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Danish demonstration projects as drivers of maritime energy efficient technologies

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ABSTRACT

This article presents a multiple case study of demonstration projects addressing technologies for energy efficient retrofit solutions for the maritime sector. Inertia in the sector in general prolongs the implementation of energy efficient technologies. Demonstration projects have the purpose to test a given technology and its ability to enter the market to support the diffusion of technologies. The aim of the article is to analyze the drivers and barriers in demonstration projects in the maritime sector and the potential outcome of the projects. We analyze the dynamics of the processes in the demonstration projects in order to understand how the projects can facilitate the implementation of energy efficient technologies. The analysis consists of a case study of 5 Danish maritime demonstration projects. The demonstration projects involve both actors that are used to collaborating and actors in new constellations. When the actors do not know each other in advance, their collaboration involves challenges, but they also have the potential for contributing with new knowledge in the network.

Demonstration projects are an opportunity to facilitate green retrofits in a somewhat resistant maritime sector, as they serve as a platform for both the development and the implementation of cleaner technologies.

Demonstration projects make it possible to test and develop technologies from other sectors. The test of energy efficient technologies contributes to changing the mindsets of the users of the technologies and thereby changing the practices on board the vessels. The potentials for developing and testing technologies in multi-party networks and the economic funding that reduces the economic risks of the involved actors are the main drivers in the demonstration projects. The main barriers, on the other hand, are the existing energy management practices in the sector and the uneven economic risks of the actors involved in the projects. Our results contribute to the understanding of how demonstration projects in the maritime sector are in an early stage of the innovation process where prototypes are not yet developed. The demonstration projects create an opportunity for non-maritime actors to enter the somewhat closed cyclic collaborations in the maritime sector.

1. Introduction and analytical framework

1.1. Energy consumption in the maritime sector

Climate issues and energy consumption are central topics in both research and practice (Dovì et al., 2009; Brewer, 2003). One of the major contributors of greenhouse gasses is transport, and in 2010, the contribution to the total greenhouse gas emissions from transport was estimated at 14% (Love et al., 2010). While decreasing for other sectors, greenhouse gas emissions continue to increase for transport (Love et al., 2010; Harvey, 2013). Road and rail transport are focus areas in the reduction of greenhouse gas emissions from transport in Europe. There has been a technological focus on effective engines and weight reductions (Harvey, 2013). Shipping has been shown, in general, to be an energy efficient means of transport compared to other modes (Buhaug et al., 2009), but due to the scale of transport, the sector still accounts for a significant part of the global CO_2 emissions. To meet sustainability objectives, the EU has the goal of reducing CO_2 emissions from shipping by a minimum of 40% by 2050 compared to 2005 levels (EC European Commission, 2011). Increased energy efficiency - defined as energy use per transport work – achieved through better operational

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practices and new technologies is a key element in the effort to meet the emission targets (EC European Commission, 2011).

Shipping is estimated to account for 3.1% of the global emissions as an average of 2007–2012 and it is forecasted to increase by 50%–250% by 2050 as a result of the growth in shipping (Smith et al., 2014). The emissions constitute a significant part of the total global emissions both now and in the future. To reduce greenhouse gas emissions from maritime transport, the International Maritime Organization (IMO) emphasizes technical, operational and market-based measures (Buhaug et al., 2009). An analysis of Buhaug et al. (2009) shows that a 25–75% increase in CO_2 efficiency in shipping is reachable with known measures mainly directed towards energy efficiency. Reductions of more than 33% could be achievable by 2030 at a negative or zero marginal cost (Eide et al., 2009). Cleaner technologies and energy efficiency become still more important to the sector, both due to the increased focus on maritime transport in environmental legislation (EC European Commission, 2011) and due to increasing fuel prices (Corbett et al., 2009).

1.2. Energy efficient technology

The diffusion of clean technology is governed by endogenous mechanisms or socio-economic factors, such as costs, research and design activities, learning, and increment in the innovation of new technologies, and by exogenous mechanisms, such as legislative activities and market structure (Kemp and Volpi, 2008). Policies are important to the diffusion of clean technology (Kemp and Volpi, 2008). Other factors like the characteristics of the clean technology and the absorptive capacities of potential adopters are also important. When the companies search for solutions, certain technologies may be totally overlooked, especially if they are traditionally applied to other sectors (Mosgaard et al., 2014a).

Innovation and the use of cleaner technology in the maritime industry require the involvement of a number of stakeholders to achieve the desired output (Mosgaard et al., 2014a). The introduction of cleaner technologies in the maritime sector is complex and history shows that it may carry difficulties (Mosgaard et al., 2014a). Studies suggest different barriers such as the non-existence of a binding international regulation and technical standards; uncertainty about the reliability and efficiency of the equipment; high development and installment costs, and inadequate technical expertise in developing and supervising the installation processes (King et al., 2012). Greenhouse gas reduction efforts have been focused on large vessels in terms of reducing fuel consumption by improved operation (Buhaug et al., 2009; Lindstad et al., 2011). Improved operation may include changes in both practices and technologies.

Marine vessels generally have a long lifetime. As an example, the global cargo carrying fleet in 2011 includes 55,138 ships with an average age of 19 years (IMO, 2012). The long lifetime means that the reduction of the environmental impacts from maritime transport cannot only happen through the development of cleaner technologies in new vessels, but also involves retrofitting existing vessels.

However, there seems to be inertia towards implementing cleaner technologies in vessels even when economic and environmental arguments are favorable (Corbett, Fischbeck, 2002; Hermann, Köhler, 2012; Lyridis et al., 2005; Eide et al., 2009). This also means that changes only happen slowly. Studies have, however, shown that demonstration projects facilitate energy efficient shipping practices (Krozer et al., 2003).

1.3. Case selection and aim of study: demonstration projects addressing energy efficiency

Testing technologies in demonstration projects is a means of showing the feasibility of the technology, but also a way to develop the technology further and thereby facilitate innovations that meet the demands from the stakeholders (Harborne and Hendry, 2009).

Demonstration projects play an important role in technological development as they bridge a gap between technological breakthroughs, industrial application and commercial adoption (Frishammar et al., 2015). Several papers analyze the role and theorization of demonstration projects (Frishammar et al., 2015; Krozer et al., 2003; Klitkou et al., 2013), but related to the maritime sector, the drivers of entering the projects and the outcome of these projects are not thoroughly discussed and described.

The aim of this article is to analyze the drivers and barriers in demonstration projects in the maritime sector and how these projects can facilitate the implementation of energy efficient technologies.

2. Analytical framework

The analytical framework combines three research areas; demonstration projects, innovation in demonstration projects, and innovation in multi-party networks. The first part introduces previous experiences with demonstration projects; their content, drivers and barriers. The second part shortly introduces the complexity of eco-innovation, as eco-innovations are the focus point of the demonstration projects. This leads up to a discussion of innovation in multi-party networks as the demonstration projects included in this study are handled in multi-party networks. Thereby, the analytical framework includes the object of the demonstration projects (eco-innovations), the subjects (multi-party networks), and the framework in which the innovation happens (demonstration projects).

2.1. Demonstration projects

Demonstration projects are defined in various ways (Bossink, 2002), but in a Danish context, they include several actors that jointly test a given technology and its potential for entering the market. Thereby, the projects address the diffusion and testing of a given technology in a (new) market relevant context. The projects have the purpose to ease the pathway for new technologies to enter the market.

The literature points towards a number of factors that may influence the success rate of demonstration projects, such as user involvement and alignment with existing institutions. These factors are difficult to address in practice as the actors involved may have divergent views on how to distribute knowledge and secure knowledge rights (Frishammar et al., 2015). Another uncertainty is related to how to effectively manage and organize demonstration projects in the individual firm (Frishammar et al., 2015). The projects may generate knowledge spillovers that benefit other firms at the expense of those involved in the projects. Even though this may be beneficial to society at large, it may delimit the incentives for firms to contribute to the development of the projects (Mowery et al., 2010). There is a need for understanding the actor networks surrounding the projects and this requires research that analyzes demonstration projects in relation to innovation management (Frishammar et al., 2015).