Governing with/through Smart Ports

Contested infrastructural spatialities in the port of Hamburg

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Introduction: Smart ports and the politics of transformation

> "The smart port is a connected, sustainable, safe and automated port, which relies on smart infrastructure and equipment, skilled personnel and smart managerial practices, to ensure customer satisfaction, environmental protection and a better quality of life for the citizen." (Belmoukari et al. 2023, 10)

For at least the past decade, the Port of Hamburg has been working toward becoming *smart*. It is not alone in this ambition; ports around the world are all striving to transform themselves into *smart ports*. However, there is no consensus about an exact classification of this term and considerable terminological ambiguity remains. In this text, I adopt Belmoukari et al.'s (2023) definition, provided above, to underline the all-encompassing aspirations attributed to the ports of the future. Becoming a smart port entails responding to both immediate and anticipated challenges, such as spatial constraints, productivity pressures, fiscal limitations, security risks, and sustainability concerns (Deloitte 2017, 3). What this means in concrete terms for the case of Hamburg will be discussed throughout this chapter.

Hamburg's port spaces serve as pivotal nodes within both global logistics and in the metropolitan area and exemplify the convergence of both digitalization and urban transformation. In terms of container throughput, it is Europe's third largest (Jessen-Thiesen 2022) with China and the USA ranking as its most important trading partners. It is Germany's largest sea (and railway) port and offers work to around 50,000 people within international logistics (NDR 2025a).

Logistics, sometimes regarded as the "central discipline of the contemporary world" (Thrift 2008, 589), transcends the mere 'neutral' organization of production, trade, and circulation. It also has significant socio-political repercussions and facilitates a contemporary "supply chain capitalism" (Tsing 2009). As Hesse (2018) notes, logistics can actively (re)structure territories, thereby shaping transformations across multiple scales and dimensions within urban environments. Ports, in particular, are sites of concentrated logistical power. They exemplify broader shifts

in how infrastructural spaces are reconfigured through socio-technical systems as 'testbeds' for smart innovations. Port spaces are not isolated, but are instead inherently connected to other urban spaces, thereby contributing to what Halpern et al. (2013) call "test-bed urbanism."

In this chapter, I engage with these transformations through the lens of governmentality, positing that smart port technologies are not merely technical enhancements, but are instead mechanisms of power that reshape spatial, economic, and social relations. The promises of 'seamless flows' take place in a context that is marked by connections that are full of frictions (Tsing 2011). The guiding questions are: How do smart logistical infrastructures function as technologies of government? Where and how do contestations, frictions, or resistances emerge within these logistical regimes? And, finally, how do these transformations relate to the ports' urban contexts?

Understanding logistical infrastructures as spaces of both frictions and flows, of contestations and consolidations, reveals that a port's impact extends far beyond its docks and piers. Contemporary logistics is not confined to the (often prominently featured) container terminals, whose standardized 'boxes' (port slang for containers) have become a visual metaphor for the economy. An even greater volume of logistical operations occur in adjacent spaces, across complex networks and in connective infrastructures. Moreover, contemporary logistics is enacted not only through material operations, but also in/through commercial conventions, corporate lounges, and public townhalls – sites in which logistical strategies are negotiated, legitimized, and contested.

Infrastructural governmentality in (smart) ports

Foucault's concept of governmentality (2019 [1978]) moves beyond state-centric notions of government and focuses on the dispersed mechanisms through which populations are managed, controlled, and shaped. I follow Lemke (2007), who highlights the concept's internal tensions and contradictions, in order to distinguish this from conventional political science's understandings of government. In the context of smart ports, governmentality provides a lens through which to examine how digital technologies function as systems of power and knowledge, shaping and enacting certain modes of conduct. Seemingly neutral technological systems both produce specific forms of subjectivity and regulate behavior (Bröckling et al. 2011; Lemke 2021).

This chapter extends this perspective in order to explore how digital transformations in/of the port exemplify advanced modes of government. 'Smartness' is not merely a matter of technological innovation, but is instead a strategic approach (and attempt) to managing complex logistical, economic, social, and environmental chal-

lenges, while also reshaping spatial and economic relations. The analysis focuses on how smart ports operate as interplays of modes of government and political technologies by applying a governmentality perspective. They mediate between global economic imperatives and local urban contexts (Dzudzek and Reuber 2021) and produce new forms of knowledge and/or control.

Infrastructures are conceptualized as socio-technical and power-laden configurations, inherently relational through the in-/exclusion of human and non-human actors. They are embedded within broader assemblages of tools, measures, and built environments (Amin 2014; Star 1999), facilitating the circulation of goods, people, and information (Larkin 2013), and organizing social and economic life (Tonkiss 2015). Infrastructural transformations reveal how power is exercised through logistical operations and though the (re)shaping of space and territory (Easterling 2014).

Methodologically, this chapter draws on insights from my doctoral research and combines ethnographic fieldwork and discourse analysis.[1] This approach enables a critical reading of how socio-technical configurations in logistics respond to current global challenges and how they seek to reposition themselves within shifting (geo)political landscapes. I examine smart port initiatives as attempts to reconfigure maritime and urban futures through 'innovative' technological frameworks. Smart ports serve as analytical sites (Riofrancos 2021) through which broader political-economic dynamics unfold beyond the boundaries of specific local interventions. Ports, as Kokot (2008) argues, offer a unique vantage point to examine global processes within grounded, local settings; ethnographic methods and a spatially sensitive approach are particularly valuable in unsettling dominant narratives about technological progress and neutrality. Spatial particularities are significant, particularly in Hamburg. Unlike many contemporary ports that operate invisibly outside urban cores, Hamburg's port remains deeply entangled with the city. This proximity positions it as a testbed for urban interventions; the port, thus, becomes a site to study governmentality as something indicative of broader developments.

1 Doing embodied fieldwork is always a messy process that encompasses both constraints and possibilities. As a woman with no personal ties to the maritime sector, my positionality often marked me as an outsider, particularly in a field dominated by men in formal, technocratic settings. I navigated these dynamics by trying to attend closely to the situational habitus and by observing interactional cues. Gaining access to port environments also presented challenges, given their status as critical infrastructures that are subject to strict security protocols. Yet these difficulties also offered ethnographic insight into the boundedness and opacity of logistical spaces, further revealing the politics of access, visibility, and control that structure the smart port.

Case study: Hamburg's smartPORT

The Hamburg Port Authority (HPA), a public institution founded in 2005, oversees all official matters relating to the Port of Hamburg and owns most of the port's land. With approximately 1,800 employees, HPA is responsible for port operations, including infrastructure maintenance and development, vessel traffic safety, railway facilities, real estate management, and the economic conditions. Several subprojects have been launched under its overarching smartPORT framework (and vision) over the past years. Overall, the goal is to facilitate sustainable growth, to efficiently utilize resources, and to minimize environmental impacts (Saxe and Jahn 2017).

smartPORT represents the complex entanglement of concrete projects, strategic visions, technologies, discursive representations, and networks common to "smart" initiatives and was launched in 2013, in anticipation of the 2015 World Port Conference. This effort was not merely one of technological modernization, but was instead a strategic reconfiguration of port infrastructure into a dynamic, interconnected, and responsive ecosystem. smartPORT originally aimed to transcend incremental optimization, instead reimagining the port as a data-driven, adaptive ecosystem and was framed as a response to "mega trends" such as climate change and supply chain volatility.

Among the core issues that smartPORT was designed to tackle was the growing perception of spatial constraints. Like other port actors, my interlocutors at HPA believed that increasing cargo volumes could no longer be managed within the port's existing footprint. As a mid-level employee from a major port logistics company explained: "If we now must handle more cargo on the same surface area, we won't manage. So how can we do it? We can only do it by becoming smarter" (Interview, May 2024).

The smartPORT framework was initially structured around three main pillars: logistics, infrastructure, and energy. Some of the projects have failed, while others have remained under development or are still in operation. The first pillar, smartPORT logistics, focused on traffic management, with the goal of optimizing the flow of goods and of reducing congestion within the port area. The initiative aimed to safeguard the port's competitiveness, in light of the anticipated growth in container throughput, under the slogan "The journey is the reward. Through the port more quickly, safely, and efficiently" (HPA 2015). It included the SPL project that sought to integrate logistics actors "for their mutual benefit" (HPA2015: 1), thereby enabling more effective planning and the coordination of transport operations through digital platforms and apps. The SPL, which was co-developed with the German companies Deutsche Telekom and SAP, combined real-time traffic data and parking availability information in order to reduce terminal wait times, optimize truck flows, and

minimize environmentally harmful empty trips. However, the project was discontinued by mid-2018 due to limited user adoption (THB 2017).

The infrastructure pillar centered the vision of a data-driven ecosystem (Jahn and Saxe 2017, 104). The implementation of sensor technologies to create responsive environments was its aim. A prominent (and currently ongoing project) is the development of a digital twin of the Köhlbrand Bridge. Completed in 1974, the listed structure, located within and spanning the port area, is one of Hamburg's most iconic landmarks. It is slated for replacement by 2046, due to material fatigue and an insufficient clearance height for modern container ships (NDR 2025b). The smartBRIDGE project includes sensors to monitor wind speeds and to detect structural stress in real-time. A software aggregates different data and is meant to "set a new standard in the digital transformation of bridge maintenance" (HPA 2025). This is referred to as the "present of the future," and is "a decisive step for the predictive maintenance management of structures around the world" (HPA 2025). These sensor technologies promise not only to pre-empt disruptions, through continuous monitoring, but also to enable "predictive maintenance," thereby increasing "reliability and operational efficiency" (homePORT, n.d.). In this context, infrastructure itself becomes "smart," and the cost of infrastructure maintenance in the port is expected to "decline significantly" (Jahn and Saxe 2017, 104).

The third pillar is centered on energy and 'green sustainability,' an objective aligning with European regulations for more sustainable standards in ports (Molavi et al. 2020). The respective initiatives should reduce environmental harm and is expected to lower energy consumption, thereby emphasizing the port's responsibility as a major energy consumer. The port could "do a lot to support Germany's energy transition and make the port more attractive to business" (HPA 2015b, 3). The strategy makes the economic rationale behind its environmental goals explicit: "a cleaner environment and increased efficiency will translate into economic advantages" (ibid.). Sensor networks are envisioned to both monitor and optimize energy consumption across port operations, thereby reinforcing the idea that digital infrastructure can serve both ecological and economic objectives. Although not all initiatives under the smartPORT energy umbrella have been fully implemented, some – such as shore-side electricity for cruise ships – are partly operational.

Government with/through infrastructure: ecosystem, labor, and anticipatory devices

The smartPORT initiative extends beyond the logistical and industrial confines into the urban fabric, thereby reflecting Hamburg's deeply spatial, political, and social entanglement of port and city. Transformations within the port reverberate beyond its borders and affect these relationships in ways that are explicitly acknowledged –

and pursued – by port planners and authorities. As Tesse et al. (2021, 8) note, "traffic exiting the port area will inevitably enter the city area" and that a "strong will to collaborate [between port and city authorities, S.L.] exists." More generally, Hamburg's smart port programs intend to put "projects of innovation and digitalization" into practice, not only to ensure "sustainable economic growth," but also to test the "mobility of the future" for the city through "innovative, real infrastructures" (HPA 2021). Smart port spaces, thus, serve as testbeds for urban experimentation, thereby (potentially) reconfiguring port-city relations: "Participation in this context means, for the city, learning from and benefiting from the port's digital experiences, as well as transferring or scaling solutions developed in the port to the urban realm – or vice versa" (Saxe 2017, n.p.).

While early smartPORT projects primarily focused on port operations, their orientation began to shift outward around 2018. Tesse et al. (2021, 3) note that the HPA began "opening up to the city of Hamburg, targeting a deeper integration between the two, especially in the context of traffic coordination and guidance of cruise passenger flows." This illustrates how digital port infrastructures serve as tools for urban governmentality. The port becomes a laboratory for experimenting with modes of governing urban mobility through the regulation of more-than-human flows, mediated by materialities and data technologies. It (re)configures circulation and control, indirectly constructing the urban population as governable subject: datafied traffic and mobile nodes within a programmable system of urban flow. This logic reflects the Foucauldian notion of government as "arranging things" (Lemke 2021, 11), and signals an epistemological shift that privileges calculability, responsiveness, and seamless circulation. From this perspective, the smartPORT transcends technical upgrades, instead acting as a broader strategy of government through infrastructure and structuring the (more-than) port environment as an adaptable, data-driven ecosystem. These infrastructures function as modes of government – techniques and procedures that seek to steer the conduct of individuals and organizations through anticipatory logics, calculative rationalities, and knowledge production.

Digital, and so-called "intelligent," technologies are not entirely new to the port. Port Community Systems for the collection and exchange of logistical data have been in use since the 1980s. What distinguishes smartPORT is its holistic ambition. Instead of isolated projects, the initiative instead seeks to integrate diverse actors and infrastructures into a unified digital ecosystem. This effort is described as a "comprehensive transformation," rather than a mere accumulation of technical innovations. The former Chief Digital Officer of HPA outlined a multi-stakeholder model that included "the key players" politics, administration, business, civil society, and academia in a coordinated, "networked manner" (Saxe 2017). He described this implementation process as an "iterative process of decentralized innovation and centralized governmental (re)action," one that combined experimental flexibility with

centralized oversight. In so doing, smartPORT exemplifies an infrastructural mode of government in which regulatory authority is envisioned and exercised through standardized data flows and through platform-based coordination.

Digital infrastructures promoted within the smartPORT framework have tangible effects on labor practices. While smartPORT did not initiate automation in Hamburg's port, its push for digitalization and integrated infrastructures contributed to the expansion and legitimization of automated workflows. As a mid-level employee of a terminal operator put it, advancing digital infrastructure is now regarded as a necessary foundation for automating work processes (Interview, June 2024). In this regard, the smart port's digital technologies could function as disciplinary technologies, subtly reconfiguring labor practices and reinforcing hierarchies of control under the guise of "progress" and "innovation."

These changes are felt acutely in some dockworkers' embodied experience. For example, in crane operations, the transition from the tops of gantry cranes to remote-controlled container movement inside offices means that operators now rely primarily on visual inputs from cameras, rather than on full-body physical cues. One worker informally explained how previous operations relied on "feeling the weight, the wind, the vibrations – it's not just visual perception; it's bodily" – an embodied attunement that defined skilled labor in this environment (Fieldnotes, late 2024). The obsolescence of this sensorium entails processes of re-/deskilling, thereby producing new affective orientations to work. Competence is now cultivated through forms of abstraction and virtual simulation that reconfigure what it means to be present on the job.

This reorganization of labor exemplifies modes of government that extend beyond formal political institutions to regulate individuals and groups through "more or less deliberate and calculated modes of action, all of which are designed to influence the possibilities of action of other individuals. In this sense, government means *structuring the possible field of action* of others" (Foucault 1987, 255, emphasis S.L.). This form of government enters domains of embodied practices and conditions of labor as a mode of shaping the "conduct of conducts" (Foucault 1987, 255). The conduct of workers is shaped not only through formal rules, but also through affective, spatial, and infrastructural arrangements. Tasks that once required physical presence are increasingly performed remotely, transforming both daily operations and the (self)formation of the working subject as sites of intervention. Labor is disciplined through demands for flexibility and through the extraction of formerly embodied, tacit knowledge. Some of the dock workers understand this as a threat, given that their work is becoming interchangeable within digitally mediated workflows and across spatial boundaries (Interview, November 2024). In this sense, smart port initiatives represent deeply political interventions in both the material and symbolic conditions of working life.

A defining feature of these infrastructures is their anticipatory logic. Smart technologies are designed to pre-empt disruption, to ensure smooth circulation, and to increase predictability in global supply chains, thereby reflecting the imperatives of just-in-time capitalism, where time is compressed and uncertainty is rendered in a calculable manner (Campling and Colás 2021). Enhancing the ability to foresee and to adapt to disruptions becomes a central logic: governing becomes an anticipatory practice that is oriented toward resilience, agility, and risk management. As Dzudzek and Reuber (2021, 481) argue, governmentality today involves the regulation of "diverse power-laden economic and social processes of globalization with their networked flows and circulations that penetrate and intersect the territorial order of states."

smartPORT's anticipatory orientation is also expressed in its aspiration to monetize digital services beyond conventional port logistics. Predictive analytics and real-time tracking are no longer supplementary tools, but are instead essential services in a logistics industry that is dominated by a few global actors. As one IT sector interviewee noted, digital services enable ports to expand their functions "beyond mere goods handling" to include "digital services": the long-term challenge lies in designing integrative digital services that meet the needs of ports, carriers, and inter-port networks across Europe (Interview, May 2024). This represents not just a commercial strategy, but also a form of infrastructural geopolitics, where control over digital logistics platforms is increasingly central to shaping global power in trade.

Contestations and frictions within the regime of smartness

One of the promises underpinning smartPORT's agenda is to address the "challenge" of sustainability, primarily through strategies focused on energy management. These strategies include the installation of renewable energy facilities, the use of data for energy consumption planning, and the promotion of "eco-friendly mobility" (Jahn and Saxe 2017, 107). As the authors note:

> "strategies foster the relationship between the port's urban areas and increase the touristic attractiveness of the Port City. The 'greener' image is of benefit for public perception and for marketing purposes increasing the attractiveness of the port location. The Port Authority publishes environmental key performance indicators regularly and helps to make available the carbon footprint of the different port areas and located companies" (Jahn and Saxe 2017, 107).

Significant contradictions arise as the technocratic rationalities envisioned by smartPORT confront socio-political and ecological realities. These tensions are

evident in the dissonance between the discourse of sustainability and infrastructural expansion, most notably regarding the deepening of the Elbe River. While smartPORT advanced a narrative of ecological modernization, it was undermined by large-scale interventions, such as the river deepening to accommodate ULCV.[2] Though justified by port authorities as necessary to remain globally competitive (HPA 2020), the project caused the degradation of sensitive estuarine ecosystems (Hein and Thomsen 2023) and delivered only marginal economic gains (Vöpel and Wolf 2025). One of the key rationales behind "smartness" was to enable higher cargo throughput without expanding the port's footprint: "This means we need to become more efficient in order to handle more cargo within the same area" (Interview, May 2024).

smartPORT tends to confine ecological concerns to isolated pilot projects and representational discourse, as illustrated in the quote above. At the same time, these projects are expected to generate economic returns. In this context, sustainability operates less as a transformative commitment than as a strategic narrative, one that obscures the increasing socio-ecological impacts of port infrastructures. This discursive narrowing not only conceals the costs of projects, like the Elbe deepening, but also contributes to lock-in effects: expanding container trade capacities reinforces traditional economic models. As Swyngedouw (2018, 81) argues, the "fantasy of sustainability" functions as a de-politicizing force and, thus, marginalizes alternative development trajectories.

Additional frictions emerge in the principle of collaboration, which is central to smartPORT's vision. The approach to optimizing flows of goods is based on the assumption that comprehensive, real-time information about the location and movement of cargo can be made available and shared across actors:

> "To achieve that, other players in the port need to assist in compiling the available information. Already existing IT platforms must be interlinked to create added value from this information and give logistics services providers, hauliers and agents the opportunity to choose the most efficient mode of transport for their goods" (HPA 2014).

Collaboration is also emphasized as foundational to a new port work culture. Yet, in practice, collaboration reveals asymmetrical power dynamics underpinning smartPORT. Data sharing, central to the promise of smart logistics, becomes a site of friction, as competition between actors inhibits transparency. While port authorities advocate interconnectedness, critical data remain concentrated in the hands of dominant corporate players. Rather than flattening hierarchies, smart

2 Ultra Large Container Vessel (ULCV) is a term used for the world's largest container ships with capacities of between 12,000 and 24,000 Twenty-Foot Equivalent Unit (TEU).

logistics may instead ultimately reinforce them. The smartPORT can, thus, be seen as a techno-managerial approach that masks underlying tensions. My field notes from a roundtable discussion on the smart port capture this tension well. While one logistics provider stated, "Well, if they don't give me the data, I can't do business anymore," another countered: "That's all great and helpful at this level – but you're not getting my data." (Field notes, September 2024). New forms of power and knowledge are created even alongside the intention of introducing data-driven decision-making processes.

The rhetoric of collaboration also obscures another layer of friction. It privileges corporate port stakeholders while marginalizing local communities – particularly residents of port-adjacent areas. The neighborhood of Moorburg, for instance, has been designated as a port expansion zone, leaving its residents in a state of permanent uncertainty regarding their right to remain. Their perspectives are absent from smartPORT's notion of collaboration, however. Instead, residents are excluded from meaningful participation in policy-making processes beyond the scope of smartPORT (Hilder and Hein 2023). This lack of inclusion as relevant actors is compounded by the continued pursuit of economically and ecologically contested port expansion projects (Vöpel 2020) that directly contradicts smartPORT's stated objective of increasing spatial efficiency.

Smart mentalities: government of subjectivities in the port-city interface

This section explores how the smartPORT program cultivates specific mentalities and subjectivities that are aligned with the logics of automation, digitalization, and technocratic government. Understood as "smart mentalities," these orientations extend beyond technical competencies, thereby shaping how individuals and collectives are expected to think, feel, and to act within digitally mediated environments. Rather than merely transforming infrastructures, the initiative cultivates new forms of self-conduct, adaptability, and resilience – qualities seen as essential to navigate uncertain futures. These developments are especially visible in labor practices and training regimes, in which the formation of flexible, error-tolerant, and innovation-oriented subjectivities is deliberately pursued.

One particularly illustrative case is a new training center established at the Container Terminal Altenwerder. Designed to simulate "the behavior of port employees" within a "realistic virtual environment," the facility enables trainees to acquire what are called "competencies essential for the future of the port" and these are deemed to be critical for work in an increasingly automated port (Field notes, December 2024).[3]

3 How the data from these training is used as a knowledgebase for automation is a consideration that requires further investigation.

During my site visit, I was struck by the gamified 'nature' of the work environment: several monitors and joystick setups were used to simulate block storage systems. A trainer described the design of these simulations:

> "You can program various incidents at different levels of escalation to challenge the trainees and prepare them for those situations. […] The operation must continue, containers have to be loaded and unloaded from the ships, and they need to leave on schedule. We can increase the pressure accordingly to train under stress. […] Or take a simple example like a fire in the block storage area, which can realistically happen. In the past, training for that required closing off a storage block, setting up precautions, and doing it in the middle of the night when terminal activity was minimal. Now, we can run these simulations 24/7. The simulation starts, and you enter the scenario" (Interview, December 2024).

In addition to technical training, this environment is designed to instill a 'culture of error.' As one interviewee explained:

> "You are allowed to make mistakes here; mistakes are even welcomed. That's how people learn. This is an important aspect: to establish a culture that embraces error. Especially we Germans or Europeans are still very much embedded in a zero-error culture" (Interview, December 2024).

This emphasis on flexibility, risk-taking, and resilience reflects a managerial shift to test "smart" subjectivities that are characterized by adaptability. The center promotes not only technical skills, but also so-called soft skills – "communication, teamwork, concentration, and resilience" (ibid.) – which are framed as necessary for collaborative problem-solving in rapidly changing environments. One trainer emphasized, "the goal is that when a process changes, the different occupational profiles […] are able to work together as a team to solve problems collaboratively" (ibid.).

These individual training practices index a broader regime of subject formation within the port. The primary obstacle to implementing digital infrastructures, as repeatedly emphasized in the field, is not technological, but rather organizational; this ensures that people align themselves with the new operational logics (Saxe 2017; Field notes, September 2024). In this sense, the smart port becomes a site in which mentalities are governed as much as material flows. Smartness, here, is less a matter of devices and more a matter of dispositions. Union representatives have also drawn attention to the wider societal implications of these transformations. One remarked:

> "We *the labor union and urban society* [emphasis S.L.] must work together to ensure that the humane and fair handling of technological progress becomes a city-wide concern. The question of how the work of the future is organised is not merely a

> corporate issue. It affects everyone. It is the most pressing social issue we face!" (Seebold 2018: 2).

These labor arrangements resonate with broader urban transformations. The smart port functions not only as a testbed for technical systems, but also as a space for new forms of government that may be scaled to the city at large (Field notes, November 2023). The temporality of implementation becomes provisional in such experiments, often framed as "proofs of concept": solutions can be advanced, suspended, or redirected depending on performance metrics (Field notes, November 2023). This experimental and provisional ethos enables a technocratic rationality that bypasses democratic deliberation, echoing what Morozov (2013) termed technocratic solutionism. What emerges is a mode 'governing with/through infrastructure,' in which optimization becomes synonymous with progress, and social contradictions are reframed as operational inefficiencies.

These developments illustrate the emergence of smart mentalities as a key governmental technique. The port ceases to be an infrastructural node within this framework, instead becoming an urban prototype that exemplifies a post-political logic in which urban futures are imagined as programmable, rather than contestable. Social contradictions are depoliticized, spatial inequalities rendered as data anomalies. Port-city relations, then, are not simply shaped by goals of connectivity and competitiveness, but are instead entangled in ongoing struggles over how urban space, labor, and life are governed – and in whose interest they are governed.

Conclusion: Spatial smartness strategies and logistical rationalities in/of the port of the future

This chapter has critically examined Hamburg's smartPORT initiative as a case for understanding how digitalization and infrastructural transformation intersect in a contemporary port. Using a governmentality framework, I have argued that smart logistical infrastructures operate as deeply political technologies that reconfigure spatial relations, operational logics, and socio-material arrangements. Rather than delivering neutral, efficiency-oriented improvements, smart port strategies instead enact specific forms of power and knowledge that (re)structure behavior, (re)shape labor processes, and promote anticipatory rationalities across both logistical and urban environments.

Empirically, the case shows how smartness operates both discursively and becomes materialized. It emerges as a strategic response to (constructed) challenges of spatial scarcity, global volatility, and competitive pressure. Yet these responses are full of frictions, contested, and are often contradictory. Project failures, the dis-

sonance between ecological claims and infrastructural expansion, and the private sector's entrenchment influence all of the tensions at the heart of smart port governmentality. The smartPORT strategies do not overcome urban tensions; rather, they relocate and reframe them within technocratic logics. The promise of frictionless, technologically driven efficiency is revealed as a partial and contested imaginary, one that is frequently disrupted by the everyday material complexities of port logistics.

I began this analysis by outlining the smart port's promise of improved urban life for all and proceeded by tracing how logistical rationalities associated with the smart port extend beyond the terminal gates into the urban realm, intersecting with urban government, infrastructure, and mobility. While some components of smartPORT, such as emissions reduction, may produce tangible effects in the city, others, like seamless circulation, remain aspirational. How port-city relations are ultimately being reconfigured through these adjusted modes of digital experimentation, infrastructural urbanism, and technocratic optimization remains part of port-city-futures. Yet, smart ports are envisioned as testbeds for future-oriented modes of government in which 'solutions' are deployed in ways that often foreclose upon alternative imaginaries.

This logic coheres to what may be termed "smart mentalities" – modes of thinking characterized by faith in datafication, adaptivity, and technocratic solutionism. These mentalities are not necessarily codified, but are instead reflected in the anticipatory government of flows, the valorization of innovation as ecological modernization, and the reconfiguration of labor through digital infrastructure. They underlie the ways in which smartness is both imagined and operationalized, as a technocratic rationality that seeks to manage complexity, minimize friction, and to standardize circulation. Making this pattern explicit helps us to understand how the government of infrastructure operates through dispersed logics of calculation, responsivity, and future-oriented experimentation. The smart port's transformation of labor relations further reveals the political dimensions of these developments. As automation expands, the working body becomes a subject to be recalibrated – retrained, monitored, and integrated into new systems of digital control. Subjectivity, in this sense, is produced through evolving modes of government that shape not only tasks, but also the embodied dispositions and sensoria of labor.

The consolidation of power within the global shipping industry underscores the geopolitical and economic stakes of these transformations. In 2022, the Danish carrier Maersk reported its most profitable year in its 120-year history (Glismand et al. 2023), profiting from the very disruptions, such as port congestion, pandemic-related delays, and the war in Ukraine, that strained global supply chains. This points to a central paradox: while smart port discourses promise narratives of frictionless, seamless circulation, the political economy of global logistics increasingly capitalizes on both volatility and disruption. What is at stake, then, is not just the pursuit

of operational efficiency, but the government of uncertainty – and with it, the redistribution of risk and rewards across a deeply uneven logistical landscape.

Ultimately, smart ports are more than logistical hubs and are instead infrastructures of political imagination and experimentation. The promise of smartness may lie in the frictionless coordination of flows, but its practice is deeply embedded in asymmetrical power constellations, contested urban space, and in material constraints. Thus, smart ports could be interpreted as contemporary and anticipatory sites of government, in which logistical rationalities shape not just the movement of goods, but also the contours of labor, territory, and subjectivities.

References

Amin, Ash (2014) Lively Infrastructure, *Theory, Culture & Society*, 31(7-8), pp. 137–61.

Belmoukari, Basma, Audy, Jean-François, and Forget, Pascal (2023) Smart port: A systematic literature review, *European Transport Research Review*, 15(1), p. 4.

Bröckling, Ulrich, Krasmann, Susanne, and Lemke, Thomas (2011) Governmentality: Current Issues and Future Challenges. From Foucault's Lectures at the Collège de France to Studies of Governmentality. An Introduction. In Bröckling, Ulrich, Krasmann, Susanne, and Lemke, Thomas (eds.) *Governmentality. Current Issues and Future Challenges*. New York: Routledge, pp. 1–33.

Campling, Liam and Colás, Alejandro (2021) *Capitalism and the Sea: The Maritime Factor in the Making of the Modern World*. London/New York: Verso.

Deloitte (2017) *Smart Ports. Point of View*. Rotterdam: Deloitte.

Dzudzek, Iris and Reuber, Paul (2021) Gouvernementalitätsansätze in der Politischen Geographie. In Schneider-Sliwa, Rita, Braun, Boris, Helbrecht, Ilse, and Wehrhahn, Rainer (eds.) *Humangeographie. Das geographische Seminar*. Braunschweig: Westermann, pp. 481–489.

Easterling, Keller (2014) *Extrastatecraft: The Power of Infrastructure Space.* London: Verso.

Foucault, Michel (1985) Freiheit und Selbstsorge. Gespräch mit Michel Foucault am 20. Januar 1984. In Becker, Helmut, Wolfstetter, Lothar, Gomez-Muller, Alfred, and Fornet-Betancourt, Raúl (eds.) *Michel Foucault, Freiheit und Selbstsorge. Interview 1984 und Vorlesung 1982*. Frankfurt a.M.: Materialis, pp. 7–28.

Foucault, Michel (1987) Das Subjekt und die Macht. In Dreyfus, Hubert L. and Rabinow, Paul (eds.) *Michel Foucault. Jenseits von Strukturalismus und Hermeneutik*. Weinheim: Beltz Athenäum, pp. 243–264.

Foucault, Michel (2019 [1978]) *Sicherheit, Territorium, Bevölkerung. Geschichte der Gouvernementalität I*. Frankfurt a.M.: Suhrkamp.

Glismand, Finn, Jensen, Henrik, Ryttersgaard, Thomas, and Spray, Sarah (2023) *Annual Report 2022*. Available at: https://investor.maersk.com/news-releases/news-release-details/annual-report-2022 (Accessed July 29, 2025).

Halpern, Orit, LeCavalier, Jesse, Calvillo, Nerea, and Pietsch, Wolfgang (2013) Test-Bed Urbanism, *Public Culture*, 25, pp. 272–306.

Hein, Jonas and Thomsen, Jannes (2023) Contested Estuary Ontologies: The Conflict over the Fairway Adaptation of the Elbe River, Germany, *Environment and Planning E: Nature and Space*, 6(1), pp. 153–77.

Hesse, Markus (2018) Focal firms, grand coalitions or global city makers? Globalization vs. new localism in Hamburg's maritime network. In Hoyler, Michael, Parnreiter, Christof, and Watson, Allan (eds.) *Global City Makers*. Cheltenham: Edward Elgar, pp. 151–169.

Hilder, Nils and Hein, Jonas (2023) Der Hamburger Hafen im Wachstumszwang. Das Hafenerweiterungsgebiet als Territorium der (Un)Gerechtigkeit? In Klepp, Silja and Hein, Jonas (eds.) *Umweltgerechtigkeit und sozialökologische Transformation*. Bielefeld: transcript.

HPA (2014) *Hamburger Hafen–Digitales Tor zur Welt*. Hamburg: Hamburg Port Authority.

HPA (2015a) *Der Weg ist das Ziel*. Available at: https://www.hamburg-port-authority.de/fileadmin/user_upload/150618_spl_app_web.pdf (Accessed July 29, 2025).

HPA (2015b) HPA goes smartPort. Available at: https://www.hamburg-port-authority.de/fileadmin/user_upload/150422_tl_messe_lowres.pdf (Accessed: July 29, 2025).

HPA (2020) *Sicherung der wasserseitigen Zugänglichkeit zum Hamburger Hafen*. Hamburg: Hamburg Port Authority.

HPA (2021) *homeport*. Available at: https://homeport.hamburg/ (Accessed July 29, 2025).

HPA (2025) *smartBRIDGE Hamburg*. Available at: https://digitalerzwilling.bundesfernstrassen.de/smartbridge-hamburg-expertenvideos (Accessed July 29, 2025).

Jahn, Carlos and Saxe, Sebastian (2017) *Digitalization of Seaports – Visions of the Future*. Hamburg: Fraunhofer.

Jessen-Thiesen, Levke (2022) *Am Puls des Welthandels – der Umschlag im Hamburger Hafen während der Corona-Krise*. Kiel: Institut für Weltwirtschaft.

Kokot, Waltraud (2008) Port Cities as Areas of Transition Comparative Ethnographic Research. In Kokot, Waltraud, Gandelsman-Trier Mijal, Wildner, Kathrin, and Wonneberger, Astrid (eds.) *Port cities as areas of transition: Ethnographic perspectives*. Bielefeld: transcript.

Läpple, Dieter (2024) Wann findet Hamburg den Mut, sich von dem Primat des Hafens zu verabschieden?, *DAB Regional Juni-August.*

Larkin, Brian (2013) The Politics and Poetics of Infrastructure, *Annual Review of Anthropology*, 42(1), pp. 327–343.

Lemke, Thomas (2007) *Gouvernementalität und Biopolitik*. Wiesbaden: Springer.

Lemke, Thomas (2021) *The Government of Things. Foucault and the New Materialisms*. New York: NYU Press.

Molavi, Anahita, Lim, Gino, and Race, Bruce (2020) A framework for building a smart port and smart port index, *International Journal of Sustainable Transportation*, 14(9), pp. 686–700.

Morozov, Evgeny (2013) *To Save Everything, Click Here: The Folly of Technological Solutionism*. New York: Public Affairs.

NDR (2025a) *Hafen der Zukunft*. Available at: https://tinyurl.com/2wk53ju9 (Accessed July 29, 2025).

NDR (2025b) *1970: Erster Rammschlag für Hamburger Köhlbrandbrücke*. Available at: https://tinyurl.com/4mzjhwjr (Accessed July 29, 2025).

Riofrancos, Thea (2021) From Cases to Sites: Studying Global Processes. In Simmons, Erica and Rush Smith, Nicholas (eds.) *Comparative Politics: Rethinking Comparison*. Cambridge: Cambridge University Press, pp. 107–126.

Saxe, Sebastian (2017) *Erfolgsfaktoren für Digitalen Hafen und Digitale Stadt*. Available at: https://hv.hansevalley.de/2017/09/hansepersonality-sebastian-saxe.html (Accessed July 29, 2025).

Seebold, Torben (2018) Editorial. In ver.di (ed.) *Waterfront 02/18, internal report*. Berlin: ver.di Bundesverwaltung.

Srnicek, Nick (2017) *Platform capitalism*. Cambridge UK: Polity.

Star, Susan L. (1999) The Ethnography of Infrastructure, *American Behavioral Scientist*, 43(3), pp. 377–391.

Swyngedouw, Erik (2018) Post-Politicizing the Environment: Ecology as the New Opium of the Masses. In Swyngedouw, Erik (ed.) *Promises of the political*. Cambridge: The MIT Press, pp. 65–90.

Tesse, Jöran et al. (2021) *Extending Internet of Things Enterprise Architectures by Digital Twins Exemplified in the Context of the Hamburg Port Authority*, conference paper.

THB (2017) *Aus für Smart Port Logistics*. Available at: https://www.thb.info/rubriken/maritime-logistik/detail/news/aus-fuer-smart-port-logistics.html (Accessed July 29, 2025).

Thrift, Nigel (2008) *Non-Representational Theory*. Oxon: Routledge.

Tonkiss, Fran (2015) Template urbanism, *City*, 15(5), pp. 584–588.

Tsing, Anna (2009) Supply Chains and the Human Condition, *Rethinking Marxism*, 21(2), pp. 148–176.

Tsing, Anna (2011) *Friction: An Ethnography of Global Connection*. Princeton, NJ: Princeton University Press.

Vöpel, Henning (2020) *Die Zukunft des Hamburger Hafens. Determinanten, Trends und Optionen der Hafenentwicklung*. Hamburg: Hamburgisches WeltWirtschaftsInstitut.