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IOIS ADOPTION AND DIFFUSION A REVIEW OF PORT AND CARGO COMMUNITY SYSTEM LITERATURE

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Research Paper

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Abstract

We investigate how Port and Cargo Community System (CS) adoption research has been operationalized with a Structured Literature Review approach to test whether CS adoption research has a different thematical and methodological focus than overall IS, specifically Inter-organizational Information System (IOIS) research. Despite drastic contextual changes, the dominant research paradigm and subsequently models used to investigate IS innovations' adoption and diffusion mechanisms originated in the early times of computers and the internet. CS research's different focus allows us to uncover that three underlying assumptions of the dominant paradigm should be challenged in increasingly complex environments, viz. the deterministic view on dependent variables, the independence of explanatory variables, and the independence of innovations from previous, related innovations. Our novel framework, which integrates these insights, can be used in future research and by practitioners to account for the increasing complexity of IS adoption and diffusion processes.

Keywords: Adoption factors, Port Community System, Cargo Community System, Research paradigm, Structured literature review

1 Introduction

Port and Cargo Community Systems (CS) are inter-organizational information systems (IOIS) at sea- and airports enabling more efficient and effective business-to-business (B2B) and business-to-government (B2G) communication, thereby facilitating the end-to-end digitalization of port processes (A. Moros-Daza et al. 2020; Rodon et al. 2008). CS present a unique set of characteristics that distinguish them from other IOIS. First, CS are locally bounded IOIS, which means that they are only applied at a specific physical location, viz., the respective sea- or airport which allows for a strong contextualization. Second, they connect a broad range of port stakeholders, including the various actors involved in the physical transportation of cargo, service providers, insurances, banks, software developers and governmental agencies such as customs or police (Rodon et al. 2008; Wallbach et al. 2019). This can be hotbed for interesting constellations with co-opetition amongst firms with heterogenous interests. Lastly, said governmental agencies are commonly deeply involved in the development and operation of CS, which can introduce unique facilitators to overcome common barriers to the adoption of IOIS but can also lead to new barriers itself (Chandra and van Hillegersberg 2018; Rodon et al. 2008). CS offer a variety of benefits to its users, such as lower information access and communication costs (Aydogdu and Aksoy 2015; Carlan et al. 2016), higher information distribution speeds (Di Vaio and Varriale 2020) and a decrease in transaction opacity, i.e., fewer errors and data inconsistencies (Damsgaard 1999; Di Vaio and Varriale 2020).

A recent literature review by Moros-Daza et al. (2020) uncovered that a majority of seaport-related CS research focuses solely on the functionalities and benefits of these IOIS. As researchers mostly take a transportation and supply chain-centric viewpoint, studies lack holism as they do not account for the systemic and interconnected nature of CS (A. Moros-Daza et al. 2020). While the focus of Moros-Daza et al. (2020)'s literature review lies on seaport-related CS research in general, the literature body addressing the adoption and diffusion mechanisms of CS remains both scattered and opaque. Singular studies attest to high adoption rates of CS at seaports in developed countries (Carlan et al. 2016; Keceli et al. 2008), but their counterparts at airports seem to develop more slowly (Wallbach et al. 2019). The current level of structure and rigor of the CS literature body does not allow for coherent explanations of such differences, hindering practitioners from retrieving relevant contextualized information on adoption barriers and facilitators. This is despite the strong contextualization that CS offer. Accordingly, to provide such structure for future research, we pursue a structured literature review (SLR) (Durach et al. 2017; Tranfield et al. 2003) and ask:

RQ1: How has Community System adoption and diffusion been operationalized?

To address this research question, we take a positivistic IS innovation standpoint which is appropriate as CS are a particular form of an IOIS (Rodon et al. 2008). We are motivated by the strong contextualization CS offer and more importantly by the interesting situations of co-opetition that the complex network of stakeholders of a CS can create. The study of IS innovations is concerned with understanding and unraveling the mechanisms behind the adoption and diffusion of IS-based products, services or processes amongst a group of potential adopters (Fichman 2004). Due to the high popularity of the field, different types of adopters have been studied over time, ranging from individuals (e.g., (Davis 1989)), to organizations (e.g., (Swanson 1994)) or networks of organizations (e.g., (Kurnia et al. 2019)) for many different contexts such as countries or industries (Jeyaraj et al. 2006). Concomitantly, a broad set of fundamental theories has been developed, such as the Innovation Diffusion Theory (Rogers 1995a), the Theory of Reasoned Action (Fishbein and Ajzen 1975) or the Technology Acceptance Model (Davis 1989). Especially the latter has been tested and applied in a multitude of settings and has been refined and extended regularly (Venkatesh et al. 2003; Viswanath Venkatesh and Bala 2008). The vast majority of these economic-rationalistic models follow the same predominant paradigm, viz. that a set of independent factors determines the quantity of innovation adoption (Fichman 2004). Due to increasing complexity, contextualization has become more important for adoption and diffusion research (de Reuver et al. 2018; Jackson et al. 2019). Drastic contextual changes took place in the last 30 years regarding IS innovation adoption and diffusion, as computers were still something exotic when the TAM was first developed and applied. Today many aspects of our everyday lives are deeply influenced by digital technologies and information systems. Accordingly, one should not casually assume that all of the underlying assumptions of the predominant paradigm of IS innovation research are still fully valid in all contextual situations, despite the many times it has been applied and confirmed. CS bring together a wide range of different stakeholders that engage in a co-opetition environment with some shared but also some heterogeneous interests. All involved parties want the respective sea- or airport to thrive. While a facilitated information exchange can enable a better transparency amongst all stakeholders, some involved firms, such as freight forwarders, might not want maximal transparency as their business models depend to a certain extent on opacity (e.g., (Damsgaard 1999)). This complex co-optetition context could create results that challenge the underlying assumptions of extant IS innovation research. Accordingly, we choose the CS context to specifically investigate what we can learn from the respective literature body about adoption and diffusion research and its underlying assumptions. Therefore we ask:

RQ2: Which assumptions of the dominant paradigm of IS innovation adoption research are potentially conflicting with results from CS adoption literature?

Our study contributes to the general literature on IS adoption and diffusion and specifically to CS research in various ways. First, we address the call of Moros-Daza et al. (2020) to add to the limited body of holistic CS research studies by developing a multi-level, conceptual CS adoption framework. We thereby also answer the calls for more multi-level research in the IS field (Bélanger et al. 2014;

Kurnia et al. 2019; Zhang and Gable 2017). Second, we add to the knowledge base of conditions causing IOIS to succeed, especially on sectoral and geographic differences (de Reuver et al. 2018; Robey et al. 2008). Third, we uncover that several assumptions of the dominant paradigm of IS adoption research might be challenged in future research.

The remainder of this paper is structured as follows: Section 2 presents the theoretical foundation of our research, i.e., CS and the predominant research paradigm of IS innovation research. Then, Section 3 describes the methodology of our structured literature review. Section 4 focuses on the results and analyses accordingly, which is followed by the conclusion in Section 5.

2 Theoretical foundation

2.1 Port and Cargo Community Systems as IOIS and multi-sided platforms

CS are geographically bounded, digital IOIS, enabling more efficient and effective B2B and B2G communication (Chandra and van Hillegersberg 2019; A. Moros-Daza et al. 2020; Srour et al. 2008). Additional services are realized and offered through a modular architecture (e.g., (Carlan et al. 2016; Mayanti et al. 2020; Simoni et al. 2020; Wallbach et al. 2019)). Depending on the specific location of CS, they are referred to as "Port Community System" (PCS) in the context of seaports and "Cargo Community System" (CCS) or "Airport Community System" (ACS) at airports (Carlan et al. 2016). Currently, a certain ambiguity and conceptual overlap exist between the terms "Community System" and "Single Window" (A. Moros-Daza et al. 2020). The International Port Community System Association (IPCSA) stresses the interconnectivity of the various (private) firms of a port community as a key characteristic of CS (Morton 2015). Accordingly, we excluded all those locally bounded IOIS labeled "single window", which solely cover governmental interactions, as we consider them to fall under the research field of e-government (cf. (Abramson and Morin 2003; Davison et al. 2005; Silcock 2001)).

CS have been described as both digital Multi-Sided Platforms (MSP) (A. Moros-Daza et al. 2020; Wallbach et al. 2019) and Inter-Organizational Information System (IOIS) (Rodon et al. 2008; Van Baalen et al. 2009) before. They can be considered a particular case of an IOIS that can develop into a MSP as they connect a wide variety of distinct but interconnected groups, from the various cargo transport network actors, software developers, banks and insurances (B2B-connections) to governmental agencies such as customs, port authorities, and others (B2G- and G2G-connections) (Rodon et al. 2008; Wallbach et al. 2019). As their core, CS enable direct, non-exclusive communication between the various stakeholders of a port and can offer additional services such as logistical planning, banking or insurance services to the involved parties (Elbert and Tessmann 2021). We focus on the IOIS view on CS while acknowledging the MSP nature of some CS for two reasons. First, all CS are IOIS, as it is part of their core value proposition to connect multiple organizations with an IS. Still, not all CS can necessarily be considered a MSP (Hagiu and Wright 2015) and second, viewing CS as IOIS has a much longer history in research than viewing them as MSP (A. Moros-Daza et al. 2020).

CS are set in medium to highly competitive B2B networks, depending on the local circumstances. Wallbach et al. (2019) describe the ACS of Frankfurt, Germany airport to be a highly competitive B2B network based on the distinction of competitive models by Farahani et al. (Farahani et al. 2014). While some evidence from PCS research seems to support this evaluation also for seaports (e.g., (Rodon et al. 2008)), other authors point out the crucial role that governmental agencies such as the port authority or customs have, especially in ports with a non-privatized management model (e.g., (Adaba and Rusu 2014; Chandra and van Hillegersberg 2018; Damsgaard 1999; Gustafsson 2007)). Given that in such cases, a seaport is rather lead-organization governed and has regulations that are at least partially imposed by government actors, seaports can also be viewed as conventional or medium competitive B2B networks. CS commonly face a long-lasting and strong influence by governmental agencies, as they are commonly part of the directly involved stakeholders (Chandra and van Hillegersberg 2018).

2.2 IS innovation adoption and diffusion – The dominant research paradigm

As an introduction to the topic, we summarize the impactful (Kohli and Melville 2019; Templier and Paré 2018) literature review of Jeyaraj et al. (2006) and Robey et al. (2008)'s review, which stands out due to its transparency quality (Templier and Paré 2018). While Jeyaraj et al. (2006) focus on factors influencing the adoption of an IT innovation of one organization, Robey et al. (2008) focus on Inter-Organizational Information Systems (IOIS) adoption.

Jeyaraj et al. (2006) present a "review of the predictors, linkages, and biases in IT innovation adoption research". They do so by reviewing 99 studies on individual and organizational IT-based innovation adoption, both quantitative and qualitative. Their analysis identifies a total of 135 independent variables, which they group into four categories: environmental, organizational, individual and innovation characteristics. They identify eight independent variables which they consider the best predictors of IT innovation adoption and diffusion. Half of these variables are organizational characteristics, viz. Top Management Support, User Support, Professionalism of the IS unit and external information sources. Two individual characteristics were identified to be within the eight best predictors, viz. Computer Experience and Behavioral Intention. External pressure as an environmental characteristic and perceived usefulness as an innovation characteristic were also identified as highly relevant. They uncover a close linkage between individual and organizational adoption and therefore suggest that individual characteristics should be utilized in organizational IT adoption studies. Furthermore, Jeyaraj et al. (2006) establish eight dependent variables that are regularly used in IT innovation literature. Dependent variables measure the quantity of innovation adoption, which can be understood and operationalized in different ways. They present the example that researchers can measure the quantity of innovation adoption by determining the perceived system use, i.e., the self-reported frequency of use of the innovation. This can vary from the actual system use, as some evidence suggests (Straub et al. 1995; Szajna 1996). Finally, they identify common biases in IT innovation adoption literature, viz. the rational bias, i.e., that the adoption is a rational decision, the pro-innovation bias, i.e., that more innovation is (always) better, the recall bias, which occurs when the unreliability of self-reports is ignored and the pro-adopter bias, which means that commonly only adopters but not non-adopters of innovations are studied. More recent studies on digital innovation adoption seem to confirm these insights (Kohli and Melville 2019, sec. 5.2).

Robey et al. (2008) perform a literature review on IOIS by reviewing 51 empirical studies. They focus their research on three primary issues covered by IOIS research: the adoption factors, the impact that IOIS has on transaction governance and the organizational consequences triggered by IOIS adoption. We focus mostly on the first issue, i.e., IOIS adoption factors, as it is the core interest of our research. Robey et al. (2008) uncover similar independent variables to those identified by Jeyaraj et al. (2006). Similarly, these factors are grouped into three categories, viz. external environment characteristics, organizational (readiness) characteristics and innovation characteristics. On the one hand, Robey et al. (2008) do not identify individual characteristics, despite Jeyaraj et al. (2006)'s recommendation to include such characteristics in organizational IT adoption research. On the other hand, they add IOIS-specific independent variables which occur due to the inter-organizational nature of these innovation cases. Amongst the identified IOIS-specific facilitators and barriers are transaction characteristics, resource dependence of the IOIS adopters and network externalities of the IOIS, such as the expected network size, service coverage rate of the IOIS and the size of own network prior to adoption. Additionally, they uncover the influence exerted on IOIS adoption by cultural and institutional forces, such as mimetic, coercive or normative pressure, institutional trust or cultural biases. Finally, they also point out the connection between IOIS adoption and diffusion and its outcomes, viz. organizational change, financial performance, strategic and operational benefits (Robey et al. 2008)

Based on the "dominant paradigm for IT innovation", as identified by Fichman (2004), IT innovation adoption literature follows a general, underlying theory that certain independent variables ("The Right Stuff"), also referred to as "predictors", "facilitators and barriers" or "characteristics", influence dependent variables that measure the quantity of innovation adoption. The same general paradigm is

used in IOIS (Kurnia et al. 2019; Robey et al. 2008) as well as platform research (Wright et al. 2017), so it is applied more generally in IS research. In essence, all studies based on the dominant paradigm share a set of underlying assumptions, some of which we want to present here briefly. We do not aim for an exhaustive list of underlying assumptions but want to present some core assumptions that are essential to the paradigm in its current form. The dominant research paradigm is based on positivism and, more specifically, mostly takes an economic-rationalistic view. Accordingly, many models are based on variance theory and utilize quantitative methods. The dominant research paradigm is based on a set of independent variables, i.e., variables that are not influenced by each other, influencing and thereby explaining the manifestation of a dependent variable. If more than one dependent variable is investigated, those dependent variables commonly have a deterministic dependency, i.e., one variable, e.g., the intention to use an innovation, solely determines the manifestation of the other variable, e.g., the actual system use. To reduce complexity, many models also assume constant, uninfluencable effects of the independent variables on the respective dependent variable. Lastly, the IS innovation adoption and assimilation is viewed as a closed system, i.e., the study object is commonly one finalized innovation (product) that needs to be adopted by a set of users. If a successor innovation shall be the study object, the model utilized must be refitted to the new context.

We utilize this dominant research paradigm as our underlying theoretical framework for the thematic analysis of CS adoption and diffusion research to answer RQ1, which then leads to the answer of RQ2, i.e., where we can see that the underlying assumptions of this paradigm might be outdated.

3 Literature review methodology and sample characteristics

For our review, we adopt a structured literature review (SLR) methodology guidance (Tranfield et al. 2003; Durach et al. 2017). According to the references, SLRs commonly comprise six steps: (1) define the research questions based on an underlying theoretical framework, (2) determine the inclusion/exclusion criteria, (3) identify and retrieve potentially relevant literature ("Baseline sample"), (4) select the pertinent literature according to the inclusion/exclusion criteria ("Synthesis sample"), (5) synthesize the literature and refine the theoretical framework, and (6) report the results.

Filter Type	Description	Group 1 "Port Community System" "Airport Community System" "Cargo Community System"	Group 2 (*:= ("port" OR "airport" OR "seaport" OR "intermodal") "Community System" AND ("rail" OR "dry port" OR "inland port") "Single Window" AND * "Digital platform" AND * ("Inter-organizational system" OR "IOS") AND * ("Inter-organizational information system" OR "IOIS") AND * ("Multi-sided platform" OR "Two-sided" OR "2-sided") AND *	Total
Keyword search ("Baseline sample")	Search string results from: • Ebsco Business Source Premier • Science Direct • Web of Science • Wiley Online • JSTOR • EconLit • T&F Online	179	353	532
Application of inclusion & exclusion criteria	Step 1: Removing of duplicated and evaluation of relevance based on abstracts – where available	60	18	78
	Step 2: Evaluation of relevance based on full paper	39	6	45
Snowball search	Forward and backward searches based on articles from previous steps			6
"Synthesis sample" size				**51**

Figure 1: Review Protocol adapted from Weitzel and Glock (2018) and sample description

We include papers of the past 25 years, specifically those published between 1996 and 2020, as research performed a focus shift from pure-EDI to CS around the years 1996 to 1997 (A. Moros-Daza et al. 2020). Furthermore, we include literature from peer-reviewed journals, conference proceedings as well as monographs, as we aim to be inclusive rather than exclusive, following the guidelines of Durach et al. (2017). We only include literature written in English as this is the dominant language in both transportation and IS research. Lastly, we only include literature that investigates the adoption and

diffusion of CS. Figure 1 depicts the review protocol. We used a wide range of databases to retrieve relevant literature, i.e., Web of Science, Science Direct, JSTOR, EconLit, Ebsco Business Source Premier, and T&F Online and also performed a manual search scanning journal site listings. We used Web of Science as it is seen as a valid basic database tool by scholars, despite certain biases (Mongeon and Paul-Hus 2016), which should not interfere with our research due to the inclusion/exclusion criteria defined above. Nonetheless, we included the JSTOR database to enrich results from Web of Science and the more focused databases Science Direct, EconLit and Ebsco Business Source Premier. T&F Online was included as it covers multiple journals with a strong maritime focus, such as Maritime Policy & Management, Journal for Maritime Research and others, which are particularly relevant for our context.

Based on the results obtained in a first database search using the keywords of "Group 1" (Figure 1), the keyword list was expanded to cover other definitions and frequently used terms ("Group 2"). A certain ambiguity prevails with the overlap of the term "single window" and CS (Moros-Daza et al., 2020), as described above. In the context of this study, we acknowledge this ambiguity and will include the term "single window" as potentially relevant in the CS context and accordingly add it to the "Group 2" terms. We also used alternative spelling (American vs. British English) and plurals of all terms. However, we did not use any limitational keywords such as "barrier" or "facilitator" to be inclusive rather than exclusive in retrieving the "Baseline sample" (Durach et al. 2017). This also considers that previous studies found most literature in the field to not (solely) focus on barriers and facilitators or to fail to name them as such due to their descriptive approaches (Carlan et al. 2016; A. Moros-Daza et al. 2020).

The "Baseline sample" (532 studies) was reduced to 456 studies by removing duplicates. Those were then checked for relevance, first by screening the abstracts of the identified works, followed by a detailed analysis of the entire article or book chapter for potentially relevant contributions. The high number of excluded papers in Step 1 (Figure 1) results from a large portion of literature from "Group 1" dealing with CS does not investigate their adoption and diffusion. An even larger number of papers from "Group 2" focuses on port-related issues such as port choice or port performance, where neither CS nor their adoption and diffusion are in focus. This was expected, though, as we followed the recommendations of Durach et al. (2017) to be inclusive rather than exclusive when generating the "Baseline sample". In the third step, a backward and a forward snowball search was conducted for the most relevant publications identified in the earlier steps of the search. In total the "Synthesis sample" (following just "sample") has a size of 51 papers (see the Reference section).

Relevant data was extracted from the 51 papers in a structured manner (Ghobadi 2015). We extracted the demographics of the study (author details, year of publication, source), contextual data (e.g., study object, location, management model of the respective port), research methodologies utilized, the study's operationalization of adoption and factors influencing it as well as (potential) causal links between these factors. The 34 peer-reviewed journal articles come from a wide variety of journals with a wide range of topics ("Scimago Journal & Country Rank" 2020) as only five journals contribute more than one paper to the sample. An uptake in research interest over time can be seen (Figure 1), although it seems to have reached a certain saturation. Most of the sample studies use a descriptive or exploratory case study approach (55%) while 12% use an explanatory case study (Yin 2003). 14% of the literature uses a theoretical or conceptual approach and 20% of the studies use quantitative approaches. This shows the different methodological focus of CS adoption research as Williams et al. (2009) found exemplarily that almost 65% of IT adoption and diffusion literature apply a quantitative approach.

For the extraction and coding of adoption factors into the final, multi-level classification framework (Figure 2 below), we utilized a method to capture the relationships between two sets of variables (Jeyaraj et al. 2006). For qualitative studies, coding was restricted to "strong arguments", i.e., speculative findings were excluded. To be consistent and exhaustive with extraction and coding of non-quantitative studies, the first author extracted and coded all non-quantitative sample studies within one week, while the second author took the role of a devil's advocate and proclaimed authentic dissent by suggesting alternative explanations and raising critical questions (Eisenhardt 1989; Nemeth et al. 2001). We constantly compared drivers and categories, which helped us understand whether the classification

model supported and continued to support emerging concepts and categories (Ghobadi 2015; Holton 2007). Lastly, to verify the resulting classification framework, we organized a virtual meeting and conducted a confirmatory focus group with six participants plus the first author of this paper, who acted as the moderator (Tremblay et al. 2010). The meeting was not in-person due to the current Covid19 pandemic and lasted a total of 90 minutes. The six participants were selected based on their research or work and previous experience in the cargo transportation industry (e.g., seaport specialist, management consulting). The focus group discussions showed the demand for sub-categories compared to the overarching levels. For example, the sub-category "Government-related" was included in the overarching "Environmental" level of the characteristics (see Figure 2). Furthermore, some drivers were moved between categories, merged or split based on the discussion.

4 Results and Discussion

Figure 2 presents our novel framework that emerged from the analysis of our SLR results. While the framework is based in the dominant research paradigm (Fichman 2004; Jeyaraj et al. 2006), it challenges some of the paradigm's underlying assumptions, as we will present in more detail in chapter 4.2.

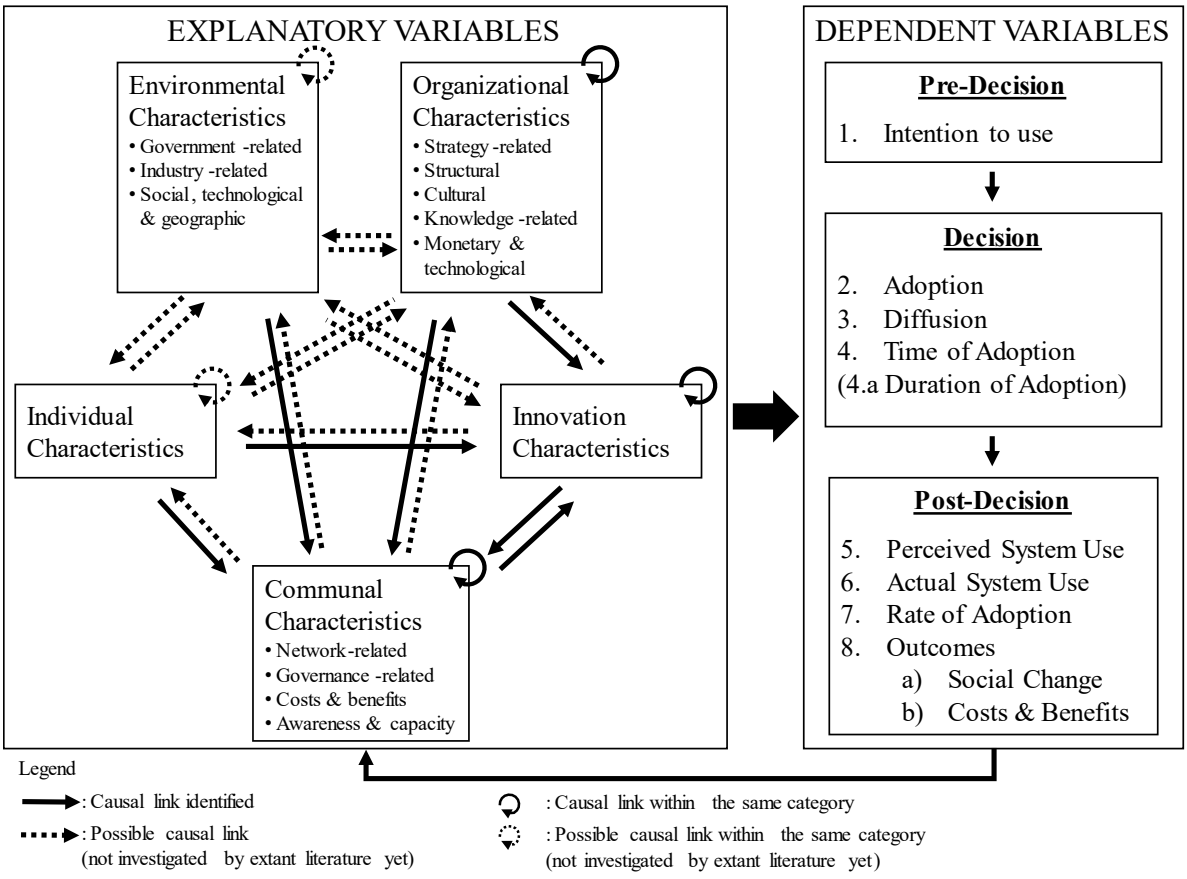

Figure 2: Multi-level conceptual CS adoption and diffusion framework. Own depiction

4.1 Operationalization of CS adoption and diffusion research (RQ1)

4.1.1 Dependent variables

Based on the SLR results, we adopted an IT assimilation process view (Rogers 1995b; Wright et al. 2017). We cluster the dependent variables into three groups according to their significance for each of the three IT assimilation steps following the definition of Wright et al. (2017), i.e., the initiation, or pre-

decision phase, the adoption decision itself and the post-decision or assimilation phase. The latter includes variables measuring the quantity of innovation adoption as well as its quality (Fichman 2004).

Current CS literature seems to be somewhat ambiguous when operationalizing the concept of "adoption and diffusion". Some authors explicitly name "CS adoption" as their dependent variable (e.g., (Keceli et al. 2008; A. M. Moros-Daza et al. 2016)), while others refer to "CS implementation" (e.g., (Polydoropoulou et al. 2011; Srour et al. 2008; Tsamboulas et al. 2012)). The term "implementation" in IT innovation research is most commonly used in the context of Rogers (1995b)'s "Diffusion of Innovation" (DoI) theory (Jeyaraj et al. 2006). "Implementation" is then described as the fourth of five steps of the diffusion process and directly follows the adoption decision. In this stage, the innovation is put into practice, but the overall decision to adopt the innovation has already been made (Rogers 1995b). CS literature is less stringent in its understanding of the "implementation" term. For example, Polydoropoulou et al. (2011) investigate the "factors affecting the successful implementation of a port community system". Implicitly, the authors then define "successful implementation" as the "likelihood of adoption", i.e., a variation of "intention to use", which is a pre-step to adoption and implementation in the DoI theory (Rogers 1995b). Srour et al. (2008), on the other hand, use both a narrow and an expanded understanding of "implementation", where their narrow concept matches Rogers' (1995b) implementation term. Still, their expanded concept seems to additionally include the pre- (i.e., knowledge, persuasion and decision) and post- (i.e., confirmation) -implementation stages (Rogers 1995b). Figure 4 presents the focus of our sample for investigated dependent variables. The Venn diagram on the left shows that 26% of studies focus on multiple adoption process steps. While the utilization of longitudinal case studies allow some studies to cover more than one adoption process step (e.g., (Chandra and van Hillegersberg 2018; Rodon et al. 2008)), most studies focus on one adoption process step. When compared to Jeyaraj et al. (2006)'s results, one can see that the general distribution seems to match for all but two dependent variables. While 40% of IT innovation adoption research operationalize the dependent variables as "perceived system use", only one CS study does so (Gustafsson 2007). On the other hand, IS adoption literature lacks studies on outcomes (Jeyaraj et al., 2006; Kohli and Melville, 2019), while CS literature has a major focus here. The outcomes under study cover a wide range of topics, ranging from direct impacts such as monetary and efficiency benefits as well as related costs (Caldeirinha et al. 2020; Carlan et al. 2016; Simoni et al. 2020; Vaghi and Lucietti 2016) to social impacts such as governance changes (Chandra and van Hillegersberg 2018, 2019) or organizational transformation (e.g., (Teo et al. 1997)). Of those, only the last two ones have been covered by IOIS research in the past (Robey et al. 2008). Lastly, both IT innovation and CS adoption literature lack a focus on "actual system usage" (Jeyaraj et al. 2006).

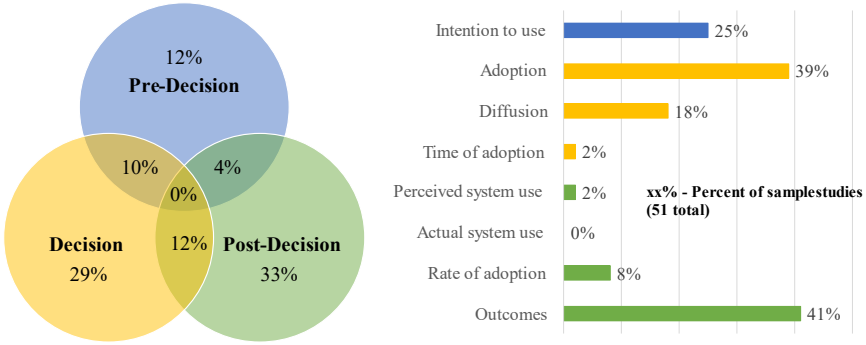

Figure 3: Operationalization of investigated dependent variables in CS literature. Percentage of the sample. Duplicates (e.g., investigation of both adoption and diffusion in one paper) within groups have been removed for the Venn diagram (left). Own depiction

From the strong focus on outcomes, we would argue that both a pro-innovation bias (Fichman 2004; Rogers 1995a) and a pro-adopter bias (Rogers 1995a) known from IT innovation adoption research (Jeyaraj et al. 2006) are present in CS adoption and diffusion literature. Outcomes are mostly studied either on a theoretical basis with a pro-innovation bias as only performance increases are considered

(e.g., (Aydogdu and Aksoy 2015; A. M. Moros-Daza et al. 2016)) or investigated with successful cases that only include those companies that actually adopted the CS (pro-adopter bias, e.g., (Caldeirinha et al. 2020; Chandra and van Hillegersberg 2019; Di Vaio and Varriale 2020)). A small minority of studies in our sample address these biases, though, and also focus their research on failure or subpar cases, which include stakeholders that did not adopt the respective CS (Rodon et al. 2008; Wallbach et al. 2019). The biases might be induced by the strong focus of CS adoption literature on developed countries' seaports, as some of those have shown success before research on the topic was even conducted (A. Moros-Daza et al. 2020).

4.1.2 Explanatory variables

In this section, we refer to "adoption" as an aggregated construct, including all operationalizations identified in section 4.1.1. We identify a total of 97 explanatory variables in our sample (grey speech bubbles in Figure 2). Figure 4 uses an adapted Venn diagram with elliptical shapes to display the distribution of sample studies between the five categories of our framework. We see that 45% of our sample investigate or identify explanatory variables from four or more categories, but only 29% of studies find or examine individual factors.

Compared to IT adoption research (Jeyaraj et al., 2006), individual factors seem to be understudied in the CS context. This is in line with IOIS research, mostly ignoring individual factors as well (Kurnia et al. 2019; Robey et al. 2008) and shows exemplarily the importance of viewing IOIS adoption as a multi-level problem, including all levels of potential influence factors (Kurnia et al. 2019; Zhang and Gable 2017). Accordingly, environmental factors, which were the least studied variable group in Jeyaraj et al. (2006)'s sample, are covered by 71% of our sample. Communal factors have been the main focus of many CS adoption studies. We would argue that the special context of CS generally justifies the focus of extant CS adoption and diffusion research on communal factors as this can enhance the understanding of IS adoption research for complex, competitive B2B environments. On the other hand, more individual factors could be included in future CS adoption research.

When comparing the specific factors that have been identified, a significant overlap between extant IS with CS adoption research can be attested. The focus in the two fields differs strongly, though. The two most studied explanatory variables in IT adoption literature viz. "perceived usefulness" and "ease of use", which are both innovation-related characteristics, can be taken as an example. Both are commonly used in quantitative methods based on Technology Acceptance Models (TAM) (Davis 1989) and have only been studied or identified by 6% of our sample. CS-related results for "perceived usefulness" and "ease of use" seem to match with those of IT adoption literature generally. However, the comparison is hampered by the small number of CS studies covering them. Jeyaraj et al. (2006) find that "perceived usefulness" is in many cases (90%) a significant factor and "ease of use" in 54% of cases. While Wallbach et al. (2019) find "ease of use" to be a significant factor for the adoption decision in the ACS of Frankfurt, Germany, they do not report on "perceived usefulness". Keceli et al. (2008), on the other hand, use a TAM model approach to investigate Busan's PCS and find that "perceived usefulness" but not "perceived ease of use" is a significant factor in predicting the intention to use the PCS. They only find the significance of "perceived usefulness" for small companies, though. General tendencies in the identified variables seem to match for other variables similarly.

Despite the significant overlap, we identified two groups of explanatory variables exclusive to the CS context. The first group of such factors is related to the strong involvement of governments in CS, both as directly involved stakeholders but also as institutions capable of changing essential contextual conditions. Given the local boundedness of CS, governmental influence is almost inevitable. Consequently, multiple studies find that a strong involvement of governmental actors such as the port authority or regulatory and law enforcement agencies facilitates the adoption of CS (e.g., (Di Vaio and Varriale 2020; Teo et al. 1997)). These governmental institutions can (positively) influence CS adoption in multiple ways. They can adapt the country's legal framework to be more CS favorable, for example, by enforcing an electronic submission of customs. This can create legal certainty for CS users and should

be aligned with international standards (e.g., (Bagchi and Paik 2001; Tsamboulas et al. 2012; Wallbach et al. 2019)). A clear political agenda can build trust with involved stakeholders and foster foreign investments, both seen as facilitators (Gordon et al. 2005; Gustafsson 2007; Vairetti et al. 2019). If a developing country's government and its respective authorities lack the appropriate financial resources, which can act as a barrier, international loans can be a viable source of funding (Adaba and Rusu 2014; Urciuoli et al. 2013). War and corruption, both strongly influenced by governments, have been found to be barriers to the adoption of CS (Adaba and Rusu 2014; Tijan et al. 2012), which seems straightforward given the lack of trust which both create. While the leadership and a potential CS start-up funding by local public authorities are identified as facilitators (e.g., (Bagchi and Paik 2001; Carlan et al. 2016; Simoni et al. 2020; Vairetti et al. 2019)), it should be noted that proper prioritization of relevant functionalities is seen as essential, i.e., the digitalization of government-related processes should not necessarily be the sole focus (e.g., (Chandra and van Hillegersberg 2019; Srour et al. 2008; Wallbach et al. 2019)).

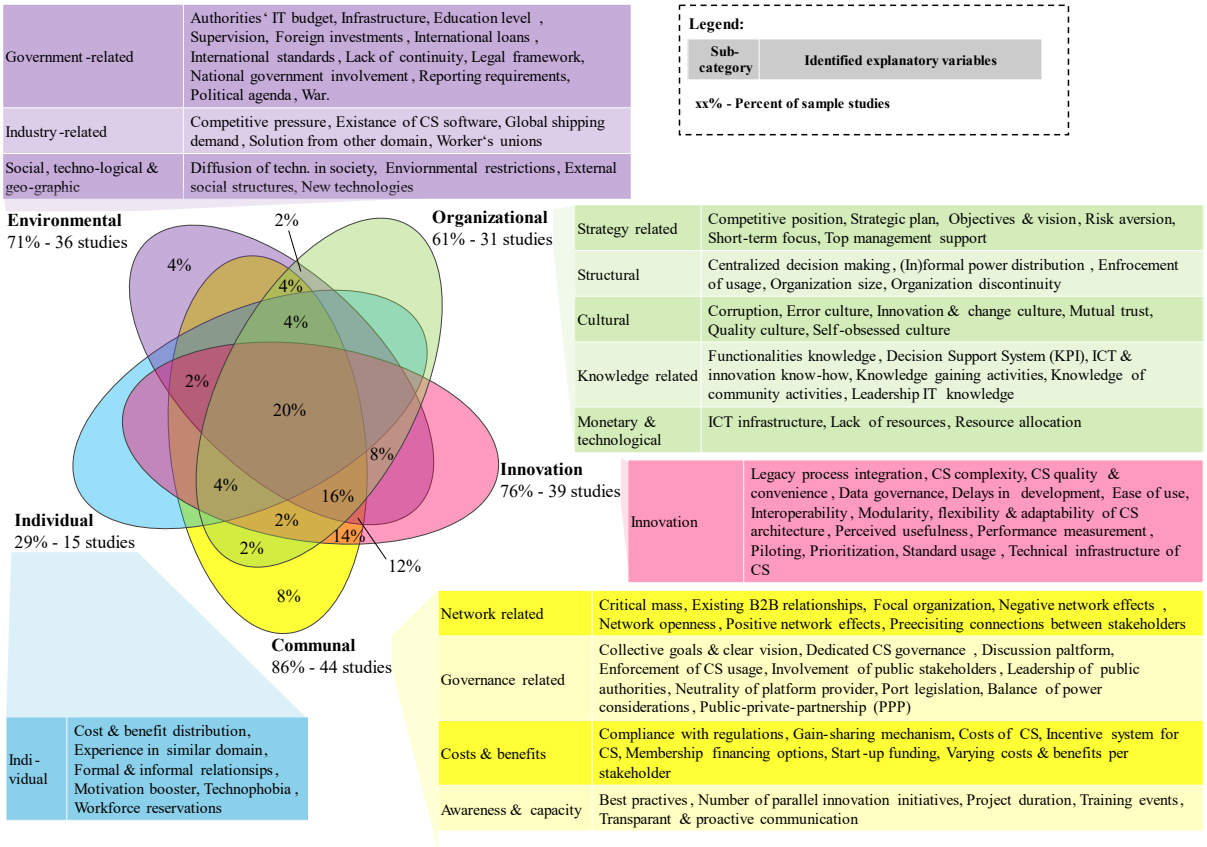

Figure 4: Distribution of explanatory variables investigated or identified per category. Percentage of studies in the sample. Blanks represent 0%, the sum of percentages in the Venn diagram is not 100% due to rounding. Own depiction

The second group of factors specifically relevant to CS evolves around the diverse set of stakeholders that come together, from various transport network stakeholders to service providers, banks, insurances and governmental authorities. Communal, inter-organizational trust is identified by multiple studies to have a significant effect on adoption (Keceli et al., 2008; Urciuoli et al., 2013), but also multiple factors that have a trust-building effect have been found. Some authors suggest that it is important to define collective goals that are shared amongst all stakeholders of the community and point out that the consideration of all stakeholder needs is crucial (e.g., (Klievink and Janssen 2014; Rodon et al. 2008)). This sounds easier than it might prove to be in practice, though. Multiple examples in our sample suggest that the more diverse the involved stakeholders are, the more complicated this process might become. For example, Rodon et al. (2008) describe the difficulties that the port of Barcelona's PCS "PortIC"

faced, when new stakeholders, in this case, banks, tried to join the IOIS. Multiple former stakeholders saw the banks as intruders with interests that were not aligned with their own, which caused mistrust amongst stakeholder groups. One operational option to overcome such issues and involve all stakeholders and their needs is to institute a dedicated CS governance, i.e., a combination of a board, working groups and discussion platforms, where all stakeholders can contribute (e.g., (Chandra and van Hillegersberg 2018; Rodon et al. 2008; Vairetti et al. 2019)). Another approach would be to set up a shareholding community (e.g., (Damsgaard 1999)).

Some relevant factors from IOIS research have not yet been studied in the CS context, viz.: "transaction characteristics", "mimetic pressure" and "elapsed time since adoption" (Robey et al. 2008). While several studies (Bagchi and Paik 2001; Nota et al. 2018; Rodon et al. 2008; Van Baalen et al. 2009) showcase the facilitating effect that normative and coercive pressure can have on the adoption of CS, mimetic pressure effects have been mostly ignored. We would argue that this focus arises from the strong involvement of governmental stakeholders in CS, who can apply both normative and coercive pressure. While a "Focal organization" has often been identified to have a facilitating effect on the adoption of CS (e.g., (Caldeirinha et al. 2020)), this is mostly seen from a governance perspective, where the focal organization takes a leadership role. The mimetic pressure that such a focal organization can have, has not been studied in CS adoption literature, though.

4.2 The dominant paradigm's underlying assumptions in the CS context (RQ2)

We now investigate which underlying assumptions of the dominant research paradigm of IS adoption and diffusion research can be challenged based on our CS context results. As described above, CS adoption research relies heavily on case study approaches. Due to this different methodological focus, some of the underlying assumptions of the dominant paradigm can be challenged as the qualitative research approaches (e.g., grounded theory (Wallbach et al. 2019)) rely less on existing models and theories and are more exploratory and explanatory. Specifically, the underlying assumptions that we challenge based on our results are the deterministic view on dependent variables, the independence of explanatory variables, and the independence of innovation from previous, related innovations.

First, the vast majority of studies investigating IS innovation adoption and diffusion focuses on a singular dependent variable (Jeyaraj et al. 2006; Robey et al. 2008), e.g., the intention to use innovation and assume that the succeeding assilimation steps are following necessarily solely based on the initial dependent variable. Exemplarily, this can be seen from the various TAM-based models (e.g.,(Viswanath Venkatesh and Bala 2008)), where the "Use behavior" is a direct result of the "Intention to use," which is the core dependent variable in the model. More recent approaches, such as the Unified theory of acceptance and use of technology (Venkatesh et al., 2016), already aim to incorporate the effects that "independent" variables can have on the actual use of innovation. Still, the outcomes, such as "individual performance" or "economic development," are once again viewed as directly influenced solely by the actual innovation usage. Especially those CS studies that utilize a longitudinal case study approach (Chandra and van Hillegersberg 2018; Rodon et al. 2008) show the weaknesses of investigating what influences the intention and maybe even the decision to adopt an innovation and then taking the actual usage and even more importantly the resulting outcomes as a deterministic result from these dependent variables. Chandra and van Hillegersberg (2018) and Rodon et al. (2008) show that actual system usage and the innovation adoption outcomes are in fact influenced by many more factors than just the "previous" step(s) in the assimilation process and that a factor combination that leads to a high intention to use an innovation does not necessarily lead to a high innovation usage, let alone a desirable outcome.

Second, some studies in our sample (e.g., (Keceli et al. 2008; Polydoropoulou et al. 2011; Wallbach et al. 2019)) identify causal links between "independent" variables (solid arrows in Figure 1). In the context of CS being highly complex digital IOIS or even platforms, more complex interactions between the variables seem to be relevant. Consequently, we rename the "independent variables" from the dominant paradigm to "explanatory variables" in our framework. Due to space limitations, we cannot present all

evidence for the causal links between the explanatory variables, but focus on two studies. First, Keceli et al. (2008) show that the organizational characteristic "organization size" has a significant effect on multiple other variables that we categorized under the organizational, innovation and communal characteristics groups. Specifically, Keceli et al. (2008) find that the organization size influences the effect strength and relevance of various other explanatory variables, including top management support (organizational characteristic), compatibility or interoperability (innovation characteristic) and enacting the power of the CS provider (communal characteristic) which can accordingly not be considered independent and with a linear effect on one or multiple dependent variables as assumed by the dominant research paradigm. Similarly, Wallbach et al. (2019) show that a wide range of explanatory variables influences the network effects (communal characteristics) of a CS, which themselves influence the adoption of the CS. It is conceivable that more causal links between variables exist that have not been uncovered by extant research yet, which we indicate in Figure 1 with dotted lines. This includes complex interactions between variables that go beyond linear effects, i.e., so-called innovation configurations (Fichman 2004). For example, some IS research examines the effect of network externalities on IOIS and platform adoption and diffusion (Ayers et al. 2009; Robey et al. 2008), but little research examines the effects that other characteristics of the innovation environment have on the network externalities themselves (Loux et al. 2020; Tan et al. 2015; Wallbach et al. 2019). Given the ever-increasing complexity of IOIS and digital platforms, we argue that the underlying assumption of independence of explanatory variables has to be given up in future research in the field.

Third, we challenge the underlying assumption of the dominant research paradigm that each IS innovation is studied independently of its origin. Our framework (Figure 2) incorporates the potential influence of previous experiences from the same innovation (environment) based on the SLR results. If an innovation outcome is, for example, a change in the governance structure, this can influence future innovation decisions (Robey et al. 2008). While the general "experience" of an individual has been studied as an independent variable in IT innovation research (Jeyaraj et al. 2006), the effects of an innovation's outcomes on future (incremental) innovations has to the best of the authors' knowledge been neglected so far. Given the modular architecture of CS, repeating innovation cycles can regularly occur that can influence each other (de Reuver et al. 2018; A. Moros-Daza et al. 2020). Again, the longitudinal case studies (Chandra and van Hillegersberg 2018; Rodon et al. 2008) investigating CS developments deliver valuable insights. For example, trust between both organizations and individuals is built over time and does not fall into one's lap. Therefore, it is helpful or even necessary for a better understanding of IS innovation adoption and diffusion to view the processes as iterative rather than independent of each other. Some questions remain unanswered such as "Is there an optimal time window for incremental innovations?" which is particularly interesting given the ever-expanding functional scope of CS enabled by the modularity of these digital platforms (Elbert and Tessmann 2021; A. Moros-Daza et al. 2020). Furthermore, the effects of different development stages of a platform on both the adoption itself as well as the factors influencing the adoption (Tan et al. 2015) have not been studied in the CS context. Given that there are many CS with differing development stages and trajectories (Elbert and Tessmann 2021), a future study of these effects seems particularly interesting, also and especially involving process theory approaches.

5 Conclusion

The adoption and diffusion of IOIS in competitive B2B networks is a highly complex and dynamic process throughout all stages and extant insights are scattered and limited in multiple aspects. We show to researchers interested in IOIS, that Port and Cargo Community Systems (CS) are a special case of IOIS in competitive B2B networks and as such worth studying. CS are also locally bounded platforms, which allow researchers and practitioners to gain highly contextualized insights called for regularly (de Reuver et al. 2018; Jackson et al. 2019; Robey et al. 2008). Research on IS innovation adoption and diffusion has followed a predominant research paradigm for a long time (Fichman 2004; Jeyaraj et al. 2006). However, key contextual conditions have changed since the origin of the first models and theories that build the basis of the paradigm. Accordingly, this study conducted a structured literature review

(SLR) to uncover how CS research operationalized adoption, diffusion and the factors influencing them (**RQ1**) as well as to determine which underlying assumptions of the dominant research paradigm of IS innovation adoption research are potentially conflicting with results from CS adoption research (**RQ2**).

Our results show that IS and CS research have a lot in common but are still somewhat separate at this point in time as CS focused studies are rarely thematized in IS-related journals and conferences. The general operationalization of CS research is very similar to IS research, as both predominantly utilize variance theory, with both quantitative and qualitative approaches. Yet, a detailed analysis of the SLR results reveals that both fields differ in the details, as CS research focuses much more on the outcomes, for example. Especially the results of the explanatory variables that influence the adoption of CS show that three of the underlying assumptions of the predominant research paradigm of IS research should be challenged in increasingly complex environments, viz. the deterministic view on dependent variables, the independence of explanatory variables, and the independence of innovations from previous, related innovations. Our results suggest valuable opportunities for future research by integrating and interleaving CS and IS innovation research more as both can benefit mutually. Firstly, IS innovation adoption research should leverage the insights from CS adoption research more by testing them in different contexts and investigate how results may differ. Secondly, IS innovation adoption research should question the underlying assumptions of key models and theories more regularly and new research approaches accounting for the complexity and multi-level interconnectedness of variables should be chosen. Given that highly complex relationships are under study, we would encourage future research to also consider the usage of process theory in addition to the predominant variance theory approaches to better understand the development of these relationships over time. Lastly, despite some longitudinal case studies in our sample, different stages of CS development and respective adoption drivers have rarely been investigated. A CS taxonomy would allow differentiating the platforms based on distinguishing characteristics. Additionally, more comparative case studies could uncover more specific and contextualized insights into geographic differences.

Our study contributes to the general literature on IS adoption and diffusion and specifically to CS research in various ways. First, we address the call of Moros-Daza et al. (2020) to add to the limited body of holistic CS research studies by developing a multi-level, conceptual CS adoption framework. We thereby also answer the calls for more multi-level research in the IS field (Bélanger et al. 2014; Kurnia et al. 2019; Zhang and Gable 2017). Second, we add to the knowledge base of conditions causing IOIS to succeed (de Reuver et al. 2018; Robey et al. 2008), such as sectoral differences for example in competitive pressure and geographic differences for example in environmental restrictions that some countries naturally have or social structures that differ from country to country. Third, we uncover that several assumptions of the dominant paradigm of IS adoption research might be challenged in future research. Additionally, the developed framework can help practitioners to better understand the complex, multi-level nature of drivers affecting the adoption of CS as a special case of an IOIS which can ultimately lead to higher adoption rates of these and similar IS innovations. The exhaustive overview of identified adoption barriers and facilitating factors can be used by practitioners to develop key performance indicators (KPI) for similar IOIS innovation projects, especially with strong governmental involvement.

Even though this paper endeavored to present a systematic review of the literature in its field, there remain some limitations. First, the search strings that were defined limited the search results to publications in English that used similar terminology. Secondly, the databases used during the search limited the journals, conference proceedings and monographs that were included in the review. Thirdly, it cannot be excluded that other relevant publications have been published in reports, theses or grey literature publications. As our findings are based on the reviewed studies, the limitations of the reviewed papers may also apply to this study. This challenge was managed by the careful selection of inclusion and exclusion criteria as well as a confirmatory focus group with six participants. Despite these limitations, this paper applied a widely accepted methodology for systematic literature reviews advocated, among others, by Tranfield et al. (2003) and Durach et al. (2017). It followed the guidelines for rigorous documentation presented in these works.

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