Exploring Attractive Quality Requirements for Short Food Supply Chain Digital Platforms

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ABSTRACT

Perceptions towards unsustainable supply chain practices in global, mainstream food systems are motivating a shift towards short food supply chains. Short food supply chains are developed to remove the physical and social distances between producer and consumer. Advances in digital technologies offer promise for short food supply chains, including platforms that can enable real-time data flow, create visibility, and support sustainable practices. This research aims to prioritise attractive quality requirements of short food supply chain digital platforms. The methodology consists of a literature review and Kano analysis for requirements prioritisation. The results show that the requirements span across the four Kano categories, attractive quality encompassing the largest number of requirements. The attractive quality requirements identified offer increased levels of satisfaction when present and have limited negative impact when missing. Therefore, they are considered exciting for potential users of a system. The limitations of the research and areas of future work are presented.

KEYWORDS

Digital Platforms, Features, Kano, Prioritisation, Requirements, Short Food Supply Chains

1. INTRODUCTION

Food system industrialisation had become prominent in the mid-to-late 1940s where much focus was placed on efficiency and economic rationalisation (Spaargaren et al., 2013). Since the 1980s, significant change is observed towards globalised food systems, responding to an ability to create competitive advantage through product diversity, economies of scale, and resource availability (Fonte, 2010). Increasing challenges faced by global food systems are driving sustainability-oriented consumers to look towards alternatives. Arising from this trend is the re-localisation of food systems. Food system re-localisation seeks to support sustainable food supply chains by offering substitutes to globalised food systems (Blay-Palmer et al., 2018; Nsamzinshuti et al., 2018; Rocha & Lessa, 2009). Examples of food system re-localisation include short food supply chains (SFSC), city-region food systems (CRFS), local food systems, and regional food supply chains (Blay-Palmer et al., 2018; Jarzębowski et al., 2020; Kitsios et al., 2018; Renting et al., 2003). In addition to perceived sustainability benefits, Cappelli and Cini (2020) suggest that COVID19 may push the re-localisation of food further as international trade restrictions are not present. This paper is on short food supply chains.

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The short food supply chain is a supply chain with reduced actors between the producer and the end customer, resulting in improved personalised trust and enhanced relations (Kneafsey et al., 2013). SFSCs offer direct relationships between producers and consumers, resulting in attractive benefits including sustainability, loyalty, trust, improved food quality, and food safety (Del Giudice et al., 2016). In SFSCs, the control over economic, social, and environmental factors is important, thus, sustainable supply chain management (SSCM) practices are sought for (Brandenburg et al., 2014). There is a need for consumers to make a valued decision when buying food, which can be supported in shorter, more local food supply chains. Challenges facing SFSCs include demonstrating the locality of food due to issues with traceability, and the governance of products (Kalfagianni & Skordili, 2018). Aggregation of producers and products, in addition to appropriate information flow, are needed to overcome the challenges and create successful SFSCs (McLaughlin & Shermain, 2014). Supply chain information flow contributes to transparency, integrity, traceability, and performance (Minnens et al., 2019; Singh, 2014; Zhu et al., 2018). In addition, real-time, consistent, asymmetrical, and reliable information flow is increasingly pursued in food supply chains. Information flow and information sharing improves business and supply chain processes, enhances responsiveness and visibility, and improves flexibility (Fawcett et al., 2011). Addressing the challenges through information system perspectives whilst seeking to also build trust within supply chains would require the adoption of an appropriate digital platform. Digital platforms are used to improve sustainable food supply chain management, through improved resource management, reduced food waste, traceability, and virtualisation (Annosi et al., 2021; El Bilali & Allahyari, 2018; Lezoche et al., 2020; Panetto et al., 2020). Digital platforms can offer benefits for SFSC, which include automating actions to replace manual processes, improve traceability, governance, integrate provenance data, and address other informational flow challenges associated with SFSCs (Burgess et al., 2021).

To leverage the information flow and establish a network effect for SFSC digital platforms, it is important to understand the associated digital platform requirements and its prioritisation. A motivation is user satisfaction. User satisfaction of a platform is crucial, as disconnections between platform design and user expectations often lead to dissatisfaction (Gohmann et al., 2013). Identifying and prioritising the main requirements of the platform is central to achieving user satisfaction. Research in respect to requirements prioritisation and digital technologies to support sustainable supply chain management are emerging (Thöni & Tjoa, 2017; Burgess & Sunmola, 2021). Burgess and Sunmola (2021) explored some of the requirements for informational platforms of SFSCs. The literature on requirements of SFSCs is very limited particularly regarding the scope of the requirements considered and the method of prioritisation used. Burgess & Sunmola (2021) used a Fuzzy MoSCoW approach to prioritise a selected few requirements of informational platforms of SFSCs. The inability to analyse a more inclusive list of requirements for SFSC digital platforms is a limitation to existing works, due to the prioritisation models used. Furthermore, lacking in the literature of SFSCs is the analysis of quality requirements of SFSC digital platforms and their prioritisation process whilst putting user satisfaction into perspective. Understanding the attractive quality requirements of SFSC digital platforms is important as it has been demonstrated in several other fields, that attractive quality requirements bring significant potential benefits when obtained (Högström et al., 2010). There is a gap in the literature regarding the identification of attractive quality requirements for SFSC digital platforms, and this motivates the current research.

This paper aims to explore the attractive quality requirements for SFSC digital platforms. Based on the unique features of SFSCs, and limitations of existing work on requirement prioritisation, the Kano model (Kano, 1984), is adopted to add novelty in understanding requirements prioritisation in SFSC digital platforms, especially towards ascertaining the attractive quality requirements associated with the platforms. The Kano model shows promise by facilitating a larger number of participants and requirements when compared to existing work, for example (Burgess & Sunmola, 2021). Further, and importantly, the Kano model provides insight into the now, and what could be over the maturity of a platform, important to SFSCs and something that has not been reported in the literature. Thus, identifying attractive requirements, that may shift towards performance and must be can be of value to those adopting SFSC digital platforms. Essentially, a Kano model and analysis is used in the paper to analyse a set of requirements for SFSC digital platforms from user perspectives. This paper is an early adopter of the Kano approach for requirements prioritisation in SFSCs and in identifying the attractive quality requirements that influence user satisfaction for platforms in such chains.

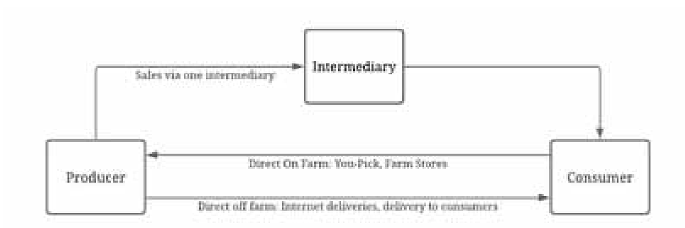
The remainder of this paper is structured as follows. Section 2 contains a literature review on short food supply chains and associated digital platforms. The research methodology is presented in Section 3. Section 4 presents an analysis and discussion of results, and it is followed in Section 5 by conclusions and areas of future work.

2. LITERATURE REVIEW

2.1. Features of Short Food Supply Chains

Food system re-localisation becomes relevant with increasing consumer demand towards enhanced quality and sustainability features, e.g. as encompassed in the notion of 'quality-turn' (Goodman & Goodman, 2009), based on the consumer need of understanding food origins and its quality features. Sergaki and Koutsou (2019) define SFSCs as supply chains with a reduced geographical distance between producers and consumers, with limited actors in the supply chain. The adopted definition for this research is "SFSCs are traceable to a producer, having as few intermediary actors as possible between farmers and consumers" (Kneafsey et al., 2013). Figure 1 shows a basic SFSC structure of the different distribution channels under SFSC offerings.

Figure 1. Short food supply chain structure: adopted from Malak-Rawlikowska et al. (2019)



Short food supply chains are not defined by the type of food product, but characteristics of products and production (Thomé et al., 2021). Geographical area indication of production is important. In addition, the authenticity of the product, the processes, and the origin of raw materials are characteristics related to SFSCs (Gellynck & Kühne, 2008). Renting et al. (2003) shows three different categories of SFSCs; (a) 'Extended' use labels to confirm production origin. (b) 'Proximate' includes cooperatives and groups to stimulate locality. (c) 'Face-to-face', which is the direct interaction between a producer and end customer. SFSCs are found in different food systems (regional, local, city region). For example, city region food systems (CRFS) can encompass short food supply chains and are defined by Jennings *et al.* (2015) as; "Networks of relationships, processes and actors in respect to food production, processing, marketing and consumptions. CRFSs are within a geographical region that includes an urban area surrounded by peri-urban, and rural surroundings."

Producers willingness to participate factors in SFSCs are stimulated by higher levels of collaboration and building a sense of community (Kitsios et al., 2018). In addition, Benedek et al. (2018) state that younger, higher educated farmers show more desire in participating in SFSCs. In contrast, older generation farmers and those lacking education may have resistance to joining SFSCs, and in turn, are less willing to participate. Prayoga and Raya (2019) argue the value of SFSC is not primarily related to the product itself, but more so about community development and stimulating local companies. Consumers invest in SFSCs due to the perception of sustainability, convenience, and closeness with food producers (Del Giudice et al., 2016). The 'quality turn' referring to improved quality and sustainability standards are driving traceability, freshness, and quality also increase consumers' willingness to pay for products in SFSCs (Degreef et al., 2019; Kawecka & Gębarowski, 2015). Within SFSCs, Bosona and Gebresenbet (2013) indicate that real-time and reliable data is required to improve trust. Marino *et al.* (2019) discuss perceived trust also as a challenge, as trust outweighs the need for guarantees in SFSCs and alternative food networks. Agri-food supply chains are encompassed by unique features that should be considered when adopting information technology. Food quality and safety are two key concerns for stakeholders (Wertheim-Heck & Spaargaren, 2016). In addition, external factors such as weather conditions can be an important variable to consider. Other key features are related to seasonality and the need for responsive chains. Information technology shows promise to improve monitoring products, reduce costs, and shorten the lead time gap in the supply chain (Allen et al., 2003; Bisogno, 2016; Loiseau et al., 2020; Paciarotti & Torregiani, 2021). A key limitation is that no matter the investment in information technology, products are produced in quantity and need to be held in storage over a considerable period (Salin, 1998). Table 1 shows a summary of the features of short food supply chains that are important when considering the adoption of information technology.

Table 1. Features of short food supply chains

Source	Focus/Theme	Feature
(Del Giudice et al., 2016)	Consumer behaviour	Sustainability; convenience; typicality; loyalty; desirable; food safety; gratifying;
(Torregiani & Paciarotti, 2018)	Farmers to small restaurants	Improved coordination and information flow; improved information over sustainability.
(Sergaki & Koutsou, 2019)	Greek cooperatives	Quality; price; locality; support producer; disintermediation; accessibility.
(Kitsios et al., 2018)	Willingness to participate	Citizen behaviour; interaction with the community (closeness); alignment; connectedness; collaboration; solidarity.
(Mesias et al., 2018)	Social media-based SFSC	Trust; product availability; brand confidence and association; quality; efficient delivery services; price.
(Aubert & Enjolras, 2018)	French Fruit SFSC	Social; environmental and economic sustainability.
(Ji et al., 2019)	Consumer Trust	Trust; multi-channel offerings
(Clark et al., 2020)	Value-added food and rural development	Commitment to the community; price premium and fair return; fair value distribution.
(Blasi et al., 2015)	SFSC factors in Italy mountain region.	Quality; locality; environmental benefits; price; convivence; trust.
(Mastronardi et al., 2019)	SFSC and sustainability in Italian food chains.	Sustainability (environment; economic; society; governance) information exchange and support.
(Szabó & Juhász, 2015)	Consumer-producer perceptions of service levels in SFSCs	Product quality (taste and appearance). Availability; price/value; reliability of vendors; variety; food safety; locality; provenance; organic;
(Reina-Usuga et al., 2020)	SFSC governance	Governance; price; trust; quality.
(Harrison et al., 2019)	SFSC and public procurement	Fair value; reduced food miles; focus on recycling. Important is to improve current systems and communication channels to create better cooperation.
(Aguiar et al., 2018)	Characteristics of SFSC	Improved control compared to long chains; direct relationships; proximity; trust; diversification; fair prices;
(Mancini & Arfini, 2018)	SFSC (Italian product Parmigiano Reggiano)	Improved relationships; trust; reputation; governance;
(Forssell & Lankoski, 2015)	Sustainability in SFSC	Product quality; distance; governance; relationships.
(Loiseau et al., 2020)	Sustainability assessment of SFSC	Environmental sustainability.

2.2. Digital Platforms in Food Supply Chains

Digital platforms are suggested to improve the feasibility of communication, improve information provision and data collection, enable community-based governance, support knowledge creation, and improve local communities through improved collaboration and cooperation (Leeuwis et al., 2018). Rohn et al. (2021) research the critical success factors through literature review and interviews of digitalisation in business models. Under the key activity, dimensions are new relationships and direct interaction. In key resources are aspects including networks, improved information exchange, focus on strategic thinking, and training for improved employee skills. Examples of value propositions include speed, efficiency, improved customer focus, and better price transparency. An important finding was the need for flexibility and adaptability in the supply chain to capture value from digital transformation. Presented by Zutshi and Grilo (2019) is a 6-layer digital platform architecture. Layers include a business layer, user interaction layer, development layer, integration layer, data layer, and an IT layer. Potential benefits are shown about inbound and outbound logistics, procurement, production, marketing and sales, and services. Badran (2021) present three definitions of digital platforms. i) The functional definition is related to the components of the product that can be extended to a third party. ii) The economic definition is related to a supply chain industry platform. And iii) The digital nature definition discusses the importance of the infrastructure required to meet business requirements. In food supply chains, digital platforms are reported to enable consistent and real-time data flow of applications throughout supply chain members (Rai et al., 2006).

Research on digital food supply chains has been reported in the literature, showing trends towards digital transformation in the agri-food industry (Hu & Li, 2022). Nakandala et al. (2017) conduct an extensive literature review on information integration in fresh food supply chains, suggesting that companies adopt technology to improve the flow of information in fresh food supply chains. The research also shows that information flow is a critical need throughout supply chain network members, however, diverse information between supply chain members is needed. Digital platforms in food supply chains leverage advances in digital technologies such as blockchain technology (David et al., 2022). Kamilaris et al. (2019) demonstrate the current applications of blockchain technology in food supply chains. The research shows that blockchain technologies are being adopted in the industry and have both benefits and challenges. A benefit is traceability, while a challenge is the difficulty of adapting the technology for small and medium enterprises. Governance and policies play a critical role in blockchain applications. The technology provides a promising outlook, however, a lack of understanding of blockchain will act as a challenge in implementation. Further research shows blockchain technology combined with the internet of things, showing operational improvements in the food supply chain, for example, provenance and traceability. In respect to SFSCs, Todorovic et al. (2018) discuss digitalisation to improve the sustainability of product distribution in SFSCs. Face-to-face distribution systems show reduced efficiency, little focus on sustainability indicators, and higher last-mile distribution costs. However, the model allows for flexibility and the most value addition. In a digitalised outsourced logistic SFSC model, efficiency, quality, costs, and the principle of competitive advantage were benefits. The potential benefits of an outsourced logistics model are dependent on the logistics service provider. The model also shows the least amount of shared value within SFSCs. The digitalised crowdsourced base SFSC provided the most social and environmental benefits. The main disadvantage in the model was the governance and quality control of products. Benefits and challenges are offered differently per SFSC structure. Important is that a one-fits-all approach is not appropriate for SFSCs as different situations need different solutions. Table 2 shows a summary of digital food platforms requirements for food supply chains.

There are several alternative requirements prioritisation methods established in the literature. Hatton (2008) describes different prioritisation methods. The simple ranking method, the 100-dollar method, the analytic hierarchy method (AHP), and the MoSCoW method with an extended version proposed by Ahmad *et al.* (2017) apply fuzzy logic to improve the traditional approach. Burgess and Sunmola (2021) adopted a fuzzyMoSCoW approach to requirement prioritisation for informational

Table 2. Digital platform requirements for food supply chains

Source	Research Focus	Requirements
(Michelino et al., 2021)	Factors and challenges/ Blockchain based platform.	Authentication; automation; disintermediation; decentralisation; efficiency; immutability; partner support; reliability; risk reduction; security; traceability; costs; transparency; trust; privacy; performance; standardisation; governance; energy consumption.
(Ostapchuk et al., 2020)	Impact of digitalisation in food and agriculture.	Data collection; big data; AI capabilities; Data analysis; Knowledge and information sharing.
(Hamid et al., 2020)	Effectiveness of digital platforms.	Easy to use; security; sustainability.
(Leyman et al., 2020)	Digital environments for geographical indication branding.	Direct communication; high information content, interactive communication.
(Prause et al., 2020)	Digitalisation across agri-food supply chains.	Financial information exchange; external factors; big data analysis capability; IoT and system integration; collaboration; real-time quality information; risks reduction; transparency; automation; traceability; forecasts; accessibility; data collection-storage-recall; supplier information; sustainability information; supply forecasting and planning
(Samoggia et al., 2021)	Digital platforms for procurement in food supply chains.	Selling and buying capabilities; communication; health-related information; food delivery related information; product information; mapping capabilities; management capabilities; supplier information; season food information; sustainability information; price information; waste information.
(Leeuwis et al., 2018)	Digital Platforms for Supply Chain and Operations in Food case studies.	Environmental monitoring and data collection; data processing; information exchange.
(Bhaskara & Bawa, 2021)	Platform in agricultural supply chains.	Learning and development; governmental policy information; improve efficiency; incorporate best practices; sustainability supporting aspects.
(Burgess & Sunmola, 2020)	Short food supply chain information platform	Key-cryptography; Big data; data monitoring; data backup; collection and analysis of consumer-related data; data integrity; real-time data on external factors supplier and product origin information; EDI (electronic data interchange); constant real-time data flow; data collection, handling recall and analysis capability real-time data distribution for supply chain stakeholders; true-price of food; real-time demand forecast data; real-time logistics data; real-time replenishment data; real-time transaction data; environmental sustainability indicators; social sustainability indicators; learning and development through best practice information; real-time quality data; traceability; real-time inventory data; transparency; real-time price data; supply chain virtualisation; decentralised; notifications; web-based; applications embedded; role-based access; modular add-in capability; calling; real-time document collaboration; KPI (key performance indicator) dashboard; device compatibility; sensor embedded compatibility; privacy and security; alert to supply chain changes
(Burgess & Sunmola, 2021)	Prioritising requirements of short food supply chains through a qualitative fuzzy approach.	Functional Requirements identified: Data backup; data handling capability; platform security; constant real-time data flow; electronic data interchange; transparency. Non-functional requirements identified: Real-time operations and supply chain related data exchange; real-time supplier-related data exchange; trace and trace; notifications; learning and development; KPI dashboard; Alerts to supply chain changes: supply chain resilience; real-time documents collaboration.

SFSC platforms. The qualitative research gathered a fuzzy assessment of three experts to prioritise ten functional requirements (FRs). Top requirements included track and trace, real-time data exchange on operation, supply chain, and supplier-related data. Middle ranked requirements include learning and development, dashboards for key performance indicators, real-time sustainability indicators, real-time data exchange, and real-time document collaboration. Lower ranked requirements were alerts, notifications, and supply chain resilience. FuzzyMoSCoW shows several limitations which included the inability to distinguish between ties and close ranking values, the inability to assess many requirements, the difficulty in creating consensus, and the difficulty to categorise requirements. A Kano model and analysis approach is adopted in this paper.

The Kano model was introduced by Noriaki Kano, see (Kano, 1984), based on attractive quality theory. The Kano model is used to prioritise requirements or features for potential system users or customers. Categories are attractive, performance (one-dimensional), must-be, and indifferent (Kano, 1984). Figure 2 shows the Kano model, used to map performance and customer satisfaction. The Kano model is based on the quality attributes of a product, service, or system.

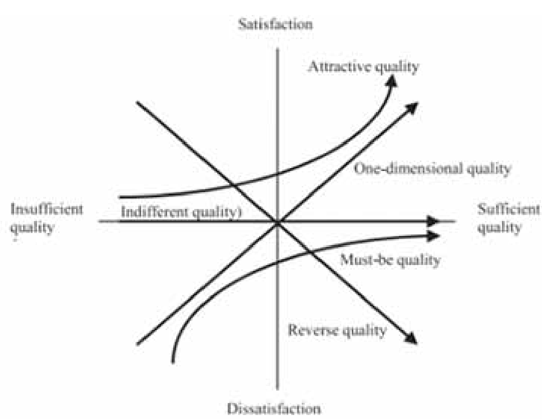
The Kano model offers to improve on the limitations of existing work on prioritisation models with the ability to assess a larger list of requirements or features and include a larger sample size. Related work that adopted the Kano model includes; Sunmola and Shehu (2020) applied the Kano approach to understanding performance requirements in electronic tendering systems. Asian *et al.* (2019) adopt a Kano model to prioritise requirements for a third-party logistics service provider. Arabzad et al. (2012) applied the Kano model to identify important requirements related to distribution companies within the supply chain. Sonnenschein et al., (2016) researched customer perceptions of safeguards for Digital Platforms. Sohn and Kim (2017) applied the Kano model to understand the perceptual gaps between buyers, suppliers and third-party logistics providers. Zokaei and Hines (2007) researched how the Kano quality function deployment technique can be used to improve supply chain effectiveness.

The approach shows a unique ability to prioritise the requirements for supply chain management and emerging digital technologies. However, Kano model has not yet been applied for digital platforms of SFSCs and can offer novelty to the current literature in the research area, and understanding of prioritisations for stakeholders in practice. In addition, Kano model will address weaknesses in existing work on requirements of SFSC digital platforms through its ability to address attractive quality and alleviate limitations of small sample sizes and the requirements included.

3. RESEARCH METHODOLOGY

Chemuturi (2012) suggests that prioritisation research methods can be adopted in the form of literature reviews, interview techniques, and quantitative research through questionnaires to support requirement analysis and prioritisation. A drawback with most of these techniques is the bias factor. In research, bias relates to the systematic error experienced in sampling or testing that results from selecting or encouraging one outcome or answer over others (Pannucci & Wilkins, 2010). An approach that eases the

Figure 2. Kano model adopted from (Kano, 1984)



limitation associated with the bias factor and misinterpretation is the Kano model (Kano, 1984). Its techniques such as the Kano customer satisfaction coefficient facilitate good quantitative assessments (Madzík et al., 2019). An incentive to use the Kano model in this study is that the Kano model facilitates concrete insights into the dynamics of user preferences which can be analysed to derive an appropriate prioritisation model.

This research adopts a quantitative approach to data collection and analysis through questionnaire survey and Kano analysis. Relating to the main steps of the research methodology of this research, Madzík *et al.* (2019), Rotar and Kozar (2017), and Sauerwein *et al.* (1996) describe the Kano model steps for requirements prioritisation. These steps are (i) the identification of requirements through literature review, (ii) the questionnaire design, (iii) administering the questionnaires, and (iv) interpreting the results. The four steps are adopted in this research and the overall approach is illustrated in Figure 3. The methods used in the data collection stages, the data analysis methods, and support for analysis are presented in the sections that follow.

3.1. Data Collection and Participants

Data was collected from both primary and secondary sources. For secondary data, a literature review was conducted to identify the features of SFSCs and, appraise a consolidated list of requirements reported by (Burgess & Sunmola, 2020) for digital platforms in food supply chains for verification and further development. A set of two search strings were adopted in the literature review. The first search was TITLE-ABS-KEY ("Short Food Supply Chain" AND (features OR requirements)). The second search string was TITLE-ABS-KEY ("digital-platform" AND (food OR agriculture) AND (features OR requirements)). Three databases were used, namely Scopus, Science Direct and Emerald Insight. The search was conducted in August 2021. 87 papers were obtained from the databases using the search string resulting in the data presented in Tables 1 and 2. In addition, snowballing was used to support theory building up to the features and requirements within Table 1 and Table 2. Exclusion conditions were imposed, papers must be written in English Language and peer-reviewed. Through reading the abstracts and the content of the papers, 39 requirements for digital platforms were subsequently selected for further analysis based on relevance to the requirements of the SFSC.

Primary data was collected from human participants through a questionnaire survey. Participants were recruited from established SFSC networks of the researchers. The participants were recruited from networks primarily in the Netherlands. The research subjects who took part in this research included 47 experts in respect to supply chain management or a related and equivalent role who are involved in SFSCs. The questionnaire was in the classical Kano model format, adapted for this study (Kano, 1984; Rotar & Kozar, 2017; Sauerwein et al., 1996). To assess performance and satisfaction, the questionnaire adopted, asks both functional and dysfunctional questions, to verify perceptions over key features, requirements, or attributes. Typical steps, include i) identification of user requirements (wants and needs), 2) designing the questionnaire, iii) administering the questionnaire, and iv) interpretation of results through measuring the extent of satisfaction and dissatisfaction (Budiarani et al., 2021). Microsoft Forms was used for questionnaire distribution and data collection. The expected response time to complete the questionnaire was 20 minutes.

Figure 3. Overall Research Approach

3.2. Data Analysis

Several methods have been proposed in the literature for analysing data from Kano model questionnaires. Table 3 shows some of the approaches to applying Kano methodology.

The approach adopted in this research is the customer satisfaction coefficient approach. User satisfaction for systems, components or processes has been described as the degree that the system meets the users' needs, desires, and expectations. To measure this aspect of quality and performance, the customer satisfaction coefficient method is often applied. The method applies standardised functional (positive) and dysfunctional (negative) questions that provide a clear requirement ranking overview (Violante & Vezzetti, 2017). In addition, the method provides a good understanding of user satisfaction if a requirement is met or not. Therefore, it provides insight into how quality requirements are perceived at present and how those requirements may shift over time (Gupta & Srivastava, 2011). When analysing the approach, customer satisfaction is measured from 0 to 1, the closer to 1 representing the greater the influence of including a feature or requirement. With the negative customer satisfaction coefficient, the scale is 0 to -1. The nearer to -1, the greater the dissatisfaction when the requirement is missing. Important to also mention is that requirements ranked in the Kano model change over time. Initial deployment of a system results in higher amounts of unexpected, attractive quality requirements. Over time, these become expected and shift between categories (Min et al., 2018). Mikulić and Prebežac (2011) discuss attribute-performance as a critical factor when assessing a system. The literature suggests that a Kano model analysis should evaluate the presence/absence of an attribute fulfilment/non-fulfilment, supporting the customer satisfaction coefficient approach.

The Kano analysis is applied to prioritise the identified list of requirements for SFSCs. The data structure associated with the questionnaire design in this study is not dissimilar to existing Kano studies applying the customer satisfaction coefficient approach (see, for example, Budiarani et al., 2021; Kohli & Singh, 2020; Salahuddin & Lee, 2020). This analytical approach is adopted in this research as it has been identified as a strong way to identify attractive quality requirements, now, and how those may develop over time. Kano model is developed by pairing functional and dysfunctional questions. First, a functional question is asked, for example reflecting on when an attribute, requirement or feature is present. Second, a dysfunctional question is asked, this reflecting on the absence of an attribute, requirement, or feature, both questions use a 5-point Likert scale as 1: I like it that way, 2: It must be that way: 3: I am neutral, 4: I can live with it that way, 5: I dislike it that way. Individual responses are then assessed and consolidated based on total response. For the analysis, a customer satisfaction coefficient (CS), and customer dissatisfaction coefficient (CD) are calculated using Equations 1 and 2 respectively, and the results are used to prioritise and plot the requirements on a user satisfaction

Table 3. Analysis methods in the Kano Model

Source	Approach	Description
(Garmaisa & Sisilia, 2014; Morita et al., 2017; Sauerwein et al., 1996) (Budiarani et al., 2021)	Customer satisfaction coefficient approach	An approach to the Kano model that assesses the extent of how users/ customer satisfaction is influenced in respect to meeting/not meeting needs. The more positive the number is, the higher the user satisfaction,
(Berger et al., 1993)	Graphical continuous approach	A method that assigns X and Y values to plot a scatter graph based on the average responses for requirements per category. The values are based on functional ('like' 4, 'must-be' 2, 'neutral' 0, 'live with' -1 and 'dislike' -2), and dysfunctional ('like' -2, 'must-be' -1, 'neutral' 0, 'live with' 2 and 'dislike' 4).
(Qiting et al., 2011)	Kano table response frequency	A simple application that assesses the frequency of responses concerning functional and dysfunctional responses. The Kano response table often supports further analysis.

graph as must-be, performance (one dimensional), attractive, and indifferent (Budiarani et al., 2021; Madzík et al., 2019; Sauerwein et al., 1996).

$$Customer\,Satifcation\,Coeffiecnt\left(CS\right)=\frac{\left(A+O\right)}{\left(A+O+M+I\right)} \quad (1)$$

$$Customer\,Dissatisfaction\,Coeffiecnt\left(CD\right)=\frac{\left(O+M\right)}{\left(A+O+M+I\right)*\left(-1\right)} \quad (2)$$

An example of the analysis for the high-level requirements R18 'Environmental sustainability indicators' is as follows. The responses for all the participants regarding the variable are correlated as shown in Figure 4. None of the respondents answered in correlation, 'Like' (The platform DOES NOT include environmental sustainability indicators) and 'Like' (The platform includes environmental sustainability indicators) hence the 0 entry for Q (i.e. is Questionable) as shown in Figure 4.

Figure 4. Example of Kano Analysis Application

R18: Environmental Sustainability Indicators		the platform DOES NOT include environmental sustainability indicators				
The platform includes environmental sustainability indicators		Like	Must-be	Neutral	Live with	Dislike
	Like	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

Requirements Consolidated Response	Q	A	I	O	M	R
R18: Environmental Sustainability Indicators	0	15	18	10	3	1

Based on the data in Figure 4 the customer satisfaction coefficient (CS), and customer dissatisfaction coefficient (CD) for R18 Environmental Sustainability Indictors are calculated in Equation 3 and Equation 4. The final values for this requirement are CS= 0.5435 and CD= -0.2826 are then plotted as attractive quality requirements in the Kano Model.

$$\left(CS\right)R18\ \text{"Environmental Sustainability Indicators"}=\frac{\left(15+10\right)}{\left(15+10+3+18\right)}$$

$$CS=0.5435 \quad (3)$$

$$\left(CD\right)\text{R18 "Eniromental Sustinability Indicators"} = \frac{\left(10+3\right)}{\left(15+10+3+18\right)*\left(-1\right)}$$

$$CD = \text{-}0.2826 \tag{4}$$

3.3. Ethics

Ethics has been approved by the University of Hertfordshire Health Science Engineering & Technology Ethics Committee with Delegated Authority under approval number ECS/PGT/UH/04111. Participation was voluntary and no invasive measures were used. All data was collected anonymously.

4. RESULTS AND DISCUSSION

4.1. Survey Participants and Descriptive Statistics

Figures 5-8 show the demographic profile of participants and companies within the study. Figure 5 shows the size of companies represented. The participants are well distributed across micro, small, medium and large, with the micro-business accounting for the smallest percentage. Representations from large participants are the largest in the sample but not overwhelming so, hence we expect a rich and balance of views across the samples. Figure 6 shows an overview of participants by years of experience. The experience the participants brought into the study averaged approximately 6 years, with 21% with less than 3 years of experience, 47% between 3 and 5 years of experience, 15% between 6 and 10 years of experience, 6% between 11-15 years of experience, and 11% representing over 15 years of experience. Figure 7 shows the participants roles concerning the supply chain area. Participants included producers, processors, transport and logistics providers, wholesalers, consultants, retailers, brokers. Example of others was education and research. Producers represented the highest percentage of the participants, followed by processors, and then logistics and transport. In respect to products/services represented, agri-fresh products including vegetables, fruits, and dairy are prominent, see Figure 8. Important to mention in respect to participant profiles is that, in this research, requirements are being prioritised for a non-specific sustainable SFSC platform, therefore, participants responses involving a diverse set of experiences will come to play which can help the overall considerations for the prioritised requirements.

Figure 5. Company size

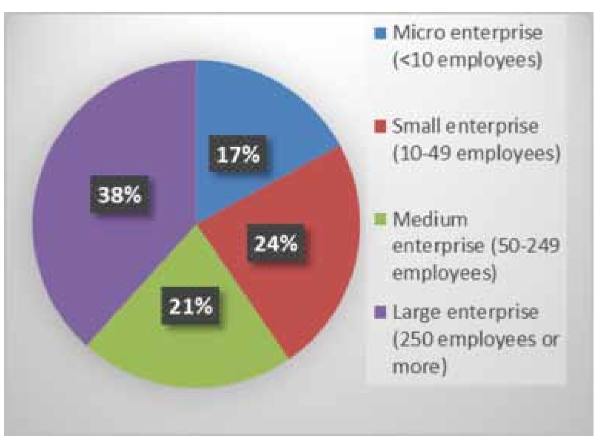


Figure 6. Years of experience

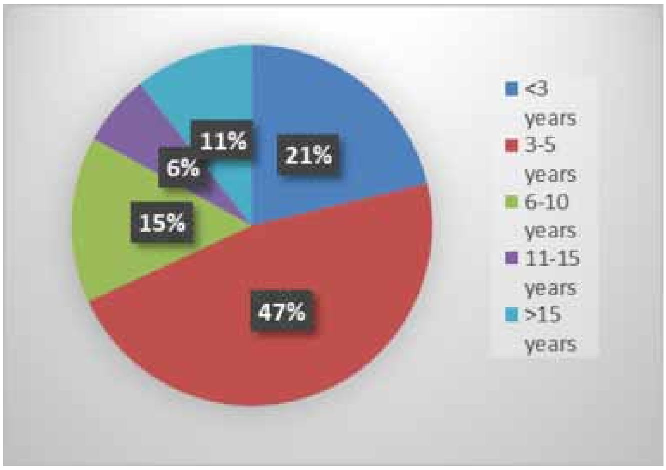


Figure 7. Participant type

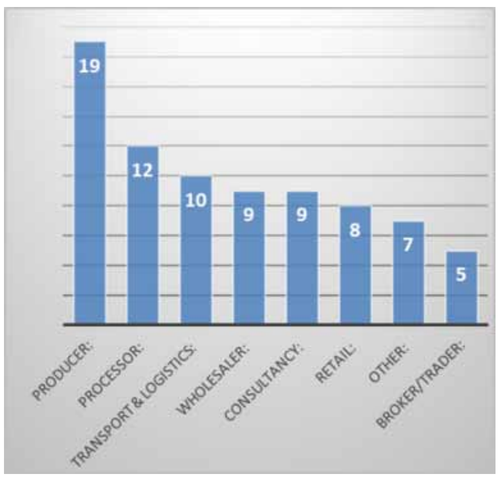
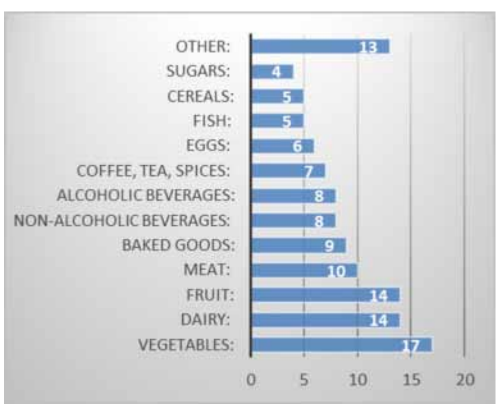


Figure 8. Product type



4.2. Kano Analysis and Categorisations

The literature review identified features of SFSCs, and requirements for digital platforms in the food supply chain. Through an analysis of related work, 39 requirements for SFSC digital platforms are selected for prioritisation in this research, which is further verification of the list by (Burgess & Sunmola, 2020), with minor amendments. The final list of requirements for Kano prioritisation is shown in Table 4.

Table 4. Consolidated list of requirements

R1	Key-Cryptography	R20	Learning and Development Through Best Practice Information
R2	Big-Data	R21	Real-Time Quality Data
R3	Data Monitoring	R22	Traceability
R4	Data Backup	R23	Real-Time Inventory Data
R5	Collection and Analysis of Consumer Related Data	R24	Transparency
R6	Data Integrity	R25	Real-Time Price Data
R7	Real-Time Data on External Factors	R26	Supply Chain Virtualization
R8	Supplier Information	R27	Decentralized
R9	EDI (Electronic Data Interchange)	R28	Notifications
R10	Constant Real-Time Data Flow	R29	Web based
R11	Data Collection, handling recall and Analysis Capability	R30	Applications embedded
R12	Real-Time Data Distribution For Supply Chain Stakeholders	R31	Role Based Access
R13	True Price of Food (Real-time Market and Price Data Exchange)	R32	Modular add in capability
R14	Real time demand forecast data	R33	Calling
R15	Real-Time Logistics Data	R34	Real-Time Document Collaboration
R16	Real-Time Replenishment Data	R35	KPI Dashboard
R17	Real-Time Transaction Data	R36	Device Compatibility
R18	Environmental Sustainability Indicators	R37	Sensor Embedded Compatibility
R19	Social Sustainability Indicators	R38	Privacy and security
		R39	Alert to Supply Chain Changes

Adapted from (Burgess & Sunmola, 2020)

The assessment results of the 39 requirements are listed in Table 5. The customer satisfaction and dissatisfaction results are used to analyse the Kano categories shown in Table 5. Satisfaction (functional) on the vertical axis, while dysfunctional (dissatisfaction) on the horizontal axis. Figure 9 shows the final Kano prioritisation satisfaction map for requirements in respect to SFSC digital platforms. The results show the categorisation of requirements for a SFSC digital platform. Table 6 shows all requirements and the respected Kano categories.

Participants responses have identified requirements across the four Kano model categories. Must-be quality requirements are R2, R12, R23, R13, R9, R6, R4, R15, R3, R36, and R38. Must-be requirements score low on the customer dissatisfaction coefficient values (-0.5106 to -0.8298), leading to higher levels of dissatisfaction when the user is unsatisfied with the requirement or it is missing. Must-be requirements do not lead to increased levels of customer satisfaction which is reflecting the low customer satisfaction coefficient values (0.2766 to 0.4783). Performance quality requirements consist of R8, R24, R11, and R21. As for performance requirements, these have a direct impact on satisfaction and dissatisfaction when or when not featured. This can be seen in the values for customer satisfaction coefficient values (0.5349 to 0.5745) and customer dissatisfaction coefficient

Table 5. Kano Dimensions and Customer Satisfaction/Dissatisfaction Results

Requirement Number	Q	A	I	O	M	R	Customer satisfaction (A+O)/(A+O+M+I)	Customer dissatisfaction (O+M))/((A+O+M+I)*(-1))
R1	1	8	21	7	8	2	0.3409	-0.3409
R2	0	10	13	12	12	0	0.4681	-0.5106
R3	0	4	12	14	16	1	0.3913	-0.6522
R4	0	5	15	12	15	0	0.3617	-0.5745
R5	0	13	12	10	11	1	0.5000	-0.4565
R6	0	8	12	11	16	0	0.4043	-0.5745
R7	0	18	9	15	5	0	0.7021	-0.4255
R8	0	7	5	19	16	0	0.5532	-0.7447
R9	0	9	11	13	13	1	0.4783	-0.5652
R10	1	16	9	10	11	0	0.5652	-0.4565
R11	0	12	8	14	13	0	0.5532	-0.5745
R12	0	9	14	13	11	0	0.4681	-0.5106
R13	0	6	15	11	15	0	0.3617	-0.5532
R14	0	13	12	16	5	1	0.6304	-0.4565
R15	0	5	12	12	18	0	0.3617	-0.6383
R16	1	8	19	13	6	0	0.4565	-0.4130
R17	0	9	15	16	6	1	0.5435	-0.4783
R18	0	15	18	10	3	1	0.5435	-0.2826
R19	0	13	22	8	3	0	0.4565	-0.2391
R20	1	14	14	13	5	0	0.5870	-0.3913
R21	0	13	7	14	13	0	0.5745	-0.5745
R22	0	11	16	11	9	0	0.4681	-0.4255
R23	0	7	14	10	16	0	0.3617	-0.5532
R24	0	11	9	14	13	0	0.5319	-0.5745
R25	0	10	15	16	5	1	0.5652	-0.4565
R26	0	15	19	9	4	0	0.5106	-0.2766
R27	1	4	23	6	6	7	0.2564	-0.3077
R28	0	11	13	14	9	0	0.5319	-0.4894
R29	0	9	15	8	14	1	0.3696	-0.4783
R30	0	13	14	11	9	0	0.5106	-0.4255
R31	0	7	19	8	13	0	0.3191	-0.4468
R32	0	15	16	10	6	0	0.5319	-0.3404
R33	0	14	25	5	0	3	0.4318	-0.1136
R34	0	16	15	7	9	0	0.4894	-0.3404
R35	0	9	16	13	8	1	0.4783	-0.4565
R36	0	1	10	15	21	0	0.3404	-0.7660
R37	0	7	30	6	4	0	0.2766	-0.2128
R38	0	0	8	13	26	0	0.2766	-0.8298
R39	1	18	13	12	3	0	0.6522	-0.3261

values (-0.5745 to -0.7447). Participants identified attractive quality requirements as R39, R7, R14, R25, R10, R28, R30, R32, R26, R20, R17, R18, while R5 is emerging now between indifferent and attractive. Attractive quality requirements result in higher levels of customer satisfaction coefficient (0.5000 to 0.7021) compared to other kano categories, besides perhaps performance requirements,

Figure 9. Kano Model Analysis

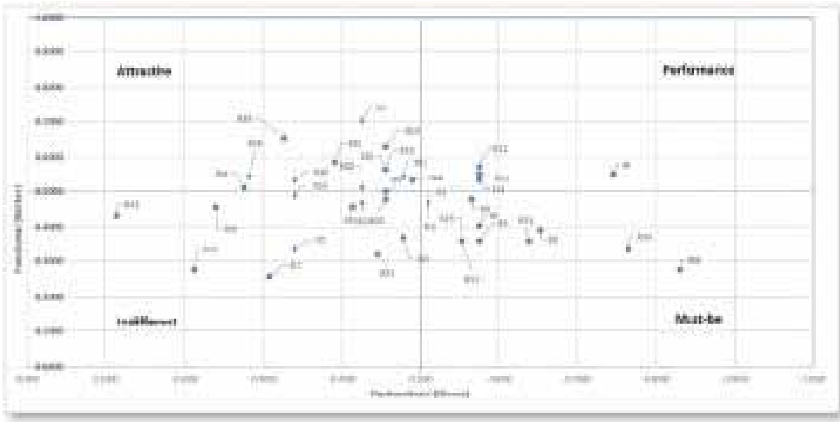


Table 6. The Quality Categories for Short Food Supply Chain Digital Platforms

Attractive	**Performance**
R39 Alert to Supply Chain Changes R7 Real-time Data on External Factors R14 Real-Time Demand Forecast Data R25 Real-Time Price Data R10 Constant Real-Time Data Flow R28 Notifications R30 Applications Embedded R32 Modular Add in Capability R26 Supply Chain Virtualisation R20 Learning and Development Through Best Practice Information R17 Real-Time Transaction Data R18 Environmental Sustainability Indicators ~~R5 Collection and Analysis of Consumer Related Data~~	R8 Supplier and Product Origin Information R24 Transparency R11 Data Collection, Handling Recall and Analysis Capability R21 Real-Time Quality Data

Indifferent	**Must-be**
R34 Real-Time Document Collaboration R19: Social Sustainability Indicators R16 Real-Time Replenishment Data R22 Traceability R35 KPI Dashboard R29 Web-based R31 Role-Based Access R27 Decentralised R1 Key-Cryptography R37 Sensor Embedded Compatibility R33 Calling	R2 Big data R12 Real-Time Data Distribution for Supply Chain Stakeholders R23 Real-Time Inventory Data R13 True-price of Food (Real-time Market and Price Data Exchange) R9 EDI R6 Data Integrity R4 Data Backup R15 Real-Time Logistics Data R3 Data Monitoring R36 Device Compatibility R38 Privacy and Security

and are often exciting for potential users as the inclusion of these requirements is often not expected and contributes to user satisfaction. Customer dissatisfaction coefficient values are closer to 0 in this category (-0.2766 to -.4894) here due to the unexpected aspect of these requirements, therefore do not lead to high levels of dissatisfaction when the requirement is included. The indifferent features included R34, R19, R16, R22, R35, R29, R31, R27, R1, R37, and R33. These requirements provide little satisfaction or dissatisfaction if or if not included and have lower customer satisfaction and dissatisfaction coefficient values compared to the other requirements.

4.3. Discussion

The quality requirements for SFSC digital platforms are assessed and show 12 attractive, 11 must-be, 11 indifferent, 4 performance, and 1 in between attractive and performance. Thus, suggesting that emphasis should focus firstly on attractive quality requirements, followed by indifferent and must be, and later performance.

Must-be quality requirements are identified as necessities to include for SFSC digital platforms, however, they may have little effect on user satisfaction. For example, based on participants responses and the Kano analysis, real-time inventory data and real-time logistics data are deemed important, however may provide little towards satisfaction to potential key users. Participants in SFSCs support the true-price requirement reflecting on expectations for fair financial returns and value sharing in the supply chain. This reflects on stimulating local companies and rural development. In addition, true-price reflects on fair and local trade, attracting consumers towards social and economic sustainability (Aguiar et al., 2018). Other must-be requirements are not exclusive to SFSC platforms but are adopted across digital food supply chain platforms presented in the existing literature. Privacy and security have the lowest customer dissatisfaction coefficient value, leading to a high level of dissatisfaction when user needs are not met. Thus, showing the importance of this must-be requirement.

Performance quality requirements contribute directly to user satisfaction and dissatisfaction, based on the presence or absence of a requirement. Supplier and product origin information enable stakeholders' ability to make informed decisions. The low customer dissatisfaction coefficient value for this requirement suggests that it is important to include otherwise leading to unsatisfied users. Furthermore, supplier information offers to support relationships in supply chains by offering insight into the origin of production, identified as important by (Sergaki & Koutsou, 2019). Participants also evaluated supplier information as a contributor to social sustainability. Supplier information in this research supports traceability as it contributes to traceability and proves the origin of food, a direct component of SFSCs (Del Giudice et al., 2016). Real-time quality data is a direct factor in creating a willingness to participate in SFSCs, and reflects on the quality-turn driving SFSCs (Ponte, 2016). This is supported in the research findings with the highest customer satisfaction coefficient values amongst the performance requirements. The requirement regarding data handling, collection, recall, and analysis capability is needed in digital platforms. Transparency is identified as a performance requirement by participants in respect to SFSCs with a strong correlation to social sustainability.

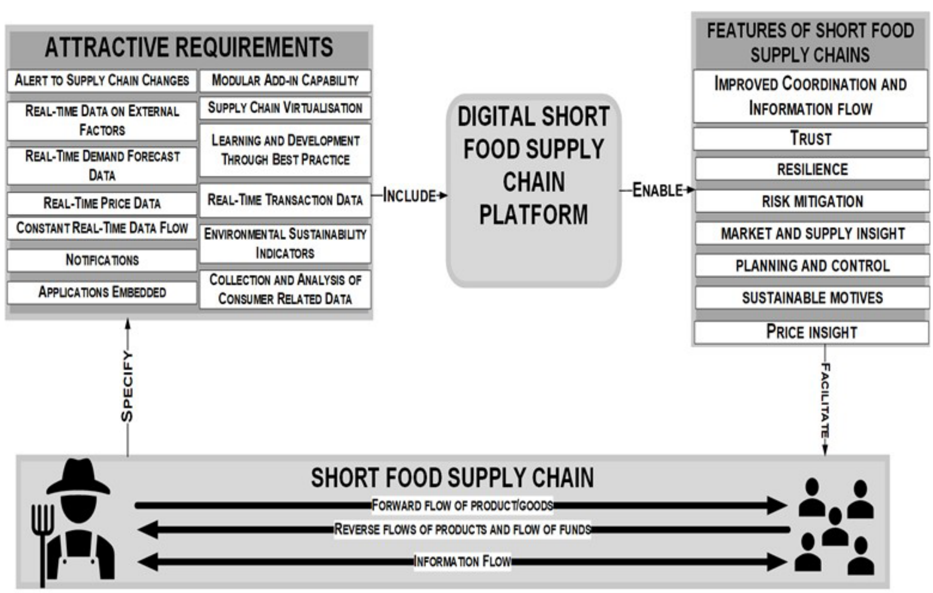
Attractive quality requirements such as real-time data exchange on price, demand forecast and external factors are attractive yet not entirely expected for SFSCs, but nonetheless a very interesting result. These requirements contribute to planning and pricing strategies, enabling competitive advantage in SFSCs. Constant real-time data flow and virtualisation provide insight throughout a supply chain and are attractive for digital platform users. In combination with other key considerations in supply chains e.g. linkages, collaborations and information sharing, the real-time data flow can help support the end-to-end visibility of the supply chain. Adopting these requirements can support SFSCs information flow needs (Torregiani & Paciarotti, 2018). Environmental sustainability is deemed attractive. However, stakeholders may be more focused on one level of sustainability in SFSCs, therefore, may not be applicable across all SFSC members. Learning and development can support social and economic sustainability in terms of awareness, knowledge and development and is offered in existing digital platforms (Bhaskara & Bawa, 2021). Alerts to supply chain changes, and real-time data on external factors are important attractive requirements creating high levels of user satisfaction coefficient values. These represent unexpected yet satisfying requirements for SFSC digital platforms.

As a rule, the Kano model suggests that indifferent quality requirements have an insignificant impact on user satisfaction. Although categorised indifferent requirements by the participants, social sustainability indicators, traceability, and a KPI dashboard are arguably becoming increasingly important for SFSCs. Social sustainability is built-in SFSCs and literature show the need for closeness, communication, collaboration, employment, rural community development, and equality. A lack of sustainability awareness and implementation amongst SMEs may contribute to the subjectivity of respondents. 62 percent of respondents fell within micro, small and medium enterprises, which suggests further development of social sustainability is needed. The literature strongly suggests that traceability is crucial in SFSCs to prove the locality of food, Burgess and Sunmola (2021) prioritising it as a highly important requirement. Traceability is established in face-to-face SFSCs, however can be lacking in proximate and extended structures. Therefore, an evaluation for those types of SFSCs can provide more understanding for requirements, concerning traceability. In addition, as Kalfagianni and Skordili (2018) state one of the main challenges in SFSCs is the difficulty in proving the origin of foodstuff due to a lack of awareness concerning traceability. Therefore, more development in this area is required for SFSCs. Sensor embedded systems and KPI dashboards are ranked indifferent. Sensors embedded systems support efficient data capture, quality, safety, inventory, and logistics requirements amongst others, while a KPI dashboard indicates current and past supply chain performance. The requirement of collection and analysis for consumer-related data places between the attractive and indifferent categories. Concerning SFSCs and sustainability, there is a dearth of literature that substantially argues for this requirement regarding SFSC digital platforms. This requirement may become more important with advances in digital platforms.

Unlike performance and must-be requirements, studied in the related literature e.g. Burgess and Sunmola (2021), attractive quality requirements are often unexpected and might be unknown to the potential user of systems. However, in general, attractive quality requirements bring satisfaction when present, but do not bring dissatisfaction in the absence of it (Tontini & Dagostim Picolo, 2013). Petrik and Herzwurm (2020) discuss attractive quality requirements as the most influential category concerning user satisfaction. However, over time, attractive quality requirements may shift to performance and must-be kano categories and therefore are important considerations in the development stages of technology (Min et al., 2018).

This research builds on existing literature by identifying and prioritising the attractive quality requirements for SFSCs, where previous research highlights must-be and performance indicators that are core to SFSCs such as transparency and supplier information. Figure 10 provides an overview of attractive quality requirements to support SFSC digital platforms. Alerts to supply chain changes, real-time data on external factors, and notifications can support the resilience of SFSCs. These requirements

Figure 10. Attractive quality requirements for Digital Short Food Supply Chain Platforms



can enable the emphasis of trust in short supply chains through risk mitigation and improved planning. Real-time demand, transaction, price data, and the analysis of consumer-related data provide upstream stakeholders insight into market developments and downstream trends, therefore professionalising the SFSC. This can also increase planning and control through an improved understanding of emerging trends. In respect to sustainability, environmental sustainability indicators are desirable when present, thus supporting sustainable motives beyond economic.

5. CONCLUSION AND AREAS OF FUTURE WORK

The research presented in this paper has prioritised a list of requirements for SFSC digital platforms. The research is an early adopter of the Kano model approach to prioritise requirements for an SFSC digital platform. First, a literature review has verified a consolidated list of 39 requirements for a conceptual SFSC digital platform. Second, the requirements are prioritised through Kano analysis. Essentially a Kano model is used to analyse and categorise must-be, performance, attractive, and indifferent quality requirements. This paper fills the knowledge gap regarding the prioritisation and identification of the attractive quality requirements for SFSC digital platforms. The focus on attractive quality requirements presents emerging requirements that will develop over time for SFSCs. Participants for the research were selected based on experiences and expertise, relevant to food supply chains, alternative food systems and digital supply chain platforms.

Six main conclusions are drawn (1) the 39 requirements of digital SFSC platforms that were reported in related research areas are validated and are believed to apply to digital food supply chain platforms. (2) The requirements span across the four Kano model categories, identifying 11 must-be requirements, 4 performance requirements, 12 attractive requirements, 1 requirement between attractive and indifferent and 11 indifferent requirements. (3) The attractive quality requirements act as delighters when present, however have a minimal negative impact when absent, thus are important to create higher levels of user satisfaction. As the SFSC digital platforms develop over time, these requirements may shift to performance and must-be categories. (4) Ranking highly as attractive quality requirements are real-time data on external factors and alerts to supply chain changes. Showing an emerging trend towards creating resilience in the SFSC through digitalisation. (5) Real-time quality data including its collection, analysis, and sharing is an important performance requirement. This is expected as it correlated with the literature regarding the visibility of supply chains in general. (6) Advances in digital technologies and their characterisations can play a prominent role. Many of the must-be requirements (e.g. big data, EDI, data backup, compatibility, privacy, and security) contribute to technical infrastructure, hence advances in this can play a prominent role in digital SFSC platforms. (7) Surprisingly, traceability is perceived by the participants as an indifferent requirement, but this is likely to change with stakeholder pressure regarding sustainability objectives and its awareness.

For system developers and providers, attractive quality requirements have the opportunity to enhance the engagement of potential users of a system. For key system users, these aspects can support the unique features of SFSCs. The Kano approach is also useful for practice and theory in respect to information systems research as it provides insight into the requirement prioritisation of the systems. For example, by adopting Kano model classification, SFSC actors can prioritise important requirements when selecting or developing a digital platform. Thus, potentially saving resources (time and finance), by prioritising requirements to focus on. Limitations are present in this study. Important is the subjectivity of participants in respect to knowledge, skill, ability, and experiences, and this can influence the ranking of requirements. The diversity in participants and respected supply chain networks provides a good overview of the requirements for SFSC digital platforms but arguably its findings cannot be generalised, by the very nature of the methodology used consisting of a limited number of participants. Including more participants in respect to information technology, fresh food logistics, and sustainability may provide better insight into requirements such as sustainability and traceability. Also, a case study approach can improve requirements prioritisation for individual digital

SFSC platforms. This would support specific supply chains to align objectives to the supply chain strategy. The requirements prioritised in this research can be adapted by future researchers to include in related studies. A method for the adaption of these baseline prioritisations for SFSCs could potentially be a future work. A final limitation is related to the high-level description of requirements in this study. Examples include environmental sustainability indicators and real-time quality data exchange enablers which may be abstracted at a lower level of detail than considered in this study but would result in added complexities for this study. This can also be an area of future work.

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