019)

The platforms shown in Table 1 are used to enable and support information flow within the supply chain to meet the needs of different types of users within supply chains. Gellweiler (2017) discuss that in relation to building a platform it is critical to align the requirements to the strategic position of the supply chain. Therefore, it is important to consider which requirements are most fitting for each type of supply chain.

Requirements determination is the gathering of information from users of a platform or system (Chemuturi 2013). Gohmann et al. (2013) highlight techniques for requirements determination. These include reviewing publications on current platform, interview techniques, questionnaires, and focus groups. Several of the main requirements for informational food supply chains can be found in the literature. Based on current literature on informational food supply chain, and analysis the requirements of short food supply chains and their correlation to each pillar sustainable food supply chains is show in Table 2.

Table 2: Requirements for Informational Sustainable Short Food Supply Chains

Social Factors of Short Food Supply Chains	
Factors	**Supporting Requirements**
Local feeling and direct relationship; Traceability to a producer; Close interaction in the supply chain; Supply chain transparency; Increased communication; Satisfaction from buying locally; The importance of governance; Education.	Supplier Information; Track & Trace; Real-Time Data Distribution; EDI (Electronic Data Interchange); Constant Real Time Data Flow; Calling, Real-Time Document Collaboration, Decentralized; Chat Tool; Transparency; Notifications; Alert to Supply Chain Changes; Data Integrity; Key-Cryptography; Data Monitoring; Data Backup; Learning and Development; Sensor Embed Systems; Virtualization

Economic Factors of Short Food Supply Chains	
Factors	**Supporting Requirements**
Confirmation of local products to provide better returns for producers; The need for food safety and food quality; Better planning and control; Convenience for consumers; Investments in community.	Track & Trace; Transparency; Sensor Embedded Compatibility; Virtualization, Notifications; Real-Time Data on External Factors; Real-Time Price Data, Real-Time Demand Data; Real-Time Logistics Data; Real-Time Replenishment Data; Real-Time Transaction Data; Real-Time Quality Data; Real-Time Inventory Data; Role Based Access; KPI Dashboard, Decentralized; Alert to Supply Chain Changes; Supplier Information; Big data.
Environmental Factors of Short Food Supply Chains	
Factors	**Supporting Requirements**
Better use of resource; Reduced emissions, Reduced geographical space and food miles; Reduced food waste; Sustainable production methods (organic)	Real-Time Data on External Factors; Track & Trace, Supplier Information; Real-Time Logistics Data, Real-Time Inventory Data.

Sources: Requirements (Sonnenschein et al. 2016), (Verhoosel et al. 2016), (LU et al. 2013), (Singh and Singh 2019), (Broersen 2019), (Niya et al. 2019) (Hisatomi et al. 2008), (Storøy et al. 2013), (Lin et al. 2015), (Verdouw et al. 2016): **Sources Sustainable SFSC Factors:** (Kallas, et al. 2019)**,** (Kawecka and Gębarowski 2015)**,** (Giampietri, et al. 2016)**,** (Jarzebowski, et al. 2020)**.**

Table 2 presents requirements that correlate with sustainable short food supply chains. Five additional requirements identified from literature are data collection and analysis, data handling capability, platform accessibility, applications embedded, and device compatibility

3. Methodology

The primary objective of this paper is to elicit and confirm a set of requirements for informational sustainable short food supply chains based on existing literature and a panel of expert. For this study a three-phase research method is adopted: a) Literature review to obtain n a list of published requirements, b) focus group of experts to understand requirements for informational sustainable short food supply chain platforms and to create a consolidated list of the requirements, and c) content analysis of the focused group discussion to give an order to the consolidated list of requirements.

The first stage is a review of literature of current informational food supply chains platforms to determine requirements. For this, a literature review is applied and the steps by Onwuegbuzie and Fries (2016) are followed. Emerald, Scopus, Science Direct, and IEEE databases are used. The selected key words include requirements determination, elicitation, information technology (and platforms), supply chain (short, food, network), and informational supply chains. In the second stage of the study, a focus group of a panel of experts is constituted. The panel is composed of seven experienced stakeholders within supply chain management, short food supply chains and sustainability fields involved with the food industry and sustainability. Experts had multiple specializations and roles. Table 3 summarizes these aspects in respect to the participants**.**

Table 3 Specialization of Participants

Function	Small Organization	Medium Sized organization	Large organization
Owner/Operator Company	3		
Director	1	1	
Consultancy	1		
Research and Education			2
Logistics and Supply Chain Management	1		1
Trade and Distribution	3		
Sustainability	1		1

The approach suggested by Nyumba, et al. (2018) is adopted for the focus group. To provide order to the consolidated list of requirements a content analysis of literature and the focus group was conducted to understand relationships

between requirements and sustainable short food supply chains. The analysis followed the steps suggest by (Hsieh & Shannon, 2005). For the content analysis of literature findings, key factors that relate to sustainable SFSC presented in Table 2 were analyzed in respect to the final list of consolidated requirements. For the focus group, statements related to requirements for informational short food supply chains are used.

4. Results and Discussion

Thirty-six requirements of sustainable short food supply chains were found in the literature. Within the literature, the top requirements included track and trace, supplier information, transparency, and real-time data exchange. These requirements provide the ability to create closer relationships, stimulate and confirm locality of food, improving business processes, contribute to food safety and quality, and to improve communication within short food supply chains.

Experts in the focus group had an 86% agreement that the list of requirements identified in the literature was sufficiently complete, however statements in relation to 'missing requirements' were made. Missing requirements are the requirements that were not readily picked up in the literature review. 'Sustainability indicators', being a key requirement not picked-up in literature review. This related to 'environmental' and 'social' sustainability. Further requirements found missing included 'supply chain resilience' and 'platform security'. Table 4 shows the results for 'missing requirements' in respect to the requirements identified in literature.

Table 4: Perspectives of the focus group on the requirements found missing from the literature review

Areas of Interest	Statement
General	- As far as I can see right now, they are all in one way or the other are necessary in the in relation to the logistical aspects of our own company. - I did not see anything missing. - it is quite an extended list so a lot of things have been mentioned already - I found that there there's nothing much to be added - I think there are most of them are in important. Or at least nice to have
Social Sustainability	- I didn't see there was how to measure the social sustainability - That's where the conscious consumer is really coming in. It's almost an expectation now to be socially responsible - What might be missing is that that actual price that the producer gets. A consumer wants to know where the money is going.
Environmental Sustainability	- Everyone is now becoming very conscious, of course, about the environment. - Something that I would miss is the efficiency in terms of CO2. - I think that you said KPIs and I think sustainability is a big issue. Sustainability you can measure in terms of the CO2 ecosystem equivalent per Ton km.
Supply Chain Resilience	- It is about resilience and something can be included in a platform about the resilience of the whole supply chain.
Platform Security and Privacy	- A feature related to security is not included. - What I mean is Privacy regulations.

One requirement from literature is identified as less relevant. This requirement being the 'chat function' while one participant stated, "from my experience, adapting new technologies often works as long as you don't have to shift between current habits and new habits". The participant added "you do not want to shift to a chat function which is away from your current operation". In addition to sustainability requirements shown in Table 4, several requirements had a higher relevance then other, from the perspectives of the focus group. This is shown in Table 5. Overall, the focus group confirmed requirements identified in the literature review. The 'chat' feature is removed from the list. Based on the focus group discussions, the following requirements are added; 'environmental and social sustainability indicators', the 'true price of food indicator', 'supply chain resilience', 'platform privacy and security' and the ability to have 'modular add-ins'. The results of the literature review and focus group show 40 requirements. These requirements are analyzed in relation to the frequency of correlation of a requirement in respect to sustainable short food supply chain factors shown in Table 2.

Table 5: Statements of the Focus Group on Relevance of Requirements

Factor	Statement(s)
System integration	- It would be nice if you have one platform to supply all of these kinds of things. - I am looking at the integration of the different platforms. - What is the connection to our current systems? - For my web shop to integrate with the inventory management system and communicate these this type of data to the restaurants I work with. - A platform that allows a lot of the system to communicate with each other. - A shared marketplace/system that you can do sales and distribution with other companies in the same sector.
Supply chain transparency & traceability	- Providing a supply of related information and proof of the origin of food. - Platform can confirm that products come from local sources. - Where the platform provides a complete and transparent view of that entire food chain.
Real time data exchange	- What is important is the real data, especially about inventory. - You included the real-time price data because for me it is also very important to know what the customer paid for the last shipment/transaction. - These features would be the data collection and analysis of consumer. - We have a system which is a GPS device in the in the vans, therefore you can make better and faster deliveries.

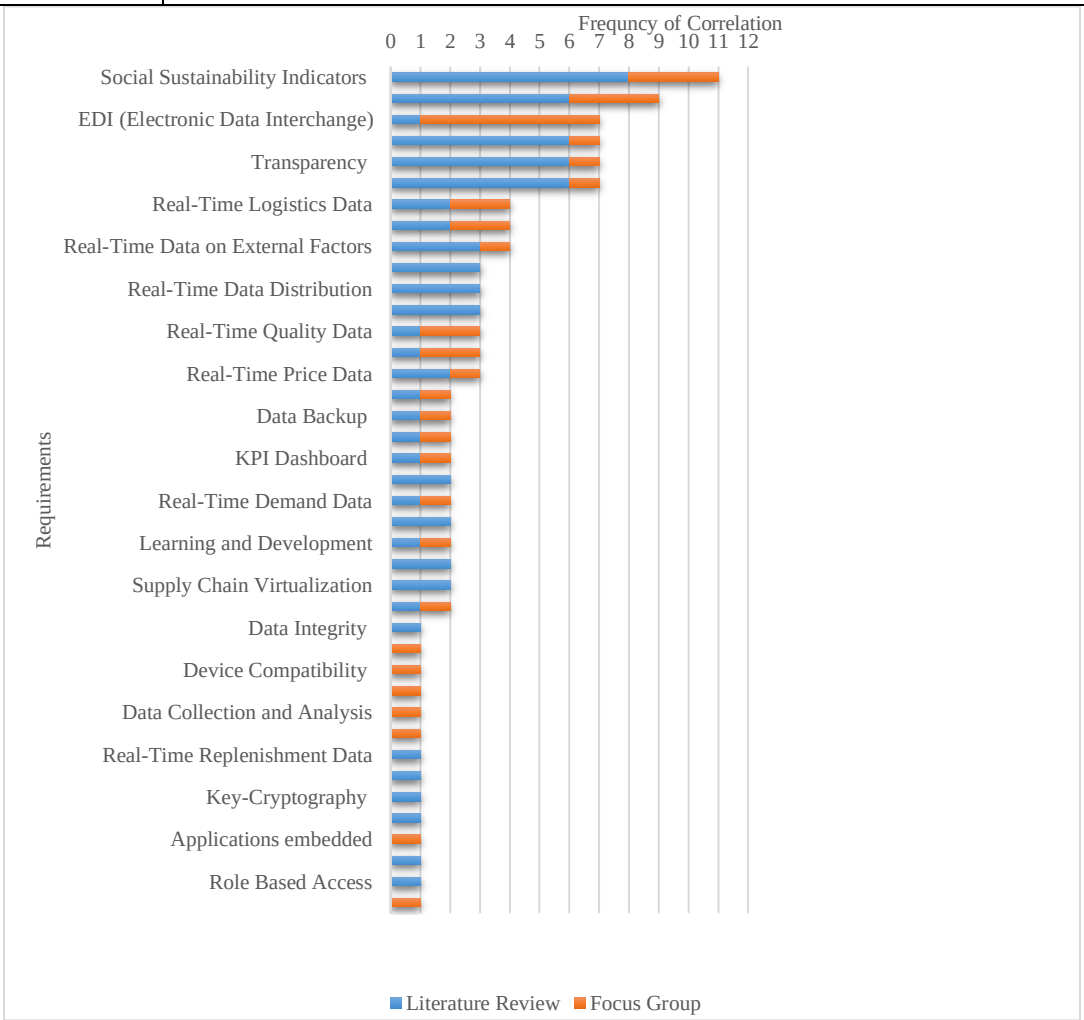

Figure 1: Consolidated List of Requirements in Respect to Informational Sustainable Short Food Supply Chains

The requirement with the highest correlation is social sustainability indicators. In the literature review, this requirement can be correlated to a local feeling and direct relationship, traceability to a producer, close interaction in the supply chain, supply chain transparency, increased communication, satisfaction from buying locally the importance of governance, and education. Figure 1 shows the final list of requirements ranked on correlation to support short food supply chains. Based on Figure 1, the consolidated list of requirements arrived at in this study is shown in Table 6

Table 6 Consolidated List of Requirements

Social Sustainability Indicators	Real-Time Price Data	Device Compatibility
Environmental Sustainability Indicators	Data Monitoring	Modular add in capability
EDI (Electronic Data Interchange)	Data Backup	Data Collection and Analysis
Track & Trace	Big-Data	Supply chain Resilience
Transparency	KPI Dashboard	Real-Time Replenishment Data
Supplier Information	Sensor Embedded Compatibility	Real-Time Transaction Data
Real-Time Logistics Data	Real-Time Demand Data	Key-Cryptography
Real-Time Inventory Data	Decentralized	Real-Time Document Collaboration
Real-Time Data on External Factors	Learning and Development	Applications embedded
Constant Real-Time Data Flow	Alert to Supply Chain Changes	Calling
Real-Time Data Distribution	Supply Chain Virtualization	Role Based Access
Notifications	True Price of Food	Data Handling Capability
Real-Time Quality Data	Data Integrity	
Platform Security and Privacy	Web Access	

The results present several of the requirements that are important for informational sustainable short food supply chains. Sustainability is a critical element of short food supply chains; therefore, environmental and social indicators are important. Short food supply chains need to have a reduced feeling of geographical and social distance. Therefore, requirements including track and trace, supplier information, transparency, and real-time data distribution are important. Within short food supply chains, a higher level of collaboration is important. Therefore, it is important to include collaboration tools. Short food supply chains can create the ability to improve planning and control, therefore it is important to also include the requirements associated with real-time operations and supply chain related data exchange.

Current literature on requirements for informational food supply chains provides a valuable list of requirements for informational sustainable short food supply chain platforms. The focus group has provided the ability to confirm, validate and determine further requirements for informational SFSCs. The results show a useful validated consolidated list of requirements for informational sustainable short food supply chain platforms.

5. Conclusion and Future Work

The study reported in this paper presents the results of a research that seek to provide a consolidated list of requirements for an informational short food supply chain platform. In the paper, thirty-six requirements were identified in the literature. The focus group confirmed thirty-five of the requirements and added five additional requirements. As a result, a consolidated list of forty requirements for informational sustainable short food supply chains is obtained. Results from the literature review and the focus group provide evidence of which requirements are most relevant for informational short food supply chains. Social and Environmental sustainability factors are shown to have the highest amount of correlation for informational sustainable short food supply chains. Electronic data interchange, transparency, real-time supplier information, and track & trace also prove highly relevant for informational short food supply chains. All requirements shown in the consolidated list have been validated through the panel of experts. The illusion of agreement leads to one limitation of the research due to subjective opinions of experts. Further research should be conducted to include a wider set of experts. In addition, it will be useful to categorise the requirements into functional and non-functional requirements. In addition, further research should be conducted on requirements prioritization for informational short food supply chain platforms.

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