# An explorative study of anticipatory infrastructural alignment for autonomous shipping

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## Introduction

Ships and ports are ready for operation without humans, but only if the maritime industry work through a number of systemic challenges first (Negenborn et al., 2023). Not only is the task of combining maritime systems "daunting"; autonomous ships also need to be "plugged into a broader ecosystem of maritime technologies, including interactions between ships and cargo handlers, equipment, pilots, traffic services and ports" (ibid., p. 3). In this paper, we approach these challenges through the analytical lens of *infrastructural alignment* (Haila, 2023; Fujimura, 1987; Star and Ruhleder, 1996), as this alignment of different sets of infrastructures is required for the autonomous transformation to take hold. Our focus, specifically, is that of *anticipatory* infrastructural alignment (Alvial-Palavicino, 2015). We ask which kinds of infrastructures are seen by current actors to be of the most critical significance for the transformation, and how can these interfaces be constructively addressed in an anticipatory way?

## Materials and methods

We explore our central questions through a methodological approach that combines elements from science and technology studies STS (the notions of *infrastructure* and *alignment* as understood within STS) with elements from environmental policy and futures studies (in particular, the notions of *anticipation* and *clusters of practices* or *assemblages* as understood within these fields). Our materials consist of documents on autonomous shipping and its broader context gathered during the Spring, Summer and Autumn of 2023 and interviews on the same topic conducted with central Finnish actors done within the same period. These materials are set against the backdrop of the background interviews performed during the Winter of 2023. All our methods and materials will at this point in time be qualitative.

## Results

We will use the selected analytical tools in the context of autonomous shipping to produce an analysis that enables the identification of *infrastructural leverage points*, i.e., junctures at which interventions hold promise of effecting a process of change towards an increase in the sustainability of autonomous shipping as part of a broader ecosystem of maritime technologies (see also Meadows, 1999). Our aim is to being able to anticipate such infrastructural leverage points (as well as possible risks associated with them in a way that enables their integration already in ongoing technological development processes; see e.g. van Eeten and Roe, 2002). We will report the results of our work in predominantly in the form of scientific articles.

## Implications for sustainable maritime operation

Autonomous shipping has the potential to improve the efficiency of global maritime logistics, and, thereby, reduce the carbon footprint of operations. Others have speculated that autonomous shipping can enhance shipping operation safety, reduce maritime accidents, and mitigate piracy threats (Theotokatos et al., 2023). Autonomous shipping can be seen to be intertwined with other issues (ice navigation, alternative fuels) and thus improve ice navigation safety, efficiency of the use of alternative fuels etc. However, none of these developments are guaranteed. Rather, we propose, the sustainability outcome of autonomous shipping is a function of how the system interfaces with other systems and infrastructures in practice. We ask, therefore, if anticipatory practices can help provide pathways to preferable anticipatory alignments. This is in line with the notion (c.f. Gibbs & Flotemersch, 2019) that analysis of environmental anticipation has "*the potential to change public attitudes, alter policy, and reframe discourse around environmental issues"*. Our work here draws particularly on the idea of "nature as infrastructure", or rather, on the inextricable intertwinedness of nature and culture in specific "naturecultures" enabled by a variety of infrastructures (Haila, 2023).

## References


Alvial-Palavicino, C. (2015) The Future as Practice. A Framework to Understand Anticipation in Science and Technology. *Tecnoscienza* 6(2).

Fujimura, J. (1987) Constructing 'Do-able' Problems in Cancer Research: Articulating Alignment. *Social Studies of Science* 17: 257-93).

Gibbs, D. A. & Flotemersch, J. (2019) How environmental futures can inform decision-making: A review. *Futures,* 108, 37-52,

Haila, Y. (2023) The Biosphere and the Garden: Nature as Infrastructure? In Valkonen et al. (Eds.) *Infrastructural Being. Rethinking dwelling in a naturecultural world*. Palgrave: Macmillan.

Meadows, D. (1999) *Leverage Points—Places to Intervene in a System*. Hartland: The Sustainability Institute.van Eeeten, M. & E. Roe (2002) Ecology, Engineering, and Management. Reconciling ecosystem rehabilitation and service reliability. Oxford. Oxford University Press.

Negenborn, R.R. et al. (2023) Autonomous ships are on the horizon: Here's what we need to know. *Nature* 17.2.2023.

van Eeten, M.J.G. & E. Roe (2002). *Ecology, Engineering and Management. Reconciling Ecosystem Rehabilitation and Service Reliability*. Oxford and New York: Oxford University Press.

Star, S.L. & K. (1996) Steps towards an ecology of infrastructure: Design and access for large information spaces. *Information Systems Research* 7: 111-134.

Theotokatos, G. et al (2023) Autonomous shipping — an analysis of the maritime stakeholder perspectives. WMU Journal of Maritime Affairs 22: 5-35.