Designing Community Collaboration Support System to Facilitate the Resilience of Supply Chains During Crises

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Abstract

This study explores how to design an information system that facilitates the resilience of supply chains and the collaboration of different stakeholders during various crises. The ultimate objective of this study is to develop a knowledge base for formalizing design principles essential for designing and conceptualizing the Community Collaboration Support System to facilitate the resilience of supply chains during a crisis. To derive the design principles, we followed the design science research approach. Drawing from the literature, this paper used kernel theories as a part of the process. The design principles are well positioned and aligned with the acquired knowledge base. This study contributes to the existing research in distributed and collaboration technology. Additional explanatory studies are needed to validate posited design principles.

Keywords: Distributed and collaboration technology, Community Collaboration Support System, supply chain resilience, crisis management, design principles.

1. Introduction

In different crises such as weather disasters, military conflicts, terrorist attacks, epidemics, pandemics, technological, humanitarian and other crises, the performance of existing *supply chains* (*SCs*) can be significantly impacted due to their complicated relationships and fragile design (Burton & Cho Walsgard, 2019; Quayson et al., 2020). For instance, due to the COVID-19 pandemic, many industries and communities experienced systemic vulnerabilities in emergency preparedness, risk mitigation, and ineffective SC management (Bekrar et al., 2021). Once a dramatic change within a SC occurs, the SC optimization becomes ineffective, making it not sustainable (Suk & Kim, 2021; Tseng et al., 2022; Tukamuhabwa et al., 2015). Moreover, creating new ad hock SCs that should address new or increased needs resulting from the crisis (e.g., refugees' or tornado victims' needs) is challenging and not always feasible.

The literature suggests that fragmented operations, underutilization of resources, unconsolidated shipments, lack of coordination, inefficient transport, and delays in the distribution and delivery processes, are common in the relief operations (L'Hermitte et al., 2018). However, there is a lack of mechanisms that could reduce or eliminate the frangibility of SCs affected by a crisis and assist in collaboration among all SC stakeholders.

There is a need to change the traditional views of SC resilience processes, especially during crises. Having a common goal in contributing to SC resilience during a crisis, crisis-centric communities, communicating among SC stakeholders, need to act as suppliers, shippers, distributors, or retailers, along with the first-middle-and last-mile delivery framework in a flexible, self-fulfilled and self-sufficient fashion independently of their geographic locations. We define crisis-centric communities as a group of individuals and organizations with a feeling of fellowship with others, sharing common attitudes, interests, and goals related to overcoming crisis challenges and consequences.

SC resilience unfolds in four major dimensions: 1) anticipation of pre-disruption dimension, 2) agility and ability to manage and adjust to the dimension of the rapid change, 3) recovery dimension with the ability to revitalize operations in the SC network, and 4) organizational learning dimension to understand and improve for future performance (Ali et al., 2017; Dubey et al., 2021; Myamba & Nguni, 2022).

Literature suggests that while the number of crises is increasing everywhere in the world affecting SCs, various policies and approaches have been employed to facilitate the resilience of an SC (Fluri & Tagarev, 2020; Lambert, 2017; Stauffacher, 2021). It was widely acknowledged that advanced information technologies (IT) could help to manage the impact of crises more efficiently and unite the resources to withstand the consequences (Ivanov, 2020; Shaw et al., 2020). In recent years, many multi-agent ISs have

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been developed to support resilience to crises, focused on partnering, collaboration, rules and legislation management, and coordination (Benaben et al., 2017; Ivanov, 2020; Krumeich et al., 2014; Rasouli, 2019). Some of the existing community-focused solutions use social media or are based on various web-based platforms, e.g., Ushahidi, OpenStreetMap, Disasters 2.0, Sahana, eBayanihan, (Besaleva & Weaver, 2013; Estuar et al., 2014; Poblet et al., 2014). However, the existing systems, originally designed to solve the problem, are unable to tolerate any disruption and facilitate the resilience of SCs. Most existing solutions are ineffective, centralized, expensive, and offer weak functionality (Appiah et al., 2021; Durach et al., 2015).

Literature indicates a lack of efficient, theory-driven information system (IS) intentionally designed to help crises-centric communities to collaborate and address the challenge of SC resilience due to disruption and operation risks during humanitarian crises. There is also an indication of a call for research using Design Science Research (DSR) for conceptual frameworks in the adaptation of SCs to rapid changes (Wang et al., 2021). Therefore, we are motivated to develop a theory to design IS solutions for collaborative community support to facilitate SC resilience during crises. In this research, we also see an opportunity to conceptualize design principles (DPs) of such sub-class of systems that we call the Community Collaboration Support System (CCSS). The CCSS can play a significant role in helping crisis-centric communities to establish collaboration among all its stakeholders to achieve the resilience of an SC. We aim to systemize the primary knowledge base for developing and formalizing DPs for an IS that facilitates the resilience of SCs and the collaboration of different stakeholders during various crises. To derive DPs for CCSS, we employ DSR methodology (Gregor & Hevner, 2013). As a part of the DSR, we use kernel theories from the natural and social science (Markus et al., 2002; Walls et al., 1992). Kernel theories govern design requirements and processes and help to indicate that the developed artifacts contribute to the body of knowledge (Gregor & Hevner, 2013; Walls et al., 1992). The system's design will include the current knowledge base of the existing technical solutions and incorporate relevant IS theories, as discussed further in this paper, which will be used as a base for the DPs.

The result of this research contributes to existing research in Information Collaborative Systems by formalizing the DPs of CCSS to facilitate balancing and improving the stability in the SCs during uncertainties and crises. The practical implications of this research are expected to appeal to the common needs of all SC stakeholders, like overcoming crises collaboratively and enhancing resilience in their SCs in response to the rapid changes and disruptions in SC operations. The major SC stakeholders' groups could include individuals, communities, governments, civil societies, academia, non-governmental organizations, and international organizations, as well as a business consortium interested in the utilization of innovative technologies for SC resilience strategies and help in mitigating the impact of the SC risks and overcome crises.

2. Theoretical foundation

In formulating DPs for the CCSS model to be used in IS-supported communities for SC management during crises, this study employs several kernel theories drawn upon the 3C's collaboration model (Agostini & Mechant, 2018; Fuks et al., 2007), the Information System Success (ISS) theory (DeLone & McLean, 1992), and the theory of Commons-based peer-production (Andreev et al., 2011; Benkler & Nissenbaum, 2006).

This section provides theoretical foundations on adopted and modified constructs of the above theories, which configure a knowledge base for DPs.

The resulting CCSS model is formed based on the relevant concepts shown in Figure 1.

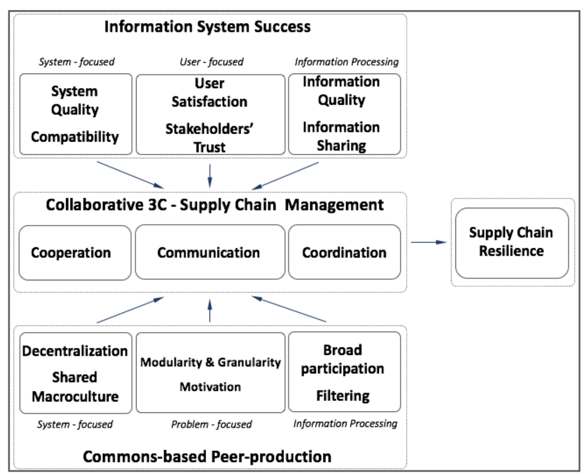

Figure 1. CCSS model

2.1. Collaborative Supply Chain Management

The 3Cs collaboration model, initially developed by (Ellis et al., 1991), distinguishes three critical components that enable *collaboration*: *communication, coordination and cooperation* (Fuks et al., 2007), used mainly in IS (Morán et al., 2006) and SC management (Camarinha-Matos & Afsarmanesh, 2008). In this study, the 3Cs model is appropriate since the goal of all stakeholders is to strengthen the resilience activities of SCs during a crisis, which is a collaborative effort.

In the light of SC resilience during crisis, ***collaboration*** is the ability of SC stakeholders to respond to rapid changes and disruptions in SC operations through collaborative planning, cooperation among SC stakeholders and sharing of resources, effective communication for achieving common goals, i.e., resolving the consequences of a crisis and enhancing resilience in their SCs (Ali et al., 2017). SC management literature identifies several key factors that should be taken into account when considering successful collaboration of SC stakeholders, e.g., trust among the SC stakeholders, commitment to social purpose, support relationships at all levels (organizational, community, individual), environment facilitating crisis resilience and other safety activities (Myamba & Nguni, 2022). The literature also suggests that collaboration among SC stakeholders is an entry point for SC crisis and risk management through information sharing to better prepare for potential threats and coordinate the response itself (Ali et al., 2017). Information and intelligence sharing make the information updated and accessible by all SC stakeholders (Baah et al., 2022), which enhances the resilience of SCs and is the key to coordination to the immediate response to crisis (Ali et al., 2017).

Incorporating the SC management knowledge base, we argue that for *collaborative* SC management to facilitate resilience during a crisis should be considered as a three-dimensional approach: C*ooperation* among SC stakeholders through sharing resources and information throughout all stages of crisis (i.e., pre-during and post-disruption); *Coordinated* in an efficient manner (i.e., with minimal time to respond and minimum long-term effect), using advanced technological means to assure good *communication*. We call these basic concepts "the 3C's of community collaboration support for SC management".

Collaborative arrangements and practices in SC crisis management, e.g. readiness to disruption, responsiveness during disruption and recovery or growth stage after the disruption, need ***Coordination*** of SC stakeholders, activities and processes (Ali et al., 2017; Myamba & Nguni, 2022) and ability to adapt to new conditions. Coordination is essential to minimize the time of responsiveness, reduce the immediate and long-term effect of the disruption (Ali et al., 2017) and improve SCs performance. To improve the ability to respond to the changes, increase competitiveness, enhance coordination among SC stakeholders, and increase information-processing capacity, a robust information system may need to be developed for better coordination (Dubey et al., 2021).

Communication is an interaction among SC stakeholders via information flow, which supports collaboration and directly affects SC performance (Hu et al., 2014; Nunes et al., 2022). The literature proposes that communication is a key to balanced SC stakeholders' partnership positioning strategic goals and expectations. The SC management literature stresses that communication in crisis management situations may be further improved by employing Web 2.0 technologies (Kavota et al., 2020). Many different platforms are being used to share information in SCs, including online media, e.g. websites, social media, video conferencing, and internal or external corporate communication platforms (Westhuizen et al., 2015).

Cooperation is a group effort in the production, manipulation and transfer of information, using groups' shared resources towards achieving a common organizational goal (Agostini & Mechant, 2018; Fuks et al., 2002). This collaboration component can be achieved by distributing some tasks among the group members (Camarinha-Matos & Afsarmanesh, 2008; Fuks et al., 2007).

2.2. Information System Success concepts

The ISS model (DeLone & McLean, 1992) is commonly used to assess the success of IT systems under the users' evaluation (Dam et al., 2020). It includes quality factors which, hypothetically, can affect usage and user satisfaction, affecting net system benefits (Lwoga et al., 2020). For this study, we selected ISS concepts as described below.

Information quality is a critical concept in the ISS model, which plays a significant role in the usefulness of the entire system impacting ISS usage and success (Lai & Yang, 2009). It includes the following fundamental characteristics important for user needs: accurateness, objectivity, reliability, relevance, timeliness, completeness, unity, interpretability, coherence, representativeness, contextuality, accessibility and security (Lwoga et al., 2020). Having most or all of these characteristics in place may positively affect the usefulness of the entire system (Pereira et al., 2021).

System quality is defined as the extent to which users believe a system is pleasant and useful to use via its general characteristics (e.g., system accuracy, flexibility and reliability, online response time, ease of use and learning how to operate, additional availability of system features of intuitiveness, sophistication) (Lwoga et al., 2020; Pereira et al., 2021). This effective construct assures that appropriate system quality can make users rely on the system's functions and improve their performance while operating the system (Lai & Yang, 2009).

Prior IS research has stated that in order to connect to the IS being developed, organizations should be able to use, transform or re-engineer their existing IS to be compatible with the new IS platform (Choi et al., 2020). The literature defines ***Compatibility*** as the extent to which a new IS can be integrated into the existing system, taking into account the consistency of the existing values, past experiences, and needs of potential users with a new IS (Choi et al., 2020). In this study, compatibility may improve operational efficiency (Mohd Salleh et al., 2016), which is a part of the 3C's community collaboration support for SC management.

User satisfaction is an important construct in developing the IS user's perception of the system's influence on IS usage, as it can directly affect further collaboration with the IS users (Lian, 2021; Lwoga et al., 2020). There is evidence in the literature that based on stakeholders' emotional state as a user, the satisfaction level (e.g., system use satisfaction) can affect the degree of their involvement in the processes and finally increase the desire to collaborate (DeLone & McLean, 1992; Lian, 2021; Lwoga et al., 2020; Phaosathianphan & Leelasantitham, 2021). However, there is a risk of failure of the IS if the user's expectations are not met (Mustafa et al., 2020).

We also employ the following two concepts borrowed from Innovation Diffusion Theory for CCSS for SC management during crises: *stakeholders' trust* and *information sharing* (Chang et al., 2020; Choi et al., 2020; Kamble et al., 2021) as additional factors in our model.

Stakeholders' trust is a prerequisite to the IS development for the SC community collaboration management as it is critical in light of the safety and sensitivity of information flow and security financial transactions (Kwee-Meier et al., 2016). It is based on the community norms, values and beliefs that create a sense of community identity and maintain relationship dynamics (Andreev et al., 2011; Queiroz & Fosso Wamba, 2019). It also creates the grounds for democratic decision-making in achieving objectives transparently and enhances reputation in the community (Andreev et al., 2011). Study shows that trust can be supported by the automation of processes and transactions, significantly enhancing collaboration, communication and coordination in SC communities (Kwee-Meier et al., 2016).

Information sharing is considered an additional critical factor, which is vital for operations performance and can influence SC collaboration (Queiroz & Fosso Wamba, 2019). By passing information among the stakeholders (exchanging commercial and operational data, sharing opinions, offering suggestions, answering questions), information sharing can help increase trust in organizations and facilitate improvement of 3C's. In the context of this study, sharing refers to the visibility of information in the network. Hence, the IS being developed should provide transparency and accessibility of information to increase trust and coordination of SC stakeholders and access the database for audit transactions without third-party authorization. This feature also improves the traceability of the resources available in the network, making the entire transaction history of the assets available throughout its lifetime, improving accountability and trust, which is often a significant problem in the SC networks (Queiroz & Fosso Wamba, 2019). Many studies promote the use of advanced information technologies and automated IS design to improve information transparency and visibility in SCs for better collaboration, communication, and coordination (Lambert, 2017; Shaw et al., 2020; Stauffacher, 2021).

2.3. Commons-based Peer-production concepts

Having reviewed theories describing collaboration in self-organizing communities, we selected the Commons-based peer-production (CBPP) theory as a critical kernel theory for the development of the DPs for CCSS. CBPP is a self-governance production model for resource management based on trust and complete transparency. CBPP is a voluntary model of production and providing services that follows a common, shared ideology, collaborating in communities for a common good. The main concepts that define CBPP are modularity, granularity and low-cost integration (Andreev et al., 2011; Benkler & Nissenbaum, 2006). The CBPP is also characterized by decentralization, shared macroculture, motivation, broad participation, and filtering.

Based on the scoping literature review concerning existing crisis management IT solutions, our findings indicate that exciting IT/IS solutions for crisis management are mostly centralized (with some exceptions, e.g., Ushahidi platform), dispersed across different platforms, not fully accessible or not adopted by specific communities.

To overcome this obstacle, we include the ***Decentralization*** concept of CBPP. In this regard, we position this "peer production" phenomenon as an important element in developing DPs, as the CBPP structure is characterized by decentralization via self-assignment and self-regulation and may depend on decentralized data or information exchange, decentralized actions and decision-making (Andreev et al., 2011; Benkler, 2003). Decentralization reduces the concentration of power, provides the network participants with self-selection and self-assignment mechanism of governance and regulations, and reduces the effort and cost of establishing trust in the network of SC stakeholders by incorporating full transparency and traceability (Andreev et al., 2011; Seebacher & Schuritz, 2017).

Another CBPP-related concept is ***Shared Macroculture***, which may include shared ideology, a common approach for validation, mutual understanding, goal congruence, reputation, openness, and agreement (Andreev et al., 2011; Terjesen et al., 2013). By meeting these social and cultural orientations in society, a collaboration formed by not monetary or other incentive-driven motivations can emerge (Fathalikhani et al., 2020). Such common goal-driven collaboration is difficult to maintain without transparency, an essential mechanism for achieving congruence and harmony in the system, which can be assured by reflecting obligations on those values, norms and beliefs in a contract to promote trust in the communities for a better control (Andreev et al., 2011). As the literature suggests, contract execution automation can address the problem in IS context since it facilitates verification, reinforcement, negotiation, and execution of digital transactions (e.g., liabilities, conditions for breach of contract, penalties etc.). This may promote self-regulation and enhance cooperation and communication in the IS network (Lejeune & Yakova, 2005; Terjesen et al., 2013). In the context of SC crisis resilience, this concept enables traceability and auditability of the assets in the database.

At the core of the CBPP governance model are two important concepts, ***Modularity*** and ***Granularity***. In the context of IS design, modularity and granularity allow for the development of various projects simultaneously, which is strictly in alignment with a dominant form of governance in the development of Operation Support System projects, the rule of *self-assignment* (Andreev et al., 2011). ***Modularity*** is the ability to process modules independently and later assemble them into different product units for efficiency in the new system production (Saroniemi et al., 2022). Following this fashion, granular elements of the project modules are the predominantly fine-grained or small tasks performed by contributors within the system. Through the intrinsic motivation of a large pool of contributors, the actual peer production is enabled through modularity and granularity, which finally facilitates collaboration via a self-selection process among participants (Andreev et al., 2011; Benkler & Nissenbaum, 2006).

Unlike hierarchies and markets, CBPP does not rely on financial rewards for performing activities and has no monetary incentives to support motivation, for which it has received massive criticism. Instead, it distinguishes three different types of ***Motivation*** that contribute to successful peer production, e.g., *Diverse*, *Scalable* and *Contextually embedded* motivations. The literature suggests that large-scale collaboration can be supported by this diversity of motivations (Benkler, 2002). Diverse motivation includes monetary rewards, intrinsic hedonic rewards, and social-psychological rewards, which facilitate knowledge sharing and promotes self-interest, personal satisfaction, and self-learning. Scalable motivation comes from granulated collaboration that transforms into larger contributions through growing motivation over time. Collaborators may self-select and self-assign roles in a project, depending on prior contributions to granular tasks or modules. Socially and community-oriented, contextually embedded motivation is associated with a sense of belonging, kinship, and identification. The inspiration, passion, reputation and sponsorship drive this type of motivation (Andreev et al., 2011; Benkler, 2003).

In the context of CBPP, ***Broad participation*** is viewed through the lens of two different tools designed to trigger and enable broad participation. The first is the modularity and granularity of IS projects to perform smaller-scale tasks and activities, which enables self-selection for different roles performed in the projects and provides an opportunity to conduct multiple small projects simultaneously. The second is the usage of web-based tools that distribute development activities and facilitate broad participation in a transparent manner (Andreev et al., 2011).

Contributions or even desires to contribute to projects need to be peer-reviewed or filtered to provide clarity, validity, and authenticity of data and information. ***Filtering*** enables broad and detailed project-related discussions and reviews of activities, expertise, and interests. Effectively functioning filtering has its governance that includes specific rules, e.g., openness to constructive criticism and comments, openness of the code base permits, engagement in peer review activities, promoting transparency, and providing prompt feedback. Hypothetically, filtering accelerates processing (e.g., reaching the common goal) and enhances the quality of the process. (Andreev et al., 2011).

3. Methodology

The research employs DSR methodology (Gregor & Hevner, 2013; Vashnavi et al., 2004), with an objective to formalize DPs for a CCSS to facilitate the resilience of SCs during crises. DSR methodology focuses on the innovational aspects, e.g., design of artifacts, develop knowledge, techniques, methods, models etc. (Hevner et al., 2004; Vashnavi et al., 2004). Particularly, this study will be developing a conceptual model, which will show the components of the system and derived DPs.

The research process model has adapted the design "Cognition in the Design Science Research Cycle" by (Vashnavi et al., 2004). There are five major elements in the process steps, as described below:
Awareness of the Problem: Based on the multiple gaps and findings identified in the literature, as well as the most important problems, major research questions (RQs) are formulated (Section 1).
Suggestion: Following the research questions, we suggested designing a collaboration model, utilizing all DPs and functionalities (Section 1).
Development: To conceptualize a model, the research developed a conceptual CCSS model (Section 2), which systemizes and conceptualizes influencing concepts of CCSS. The conceptual model allows to formalize proposition and map DPs (Section 4) needed for successful design of the system.
Evaluation: Once the theoretical model is developed, it will be evaluated through statistical analysis. Crisis and risks communicators will be contacted for additional feedback on the design. All deviations and unexpected results will be carefully analyzed and reflected in the research.
Conclusion: The final results should facilitate answering the RQs and may lay a foundation for further research.

4. Towards developing propositions and design principles

Following the guidelines on the design theory and design knowledge (Chandra et al., 2015; Gregor & Jones, 2007), we formulated propositions and developed DPs, the building blocks of our proposed model.

4.1. Developing propositions

This study explored three different kernel theories, as discussed in section 2, based on which we developed six high-level propositions. The resulted propositions about DPs within the ISS category are as follows:
Proposition 1: *System-focused ISS concepts (System Quality and Compatibility) can influence IS-supported community collaborative SC management (cooperation, communication, and coordination).*
Proposition 2: *User-focused ISS concepts (Stakeholders' Satisfaction and Stakeholders' Trust) can influence IS-supported community SC management (cooperation, communication, and coordination).*
Proposition 3: *Information processing-focused ISS concepts (Information Quality and Information Sharing) can influence IS-supported community SC management (cooperation, communication, and coordination).*

Propositions about DPs within the CBPP category are as follows:
Proposition 4: *System-focused CBPP concepts (Decentralization and Shared Macroculture) can influence IS-supported community SC management (cooperation, communication, and coordination).*
Proposition 5: *Problem-focused CBPP concepts (Modularity & Granularity and Motivation) can influence IS-supported community SC management (cooperation, communication, and coordination).*
Proposition 6: *Information processing-focused CBPP concepts (Broad Participation and Filtering) can influence IS-supported community SC management (cooperation, communication, and coordination).*

4.2. Developing design principles

In this study, the DPs are based on statements which provide a knowledge base of the artifact and what and how to build it to achieve a desired design goal (Chandra et al., 2015) while performing specific tasks and activities (Vashnavi et al., 2004). Referred to the kernel theories, DPs explain how descriptive, explanatory, and predictive knowledgebase can be used in designing meaningful artifacts in IS (Chandra et al., 2015; Iivari, 2007) Effectively formulated DPs include three primary orientations in IS research, i.e., materiality orientation (e.g. properties, design or components) and action orientation (to enable or allow for something) or both. Our DPs and the goals will be formulated following the established format: "Provide the system with material property," e.g., feature, shape, function, for users to perform an action (Chandra et al., 2015). Based on the kernel theories, we developed twelve DPs that lead to a common design goal. A mapping summary of DPs developed via kernel theory concepts is shown in Figure 2.
DP1. *Provide IS system quality characteristics (e.g., ease of use, etc.) to satisfy the requirements of SC stakeholders and the criteria for system use and performance for collaborating, coordinating, and communicating with SC stakeholders.*

DP2. *Enable the design of the IS provides connection and interoperability among IT platforms, components, and subsystems of the IS to ensure communication and coordination.*
DP3. *Monitor SC stakeholders' level of satisfaction to satisfy the criteria and requirements of SC stakeholders that promote continuous usage of the IS.*
DP4. *Provide SC stakeholders with access to information about every stakeholder in a transparent manner to create and enhance trust between stakeholders for better collaboration, communication, and coordination in organizations.*
DP5. *Verify that desired characteristics of IS are in place to deliver the system's quality of information and usefulness.*
DP6. *Provide SC stakeholders with visibility of information about the system to increase SC stakeholders' degree of confidence and trust towards usage of the IS.*

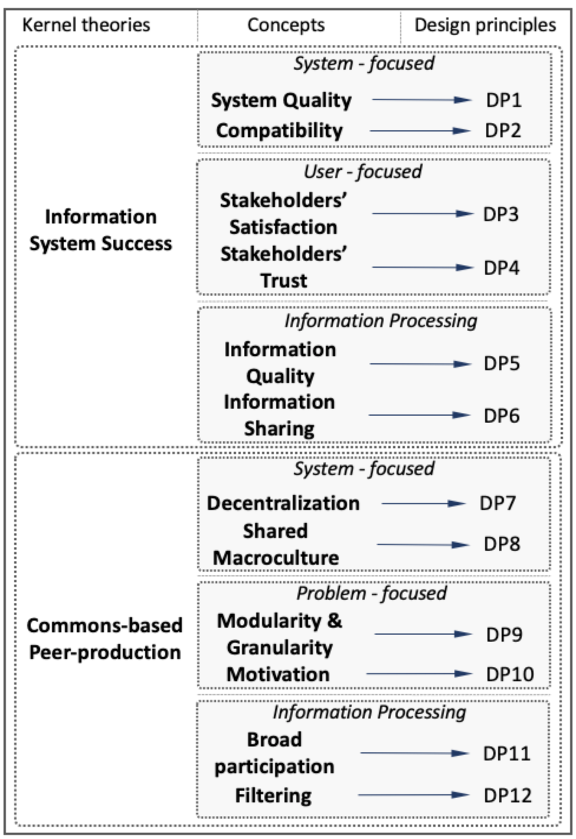

Figure 2. Design principles mapping based on the concepts from kernel theories.

DP7. *Promote self-assignment and self-regulation through a decentralized structure to remove barriers for better collaboration in the system.*
DP8. *Promote common norms and beliefs within and among communities in a transparent manner to achieve trust and self-regulation and maintain control.*
DP9. *To enable modularity and granularity of the problem allowing a large number of SC stakeholders to participate in multiple different small-scale solutions without exhausting their intrinsic motivation for participation.*
DP10. *Strengthen the environment for leveraging diverse, scalable, and contextually embedded motivations among SC stakeholders to allow for large-scale collaboration and utilize small-scale contributions that entail minimal efforts, including contributions based on a sense of belonging, kinship, or identification.*
DP11. *Deliver a variety of web-based tools stimulating broad participation (peer distribution, processor sharing, communications infrastructure sharing) to enable self-selection via peripheral participation in decomposed projects and enhance transparency via sharing communication infrastructure.*
DP12. *Provide accessibility and availability of tools, rules, and roles, facilitating transparent filtering of project contributions to enable contributors' discussions for quality, speed up development and leverage skills.*

5. Conclusion

This paper summarises the primary knowledge base for constructing DPs for an IS that facilitates the resilience of SC and the collaboration of different stakeholders during various crises. To promote effective teamwork, communication, and coordination in the IS and facilitate stability of SCs during crises, we developed three kernel theories drawn upon the 3C's model, the ISS theory, and the theory of CBPP as made available in the literature. We developed twelve DPs with two general orientations, i.e., ISS and CBPP, to meet the DPs goal. The resulting DPs are expected to add to existing IS, and Sociological Science research engaged in designing collaborative systems and technologies.

It should be noted that this conceptual study has limitations. It is acknowledged that the literature used for analysis may not have captured some details on theories and constructs used in kernel theories in this study due to scarcity of data, which can lead to fallacious arguments and diminish internal validity. It is also acknowledged that the sources used in this study may not have captured some constructs used in kernel theories to develop the DPs, and further validation is required. As a result, more significant aspects that may affect the system design could be omitted and weaken the internal validity. Due to the interpretive nature of this study, lack of data can lead to false or premature assumptions, the sources used in this paper may be biased, untrustworthy, or may not have enough knowledge about the actual condition of crisis management in SCs today and in the future, which may lead to misleading or false results and weaken the quality of the study externally. Due to the lack of empirical results in this research, there is a limitation to internal validity, slightly affecting the generalizability of this study. In addition, this study was primarily focused on the development of DPs. Additional research is recommended to validate posited propositions and DPs, focusing on regulatory and network security issues, to understand better the governance issues that may potentially affect the cost and benefits.

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