Multi-level port resilience planning in the UK: How can information sharing be made easier?

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A B S T R A C T

Port resilience planning is a subset of the wider disaster resilience literature and it is concerned with how port stakeholders work together to make port systems more resilience. Port stakeholders include government departments, the port operator, ship operators, importers, agents and logistics firms. Ports are vital for the operation of cities and whole countries, especial island nations like the UK. Single port systems are multi-level systems with complex operational-level relationships and interdependencies. Additional levels to this include government and the policy-level. Preparing for the crises and disasters that might befall ports requires information sharing between stakeholders about key dependencies and alternative actions. The complexity of ports presents barriers to information sharing; as do commercial and political sensitivities. This paper uses a multi-level case study on the UK's system of ports to propose an approach to information sharing that uses the *subjectivity of information* from a supplier's perspective and from a user's perspective to reduce barriers of complexity, confidentiality and political sensitivity.

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1. Introduction

As an island nation, the UK depends upon its ports and 97% of the UK's trade in goods relies upon them. The UK imports 50% of its food of which 91% comes by sea. The largest UK ports are highly specialised with the top ten handling 69% of all tonnage. For example, Felixstowe handles 40% of all container traffic. Several of the UK's major UK power stations and oil refineries are dependent on dedicated linked maritime facilities (including Milford Haven, Southampton and the Port of Immingham). The UK's dominant ports often handle twice as much cargo as the next port which specialises in oil, gas, containers or ferries. So it would be difficult to replace the capabilities of a dominant port if it were lost (Grainger and Achuthan, 2014). Any prolonged failure at one of the key ports will significantly affect the UK's supply chains and consumers. Potential risks to ports include tidal surges, marine accidents, sustained adverse weather, acts of terrorism, industrial action and other disasters. On 5th December 2013 a one in 500 year tidal surge almost destroyed most of the UK's east coast ports (Powell, 2015). These ports, between the Tyne and Dover, make up 57% of the UK's food imports (Achuthan et al., 2015). All UK major ports are highly specialised, and should a major disruption at any one of the dominant ports arise, it is unlikely that additional capacity within the UK can

be found without significant advanced planning, i.e. without 'port resilience planning' (ibid).

Maritime ports are complex operational systems with many different types of stakeholders, for example shipping lines, terminal operators, harbour masters, resident firms who store or process cargoes, port users, local residents, transport firms and logistics service providers (Becker and Caldwell, 2015). Their interests are seldom aligned and there is an urgent need for the UK ports sector to improve its resilience planning (Davies, 2014; Achuthan et al., 2015). In this paper we investigate the complex social system of dependencies and information requirements that form a modern port ecosystem.

Here we define resilience in terms of joined-up information sharing between stakeholders and we suggest ways to enable this. Our research objective is to understand how information sharing can be made easier in the context of port resilience planning. First we describe the theoretical background of disaster resilience, its links to the port resilience planning literature and our focus on information sharing. Next we explain our research process, which uses a multi-level case study approach based on hermeneutics; a method which is appropriate for examining the complex inter-relations between the many stakeholders of a single port and higher levels of inter-port dependencies. Then we use a rich and diverse set of examples from our research participants to highlight many of the obstacles to information sharing in the form of 'silos' that separate stakeholders. Silos that have their basis in the complexities of the port system itself. We describe how we arrived at a novel conceptualisation of information sharing in this domain. Finally,

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we use our theoretical findings to suggest how obstacles to information sharing may be avoided in port resilience planning; and how this might benefit researchers and practitioners working in this area.

2. Theoretical background

2.1. Resilience and disaster resilience

The literature on resilience has roots in many fields including mathematics, physics, ecology, engineering, climate change, metallurgy, strategic management, economic, supply chain management, psychiatry and psychology (Aldunce et al., 2014; Bhamra et al., 2011; Manyena, 2006; Bahadur et al., 2013). Here we focus on the field of disaster management where the concept of resilience has been used increasingly in recent years. Especially after the adoption of the United Nations' Hyogo Framework for Action 2005–2015 (UN/ISDR, 2007).

The term resilience is commonly defined as the capability of a system to return or "bounce back" to a state of equilibrium after some disruption or perturbation. The system in question could be an individual's mental or physical state, a human social system or a natural system. The term has recently expanded to include the idea of returning to some other stable state that is not the same as the initial state of equilibrium. In the disaster resilience literature this means not just bouncing back but accommodating a disruption and improving on the previous equilibrium state (Aldunce et al., 2014) or "bouncing forward" and developing a system after a disaster (Manyena et al., 2011). Within the disaster resilience literature the term has also been used in many different contexts such as the resilience of communities (Norris et al., 2008); complexity and complex adaptive systems (Welsh, 2014; Comfort et al., 2001); "fragile" and "failed" nation states (Manyena and Gordon, 2014); emergency planning (Crichton et al., 2009); and information systems (Chewning et al., 2012). Each context is used to make sense of resilience phenomena in different ways and this has led to many subtle variations in the development of the resilience literature.

2.2. Port resilience and port resilience planning

Here we look at resilience in the domain of sea ports and their communities of stakeholders. Ports are a key component of cities, and disasters affect them as much as they affect cities. Arguably ports are a significant subject within the research into disaster resilience because ports are commonly used to transport material help to effected communities.

The literature on port resilience is developing rapidly because ports are seen as vital for the operation of cities and whole countries, especial island nations like the UK (Achuthan et al., 2015). Recent research on port resilience includes the roles of different port stakeholders in resilience planning (Becker and Caldwell, 2015); managing supply chain disruption using structural equation modelling (Loh and Thai, 2015); resiliency metrics for maritime transportation systems (Omer et al., 2012); the vulnerability of port to failures using the perspectives of interdependency and co-opetition (Hsieh et al., 2014); risk-based strategic decision-making for investments (Mansouri et al., 2010); business continuity planning which identifies alternative ports (Akakura et al., 2015); port capacity bottlenecks (Trepte and Rice, 2014) and simulating port network capacity in disaster response scenarios (Paul and Maloni, 2010). A significant characteristic of ports that all these papers include in their investigations is the notion of a port's capabilities to transfer people and cargoes between land and sea transportation. The literature is concerned with the effect of a crisis on the ability of different ports, or systems of ports, to transfer people and cargoes using different modes of transference, e.g. containers, roll-on-roll-off systems, bulk material handling equipment or a cruise passenger terminal. Also, much of the resilience literature includes *planning* of some sort because resilience

itself includes some notion of being ready for, and also mitigating, the effects of a crisis. For example, learning how to plan from past crises (Crichton et al., 2009).

But within the literature there has been little research into how information is shared. Bharosa et al. (2010) studied how information was shared for coordination purposes, especially with respect to the obstacles to sharing whilst coordinating information for disaster response exercises. These obstacles included organisational silos, privacy issues, lack of incentives to share, security issues, conflicts of interest, lack of opportunity, a lack of platforms to share with, information overload and information quality. A significant insight was the mismatch between the information requirements of an information user and the understanding of this by the information provider. But the focus of Bharosa et al. was on *crisis response* rather than resilience planning purposes. Chewning et al. investigated how information systems facilitate information sharing with respect to communicating with the public, but again this was concerned with response rather than resilience *planning* (2012). The same is true for a study on the relationship between trust and information sharing by Ibrahim and Allen (2012), or an investigation of information sharing in high velocity environments by Allen et al. (2014) and a development of emergency data standards for information sharing by Chen et al. (2008).

Interdependency is also an area that is starting to be investigated within the literature. The interdependency of port stakeholders is important for two reasons. First, port stakeholders and their assets rely on each other for resources that include port services, the supply of people and cargo, and information. A crisis that makes some resource unavailable may in turn remove other resources from the port system (Hsieh et al., 2014). Second, the interdependency and interlinking of port stakeholders suggests the possibility of mutual assistance and help with alternative resources (Akakura et al., 2015). Unfortunately the complex interdependencies of stakeholders and their operations produce emergent phenomena that are difficult to make sense of (Comfort et al., 2001; Welsh, 2014).

In summary, the disaster resilience literature includes the subdomain of port resilience planning and within this there has been little research on information sharing in terms of interdependencies between port stakeholders. Here we focus on how interdependent port organisations share information between each other for resilience planning purposes and with a specific focus on the port system's capability to transfer people and cargoes between land and sea transportation.

3. Research method

3.1. Research process

Our objective was to understand how information sharing can be made easier so as to improve resilience planning. So we chose to take a qualitative approach as we were interested in subjective questions of 'how' and 'why' rather than of 'how many'. Our focus was to study different stakeholders' requirements for information, and the information that they held, which was subjective. In seeking to answer questions of 'how' and 'why', we followed Yin and used a case study approach (2003). Case studies are useful for investigating contemporary phenomena, which researchers have no control over (Eisenhardt, 1989). They are also a valid approach for information systems research (Benbasat et al., 1987; Lee, 1989). A case study approach was especially suited to our focus on business relationships between different stakeholder organisations. We were concerned with dynamic phenomena so we used several different data collection methods and many different data sources (ibid).

3.1.1. Data

We collected data between January 2010 and March 2016. We held semi-structured interviews and meetings with the managers and staff of the Department for Transport (DfT), port landlords and other port