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ABSTRACT
The purpose of this article is to analyze the impact of information technology (IT) solutions on the knowledge sharing process within the sea-land logistics network. To tackle the research aim, we illustrate the case of the Port of Genoa, the most important in Italy, the first to adopt a port community system to coordinate logistical processes. Our findings indicate how the IT platform, called E-port, improves interconnections within the system by creating a virtual network that facilitates data exchange among actors. Recent studies investigate ports as a simple logistics supply chain and not as a business network. This paper fills this gap by adopting an actor’s network perspective interconnected by an IT infrastructure that acts as a knowledge orchestrator in the business network.

KEYWORDS: Knowledge Sharing, Sea-Land Logistics, Networks, Port of Genoa

JEL CODES: M11, M15, O33
Sustaining knowledge sharing and the form of its transfer from one context to larger contexts poses questions from various research perspectives, especially when we consider business networks, which are reputed to be highly structured and institutionalized (Farinha et al., 2016). Knowledge sharing is defined by Pangil, Chan (2014, p. 52) as “the communication of knowledge from a source in such a way that it is learned and applied by the recipient”. This form of transfer can be described as the exchange of the approaches and behaviors that must be implemented within a business network in order to obtain competitive advantages over the competition (Bergman et al., 2004). The aim is to exploit the skills of human resources and the continuous innovations of the external environment (Chuang et al., 2016). Knowledge diffusion is viewed as the expansion of networks of users which are continuously interested and participating in these networks, so that original business ideas and solutions could escape their initial business contexts to extend to a wider context (Ernst, Kim, 2002; Narteh, 2008).

Recent scholars have analyzed the field of knowledge sharing in logistics business networks (Van Baalen et al., 2005; Smirnov et al., 2009; Kalogeraki et al., 2018). In this regard, we investigate the role of information and communication technology (ICT) in the sharing of knowledge in logistics business networks in order to improve business processes. For these reasons the research question of the study is: “How do IT solutions improve an actor’s knowledge sharing in a sea-land logistics network?”

In addition, knowledge sharing operates over different types of network systems (Davenport, Prusak, 1998; Damodaran, Olphert, 2000). Previous studies suggest that the logistics issue varies with network communication (Reagans, McEvily, 2003). Although the relationship between port user and ICT solutions in the port logistics network i.e. the port community system) has been studied intensively in this business network context (Chiu, 2006; Noll et al., 2010), much work still needs to be done to better understand the role of ICT solutions in knowledge sharing. For instance, the use of the port community system (henceforth: PCS) in a sea-land logistics network can contribute to port competitiveness in many different forms, such as the sharing of knowledge between different users (Carlan, Vanelslander, 2016). Solving the issue of communication among actors enrolled in a sea-land logistics network therefore remains a critical issue to secure the extension of networks and translate business operations. The article reports the case study of the port of Genoa, also known as one of Europe’s largest ports, which, in 2008, started to use a port community system to improve their business processes in sea-land logistics networks. The result of the study is a knowledge sharing model for port authorities and port users using PCS to collect and organize
external and internal knowledge to manage and implement their business operations. From 2008 to 2018 the port of Genoa increased its competitiveness with regards to a reduction in the variability of sorting times for goods, the reduction of entry and exit times of goods, the overall improvement of the level of sustainability of production phases in terms of the work environment, and the “physical” increase of goods as a consequence of the “telematization” of sorting and control procedures. All of these issues are examined in the following pages. We tried to analyze the main features of new transport and logistics systems, starting from the needs of companies operating in a global context, and which are embedded in the logistics business network. We described how complex transport is organized, what are the phases, the peculiarities and the role which every service has in the logistics chain.

The research is structured as follows. Section 2 reviews the main literature about knowledge sharing processes and IT solutions in a logistics business network. Section 3 reports the research method used to analyze the case study of the port of Genoa, which is explored in Section 4 with the main findings. Section 5 discusses the results of the proposed descriptive model. Finally, Section 6 sums up the main conclusions of the study.

**Theory Background**

**Structuring a Theoretical Model**

Knowledge sharing is a field of research that has been investigated much more. A lot of scholars have achieved an understanding of the phenomenon in several different aspects. Our study of the literature has stemmed from the necessity to set up a theoretical model that is able to grasp the mechanisms of a digital platform network, in a very complex and heterogeneous community like that of a port. To build our model we have conducted a literature review by focusing on the impact of IT solutions at two levels: 1) on knowledge sharing processes and 2) on the logistical operations. We have successively circumscribed all the positive and negative effects and interconnections generated by the adoption of an IT infrastructure. It was useful to understand how our sample has reacted to the implementation. In the first part we have formulated a review with the aim of clarifying the strengths of an IT network that works well. Then we have briefly shown the risk exposure suffered by the players involved. In the second part of our literature study, we have reviewed the most quoted scientific papers in the field of logistical management with the possibility of capturing the main factors that determine a successful digital platform implementation in a port community.
Knowledge Sharing Processes and the Role of New Technologies

The concept of knowledge is defined, according to Choo (2000), as “the outcome of people working together, sharing experiences, and constructing meaning out of what they do”. The role of knowledge has a significant impact on economic institutions. Knowledge is a critical strategic resource, allowing organizations to gain competitive advantage (Spender, Grant, 1996, Davenport, Prusak, 1998, Foss, Pedersen, 2002; Neukam, Guittard, 2018). For these reasons, scholars have developed theories around the concept of knowledge, for example the resource advantage theory (Grant, 1996) and the knowledge-based view of the firm (Bock et al., 2005). Knowledge has been defined as tacit and explicit: in the first case, knowledge is an informal outcome, not codified, in the second case knowledge has formal and transferable features (Lawson et al., 2009). Lam (2000) uses the concepts of tacit and implicit knowledge, linked to the level of individual or collective analysis. In this way, he decodes four types of knowledge: (1) embrained knowledge that has, from an individual perspective, an explicit feature; (2) embodied knowledge, that has, from an individual perspective, a tacit feature; (3) encoded knowledge, characterized by explicit features from a collective perspective, (4) embedded knowledge, that has more tacit features from a collective perspective (Lam, 2000). We selected both the collective perspectives because of the high degree of complexity of sea-land logistics, which is better explained through a broader approach. The choice of not operating a delineated distinction among tacit and explicit knowledge hinges on the high heterogeneity of information and the actors involved in the investigated network, which hinders categorical knowledge labelling.

Knowledge sharing is the process by which information and know-how is conveyed between the actors of organizations in order to develop new ideas, to implement best practices or new procedures (Cummings, 2004). According to Santos et al. (2012) knowledge sharing is defined as “a provision of task information and know-how to a person, so that (s) he can collaborate with others to solve problems, develop new ideas or implement policies or procedures”. Davenport and Prusak (1998) enrich the debate on the knowledge sharing process by emphasizing the aspect of the absorption of knowledge which is significantly linked to the capacity to receive, implement and exploit the knowledge. In agreement with Davenport and Prusak (1998), our study points out the mutual mechanisms of absorption within sea-land logistics networks. In other words, the right circulation of information is the most efficient means to result in exploitation of the relationships. A knowledge sharing process that works well powered the networks by acting as a link...
between the individual and the general level within an organization, modifying the structure and functioning of the system (Davenport, Prusak, 1998; Damodaran, Olphert, 2000). Several empirical studies have confirmed the thesis according to which an organization which implements best practices related to knowledge sharing achieves improvements in terms of cost reduction, innovative capabilities, new product development, and business growth rate (Cummings, 2004; Lin, 2007d; Mesmer-Magnus, DeChurch, 2009). Different branches of the social sciences have analyzed the knowledge sharing process. In order to clarify the meaning of knowledge sharing, and to support the objective of this study, it is useful to divide the literature on knowledge sharing into four strands: ICT systems studies (Wasko, 2005), organizational behavioral studies (Bordia, 2006), strategic management studies (Reagans, McEvily, 2003), and psychology studies (Lin, 2007). After segmenting the literature into four main streams, one for each of them, a critical and crucial level of analysis emerges. The four levels of analysis to improve the knowledge sharing process (Choo, de Alvarenga Neto, 2010) are: the social and behavioral characteristics of members of the organization (e.g. inclination to collaborate, interaction, trust); cognitive characteristics (e.g. values, sharing of objectives); endowment of informative systems (e.g. communication platforms, social networks); and organizational strategy (e.g. organizational structure, recognition of leadership).

In order to more fully support this study, our literature review is more focused on the role of technology and social networks within an organization. We have built up the theoretical background by withdrawing from the IT and managerial field of research and focusing on the endowment of informative systems within complex and heterogeneous system. IT researchers have highlighted how the role of digital platforms has stimulated the proliferation of new links within organizational networks (Reagans, McEvily, 2003; Attour, Barbaroux, 2016). Some empirical studies have shown how the provision of a digital platform increases the number of links within an organization (Cummings, 2004). Other previous studies have highlighted the role of a platform as a conveyor of knowledge toward and into the network (Chiu, 2006; Wasko, Faraj, 2005). Chiu (2006) has shown a positive correlation between the helpfulness of knowledge shared and the provision of virtual communication platforms. Several drawbacks might affect the design and the maintenance of a digital network. Researchers highlight four points of weakness: geographical distance, time zones, trust, and cultural distance (Noll, Beecham, Richardson, 2010). According to Boschma, (2007), all factors of weakness could in particular undercut those much more fragmented networks, where distance is a crucial factor; this is the case with the shipping industry, although, according to Boschma (2007), the difficulties are
less and less relevant from the collective perspective. In this case difficulties due to the geographical and cultural issue could be mitigated by the commitment of other players within the network. Although, when at least one of these difficulties occurs, the knowledge sharing process is delayed in terms of responsiveness, which impacts on the process of absorption and the use of knowledge flows (Nguyen et al., 2009).

A digital platform can enable a broad mass of advantages but, as with all disruptive revolutions, it may hide several risks. To carry out a broad analysis of the phenomenon, we must consider at least two kinds of drawbacks related to such a technological revolution. To begin with, a technological implementation may attract a backlash by constraining the actors to face the risk of stealing of data for all the actors involved in the digital networks. According to Belanger et al. (2019), when a community starts to use a digital platform this dramatically expands the probability of data leakage. This unexpected issue may affect the equilibrium among the actors by generating asymmetries and positions of weakness for some stakeholders. Another big issue is exposure to malware or viruses. In fact, the greatest concern is that actors may be threatened by the risk of cyber-attack. According to Allam et al. (2014), all the devices associated with the digital platform must be safeguarded by periodical updating or renewal.

**IT Solutions in a Logistics Business Network**

In the current economic scenario, the logistic function has become increasingly important for each company, especially those operating at an intercontinental level (Christopher, 2016; Wang et al., 2016). Recent scholars have attested to the success of organizations that manage their logistics strategy well (Grawe, 2009; Fabbe-Costes, 2018; Tu, 2018). The main issue for future logistics managers is the concept of operations strategy, since this integrates many different elements, such as the elements from basic inputs into completed goods and services for the end customer (Brown et al., 2013, p. 9). Moreover, as a result, it is possible to reduce management costs and at the same time offer to the customer a qualitatively superior service (Laari et al., 2016). The term "logistics" is used more and more, sometimes inappropriately, in particular for the transfer of goods from one place to another. Taking this into account, the transport world, in a logistics network, has reorganized itself to meet the new needs of operators and users (Alshamsi, Diabat, 2015). Firms need to create a service that is cheap but of high quality (Hollebeek et al., 2018). Basically, more means of transport need to be used, even when physically this is not essential, so as to achieve savings. The reduction in the cost of transfer was made possible both by the best techniques applied over
the years to the means of transport, and by a new concept in the handling of goods, which provides for a more intensive use of new technologies as a crucial driver for the improvement of business processes (Davenport, Short, 1990).

This solution is made possible by some factors such as the use of the mode of transport that allows cargo to travel at lower costs on a certain route, the exploitation of new technologies, or the use of hub and spoke techniques (Tu, 2018). Although additional costs such as handling the additional load or lengthening the routes and times must be borne, the lower costs associated with the purely transport phase can generate cost advantages that amply compensate the cost drivers for the complex cycle of transport in the logistics network (Indounas, 2018).

In addition to this rich stream of logistics process improvement methodologies, the recent arrival and adoption of information and communication technologies has created a new opportunity for logistics networks. By using cloud platforms companies can access a common data system that is able to deliver, at the same time, the interdependent processes of the various platform users (Helo, Szekely, 2005; Ferretti, Schiavone, 2016). Moreover, as affirmed by Goldsby, Zinn (2016), these and other technological developments point to major changes in supply chains, logistics systems, and the skills needed to operate in this new environment.

In recent years, the sea-land logistics network has undergone some radical changes that have rapidly transformed relationships between the reference players, increasing competition and revealing how local companies are increasingly involved in the economic development processes of the regions (Notteboom et al., 2017; Berli et al., 2018). Moreover, actors with an innovative background are involved in integrated sea-land logistics activities (Bichou, Gray, 2004). Sea-land operations are particularly exposed to these scenarios, which involve diverse port users with different needs and characteristics (Ferretti, Schiavone, 2016).

The transformation of logistics networks has actually developed ports in multi-user contexts (Ferretti et al., 2017; Parola et al., 2018), redefining the role of key users in sea-land logistics networks (e.g. port authorities, shipping companies, terminal operators, transport service providers, logistics companies, etc.). Sea-land logistics networks constitute a rather unique range of adjacent sectors in which the main actors interact and compete with each other in the various areas of specialization. The challenge of port-cities requires a combination of the supply of efficient logistic services with social demands and the problems posed by local populations (Parola, Maugeri, 2013). Therefore, it should be borne in mind that a logistics network must
in any case be functional for a certain type of transport, and allow a service
caracterized by time and costs in line with the expectations of operators
and customers (Ferretti, Schiavone, 2016). These are, in fact, that they will,
directly or indirectly, use the structure, and the indications that they provide
allow them to understand if a project concerning the construction or redevelop-
ment of a logistics base can be successful or not (Nottemboom et al., 2017).

In port management literature, recent studies have analyzed the adoption
of new technology solutions such as port community systems as a critical
success element of sea-land logistics networks (Marek, 2017; Chandra, van
Hillegersberg, 2018). As affirmed by the IPCSA¹, a Port Community System
"is an electronic platform that connects the multiple systems operated by a variety
of organizations that make up a seaport or airport community. It is shared in the
sense that it is set up, organized and used by firms in the same sector – in this case,
a port community". For instance, Tijan et al. (2015) analyzed Croatian seaports
regarding ITC integration, indeed, some ports are developing new IT solu-
tions to support business networks respecting the current state-of-the-art, and
to sustain the intermodal chains of sea-land logistics (e.g. railways) through
the diffusion and adoption of Intelligent Communication Technologies (i.e.
Internet of Things - IoT, Artificial Intelligence, Big Data Analytics, etc.),
in order to improve their knowledge-based competitive advantage in global
logistics business networks.

Research Method

The article opted for a qualitative approach using the case study method
based on multiple sources of evidence to explore how IT solutions influence
actors’ knowledge sharing in logistics networks. The case study is a research
method in management studies, and it is used when the shape of research is
“How” (Yin, 2009). As affirmed by Stake (1995), the case study is “the study of
the particularity and complexity of a single case, coming to understand its activity
within important circumstances”. Indeed, the multiple data elements provide
a stronger demonstration of, and consistency with, the key objectives of the
case study. We selected a case example to explore the processes described
above: the lack of in-depth recent management studies about this phenom-
enon supports the development of an illustrative study (Stake, 1995). The
Genoa case was selected according to the extreme case method. According
to this methodology, some issues observed are analyzed by inferring the exist-
ence of some preconditions (Seawright, Gerring, 2008).

¹. https://ipcsa.international/pcs
This paper investigates a new IT practice entitled the port community system (PCS) adopted by the Genoa port authority, focusing on the knowledge sharing challenges that port authorities, firms and port users face in the transition from the usual practices to the new one.

Specifically, in the case study, we analyzed the concept that issues in transferring knowledge for firms and port authorities could be solved using PCS solutions. Accordingly, exploratory research into the PCS implementation was conducted through the following phases:

- mapping of the actors’ logistics network according to their skills functionality and documentation of the connected intervention of reorganization;
- identification of the subjects involved in the process according to their own specific contribution to the system;
- analysis of the interchange nodes of knowledge in terms of data and best practices;
- identification of delays affecting the logistics process (e.g. transport operations and import/export operations).

We analyzed the case of an E-port as a PCS solution adopted by the Genoa port authority using more data and elements from multiple sources of evidence (Yin, 2009):

- documentation (collecting and analyzing online data from the trade press and social magazines such as port conference reports and European Union documents);
- actors’ network observations. Interviews were conducted with eight experts (i.e. four researchers and four logistics managers) to explore in depth how knowledge could be shared within the sea land logistics network via PCS adoption. All the eight respondents are experts in port logistics and are involved in European projects about these issues. Our research aim was focused on the improvements, effects and risks of PCS adoption with regards to knowledge sharing processes. Each interview with five open-ended questions typically took 60 minutes. We also reported data from selected interviews found on the web through desk research of actors of the logistics network in the port of Genoa.
- archival records (official data from the annual report of the Port of Genoa and official social media pages. We compared official communications from 2008 to 2018 using multiple sources of evidence. We also analyzed information regarding the goals planned and achieved by PCS of the Port of Genoa).
All interviews were audio-recorded and wrote down verbatim. We interpreted and coded the key elements of the actors involved in the sea-land logistics network using the holistic approach described by Saldana (2015): “To codify is to arrange things in a systematic order, to make something part of a system or classification, to categorize. Coding enables you to organize and group similarly coded data into categories and family because they share some characteristics”. For these reasons, we also identified and analyzed actors’ categories in order to develop a knowledge sharing model for this business network.

This research method helps to provide important information about knowledge sharing in terms of communication between different users. Indeed, we focused on the actors’ network involved in sea-land logistics processes (e.g. transport operations, import export operations).

In this way, it is feasible to investigate what happened from 2008 (PCS implementation) to 2018 (PCS improvements). Data triangulation is made possible by the disposability of different data sources that provides stronger demonstration of, and consistency with, constructs and findings. The following section shows the results of the PCS analysis.

Case Study Analysis and Main Results

This section reports the results of the case study analysis. The process of goods movement involves the passage of the container, which arrives by ship or by land, along the entire logistics system, and which requires some documents before leaving the port. These documents have to be drafted and transmitted within the port network manually. At the beginning of the millennium, due to the increase in the flow of goods, the Genovese port system was strongly hindered by the sum of all the delays.

For this reason, since 2008 an IT platform has been implemented to promote the exchange of knowledge within the network. This was called E-port Logistic.

E-PORT² is a platform that allows the various players present within the Genoa port system to integrate the available IT systems. The logistic chain is composed of various institutions, from the Public Administrations (e.g. Coast Guard, Customs Agency and Financial Police) to private operators (e.g. shippers, marine agents, terminal carriers and haulers).

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According to the Port Genoa official website³, 20,000 users and over 1,500 companies are connected to the E-port platform, managing more than 15 million import/export documents per year (including customs declarations, bookings, gate in/gate out management, truck appointments).

As affirmed by one of the logistics managers interviewed, the E-port system improves data flow and reduces the transit period in order to decrease costs “E-Port is the operating system that informs in real time the arrival and departure of the truck and the ship. The aim is to avoid unnecessary waiting times and queues. This platform informs all the actors about who does what (e.g. Port Authority, ship forwarders, terminal operators, transport carriers). Therefore, certainty and the improvement of goods exit times from the port are the key elements on which to focus attention, aiming at a strong de-bureaucratization of the procedures and the de-materialization of the documentation in favour of advanced IT systems”.

The Port Community System of the port of Genoa has recently been integrated into the National Logistics Platform⁴ which, through the integration of systems and procedures, seeks maximum operational efficiency for the entire Italian logistics system. Supply chain analysis was conducted through the perspective of the various actors involved in the logistics network.

**Identification and Analysis of Actors in the Sea-Land Logistics Network**

During the Genoa port analysis, we collected data about E-port evolution from 2008 to 2018. This choice aims to focus on the actors and on their relationships that make up the network:

- Ship forwarders
- Developers
- Customs authority
- Terminal operators
- Transport carriers

- The ship forwarder is the operator that prepares documentation for each ship arriving or departing. The office has two important functions:
  - fills and transmits arriving goods documents;
  - fills and transmits departing goods documents.

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⁴ https://www.airnet.it
Ship forwarders work in cooperation with the customs and draw up a document of arrival or exit of the ship. At this stage of the logistics process, the forwarder encounters the transporter awaiting the sorting of goods or cargo. Prior to the introduction of the E-port platform, the relationship was managed directly by the actors, then the E-port intervened as a moderator of information, reducing waiting times.

The group of shipping companies, in a business network perspective, has formed an association called “Spediporto”. This association has promoted the implementation process of the E-Port platform, by the HUB Telematica, which is the developer of the E-port project, created with the aim of innovating the process of sharing data, the dematerialization of documents, and the creation of a virtual business network. The President of Spediporto, Alessandro Pitto, participating in the 18th edition of the Sea Freight Conference said:

“It is a unique system in the Italian scene that guarantees efficiency and safety. We started working in 2004 in the wake of the daily queues and congestion at the gate - he says - then the port moved 1,600,000 teus and waiting times for trucks could even take up to 4 hours. Today, the port handles 2,600,000 teus, almost double, and the maximum waiting time for a truck for the terminal tour is 30 minutes” (http://www.ansa.it/mare/notizie/portielogistica/news/2018/02/01/portigenovapitto)

These statements highlight the increase of 62.5% in the volume of goods, and a reduction of 87.5% in waiting times for trucks. In the same conference the President affirmed: “With equal infrastructures thanks also to E-port, Genoa port could almost double the volumes”.

This statement highlights how the exchange of knowledge in terms of data, within the port system through a telematic platform, brings a competitive advantage with the same physical infrastructure.

– The developers Hub Telematica and Elsag Datamat have developed the E-port IT platform. The two companies are part of the “Spediporto” association. This highlights how the need to improve the process of sharing information is created from within the network. The same actors were the developers of the innovation, in an attempt to exploit their knowledge to create a competitive advantage over other ports in Europe. The advantages deriving from implementation of the platform were highlighted in an
interview with the ILSOLE24ORE® newspaper by Eng. Giorgio Cavo, CEO of the Telematic Hub.

“The transition from paper to the electronic transmission of documents was a project strongly shared by all the components involved”… “Now we have transferred onto a web-based system all the exchanges of documentation necessary for the importation of goods and a good part of those for export. The operators have to transmit their documents in a pre-established format and the system is a great concentrator of these messages, which are sorted to the right ‘boxes’ in a few seconds, allowing synchronization of the exchange of documents between all the subjects involved” (http://elenacomelli.nova100.ilsole24ore.com/2010/04/25/a-genova-limportexport).

These words highlight how the technological component can enhance the passage of data within a business network.

– On the date of implementation of the E-Port system the customs authority of Genoa port had a platform called AIDA. The innovation process led to the connection of the AIDA system to the E-port platform and the consequent creation of a single customs desk. The creation of this branch facilitated a reduction in time by means of a procedure that is called “preclearing” or better, “customs clearance at sea”. Through this innovation, data can be used when the ship is still at sea, thus starting the data exchange process. In this way the port network can use a unique virtual office, which takes care of information from ships and gates simultaneously. The importance of this telematic desk is supported by the declarations of the director of the Liguria Customs Agency, Claudio Monteverdi, who stated in the press: “The Single Customs Desk is the tool that is upstream of the release of goods and can significantly affect the speed of the whole logistics process” (http://genova.erasuperba.it/porto-e-port-sistema-telematico).

– The operations carried out at the terminals concern the handling of containers, in particular the incoming flows of empty containers for loading or full containers for unloading. Due to the substantial number of documents and reports, the terminal operation is one of those which have benefited the most from implementation of the technological platform within the port network. E-port has proved to be an excellent catalyst for outgoing and incoming information to the benefit of the gates, the ship forwarders, and the control authorities. Therefore, with a single flow of information to the platform, several actors were able to find the requested information at the same time.

These advantages were highlighted by the managing director of the container terminal PSA Voltri, Gilberto Danesi. “Our decisive objective is towards the automation of the yards, which is the only way to increase productivity and try to really compete with the ports of Northern Europe” (http://www.ansa.it/mare/notizie/portielogistica/news/2018/01/24/porti-genova-danesi).

– Most goods leave the port of Genoa by road transport. For this reason, the important actors in the port logistics network are the transport carriers. The two associations that participated in the improvement process of the E-port system are “Trasportounitò” and “Assotrasporti10”. The fundamental relationship between transporters and the gate is a crucial logistics node in entry and exit operations from the port area. In order to distribute or pick up a container, the carrier must deliver a waybill to the gate operator, using the E-port procedure. Through the platform the transporter also verifies that the container is withdrawable/deliverable, and subsequently can send the relevant notice of arrival.

Finally, by means of the E-port procedure, starting from 2016, the weighing times of the vehicle have been shortened through communication of the weight of the vehicle to the control authorities, via E-port.

In summary, the E-port platform aimed to solve two problems affecting the incoming and outgoing logistics process within the business network, such as the reduction in sorting time for goods and the low volume of goods.

In this network a larger number of potential actors were reached, economies of sharing and the management of the port community system were achieved, and higher network externalities, based on a wider sharing of data, were obtained. The confines of the logistics network were thus kept as broad as possible. The results highlight how the dynamics of knowledge sharing can be facilitated within a business network by the introduction of a technological platform, which acts as an orchestrator and mediator. In the case of the port of Genoa, the main actors of the network contributed to the creation and development of the E-port platform (see Figure 1).

Discussion, Limitations and Conclusions

The case of the Genoa port analyzes the adoption of PCS that leads to knowledge sharing improvements in sea-land logistics processes. The port of Genoa has been one of the first Italian seaports in adopting this IT solution, due to the large structure of its business network. The findings contribute to

9. https://www.trasportounitò.net/
a better understanding of how PCS can have a positive influence on knowledge sharing for its actors. More evidence of the Genoa case is that many types of actors should be involved simultaneously in order to boost their positive influence on the performance of logistics processes (e.g. transport operations, import/export operations).

As already reported in the literature, the key challenges for a PCS-driven reorganization of logistics processes is the improvement in communication and interactions within the network. This case highlights how technological implementation may support such a competitive and dynamic industry as the sea-land logistics network. As mentioned above, Davenport (1998) emphasized the role of infrastructure to increase competitiveness at two levels: the reduction in costs and growth of the sector. We point out a reduction in indirect costs in terms of time saved throughout the process, as confirmed by the CEO of Telematic Hub. In terms of growth of the system we have compared the volume of treated containers. The TEU traffic, for instance, starts to increase from 1,533,627 in 2009, the first year after implementation, to 2,609,138 in 2018 (Port of Genoa website). Less evident but consistent

![Figure 1 – E-port as “knowledge orchestrator”](source: Authors’ elaboration)
are the data about total traffic, including passenger vehicles; these changed from 47,453,500 tons in 2009 to 54,264,055 tons. This empirical case is useful to work out the improvement in interconnections and the impact on the quality of relationships. According to Hollebeek (2018), the E-Port platform acts as a facilitator, by increasing the quality of the system and aiming to cut costs, as we have just discussed in the previous section. As shown in Table 1, we can claim that data sharing is improved by the adoption of the platform. The interviews have confirmed that the E-Port has reduced barriers, such as geographical distance, or the heterogeneity of stakeholders, by acting as an enabler of absorptive capacity in the sense of building confidence with the norms and procedures of the sea-land logistics process. The most important issue within the knowledge sharing process is that the greater the degree of openness of the network, the greater the risk that knowledge can leave the network itself (Hackney et al., 2008). The threat can come from an internal or external player in the business network. A business network built around an IT orchestrator improves the process of knowledge sharing.

Table 1 – A knowledge sharing model for the sea-land logistics network

<table>
<thead>
<tr>
<th>Knowledge sharing drivers</th>
<th>Data Sharing</th>
<th>Virtual Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship forwarders</td>
<td>Reducing waiting times for goods documentation</td>
<td>Direct relationship with cargo actors and customs authorities</td>
</tr>
<tr>
<td>Developers</td>
<td>Exchange of documentation in a pre-established format</td>
<td>Electronic transmission of documents</td>
</tr>
<tr>
<td>Customs authority</td>
<td>Customs pre-clearing at sea</td>
<td>Single customs desk (esp. Integration of the AIDA System in E-port)</td>
</tr>
<tr>
<td>Terminal operators</td>
<td>Reducing data volatility about outgoing and incoming flow of containers</td>
<td>System collaboration within the other technological infrastructure of the port industry; Electronic loading and unloading lists</td>
</tr>
<tr>
<td>Transport carriers</td>
<td>Waiting time for a truck at the gate from 4 hours in 2004 to 30 minutes in 2018</td>
<td>Crucial logistics node between transporters and gate</td>
</tr>
</tbody>
</table>

Source: Authors’ elaboration

However, a highly computerized system is exposed to the risk of cyber-attack and data stealing. A cyber-attack in the port of Genoa would lead to a blockage of logistics operations, as pointed out by the managing director Gilberto Danesi: “If everything depends on a single computer system, and
this is attacked, the consequences would be devastating, which today is not yet adequate”. In 2018, two international ports, San Diego and Barcelona, were the victims of two cyber-attacks. The Port of Barcelona suffered a significant slowdown in land operations alone, while for the port of San Diego the slowdown also involved maritime activities. In both cases, IT task forces were used to restore the normal functioning of the IT system.

The other risk that can hinder the process of knowledge sharing is the stealing of data. The actors participating in the business network share economic and financial data, such as revenue and costs, which could benefit direct competitors. Thus, the main goals are to pursue the strategy of increasing the competitiveness of the port of Genoa. Given the area in which the port is located, the goal is to become the port hub that is able to serve the macro-economic region which includes: southern Germany, Switzerland, Austria, and Italy. Therefore, the sea-land logistics network must also consider externalities from different actors not involved in this logistics context.

This study provides multiple theoretical and practical implications for the relationship between IT solutions and the knowledge sharing processes of the actors’ network.

From a theoretical prospective, we contribute to the current literature analyzing how the IT infrastructure improves an actor’s knowledge sharing in a logistics network. We show a clear knowledge sharing model for a sea-land logistics network and a better understanding of the PCS benefits at actors’ level.

From a managerial prospective, we provide port users with a precise analysis of all knowledge sharing drivers that can be used by the adoption of an efficient port community system. They will be able to analyze the impact of the adoption of this IT infrastructure, focusing their attention on the value co-creation of the virtual business network.

Furthermore, the goal of this research is to justify that the correct use of IT solutions, during operational phases, avoids delays and bad practices (see Table 1).

Referring to the E-port plan, the port user should have respected these deadlines to prevent serious problems once the PCS was implemented. The study analyzed the main issues which occur during the operational stages regarding the main actors involved in the sea-land logistics network. A case study approach is used to answer the research question. To tackle the research question, the case study analysis demonstrates the benefits and improvements for the main actors involved in the sea-land logistics network. Indeed,
technological innovation has allowed a more efficient transmission of data, leading to achievement of the following objectives:

- reduction in the variability of goods sorting times;
- reduction of entry and exit times of goods;
- overall improvement in the level of sustainability of the production phases in terms of the work environment;
- the “physical” increase in goods because of the “telematization” of sorting and control procedures.

This study presents some limitations, such as the interconnection between E-port and the national logistics platform. In the last year, a trial of the national logistics platform was completed, but data on the interconnection between all the ports are not yet available. For this reason, the study presents a limitation on the ability of Genoa’s logistics network to exchange knowledge with high external partners. Furthermore, during the actors’ mapping phase, we have selected the most important actors within the logistics network. We suggest further studies after the phase of implementation is completed. The last limitation concerns comparability with other ports.

In summary, this paper aimed to analyze the dynamics within the network, omitting the phase of comparison with other international and national ports. Another comparative study could be developed between ports that have not yet adopted an IT infrastructure and the port of Genoa. These studies could be developed with a logic of comparison in order to identify the best practices to be adopted to improve the process of sharing knowledge.

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