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Cloud Atlas. A Global Analysis of Cloud Infrastructures

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Abstract

Through document analysis and participant observation, the thesis employed a genealogical lens to examine how, at the unfolding of the current crisis conjuncture, cloud infrastructures shape the politics of automation by mediating with capital, states, and transitional regimes of labour. Following an introduction to the theoretical and methodological framework, the thesis is organised into four articles: documentary analysis and participant observation in Italy (Articles I–II); archival research in Guadeloupe (Article III); and documentary research conducted in Australia focusing on Malaysia (Article IV). With a Cloud Atlas, I call for the development of a historical and geographical-oriented framework to analyse the entanglements between the politics of automation (framed in logics, geographies, and aesthetics) and the politics of cloud infrastructures as disjunctive conjunctures in the long durée of global capitalism.

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CHAPTER 1

THEORETICAL AND METHODOLOGICAL FRAMEWORKS

Introduction

This dissertation examines contemporary transformations of capitalism by analysing the emergent role of cloud infrastructures within the current crisis conjuncture—marked by the COVID-19 pandemic, war regimes, and a hegemonic transition (Mezzadra & Neilson, 2024). The thesis is articulated through four articles—three published in 2023, 2024, and 2025, and one currently under submission—based on documentary analysis and participant observation in Italy (Articles I–II), archival research in Guadeloupe (Article III), and documentary research conducted in Australia focusing on Malaysia (Article IV). This doctoral thesis does not purport to provide exhaustive analysis; rather, it shares an initial scaffold for a broader research program. Its title, Cloud Atlas, should be read as a methodological instruction for further research steps: the term reflects a historically and geographically informed grid for tracing how cloud infrastructures mediate relations among state, capital, and labour across sites and scales.

In “The Long Twentieth Century,” Arrighi commented on the crisis of the 70s by arguing that contemporary domination appears to move simultaneously “forward” toward a new order and “backward” toward early-modern state and war forms (1994). By examining how cloud-infrastructures intersect with transformations of labour, capital, and state power, I conceptualise these dynamics as disjunctive yet mutually conditioning movements that characterise cycles of accumulation in global capitalism. Rising to address a crisis of capital reproduction, cloud infrastructures produce an “asynchronous synchronicity” between the temporalities of social reproduction and those of capital’s circulation and reproduction—deferring systemic crisis over time while diffusing it spatially.

My work started in 2022 with an investigation into agreements between Amazon Web Services and the Italian public administration within the context of welfare digitalisation at the onset of the pandemic crisis. The article titled "Digitalizzazione del welfare, verso nuovi oligopoli? Il Caso di Amazon Web Services" consolidates the principal findings.

This initial observational study led to the recognition of the need to understand the technical operations of cloud infrastructure through visits to data centres in Northern Italy and Switzerland. These initial fieldwork experiences gave me the opportunity to broaden my perspective beyond the theoretical frameworks of a young scholar in the social sciences. I’m grateful to the data centre workers I met for their help.

Soon thereafter, I expanded the initial inquiry over the Italian welfare to encompass the political process that, during those years, orchestrated the digitalisation not only of welfare but also the dismantling and "migration" of all public, critical, and strategic state data into the infrastructures of Amazon, Google, Microsoft, and Oracle from 2024 to 2039. This initiative allocates 27% of the funds from the National Recovery and Resilience Plan (PNRR), a strategy through which the state, according to one of its representatives, intends to 'ultimately dispense with 80% of the work in the Public Administration' (Blotta, 2023).

Article II ("A New System? Crisis, State, and Capital in Italian Digital Sovereignty") presents findings derived from documentary analysis and participant observation conducted within National Strategic Hub data centres and during negotiations concerning the Telecom dossier and the Italy Cloud Strategy. These meetings involved representatives from the Italian government, international consulting firms, and prominent technology and telecommunications companies—both Italian (e.g., Leonardo, TIM) and American (Big Tech).

Capital, Braudel wrote (1992, 123), "only triumphs when it becomes identified with the state, when it is the state." The article analyses the infrastructures mobilised by the state to address not a crisis of social reproduction but a crisis of capital reproduction and hegemonic transition.

It is in this context that the second article concludes by suggesting mobilising interpretive frameworks situated within a global and historical spectrum: a move that incised in my visiting periods first in the Caribbean, at the University of French Antilles, Pole Guadalupe (FR) in 2024, and in Sydney, Australia (NSW), at the Institute of Culture and Society (ICS) at Western Sydney University between the end of 2024 and 2025. Here, I found the theoretical, methodological, and human support to continue the research while extending the scope of the study beyond the European context and beyond the present.

In this regard, scholarly work in critical logistics has proven essential to frame data centres' operations as logistical technologies of value circulation. These infrastructures shape the future of work, yet they impinge on a long genealogy that must be traced beyond a linear narrative of technology and beyond a history of progress from the centre to the peripheries of the global system. The Atlantic Slave Trade is regarded as the origin of global logistics and modernity (Harney & Moten, 2013), a perspective that influenced my decision to reside in Guadalupe for several months.

Following the study of a) ship logs and letters of a French slave vessel (The Marie Seraphique) and b) inbound-outbound charts of one of the first logistical standards in global trade (the Luango Port system), I examined how, in the Middle Passage, the organization of value circulation was based on operations that sustained the control and the social reproduction of migrant labour during the transit aboard slave vessels, warehouses and ports. In the article I wrote (III), entitled "The Black Archives of Automation", I frame these documents as logistical/environmental media (Rossiter & Zehle, 2023; Zieger, 2021) that served as antecedents of predictive computing.

Building upon Marxist labour theory, Operaist literature, and colonial archives, the essay explores a postcolonial history of automation where the development of slave vessels, ports, and feritoias (colonial warehouses)—pictured as machines of labour abstraction—followed the slave

acts of social intelligence to collaborate and resist. Here, the fantasy of logistics to "do without the subject" (Harney & Moten, 2013) historically informs what I define as the logics, the geographies, and the aesthetics—collectively, the politics—of contemporary automation.

While data centres may serve as the archives of the present, the genealogy of the Atlantic trade provides an example that the operations and imaginaries that unfold capitalism are always historical yet contingent: as Marx wrote, every machinery, rather than "a simply technical device, embodies the social relations and struggles that produced them" (Marx, 1993, 690–712). I wrote this third article while living in a rural area near the slave *feritoias* –a slave prison/warehouse- of Port Louis, Guadalupe, situated between sugar plantations inhabited by descendants of African slaves and Indian indentured labourers. At the time of submitting the manuscript, I spent a month—like nearly everyone else there—without gas or running water, due to a general strike by water-pipe workers that escalated into acts of sabotage. As a result, the main port terminal (where people refuel with gas) was shut down; its ownership, like that of any large economic sector in the island-notably sugar plants- significantly traces back to the descendants of plantation slaveholders: the *Békés*. The term means « blanc des quais » "a white from the quay" as the white colonists and merchants controlled the ports, in the seventeenth century. In Guadalupe and Martinica, slavery was first abolished, within the French Revolution, then relegalized in 1802 and re-abolished in 1848: the crisis of labour that followed- slaves run away as they preferred to be free...-was "solved" by instituting the juridical figure of "immigré", and opening channels of temporary migrant workers from India and China- the *indenture*. Following abolition in 1848, slave owners reinvested the state-funded "reparations" they received into major infrastructural assets that still structure economic life in the French Antilles. These islands are live archives marked by perpetual violence and cyclical insurrections.

Here, through logistics studies, I felt the need to extend my analysis of cloud and data centres to broader infrastructures of global capital circulation, as these support so-called "revolutions" in the Marxian sphere of production. Crucially, in the crisis conjuncture of the mid-nineteenth century, the transition from slave labour to contract labour was underpinned by an infrastructural fix that delayed the crisis of capital reproduction by re-channelling capital and labour brokers' investments into labour and capital infrastructures of the Second Industrial Revolution. This reconstruction enables a historical analysis of the research presented in the thesis's final article, which explores the genealogy of contemporary dormitory labour regimes in semiconductor manufacturing in Johor, Malaysia. From the perspective of transnational labour theory, as the Export Processing Zones (EPZs) of Johor play a pivotal role in the geopolitics of automation, I analysed that the shaping of Johor, in Malaysia, as a spatial-temporal fix for the digital economy is driven by a "return" of colonial infrastructures mobilised during the crisis conjuncture of the mid-nineteenth century. Notably, these include the politics of social reproduction of labour that recall local indentured labour systems, such as the kangchu and the kadar regimes. Here, the concept of the Marxian "reflux" reemerges to remind us of these historical yet contingent and recursive lineages, which

are essential for understanding the asynchronous synchronicity between colonial debris (Stoler, 2013) and the future of work.

"Remember, data centres are divided into 'stations' and 'cathedrals'." As an Internet Exchange Point (IXP) manager in Milan remarked, this distinction captures the dual political ontology of contemporary cloud infrastructures. As 'stations', data centres operate as logistical nodes that organise, accelerate, and govern the circulation of capital; as 'cathedrals', they function as centres of authority whose power derives from the concentration, control, and orchestration of information and knowledge. It is this latter dimension that grounds an archival reading of data centres as the political institutions of the present, in which the future is anticipated, classified, and rendered actionable. From this standpoint, the dissertation argues that the analytical object at stake is not the computer as a discrete technological artefact, nor platforms as exceptional formations, but computation as a historically recurrent ensemble of calculative techniques.

These techniques predate digital machines and are continuous with imperial infrastructures of knowledge—ship logs, vessel charts, botanical gardens, museums, archives, and statistical offices—that operated as obligatory passage points for planetary coordination, comparison, and extraction. Read genealogically, contemporary cloud infrastructures appear as the sedimentation of these logistical projects: modern clearinghouses that discretise the world, fold spatial and temporal variation into informational systems, and produce regimes of legibility through which state and capital act.

Crucially, such infrastructures do not resolve capitalism's structural contradictions; rather, they engineer asynchronous synchronisations between the temporalities of social reproduction and those of capital's circulation and reproduction, thereby deferring, displacing, and rearticulating crises across space and time. Conceived as a methodological instruction, *Cloud Atlas* thus maps the historical continuities and geographical differentiation through which infrastructural power mediates relations between state, capital, and labour. The chapters that follow operationalise this framework, moving from theory to empirical analysis in order to trace how infrastructural time itself has become a central political technology of contemporary capitalism.

1.1 Crisis, State and Capital in the Process of Italian National Digitalisation

Based on participant observation in Italy, the first two articles analysed how, during the pandemic crisis, the digitalisation of the Italian welfare led U.S. cloud providers (Google, Amazon, Microsoft and Oracle) to become essential infrastructures for the reproduction of capital. The articles provide lines of research that frame the politics of cloud infrastructures as politics of state restructuring, as a *moment* of capital, within the pandemic and war conjuncture (Mezzadra & Neilson, 2024). Building on Braudel's analysis of global capitalism and anti-market, the research builds on documentary analysis and participant observation in 'the zones of opacity', where, instead of 'competing in the market', 'capital *identifies itself* with the State, *it is* the State' (1992, 54). Namely, I attended institutional meetings and visited the data centres of the National Strategic

Pole (PSN). The PSN, publicly operated by Italian firms (Leonardo, Tim, Sogei, Cassa Depositi e Prestiti) and funded with the European Recovery and Resilience Plan (PNRR) is, instead, the Cloud Region of Google in Northern Italy operated by Amazon, Google, Microsoft and Oracle.

As these practices emerge from "hidden" political tactics by the government and U.S. Big Tech against national and European regulations (act. Schrems I, II), the results align with a broader theoretical framework for analysing crises, capitalism, and the State (Braudel, 1992). Notably, the politics of cloud infrastructures fund market imperatives with state power, producing new modalities of "marketised statism" that blur the distinction between public and private functions.

Here, the state, rather passively or neutrally, followed the "infrastructural turn" (Musiani, 2022) at play in the crisis conjuncture, becoming a direct agent of capital accumulation, combining its infrastructural, logistical, legal, and financial capacities with those of leading U.S. technological companies. Crucially, the pandemic magnified a long-standing shift toward what Polanyi might have described as an inversion of the social contract: the use of state mechanisms, such as legislation, not to protect society from the market, but to protect the market from society. Here, while private and national stakeholders refer to the national digitalisation as a "rupture"- calling for a "cultural revolution" in new state functions, the article stresses the need to historicize the rising role of the cloud infrastructures within a broader analysis of the crisis, the state and the capital at stake.

Building on the concept of a crisis of social reproduction (Fraser, 2014, 2016), authors such as Rao and Vakulabharanam (2019) interpret the impact of Covid-19 in state restructuring by distinguishing between crises of social reproduction affecting labour and those impacting capital (Rao, 2021). Moving beyond this distinction is particularly helpful not only for situating the new developments of U.S. platforms in a 'new market', but also for addressing the roles of both capital and the state in the crisis. As the coronavirus crisis serves as an exceptional example of a crisis in social reproduction, feminist authors analysed welfare states' restructuring in relation to the needs of the American and European national states to confront the cyclical crises of capital social reproduction caused by contradictions inherent in the capitalist mode of production (Mitchell, Marston and Katz, 2003; Mezzadri, 2019). In this lens, authors agree that the COVID-19 pandemic must be understood not simply as a health emergency but as a paradigmatic instance of a broader crisis in the reproduction of capital (Rao, 2021; Li, 2023). While it exemplifies a crisis of social reproduction—particularly by destabilising care infrastructures, public health systems, and household labour (Fraser, 2014, 2016)—its disruptive effects on the capacity of labour power to sustain capital accumulation reveal its character as a crisis of reproduction for capital (Caffentzis, 2002; Rao & Vakulabharanam, 2019). In this sense, the pandemic exposed vulnerabilities at the heart of capitalist economies: the inability to maintain the social and biological conditions required to reproduce labour power at scale, threatening profitability and systemic continuity (Mezzadri, 2019; Mitchell, Marston, & Katz, 2003).

According to Fraser (2016), such crises are not anomalous but structurally embedded in capitalism itself, which lacks intrinsic mechanisms to secure and sustain the long-term

reproduction of labour power, relying instead on undervalued and often feminised reproductive labour. In line with social reproduction theory, pandemics and other large-scale disruptions, such as wars and ecological disasters, do not merely disturb daily life; they endanger capital's reproduction by diminishing either the quantity or the quality of labour available for exploitation (Bhattacharya, 2017; Caffentzis, 2002).

These events reveal and intensify the contradictions between economic production and social reproduction that have historically necessitated interventions such as the welfare state to mitigate systemic breakdowns (Fraser, 2014). The digitalisation of the Italian welfare system, driven by actors such as Amazon Web Services (AWS), goes beyond a mere technical response to the COVID-19 pandemic. Instead, it must be situated within the broader historical and theoretical understanding of how welfare states emerge and evolve in response to systemic crises of capital accumulation and social reproduction (Fraser, 2016; McDonough et al., 2021). As capitalist accumulation undermines the social conditions upon which it depends—namely, adequate healthcare, education, income, and care infrastructures—these contradictions recur cyclically, reaffirming the fundamental assertion of social reproduction theorists: that crises within capitalist societies are not external shocks, but rather periodic disruptions rooted in the internal dynamics of reproduction itself (Katz, 2001; Elson, 1998; Bakker & Gill, 2003).

In fact, while AWS integrated Italian public welfare infrastructure during the first wave of Covid-19 infections, its engagement with Italian institutions predates the pandemic, with early agreements—such as the 2015 agreement between AWS and Corte dei Conti (The Italian Court of Audit) (Blotta, 2023). Defined as “a choice enforced by the national necessity to cut public costs”, the Court of Audit’s spokesperson's words are particularly relevant to understanding the national State's perspective on the process (ivi). While the first article frames the Italian welfare as a “test bed” for the developments of Amazon Web Services in the Pandemic, the second essay, entitled “Toward a New System? Crisis, State and Capital in the Italian Digital Sovereignty” anchors three vectors to further the analysis: the role of crisis, and the roles of capital and the State.

In fact, beyond processes of neoliberal restructuring that have long unfolded in the Western, European and Italian welfare structure, the emergence of data oligopolies require us to understand that cloud infrastructures developed proprietary toolkits and infrastructures that provide them with new archival, processing, and informational capacities that, in the case of health data, surpass what public or private healthcare institutions have historically been able to extract, store, and analyse (cf. Van Dijck et al., 2019, 189, Blotta, 2023). This is particularly important in this context, as the automated collection of individual data can reshape the aims and roles of national social welfare provisions. In fact, cloud infrastructure can bypass traditional institutional filters, integrating user data into a complex ecosystem where information is combined and aggregated using a proprietary, externally uninspectable algorithm. Here, companies like Google, Microsoft Azure and Amazon Web Services can provide the national state with the largest infrastructures of the global “data economy” (Ragaglia & Roma, 2015; Van Dijck et al., 2019), increasing the national state’s ability to acquire, sustain and elaborate public services based on user-generated data.

Indeed, unlike welfare systems whose social and economic rationale lies in the care of patients, the interest of private digital platforms is pivoted—due to contractual and business considerations—to the collection and monetisation of data (Van Dijck et al., 2019, 209). This distinction is crucial, especially considering that while the volume of medical data stored in clinical systems has increased globally by 500% between 2016 and 2020, Big Tech corporations such as Amazon, Apple, Google, and Microsoft have been the primary users of this data. They have leveraged it to identify pharmacological targets, forecast real-time medication demand, and develop technologies for patient monitoring and electronic health record management (Blotta, 2023).

Thus, while unfolding in the already ongoing process of restructuring and outsourcing of the public sector, the new alliances between the welfare state and U.S. cloud providers reflect a more profound strategic transformation in the role of the state, not as retreating, but as being reoriented to facilitate new forms of capital accumulation through technological infrastructures (Jessop, 2002).

First, I examine the role of the State, then the analysis shifts in the understanding of the pandemic crisis as a conjuncture of capital crisis (Mezzadra & Neilson, 2024), thirdly, the essay moves to examining the rise of cloud infrastructures as a capital restructuring to delay the current crisis.

1.1.1 State

Given the sheer magnitude of the pandemic, the crisis of social reproduction, and the other interlinking crises mentioned above, there have been renewed calls for the state to play a more active, mitigating role. The most common form of these social democratic and neo-Polanyian arguments is to diagnose the disruptive effects of decades of neoliberal adherence to globalisation and free markets and, in response, to posit the state as a means of social protection against the harmful 'disembedding' effects of the market.

Alongside the 'new protagonism' of the European national states in times of the pandemic, authors such as Gerbaudo (2021, 252) observed that the crisis prompted a demand for a new 'politics of care'. However, despite these agreeable goals, Gerbaudo's account falls short of convincingly explaining how and why the state would be in a position to implement them (Jäger, 2021).

However, the Marxist-feminist critique in social sciences reminds us that such progressive and social democratic neo-statist accounts that wish to "revitalise the state" for the purposes of building an anti-capitalist and anti-neoliberal project do suffer from a common problem—that of seeing the state in a relationship of externality to capital and the capitalist mode of production. That is, instead of beginning with the premise of a capitalist state, they start with the idea of the state *in* capitalism. As Poulantzas noted, in this schema either the state is a 'passive, if not a neutral, tool

totally manipulated by a single fraction' or the state is a subject, one that 'has absolute autonomy and functions of its own will' (Poulantzas, 2008, 308).

Although its particular features vary across space and time, we may theorize the state as fulfilling three general roles within the capitalist mode of production: (1) creating the socially necessary conditions for ongoing capital accumulation; (2) ensuring a degree of social reproduction beyond the 'strictly economic' dimension of capitalist social relations; and (3) generating the political and ideological mechanisms of cohesion, through which both capital accumulation and social reproduction are represented and articulated (Fraser, 2017; Rao & Vakulabharanam, 2019; Rao, 2021). These three roles are by no means mutually exclusive, nor do they ever appear in a 'pure' form, isolated from the others. They are best thought of as analytical starting points rather than descriptions of concrete (and complex and contradictory) social formations. Serving the accumulation of capital lies in the commodification of labour power, preservation of private property, and enforcement of contractual obligations via the mediating abstraction of the legal form (Block, 1977; Offe,1984; Pashukanis, 1983). Taken together, these are the concrete, material processes through which the state is involved in the ongoing valorisation and private accumulation of capital (Rao, 2021). The state provides the physical, legal, and intellectual infrastructure through which different capitalist class fractions can compete in the accumulation process, thereby serving as a stabilizing node for perpetuating the M–C–M' chain of the production and circulation of capital. In this manner, the state is rendered, in Engels' famous phrase, as the 'ideal personification of the total national capital' or the 'ideal total capitalist' (Engels, 2010, 319; Walker, 2016).

The second dimension of the capitalist state, that of social reproduction, is closely intertwined with the gradually expanding role and capacity of the historically specific form of the social welfare state that emerged over the twentieth century (Rao, 2021). Social reproduction is a demand in all stages and phases of capitalism—indeed, it is a demand upon human social organization in all modes of production; yet the role of the state in this process has been historically variable and subject to changes based on given relations of production.

Crises have a central role in restructuring state functions (Li, 2023; Jessop, 2002). What has been called the neoliberal period, understood both as a distinct regime of capital accumulation and as a corresponding political-ideological hegemonic project, emerged from a period of political and economic crisis that lasted much of the 1970s. Yet it is now almost a truism to say that, contra popular wisdom about the retreat of the state, this period of falling profits and rapid inflation actually marked a significant persistence, transformation, and even expansion of state power (Jessop, 2002).

Here, the scholarship noted the continuities between this regime of accumulation and the tendencies already present during the 'Glorious Thirty' years of the postwar boom—a period during which social democratic parties and trade unions were incorporated into national and global markets that were protected and insulated from democratic oversight and control via the institutions of the state itself (Panitch & Gindin, 2013; Cahill & Konings, 2017; Slobodian, 2018).

However, the crisis period of the late 1960s and early 1970s also initiated an important shift in the structure and social power of the capitalist state. Poulantzas' early diagnosis of these tendencies under the concept of 'authoritarian statism' noted that the organisational methods of the capitalist state shifted from political parties to the state's bureaucratic administration; the power of legislatures weakened at the expense of its consolidation in the executive. Crucially, after a vanguard phase of reorientation from 1979 to 1992, and a so-called "social regime of consolidation" from 1992 to 2007, the neoliberal project has been defined in a crisis regime of permanent exception from 2007 to the present (Davidson, 2017).

In this current phase, this state form continues to find itself hemmed in both by socio-structural incentives and past policy decisions—not least of all the financialization and transnationalization of capital and the ongoing weakness of organized labour—as well as by central state economic apparatuses like central banks.

Feminist political economy provides a practical analytic starting point for assessing the contemporary role of the state. Following Nancy Fraser's formulation, of the three functions of the modern capitalist state in capitalism, from the crisis of the 1970s onward—and with intensity after the global financial crisis of 2008—public policy has progressively prioritised the facilitation of accumulation at the expense of robust social-reproductive provisioning and of mechanisms that sustain popular legitimation (Fraser, 2017). The consequence has been a structural hollowing-out of the state's reproductive and representative capacities, which in turn produces recurrent episodes of social contestation and managerial recourse to repressive or technocratic remedies.

The COVID-19 pandemic made these structural tensions especially salient. Fraser's account of a systemic "crisis of care" under financialized capitalism helps to explain why the pandemic did not inaugurate a novel dysfunction but rather exposed and accelerated pre-existing deficits in the social reproduction of labour (Fraser, 2017). Over recent decades, the burdens of care have been shifted onto households and global labour markets through processes of privatization, fiscal retrenchment, and the commodification of services; at the same time, the global incorporation of precarious migrant labour has deepened asymmetric dependencies within transnational care chains. The result has been defined as a dualised regime of reproduction—market-mediated for those with means and precarious or privatised for those without: Needless to say, this condition renders societies especially vulnerable to systemic shocks.

Empirically, state responses during and after 2020 demonstrate continuity rather than rupture in the relations between state and capital. Rather than effecting a durable reassertion of social-reproductive responsibilities, many governments have pursued short-term measures designed primarily to stabilise capital circuits—emergency liquidity provision, targeted industry relief, and infrastructural interventions that preserve accumulation—while leaving long-term care infrastructures underfunded or structurally altered. These interventions have frequently been accompanied by coercive and managerial practices that further erode popular legitimation even as they temporarily sustain accumulation (Li, 2023).

The analytical implication is methodological and political: the contemporary moment is construed not as an exceptional break but as a conjuncture within a recurrent, crisis-tending dynamic characteristic of capitalist development (ivi). The remedies implemented—whether financial (refer to the role of the PNRR) or infrastructural (the digitalisation of the welfare state in conjunction with the national digital plan, regarded as strategic)- which tend to postpone rather than resolve fundamental contradictions, reproduce a pattern wherein crises are temporarily deferred through the re-embedding of surplus capital into material and institutional forms. Consequently, current "disruptions" manifest as contingent yet historically situated conjunctures, with their apparent stabilisations being provisional. Understanding this historical yet contingent nature is essential to diagnosing the limits of current reforms and to imagining alternatives that address the root contradictions of accumulation and social reproduction.

Therefore, instead of pursuing ruptures, it appears beneficial to conduct a more thorough analysis of the current crisis utilising a vocabulary that emphasises its cyclical nature, recursiveness, and disjunctions.

1.1.2 Crisis

Zachary Levenson (2020) identified it as a moment of an organic crisis, composed of interconnected economic, political, social-reproductive, racial, and ideological crises, which together were causing the deterioration of social stability and exposing cracks in the hegemonic order. Taking an even broader perspective, Salar Mohandesi (2020) characterised that conjuncture as comprising four interlocking, 'nested' crises, with each operating at its own level and on a distinct temporality. For Mohandesi, these articulated moments of crisis were: first, the coronavirus, representing a particular, conjunctural crisis that unexpectedly disrupted standard patterns of life; second, a more profound organic crisis of neoliberalism, marking the 'breakdown of the entire hegemonic system itself'; third, a yet even deeper structural crisis of capitalist social reproduction, in which the 'normal' precarity of life under capitalism was further compounded by the slashing of wages, layoffs and closures, and the withdrawal of public means of social care; and finally, the fourth, epochal crisis: the climate catastrophe, threatening planetary life altogether.

As crises occur in multiple domains, their relationship is more likely to be temporally dependent rather than a sequential, necessary progression from one crisis to another—for example, from the economic to the social, and then to the political (Khachaturian, 2023). However, should these crises converge, they give rise to a conjunctural crisis, a fusion of a plurality of contradictions, each with its own pertinent domain. As Stuart Hall noted, conjunctural crises occur when 'these "relatively autonomous" sites—which have different origins, are driven by different contradictions, and develop according to their own temporalities—are nevertheless "convened" or condensed in the same moment. Then there is a crisis, a break, a "ruptural fusion" (Hall & Massey, 2010, 59–60). Furthermore, while crises have both structural and proximate causes, they are moments when structural forces and their relative weight may shift into a new constellation or arrangement of the

balance of social forces. Being periods of relative indeterminacy, crises figure new openings—the 'nature of their resolution is not given' (Hall & Massey, 2010, 57)—but only under certain favourable conditions.

Examining the capital and the state in the crisis conjuncture, Mezzadra and Neilson (2024, 204) deployed the notion of the *feedback* to grasp the "growing incapacity of states to guarantee the reproduction and turnover of capital within their borders has led them to seek advantage by strengthening their control over transnational circulatory processes". In their analysis, they bridge the notion of feedback to the Marxian concept of "reflux" (Rückfluss) as it denotes the capacity of the advanced money-capital to *return* to its point of departure once augmented by surplus-value or interest, through the processes of production, circulation, and credit. Feedback (or reflux), therefore, constitutes a crucial temporal dimension of the circuit of capital (Mezzadra & Neilson, 2024): the continuity of capitalist accumulation depends on the regularity of the return of money-capital. Delays, impediments, or blockages in this reflux amplify crises of overproduction as integral elements of capitalist crises.

This shift in perspective helps situate the rise of new functions and forms of the state as *feedback* to the crisis-ridden pattern of capital accumulation that in turn necessitates a constant reorganisation of social relations of production and exchange: a "return of the state" that is integral to the reproduction of capital and does not overcome, rather postpones, the crisis.

The notion of feedback, which originates in cybernetics, will cyclically emerge in the other sections of this essay, aligning the analysis with the scholarship that observed how, historically, 'capital's economic requirements fundamentally determine the capitalist state's economic intervention' (Fine & Harris, 1976, 99). In fact, these feedbacks are more than short-ended loopholes. According to Joachim Hirsch, the capital tendency for the rate of profit to fall *is* the determining historical law, 'in responding to which the state takes on new functions and develops appropriate forms through which to carry out those functions' (Clarke, 1991, 14). In this view, the state and its operations represent *moments* of capital (Poulantzas, 2000) that serve to temporally disjunct organic crises into a series of conjunctures. Here, we can examine the role of cloud infrastructures as they *disjunct* the crisis without resolving it. The fusion of these various crises in 2020–2021 made it publicly evident that the capitalist state was either incapable or, or uninterested in, caring for its citizens (Rao, 2021). While the coronavirus pandemic exposed the state's general incapacity to protect its population—and, for a time, to secure the conditions of social reproduction necessary for continued capital accumulation, the structural contradictions that surfaced in 2020 remain unresolved, precisely because their persistence is rooted in the very nature of the capitalist state.

1.1.3 Capital

Distributed unevenly between the global North and South (Amrute et al., 2022; Milan & Treré, 2019; Ricaurte, 2019), cloud providers – also called platform infrastructures- have coalesced into

a highly concentrated oligopoly of *hyperscalers*—Amazon, Microsoft, Google, Alibaba, and IBM—whose cloud architectures centralize the commercial management of public and private information at an unprecedented scale. The new roles assumed by U.S. Big Tech made clear that far from being neutral technological systems, cloud infrastructures are deeply implicated in processes of crisis management and state restructuring. As Hu (2015) observes, crises have become the preferred terrain for the deployment of cloud technologies: from the U.S. "war on terror" and border surveillance, to the Covid-19 pandemic and the ongoing geopolitical conflicts in Ukraine and Gaza (Carr et al., 2021; Blotta, 2024).

Their capacity to *infrastructure* —namely, to intervene in and reconfigure its logistical and informational operations—emerged as a response to a crisis of capital reproduction, in which the reproduction of labour power (care, health, education, and social stability) was increasingly threatened. Moving from the Sciences, Technology and Society Studies (STS) scholarship, the notion of *infrastructuring* (Star & Bowker, 2006; Larkin, 2013; Plantin & Punathambekar, 2019) captures the temporal and socio-material process by which, providing essential services of social reproduction, technologies may develop into states as "infrastructures" of public needs and thirdly, "large technical systems".

However, extending from social to capital reproduction, authors such as Alami and Dixon (2023) argue that contemporary digital platforms are central for "state–capital hybrids" that drive capital accumulation amid stagnation and overcapacity. Far from marking a technological rupture, their integration into governance continues the historical imperative identified by Engels and later Marx: the reduction of turnover time as a condition of profitability.

Contrary to digital exceptionalisms, an extensive literature reads the political-economic transformation commonly labelled "digital capitalism" as a historically continuous investment in the capital sphere of circulation whose immediate objective is to accelerate turnover (Soskice, 2020). The "cloud," in this sense, serves not merely as a technical domain but as a political valve to sustain capital accumulation during crises of reproduction.

From this perspective, platform infrastructures and data-intensive operations function as technologies of circulation: they extract, coordinate, and monetise flows of information, attention and labour to shorten the interval between valorisation and realisation (the turnover period) and thereby mitigate pressures on profitability that arise from the tendency of the rate of profit to fall (Marx, 1894; Engels, 1878; cf. Mavroudeas, 2020). The capacity of digital infrastructures to compress circulation time — via real-time telemetry, targeted intermediation, algorithmic matching and instantaneous payment/settlement mechanisms — constitutes a core mechanism by which capital seeks to restore or sustain profitability in the contemporary conjuncture (Kjøsen, 2016; Fuchs, 2017).

This account entails a corrective to accounts that treat digital capitalism as sui generis. Where authors as Leedhonvirta (2022), Varoufakis (2023) Van Dick et al (2019) or Zuboff (2023) frames concepts such as "Cloud Empires", "Technofeudalism" or "Surveillance Capitalism" as unprecedented mutations of capitalism, a political-economy reading emphasises continuity:

datafication, targeted advertising, and platform mediation intensify pre-existing tendencies to reorganise production and realisation, rather than inaugurate an altogether new mode of social life (Fuchs, 2012; Fuchs & Sandoval, 2014). Crucially, Engels's and Marx's analyses of turnover time provide the analytic hinge: reductions in circulation time increase the effective mass of surplus value realised in a given period, and thus act as countervailing forces to the falling rate of profit (Marx, 1894; Engels, 1878). Digital techniques that accelerate circulation, therefore, operate as strategic investments in the dynamics of accumulation.

Yet the acceleration of circulation effected by digital infrastructures is not a panacea for the reproduction-crisis of capital. Instead, platform-led digitalisation has frequently deferred the crisis by synchronising capital's circulation along a temporal axis disjunct from the rhythms of social reproduction.

The historical and empirical implications of this diagnosis are twofold. First, the digitalisation of circulation produces an asynchrony in which, if on one hand, the velocity of capital's movement is synchronised to algorithmic rhythms, on the other, the social reproduction of labour — wages, care, health, household provisioning — remains governed by slower, material processes that neither the capital or the state afford to fully 'harmonise'. Second, this disjunction produces a fragile equilibrium: while circulation may be accelerated, enabling temporary profitability gains, the structural deficits in social reproduction persist and can re-emerge as crises (public-health shocks, labour shortages, fiscal constraints) that expose the current moment as a *disjunctive conjuncture* for both state and capital (Fraser, 2017; Kjøsen, 2016; Fuchs, 2017).

Nevertheless, what is the relation between cloud infrastructure and labour? The second article of the thesis concludes by reporting that, according to private and public stakeholders, the final aim of state digitalization would be to automate up to 80% of labour in the public administration.

Their words echo Caffentzis (2013, 252) when argued that "the crisis of reproduction is not a by-product of automation, but its precondition". Moving from here, the third article examines the relationship between cloud infrastructures and the transformations within regimes of capital production and labor under conditions of crisis. Specifically, it explores how cloud infrastructures intersect with what I define as "the politics of automation", situating contemporary transformations within a genealogical framework that traces the ongoing reconfiguration of capitalist reproduction through the digital infrastructures of governance, computation, and accumulation.

Through a lexicon of temporality (feedback, disjunction, synchronization, etc.), the research explores historical and contemporary lineages that help analyse the politics of cloud infrastructures in the crisis conjuncture within a conceptual framework based on logistics and media studies (Rossiter, 2018). In fact, while platform studies tend to "forecast" the future by framing linear structures of technological development, the need is to focus on a longer genealogy of the processes in this account-situating cloud as a logistical media (Peters, 2021; Rossiter, 2014, 2016, 2021; Rossiter & Zehle, 2023). With this aim, the following steps will shift the focus to the technical operations that shape cloud DCs as central infrastructures of the contemporary political economy (Archer et al., 2025; Narayan, 2024; Papaevangelou & Siapera, 2025).

1. 2 Time, Logistics, and the Politics of Cloud Infrastructures

Over the last decade, the international scholarship on data centres has consolidated into an increasingly prominent agenda across media studies, anthropology, critical geography, and Science, Technology and Society Studies (STS). Yet the dominant view remains limited in its understanding of the operations of capital (Mezzadra & Neilson, 2019) at stake in contemporary data centres. Although still emergent, the literature on data centres is in fact broadly focused on architecture design and siting, territorial clustering, infrastructural temporalities, environmental and labour externalities, as well as the aesthetics and cultural imaginaries that cloak "the cloud" (Taylor, 2023).

Ethnographies and regional case studies deepen this outward orientation. Work on "ruination" dissects build/abandon cycles keyed to speculation and shifting corporate strategies (Brodie & Velkova, 2021; Hogan, 2021; 2023). Studies of "preparedness" map bunkerized architectures and their securitarian imaginaries (Taylor, 2021; 2023). Research charting hubs and corridors—state competition for hyperscale investments, strains on power and water, and the water-adjacent siting logics of cloud—foregrounds the territorial and resource politics of distribution (Carr et al., 2022; Edwards et al., 2025; Furlong, 2021). Environmental and energetic perspectives underscore how data infrastructures are embedded in extractive ecologies and "thermocultures" of air and purity (Gonzalez Monserrate, 2023; Ortar & Velkova, 2022; Vonderau, 2021; Brodie, 2023; Salling & Maguire, 2024). At their strongest, these literatures explore data centers as rising critical institutions that mediate value –and power- through spatial and temporal configurations.

Here, the question of time and space seems pivotal, as many scholars have examined data centers via predominantly their spatial and territorial dimensions, calling for attention to infrastructural timescapes—maintenance and repair, labor time, and elemental rhythms (wind, water, heat) that punctuate "uptime" (Velkova & Plantin 2023). However, although this last reframing illuminates how cloud computing *commodifies* access to computation as a renewed form of time-sharing service, it typically stops short of unpacking the intra–data-center stack that makes that commodification *operational*—how compute, storage, and network fabrics are engineered for interoperability and scaled coordination, and how those design choices organize market power.

With few exceptions, while most literature on the so-called "platform society" tends to be obscure (with terms such as 'cloud empires') or ignores the role and functioning of cloud computing, sociological studies on data centres treat them more as buildings rather than hubs of a computational system whose internal architectures of interoperability and scalability actively shape global value accumulation. At their best, the political economy of cloud often appears as an externality (of land, energy, labor, subsidies) rather than as an *operational* logic whose internal design (of its servers) —*standardization* versus proprietary interfaces, portability versus lock-in, telemetry and SRE practices, autoscaling heuristics—actually structures market concentration, bargaining power with states in the so-called global assemblage of digital flow (Pickren, 2018).

Thus, addressing this literature gap, it is conducive to connect the existing literature in the social sciences with that in economics, engineering, and communication systems, as these studies further analyse the technical functioning of cloud infrastructures. Here, rather than treating the "cloud" as a mere metaphor, the focus is on how virtualisation, multi-tenancy, elastic provisioning, and web-modularisation reorganised computation as a time-sharing paradigm and, with it, the current infrastructural conditions for the accumulation of data into a monopoly.[1] However, as argued by Narayan (2022), since these operations shaped computing as a "radical technology of computing externalisation", the cloud needs to be seen as the evolution of an offshoring process in IT started in the 70s and accelerated in the 90s.

Between the 1970s and 2000s, companies typically managed their own computing systems through in-house data centres and IT departments, known as the "on-premise" model. The 1990s witnessed the emergence of outsourcing and offshoring services, particularly for IT labour sourced from countries such as India, while hardware and software management remained "on premise", but de-located in English-speaking countries with decent infrastructure and cheap IT labour that work on just-in-time and on-demand, providing computing as a labour-intensive service.

In this first phase, the so-called 'IT revolution' could offshore computing labour by simply inheriting U.S., British and European colonial infrastructures with the Global South. While Caribbean and South American workers manufactured semiconductors in Silicon Valley, 'on premise' data centres and internet exchange (IXP) points were distributed in ex-colonial enclaves to be linked to fibre optics cables-where internet could follow the same paths of telephone and telegraph lines connecting the West and the Rest.

The history of cloud computing lies in the second phase of IT outsourcing, where all computing layers (including hardware and software) were transformed from assets to services, shaping a paradigm based on computational abundance rather than scarcity (Kushida et al., 2011; 2014). The result was a web-based delivery mechanism with unique pricing models (e.g., pay-per-use) so that, instead of investing in computing as a fixed capital (such as hardware or software infrastructures), consumers could run computing services by adjusting usage in real time, with computing and storage provided by external providers such as AWS-developed in 2007. I will later return to the origins of AWS, as cloud computing is a direct result of its logistical infrastructure: Amazon. For now, it is important to note that clouds are everywhere because they turned fixed capital into a flexible on-demand service, thereby turning hyper-scalable computing into the largest asset of the global platform economy.

From the standpoint of fixed capital, this is critical, as economists who analysed the technicalities of cloud computing, such as Devika Narayan (2022; 2024) or Kushida (2015; 2016),

[1] Kushida, Murray, and Zysman (2015) theorize cloud computing as a "dynamic utility," mapping layered architectures (IaaS/PaaS/SaaS) and showing how pay-per-use provisioning and decoupling of hardware from software transform fixed capital (CapEx) into *operating expenditure* (OpEx), enabling utility-like computation at hyperscale while remaining a competitive, non-regulated utility from the provider's standpoint.

and Kushida et al. (2011; 2014) argue. By transferring fixed computing assets from long-term capital expenditure (CapEx) to routine operating expenditure (OpEx)[2](Narayan, 2022).

Data centres (DCs) enable multiple application systems to exchange and reciprocally manipulate already-exchanged information; in other words, they make data interoperable by ensuring persistent connectivity and usability across heterogeneous actors. This technical capacity is not neutral: interoperability dissolves a transport-centred paradigm—where the primary problem is overcoming spatial distance—and instead foregrounds the control and coordination of timing. Infrastructural synchronization, rather than simple spatial compression, becomes the key logistical operation.

Providing on-demand and just-in-time computation *as a service*, the cloud is a paradigm of radical IT externalisation based on *time-sharing* computing. Here, while DCs—colocation (rental of space, power, cooling, security, and basic connectivity) follow existing infrastructures (railways, highways, electrical and telephone lines to avoid latencies, the managed *hosting* (the leasing and active administration of servers)—transform storage and processing into rented, time-sliced services that can be scaled up or down according to demand. These forms dissolve traditional boundaries between provisioning, storage, and operational control, redefining them as periods of service delivery.

1. 2. 1 Data centres and capital. Situating clouds in the logistics revolution.

Using Marxian terminology, DCs are a compound formation: they comprise constant capital (plant, buildings, equipment, energy), variable and circulating capital (energy and other non-fixed inputs along, including labour), and fixed capital (durable installations that retain value across turnover periods) (Jha & Sengupta, 2022). A brief technical explanation of how the so-called "East-West and North-South traffic" — the traffic inside and outside the DCs — can illustrate how cloud topologies generate value by managing the relationship between fixed (servers, cables, etc.) and circulating capital (data and energy flows) through the politics of time.

The cloud is a computing paradigm based on time-sharing. It means that, through *virtualisation*, physical servers are clustered vertically (linking the computing of servers on the same rack) and/or horizontally (between different racks), as more servers allow more computation. This configuration is allowed by so-called *virtual machines* (VMs) that *abstract* software from hardware: a process called *abstraction* or, indeed, virtualisation.

Further decoupling hardware from software, alongside virtualisation, is *containerisation*, where applications are packaged into so-called virtual containers, agnostic to operating environments. If virtual machines *abstract* computing at the hardware level, containerization abstracts at the

[2] Devika Narayan builds on this with a triptych—hardware virtualisation, on-demand IT delivery, and API- and container-based modularity—arguing that cloud arrangements furnish the sociotechnical substrate of hyper-scalability in platform capitalism and reconfigure the geography of software production and competition (Narayan 2023). Technical literature on data-centre network topologies further illuminates the intra–data–centre logistics that make elasticity possible—leaf-spine (folded Clos) fabrics, East–West traffic optimisation, and virtualisation-aware routing that sustain large multi-tenant clusters (Xu et al., 2013).

operating system level, allowing each virtual machine to host a different operating system: a just-in-time model.

The process of *containerisation* enables scalability (the capacity for an infrastructure to scale its applications) by synchronising "dormant" and active containers within time-shifts of runtime and downtime (a temporal shift that allows infrastructure to be fixed, repaired, and maintained).

When client data "makes a request" for storage or processing resources, servers run computing whenever there is free space in the virtual or horizontal clusters, as *chaotic storage* is the most efficient way.

In fact, data centres work 24/h365. Yet they organise clients' data locations by time zone, so a client in Australia (who is often actually sleeping!) can be used by another client who needs computing, as it is based in, let us say, Italy. Data centres are more similar to warehouses of time than sophisticated systems. Time zones allow real-time data to run without exceeding capacity and, no less important, to be fixed (repaired) by technicians working in opposite time zones.

Supported by an international division of labour (of clients and DCs/cloud workers who work remotely and in person) synchronised across different time zones, the cloud is a paradigm that enables data centres to organise and provide on-demand, just-in-time computing as a service. But how can we further examine cloud operations in the spectrum of capital and labour? What are the broader transformations driven in the current conjuncture by cloud computing and data centres in the sphere of capital circulation, production, and reproduction?

The operational vocabulary and calculative practices that underlie contemporary cloud infrastructures— 'scalability', 'interoperability', 'containerization'—come from commercial logistics. Given the nature of the first commercial cloud —Amazon Web Services —logistics and cloud computing may share more than just words. Developed to synchronise data from warehouse dynamic allocation with Amazon.com website access in real-time, AWS built a cloud topology – the first one- just by mirroring its warehouses' *chaotic storage,* locating on-demand computing wherever there was a free space in its clusters of virtual machines and containers. Alongside this, the management of variable capital (labour) at AWS (technicians, developers, etc.) followed and developed in parallel with the well-known one at their warehouses. It is not a coincidence. In computer science and programming, the so-called Conway's principle states that the design of a complex artefact, such as software, mirrors the relations of communication between the parts of the company that contributed to it, so that "organisations which design systems produce designs which are copies of their communication structures" (1968, 25).

I will come back to cybernetics; for now, it is important to see the intricate relationship between cloud computing and logistics (from ancient Greek: logistikē "λογιστική", from lógos "λόγος", "reasoning", "calculation", "discourse")

The process of 'virtualization' used in cloud data centers was developed in the 60's alongside the one of containerization; notably, these techniques first developed to coordinate the circulation of material goods at the rise of the so-called "logistical revolution" in the 70's: a logistical *paradigm* of just-in time production and circulation that changed the global supply chain

(Bonacich & Wilson, 2008; Chua, 2018; Chua, 2020; Cowen, 2014; Alimahomed-Wilson & Ness, 2018; Neilson & Rossiter, 2022; Tsing, 2009; Khalili, 2020). Containerization was first developed for the US military Department in Cam Rah Bay, in South Vietnam (Olson, 1974). Interestingly, the first application of, instead, the cloud virtual containers, was in the U.S. and NATO bombing of Libya, in 2011, and Syria (Hu, 2015), as one of the first contracts of AWS were with the US government, the Department of Defence and the CIA (ivi). Although both logistics and cloud computing were instantly coopted in military applications, we should be wary of addressing the military origin of these two infrastructures: "the art of computation" belongs to the people themselves: a look over the Vietcong underground infrastructures is instructive in this sense.

The shipping containers in Vietnam had a longer echo, as the overall process of containerisation -e.g. the standardisation of container dimensions- spread against the necessity for the comprehensive redesign of port terminals, rail yards, and warehouses of the U.S. and its global supply. As the process needed the re-organisation of the entire logistical infrastructure, the call was for a "cultural revolution" in the U.S. industry and commerce. Alongside intermodal terminals, containerisation allowed for a total-cost accounting- called total cost analysis- that reconfigured built environments and managerial rationalities, making distant production sites optimizable (Easterling, 2014; Bonacich & Wilson, 2008).

Across North America, this transformation was evident in the emergence of an intermodal "land bridge," whereby fully loaded containers arriving at West Coast ports were conveyed across the continent by rail (Bonacich & Wilson, 2008, 52–54). This continental-scale reconfiguration of transportation networks reflected not merely a new interoperability standard but also drove the diversion of aggregate capital into infrastructural assets that both facilitated the movement of goods by locking physical infrastructure and enabled new spatio-temporal arrangements conducive to ongoing accumulation.

In fact, according to critical logistics scholars, the *logistics revolution* played a fundamental change in capitalism, emphasising flow and making production subordinate to circulation (Danyluk, 2018). However, why did capital focus on commodity circulation in the late 20th century? What goals did this serve? Answering these questions helps us better understand how and why the politics of cloud infrastructures are driven by capital and the state in the current crisis, examining how both reorganise around the cyclical involvement of fixed infrastructures in the circulation of value.

Most studies attribute the industry's growth to economic and technological factors that forced businesses to overhaul transportation and distribution after World War II. However, while this historical explanation is instructive, it overlooks deeper motives behind logistics' rise, which stem from the contradictory logic of capital itself (Danyluk, 2018).

As Marx showed, capitalism's history features periodic upheavals in transportation and communication. A complete account of the logistics revolution must also identify the systemic forces pushing capitalist firms to invest in circulation. Building on the crisis of capital reproduction of the 70's, the author develops a more theoretically informed understanding of logistics and its

attendant ‘‘revolution’’ by delineating the specific mechanisms by which changes in the industry have solved problems of profitability for capital.

In Capital, Volume II, Marx argued that “circulation” operates as a specific mode of accumulation by selling a “change in location.” According to Marx, total circulation, or turnover time, is defined as the duration from when a sum of capital, in its monetary form, is first invested in production until it is subsequently returned in its monetary form through the sale of the product and the realisation of its now enhanced value. Since ‘the duration of this turnover is given by the sum of its production time and its circulation time’, ‘a reduction in both or one of its two components raises the mass of surplus value’ (Marx, 1885, 204). In this context, while ‘the main means whereby production time is reduced is an increase in the productivity of labour’, ‘the main means of cutting circulation time has been improved communications’ (ibid.). Building on Marxist geography, Danyluk (2018) argues that the operations of the so-called “logistics revolution” resulted in a spatial-temporal solution to the 1970s crisis. Here, reshaping the times and geographies of circulation—along with those of production, consumption, and dispossession—enabled the logistical revolution to act as a logistical fix for capital accumulation and to sustain capitalist social relations into the 21st century (ivi).

Harvey’s concept of the “spatial fix,” as outlined in The Limits to Capital, offers a compelling lens for understanding how logistical infrastructures absorb and redirect surplus capital to mitigate crises of overaccumulation (Harvey, 2006, 12–13). According to Harvey, when money, commodities, or labour power cannot be profitably reinvested within an existing territorial accumulation system, there is a risk of devaluation with destabilising economic and political effects. Therefore, to tackle the crisis, the ‘spatial-temporal fix’ directs surplus capital towards developing or revamping physical and social infrastructures, referred to as the secondary and tertiary circuits of capital (Harvey, 2006, 109–111).

The notion of the spatio-temporal fix builds on the theory of value by Marx and Engels, as at the time they were fascinated by “the rapid and regular steam [ship] line’, and the new role of telecommunication infrastructures, as ‘telegraph cables have girded the whole earth’ (Marx, 1885, 204).

While today the cloud companies call for a revolution in data logistics, we can interpret the rise of data centres and fibre-optic computational paradigms in terms of one of the fundamental lessons of Marxian economic geography: for some capital to circulate smoothly, some other capital must be embedded in the ground.

Notions such as “the global assemblage of digital flow” (Pickren, 2018) are instructive in this sense, with calls for a digital fix (Danyluk, 2018). Today, adjacent to the European colonial military, commercial, and communication networks, the global economy is supported by the backbone of digital networks, which rely on substantial accumulations of opaque mobile and embedded capital.

As shipping containers of the so-called logistics revolution shaped a global division of labour according to the just-in-time model that off-shored global production, circulation and consumption,

- configuring transnational labour regimes and infrastructural territories (SEZs, EPZs, FTAs) within the suppression of space through time- the question is whether the current operations of the cloud paradigm are impinging on a configuration of labour, capital, space and time that is mirrored in their network.

The notion of fix captures how particular investments in infrastructure can stabilise capital accumulation by reorganising space–time relations of production and circulation. By materially anchoring high-speed circulation to fibre optics, internet exchange points, and cloud DCs— sited and networked for low latency, high throughput, and interoperability —virtual machines and virtual containers secure capital for a multiplicity of turnover cycles within a longer-lived hardware envelope.

We can conclude that cloud infrastructures accelerate capital turnover, thereby shaping a fix in the sphere of value circulation. The assumption would align with existing scholarships that refer to the IT or E-logistics (2022) revolution as a digital fix (Greene & Joseph, 2015) that shaped the so-called 'platform society' as a capital conjuncture (Peck & Phillips, 2020).

These studies provide a valuable analytical lens for examining the transformations of capital; however, they do not address how, in logistical terms, cloud operations depend upon, and shape, inbound and outbound configurations of labour. In other words, how cloud as a paradigm sustains particular labour regimes and, conversely, how labour regimes sustain the cloud as an infrastructural fix. This is a crucial point, as it enables attention to be directed simultaneously to the transformations occurring within the so-called "society of automation" and to shifts in the international division of labour that underpin its functioning. In other words, to analyse the cloud as an infrastructural fix requires examining not only its relation to capital, but also its constitutive relationship with labour.

1. 2. 2 The cloud as a *logistical media*. Genealogy as a method.

Drawing on an extensive analysis of aggregate capital shifts in turnover time between 1960 and 2019, Moody (2018) provides a political economy of automation as a time length shaped by the condensation of the logistical revolution in the 70's. Crucially, building on the historical analysis of U.S. capital investments in automation, the author defines the future of work as shaped by two-speed process: a short-term capital invested in data-extractive technologies (used to monitor labour)- and longer-term capital invested in labour-saving robotics (to substitute human work).

In this study, called "High tech, low growth robots",- technologies are automating labour at the time of an asynchronous synchronisation (2018). What is the role of data centres and cloud computing in this context?

Labour analysis is rare in the already scarce literature on data centres. Here, while most commentators have exposed that data centres are run by technicians, DC operators, and engineers —simply "exist" —others "lamented" the shortage of workers in data centres, as there were not enough to develop any further consideration of labour analysis. However, drawing on Rossiter's

concept of "logistical media," these infrastructures can be understood as operational environments organised through standards, protocols, and topologies that coordinate flows across territorial and political boundaries (2018). Most importantly, this scholarship was able to re-frame data centres not only as political institutions of the information economy, but as logistical nodes of global labour circulation (Rossiter, 2014; 2016; Rossiter & Zehle, 2015; 2023)

Logistical-media scholarship locates data centres and cloud platforms as nodes in a continuum of infrastructural governance—assemblages that instantiate protocols, standards, and topologies for timing, routing, redundancy and fault-tolerance—thereby remediating classical logistical problems (synchronisation, buffering, risk-apportionment) for immaterial value (Rossiter, 2016; Neilson & Notley, 2019).

Rossiter and Neilson offer a more incisive perspective: in these seemingly automated "data factories" or data farms, labour has not vanished but multiplied in new forms. In data centres, labour is nowhere and everywhere, diffused, hidden, and naturalised within the infrastructural routines signalled only by the blinking green and red lights of servers. Data is abstract labour. Neilson and Rossiter focus on the systems that logistically stitch computational territory to labour regimes (Rossiter, 2014; 2016; 2021; Neilson & Notley, 2019). Inverting container-centric logistics narratives, they examine server–client architectures, multi-tenant facilities, and network peering, generating "client footprints" that serve as territorially discontinuous instruments of coordination and control (Neilson & Notley, 2019; Hristova et al., 2022). This directly links cloud infrastructures to logistical power and the production of networked territories where labour, rather than disappearing, multiplies in other forms (Neilson & Rossiter, 2019; 2022; 2025)

Within the double speed length that shape automation as the so-called 'future of work' (Benavav, 2020), data centres serve as the enabling infrastructure that both abstracts labour into data and synchronizes automation as a fix between a) short-term and b) long term (substitution of human work) labour turnover and the heterogeneous temporalities of capital investment in a) monitoring (short-term) and b) labour saving technology (long term). The historical analogy with the logistics revolution is instructive in this regard: as capital shifted into large-scale retail networks that relied on improved temporal coordination across scales, contemporary DCs perform an analogous role for informational and material flows.

This perspective is critical because it allows us not only to understand the role of current cloud infrastructures in the age of automation, but also to frame the politics of automation in continuity with a more extended history of logistics (Moody, 2018).

Cloud infrastructures shape automation as an asynchronous synchronicity. This concept helps interpret current studies that defined automation as a contradictory mix of old and 'new' regimes of work- see the concepts of "augmented despotism" (Delfanti, 2021), "digital-algorithmic Taylorism" (Huws, 2014; Moore & Woodcock, 2021; Moore et al., 2017), or "heteromation" (Ekbia & Nardi, 2017).

Most importantly, framing automation as an *asynchronous synchronicity* mirrors the precedent analysis of the *fix* as a temporary solution, aligning with the cyclical contradictions of historical

capitalism. Harvey notes: investments in infrastructure (fixed capital investment) can support accumulation not by resolving conjunctures but by *delaying* systemic crises: thereby *disjoining* crisis conjunctures from their upcoming rupture. In other words, if the question is "how automation will change the future of work?", the answer is that cloud infrastructures shape automation by "controlling" labour and capital circulation (turnover) within an asynchronous synchronicity. Here, as far as time and space can be "compressed" by capital to tackle crises of value reproduction via circulation, the shifts in both capital and labour would always be contradictory (as the notion of reflux reminds us), as the results of a dynamic of disjunctive conjunctures.

The concept of synchronicity is central to the last theoretical point.

Scholarship on logistical-media theory situates data centres as logistical nodes in a continuum of infrastructural governance—assemblages that instantiate protocols, standards, and topologies for timing, routing, redundancy and fault-tolerance—developed *incrementally* to tackle classical logistical problems (synchronisation, buffering, risk-apportionment) for immaterial value (Rossiter, 2016; Neilson & Notley, 2019; Zehle, 2021).

Crucially, the cloud's operations of abstraction, scalability and interoperability perform for computation what logistical media long performed for commodities, converting labour and/or social cooperation into calculable, transportable, and monetizable units of digital information (data), producing a contradictory outcome where machines are set to automate the labour subjectivity even while they multiply, fragment, and re-discipline "human work" across new geographies and temporalities (Delfanti, 2021; Pasquinelli, 2023; Pasquinelli et al., 2024). In this context, rather than conceptualising an additional automation theory, it appears more advantageous to employ a genealogical perspective to emphasise underexplored historical and geographical trajectories. Viewing cloud infrastructures as logistical constructs provides a critique grounded in the historical context of technological exceptionalism and offers a framework for understanding how computation is currently reorganising the global division of labour.

However, data centres also represent contemporary institutions of knowledge: by collecting and storing information, they play a role in society aligned with that of museums, archives, and libraries (Dourish & Mainwaring, 2012). While Google's avowed mission —"organise the world's information and make it universally accessible and useful" —may seem innocuous, it visualises a single point of entry to the world (ivi). Here, data centres reflect the historical role that archives had as knowledge institutions central to the function of the Empires (ivi). However, these are always temporary power formations. While the empire's continuity relies on the invisible resilience of its knowledge infrastructures, the same holds for these "obligatory" passage points, whose politics depend on the Empire itself.

There are other non-human archives as well. In her study on forests as communication systems, Suzanne Simard discovered how trees communicate through key energy infrastructures that, if destroyed, lead rapidly to the demise of the entire ecosystem. However, the networked forests, ecologists argue, have a *memory* through which information from the past accumulates, influencing future trajectories through persistent change in the system's structure and composition.

This memory, Simard argues, "may derive from past events, some minor or random, that are reinforced through feedback in the system and constrain its future trajectory" (Filotas et al., 2014).

The following section will deploy the notions of the archive and memory as part of a methodological and political commitment to read the genealogy of cloud infrastructures and the politics of automation.

A longue-durée, decolonial genealogy pushes this comparative frame further back to Atlantic maritime calculative practices: as the storage of the *stolen lives* of the Atlantic gave the origins of modern logistics (Harney & Moten, 2013). Here, media scholars such as Peters et al. (2021), Zieger (2021) and Munn (2020) historicize contemporary cloud and logistical media in the long history of logistics. In their analysis, vessel ship logs, hold diagrams, insurance ledgers and other logistical media of the Atlantic Trade provided the first abstraction, aggregation and forecast of human labour into fungible units of space, time, costs and prices (insurance aggregates, risk tables, aggregate payloads) to secure the reproduction of labour value during its circulation. The dream of logistics is to "do without the subject" (Harney & Moten, 2013).

As well as the first industrial machines were developed to counter labour strikes in European production lines, as Marx noted, the vessels collected behavioural data of their captive workforce to set the speed, the geography and the epistemic codes of vessel internal communication to avoid the risk of slave rebellions and joint revolts by the crew and the captives (Blotta, 2025).

This analytical step further informs us that, in times of automation, labour is not deleted but abstracted, placing the politics of automation not as accidental or new, but as historically continuous with procedures deployed in the transatlantic trade and then cyclically reproduced in times of crisis. Following the logistics "dream to do without the subject", I contend that rather than substituting labour, the politics of automation are set to learn from (abstract) and to make labour refusal redundant.

The politics of cloud infrastructure reside, then, in the asynchronous synchronisation of capital and labour mobility across successive moments of capital. This synchronisation is not novel but is a core capacity of logistics, which remains latent until states and capital deploy it to surmount cyclical crises. At the moment of such synchronisation, an infrastructural fix is produced as the outcome of capital's operations, mediated by states and subaltern resistance. Read in this way, the politics of the cloud encompass a multiplicity of issues—the segmentation of labour, the constitution of infrastructural spaces, and so forth—and make time itself the principal political technology at stake.

The two following articles are designed to examine historical continuities that can prove this hypothesis, thereby framing cloud infrastructures as the current sedimentation of the logistical power to employ time as a technology to organise labour and capital circulation in a set of disjunctive conjunctures that result from contingent yet historical asynchronous synchronisations.

The two subsequent articles proceed from this position. The following one traces an Atlantic genealogy that shows how logistics—both digital and commercial—insistently configure logics, aesthetics, and geographies designed to shape labour to the needs of capital. I call this triad the

politics of automation because the Atlantic slave trade stands in a genealogical relation not only to the dominant role that commercial and digital logistics play today but also to how those logistics are transforming the logics, aesthetics, and geographies of global labour—synchronizing the management of circulation and the social reproduction of labour with new regimes of production characterized by the predominance of automation and its temporalities. In this schema, the *feritoias*—those holding depots and warehouses—and the broader infrastructural fix operate as spatial–temporal nodes in which the cloud, like earlier maritime and port infrastructures, functions as a synchronising valve between labour and capital circulation.

1.3 North- South Traffic. Toward a Black Atlantic Genealogy

Matteo Pasquinelli and other critical theorists of automation provide an account that is especially important for connecting archival history to present algorithmic regimes: Pasquinelli's labour-centred history of automation argue that contemporary AI and metric automation do not emerge ex nihilo but build on long histories of labour measurement, abstraction, and metrication—what he terms a labour or metric theory of automation (Pasquinelli, 2023, 11–13). From this perspective, "automation" is not simply a technical artifact but an ensemble of practices that translate embodied, social knowledge into calculable metrics and predictive procedures (Pasquinelli, 2023, 11–15).

A second, intersecting body of work reframes digital infrastructures—data centres, cloud services, and platform architectures—as logistical media that instantiate new regimes of temporal coordination and territorial control. Rossiter's work on logistical media and Neilson (with Notley) on data centres as logistical facilities foreground how server–client architectures, multi-tenant facilities, and network peering function as infrastructural instruments that reorganise labour, territory, and time in ways that parallel logistics (Rossiter, 2021, 132–50; Neilson & Notley, 2019, 15). This recent literature shows that rather than erasing labour, digital infrastructures re-distribute, hide, and re-encode labour in alternative forms and territories— (Neilson & Notley 2019, 15–17). From this perspective, authors such as Munn (2021) and Zieger (2021) historicize logistical media in the Black Atlantic Trade.

Accordingly, the third article of the thesis argues that automation can be framed in politics readable through three interlocking registers shaping labour—logics, geographies, and aesthetics—and that these three registers have a distinct genealogy that reaches back into the management of transit forced and waged labour within the Atlantic slave trade. Beyond historical lineages that frame machine development in the European industrialism, I argue that the Black Atlantic can extend the genealogy of automation to processes of value circulation and labour reproduction directly framed within the crew and slaves' social intelligence and cooperation to resist waged and forced labour.

At stake is a reframing of automation not as an exclusively technical or forward-looking phenomenon, but as a set of political practices for organising labour, compressing time, and

disciplining space. By tracing how shipboard diagrams, time-logs, port systems, and other colonial archives transformed the social intelligence of enslaved people into calculable information, the article treats these documents- labelled logistical media by Zieger (2021) and Munn (2020)-as formative "archives of automation" and contends that the contemporary politics of cloud infrastructures and of automation inherit and mutate techniques originally developed in the Black Atlantic to manage the circulation and reproduction of value in the form of waged and enslaved transit labour.

This argument intervenes in and extends emergent literature that connects plantation and colonial technologies to the origins of industrial and computational regimes (Crowley, 2016; Fiori, 2020a; 2020b; Inikori, 2020; Keefer, 2019; Ortega, 2014; Whittaker, 2023). Scholarship linking plantation regimes to the origins of modern industrial capitalism has become an important strand in recent accounts of global modernity. Work in this vein shows how plantation economies (and the violence that produced them) were not merely precursors to factory regimes but deeply formative of the cultural, scientific, disciplinary, and classificatory apparatuses that undergirded the formation of global capitalism and the nineteenth-century industrialization (Beckert, 2022; Crowley, 2016; Fiori, 2020a; 2020b; Hall, 2020; Inikori, 2020).

Building on and complicating this historiography, recent scholarship recasts the plantation as both a technique and a template for modern systems of extraction and labour control. Nicholas Fiori's essay *"Plantation Energy"* is exemplary: Fiori argues that the plantation's energetic regimes—where enslaved bodies were mobilized as metabolic energy and then reframed in the nineteenth century alongside steam engines and other technologies—are legible in the formation of industrial energetics and the science of thermodynamics (Fiori, 2020a, 562). In Fiori's account, the plantation's procedures for quantifying and disciplining human labour helped to produce the technological imaginaries and measurement practices of the industrial age (Fiori 2020a, 562–64).

Parallel literature in Black studies and critical race studies have articulated how racialized practices of surveillance, control, and record-keeping developed under slavery and have persisted into contemporary technologies of monitoring. Simone Browne's *Dark Matters* remains the touchstone here: Browne traces how practices such as branding, runaway notices, and other colonial policing techniques are legible in modern biometric, identity, and surveillance technologies; she insists that surveillance technologies inherit and naturalize earlier racialized regimes of legibility and control (Browne, 2015). Kathryn Yusoff and others similarly emphasise how colonial projects framed human life as an extractable energetics and thereby produced enduring hierarchies that inform environmental, scientific, and techno-scientific discourses about energy and "the human" (Yusoff, 2024).

Two synthetic moves emerge from this constellation of literature. First, many studies concentrate on analogies between the plantation and the factory: they chart how labour discipline, extraction regimes, and classificatory practices migrated from the plantation to the industrial workplace and the factory floor (Beckert, 2014; Fiori, 2020; McKittrick, 2013). Second, critical race and surveillance studies add a complementary claim: the technologies of observation, record-

keeping, and identity formation central to modern surveillance rest upon colonial archives and practices (Browne, 2015; Yusoff, 2024; Whittaker, 2023).

Yet, while the plantation–factory genealogy is richly developed, comparatively little attention has been paid to the Middle Passage itself as a genealogical site of contemporary politics (Baucom, 2005; Harney & Moten, 2013). Its records can be framed as a distinct archival formation — logistical media —that directly prefigures contemporary computation (Zieger, 2021; Munn, 2021).

The Middle Passage was not merely a connective corridor between extractive and "productive" sites between African and the American continents; it was an active site of data production and temporal-spatial management (feeding schedules, waiting zones, segmentation by language/ethnicity, surgeons' monitoring of "cargo health," and routinised timings) that translated waged (the crew) and forced (the slaves) workers social cooperation and resistance into standardized behavioral data (Blotta, 2025).

A growing number of scholars gesture toward the archival and algorithmic significance of maritime records. Fiori's analysis underscores how plantation energy regimes and the energetic framings of human bodies became legible in nineteenth-century technical vocabularies (Fiori, 2020, 562–66); Harney and Moten evoke the ship's hold as a recurrent conceptual figure for fugitivity and control (Harney & Moten, 2013).

Yet the direct mapping from ship logs/time-grams to contemporary measurement systems—such as capacity planning, latency optimisation, and predictive scheduling—remains underdeveloped in the literature on automation and surveillance (Zieger, 2021). Between logistics and automation, Neilson and Rossiter's work on data centres as logistical facilities provides the analytical vocabulary to link: once we treat cloud computing as a logistical episteme that organizes time, space, and labour (Rossiter, 2023; 2025), the Middle Passage archives acquire renewed explanatory force as early instances of datafication and time-space engineering based on real time abstraction (the *logics* of automation), labour segmentation (the *aesthetics* of automation) and infrastructural space (what I call the *geographies* of automation) (Neilson & Rossiter, 2025; Neilson & Notley, 2019, 15; Rossiter 2021, 132–50; Rossiter, 2025).

Linking digital and logistical media, the works of Munn (2020) and Zieger (2021) follow recent calls to further frame the logistics genealogy in the Black Atlantic (Cuppini & Frapporti, 2018).

Building on this literature, the article mobilises a specific comparative theoretical apparatus. I adopt Matteo Pasquinelli's labour-centred formulation of the *logics of automation*—the historical process by which embodied, collective knowledges of work are translated into metrics, protocols, and predictive routines that render social intelligence computable (Pasquinelli, 2023, 11–15)—and place those logics in explicit dialogue with the conceptual tools of logistical media studies (Peters, 2021; Rossiter, 2017). In particular, I juxtapose Pasquinelli's account with Ned Rossiter's and the *Assembly Codes* contributors' work on logistical media, Susan Zieger's attention to the environmental and documentary media of maritime logistics, and Neilson and Notley's analysis

of data centres as territorial and temporal instruments of labour coordination (Rossiter, 2021, 132–50; Zieger, 2021, 34–52; Neilson & Notley, 2019, 15–29).

Through its archives (ship logs, time-diagrams, letters of Asiento), I examine the Marie Seraphique —a French slave vessel —as a machine for abstract labour, as its logistical media deployed infrastructures encompassing the Atlantic circulation of value and the social reproduction of transit labour in its circuits.

Following the voyage from Marseille (the shipbuilding) to Luango Port, in Africa and Jamaica, in the Caribbean, the analysis foregrounds the abstraction and metric translation of slave labour knowledge (that stems from their social intelligence and cooperation to resist and refuse their condition of forced migration) into calculative logics, geographies and aesthetics ancillary to the contemporary politics of automation.

Methodologically, this comparative framing is anchored in an operaist reading (Tronti, 1966), according to which machines and technical arrangements are produced as responses to working-class refusal and therefore must be historicised from the standpoint of labour struggle (Tronti, 1966, 234–52). This synthesis allows us to view ship logs, surgeons' time-grams, and hold diagrams as moments where the social intelligence (to resist) of enslaved people and crews was observed and transformed by cartographers, surgeons, scientists, and captains aboard into calculative devices and epistemes—logics, geographies, and aesthetics of automation—prefiguring the Black Atlantic as the archive of their struggles (Blotta, 2025). I therefore expand the literature on automation history in the European industrial revolution by emphasising enslaved and waged workers as primary agents of technological development (Pasquinelli, 2023, 11–15; Tronti, 1966, 234–52).

The article defines the three policy categories as follows. Building on Pasquinelli (2023), the logics of automation denote the measurement regimes, information practices, and predictive routines that translate social knowledge into computable metrics (hold diagrams, time tables, and surgeons' recordings used to predict revolt and set vessel speed and voyage routes). Geographies of automation refer to the spatial organisation and routinisation of transit—the port systems, waiting zones, and routings (e.g., Loango, the Bight of Benin/Biafra stations) that produced stable corridors for value circulation.

The aesthetics of automation capture the sensory, visual, and rhetorical technologies (from ship diagrams to racial taxonomies) that render labour legible, segment populations, and legitimate forms of despotism that make both waged and forced labour governable. The three categories, the article argues, are not separate but mutually constitutive aspects of a political technology that organises the reproduction of value (in the form of transit labour) through time-space codification.

In this context, rather than narrating a linear technological progress from metropolitan centres to peripheries, genealogy attends to discontinuities, borrowings, and the colonial logics that have shaped present infrastructures (cf. Quijano, 2000; Chakrabarty, 2000).

1. 4 East-West Traffic. From Slavery to Indentured Labour

The management of migrant labour in transit during the Atlantic slave trade—as well as plantation labour more broadly, according to authors such as Fiori (2020a; 2020b)—points to a genealogy of contemporary automation policies: namely, the logics, geographies, and aesthetics that render logistical infrastructures into technologies of value augmentation in the sphere of circulation through the social reproduction of labour. These infrastructures operate as abstract machines (in the Deleuzian sense), converting social relations and embodied labour into calculable forms that mediate the production and realisation of value.

However, advancing the genealogy requires a further, focused analytic move: to historically interrogate the current intersection of the politics of automation and cloud politics in an asynchronous synchronisation of disjunctive conjunctures- and to specify how state interventions and conjunctural crises shape that intersection.

By tracing the crisis of reproduction from the late eighteenth to the mid-nineteenth century, we must ask how colonial logistical infrastructures became entangled with European state apparatuses, anchoring new forms of circulation to a concurrent recomposition of labour regimes. In short, the question is not only how technical practices migrated from commerce to computation, but how, more broadly, capital, statecraft and crisis management historically co-produced logistical systems that linked the governance of circulation directly to the remaking of productive labour.

Focusing on the institutional technologies mobilised by European and colonial states—the slave contract, the engagement contract, and the juridical construction of the "immigrant" as a contract worker or indentured servant—and on the interplay of these devices with the practices documented in the Black Atlantic article (the management of ports, the feritoias, navigation timetables, and the epistemic division of labour), it becomes evident that by the mid-1800s the logistical management of migrant labour, once synchronised with the turnover of labour and capital at stance in that conjuncture (a crisis of capital reproduction within war regimes), produced an infrastructural fix. In this fix, the *feritoias*—warehouses of enslaved people and subsequently of contract workers—functioned as zones for the asynchronous *synchronization* of two labour regimes (the slave and indentured labour) that at the time underpinned the new geographies and temporalities of capital at the threshold of the Industrial Revolution.

If the state mobilises, among other instruments, juridical infrastructures (such as the legal title of the migrant as a contract worker), then with the abolition of slavery it must also provide for the reproduction of capital by granting compensation rights to former slave-owners. This is an important point because, according to Hall (2020), in the conjuncture between the abolition of slavery and the rise of the Industrial Revolution, reparations and the new French and British labour code enabled capital brokers (insurers) and labour brokers (of slaves and then indentured labourers) to invest in the infrastructural projects (railways, shipping, telegraphy) that mobilized the global capital and labour of the Industrial Revolution.

This reconstruction allows us to read historically the research reported in the thesis's final article, which elaborates on the genealogy of migrant labour regimes and their relation to current semiconductor manufacturing in Malaysia. Although the asynchronous transition from slave

labour to contract labour was anchored in an infrastructural fix that deferred the crisis rather than resolving it, the infrastructures mobilised in the colonial era now directly shape the capital–labour regimes that sustain the digital age. Here, the notion of the Marxian "reflux" emerges to inform us again of these historical yet contingent and recursive lineages at stake to grasp the vexed question of colonial debris (Stoler, 2016) in contemporary times. Again, these feedbacks signal that the growing incapacity of states to guarantee the reproduction and turnover of capital within their borders led them to seek advantage by strengthening their control over transnational circulatory processes (Mezzadra & Neilson, 2024, 204).

In particular, the last article shows that the reasons why the state of Johor, Malaysia, today functions as a spatial–temporal fix for global semiconductor manufacture—the key material enabling the operation of computation servers—lies in feedback that is situated in the memory of its colonial past. In fact, Johor concentrates not only large-scale capital flows tied to the *geopolitics of automation* between China and the United States, but also a migrant workforce managed by brokers who deploy similar labour-control systems characteristic of the indentured regimes mobilised in the conjuncture of the mid-nineteenth century.

1. 4. 1 On the synchronicity of labour and capital in mid-800s.

As Marx caustically observed, "the discovery of gold and silver in America, the extirpation, enslavement and entombment in mines of the aboriginal population [...] the turning of Africa into a warren for the commercial hunting of black-skins, signalled the rosy dawn of the era of capitalist production" (1885, 41). The slave trade, he argued, was part of the primitive accumulation of capital that preceded and fashioned the economic conditions (and institutions, such as the insurance and finance industries) for industrialization.

The modes of material accumulation and production in the Industrial Revolution were relational to and dependent on indigenous, black and Asian slavery and the organization of human property as extractable energy properties. In the Black Atlantic, the logics, geographies, and aesthetics for controlling the social reproduction of transit-forced labour developed as logistical infrastructures to increase value in the moment of circulation. Here, the Middle Passage was deeply integrated into the plantation regime and the rising European Industrial Revolution, as capital accumulated in the circulatory phase was then invested in fixed infrastructure for the new industrial production, even after the abolition of slavery.

Particularly important in this context are the operations carried out by capital and the European states to synchronise slavery and, after, indentured labour in colonial plantations with the turnover of capital in the crisis conjuncture of the mid-nineteenth century.

The management of migrant labour in transit during the Atlantic slave trade — like plantation labour more broadly — points to a genealogy of what I framed as the contemporary politics of automation: a set of logics, geographies, and aesthetics through which logistical infrastructures

serve as spatial-temporal technologies that amplify value in the sphere of circulation by organizing the social reproduction of labour.

However, analysing cloud infrastructures as logistical media for the forthcoming automation requires understanding the contingent yet historical relationship between logistics and new forms of labour. Here, the genealogical method is applied again, arguing that during the crisis conjuncture of the mid-nineteenth century, the role of colonial logistics resulted in a new division of labour synchronised with new global geographies of capital turnover: a process that emerged between the rise of the Second Industrial Revolution (1875-1914) and the end of the British hegemony (Arrighi, 1994).

Focusing on the technologies mobilized by European and colonial states — notably the legal devices of the slave contract, the engagement contract, and the juridical construction of the "immigrant" as a contract worker or indentured servant — and on their entanglement with the practices documented in the third article (the management of ports, holding facilities, navigation schedules, and the epistemic division of labour), it becomes evident that by the mid-nineteenth century the logistical management of migrant labour, once synchronised with the turnover of labour and capital during wartime and reproductive crises, produced an infrastructural fix that, according to the literature in global history (Arrighi, 2004; 1994; Cheney, 2019), has been central for the rise of the Industrial Revolution. In this fix, the feritoias — slave warehouses and, later, depots for indentured labourers — functioned as zones for synchronising labour and capital circulation with the new geographies and temporalities of "global capitalism" during the European Industrial Revolution.

This reconstruction traces the genealogy of today's zones and regions of availability — clusters of cloud data centres — in which the cloud functions as a synchronising valve between the mobility of labour and capital. Here, I situate the continuity between colonial *feritoias* and contemporary data centres (Neilson & Mezzadra, 2019; Neilson & Notley, 2021), both as historical and contingent in the ability of both to shape spatio-temporal fixes of global capital- thereby configuring a multiplication of (forms) of labour.

Between the mid-1700s and the mid-1800s, shipowners confronted a recurring problem — a crisis of capital reproduction — concerning the return on long-term investments in the sphere of value circulation (Cheney, 2019; Hall, 2020). This problem was driven by insubordinations among enslaved people, which not only produced labour shortages but also brought planters to the brink of insolvency, since enslaved people and money were intrinsically linked, as reported by Le Mercier de la Rivière, a physiocratic economist and intendant of Martinique between 1758 and 1762 (Sacchi Landriani, 2020).

This situation produced a temporal gap — a delay — because metropolitan shipowners were wary of long credit-recoupment periods: in the words of a settler from Santo Domingo, the "reiterated circulation of funds" required for accumulation is slowed by "queues" caused by payment delays (Rinchon, 1956, 67). The mobility of enslaved people had to pass through

bottlenecks created by crop and navigation cycles, by wars and revolts, and, more generally, by a shortage of cash.

Sacchi Landriani records that the conjunctural crisis was addressed through the emergence of a "logistical rationality" as a science of organising and moving commodities through space according to efficiency criteria (2020). By acting on circulation, it became possible to refine market-forecasting operations and thereby counterbalance the elongation of payment times. Drawing on the accounting ledger of the shipowner Solier, we find, for example, the instructions provided to Captain Icard of the corvette La Paix about the sale of enslaved people. Solier anticipates all contingencies at the point of exchange. If prices are low, he writes, "the ship should remain on the island and send La Paix home under the second officer's command; if a truce with the Dutch is agreed before departure, the cargo should be sold prior to a price fall"; "if news of peace has not yet arrived, purchases should focus on coffee, sugar and cocoa for a future sale" (Rinchon, 1956, 221)

Within a global war regime among European powers, the response to the conjunctural crisis of capital reproduction therefore took the form of investments in the circulation of capital — investments in finance — and in the opening of migratory channels: that is, investments in the circulation of labour. The objective was to synchronize overall production and circulation turnover with a new geography of capital restructuring and hegemonic competition. In his compelling reconstruction of the British case of the Zong, Ian Baucom described the role of insurance and financial networks in shaping this epistemology of forecasting that accompanied slave logistics (2006). Time — the speed of information, economic reaction lags — instantiates a logistical rationality at the very moment that production becomes oriented toward the world market and subordinated to competitive imperatives (Fiori, 2020b; Sacchi Landriani, 2020).

On the other hand, the institutional forms that this operationality assumed varied historically and locally. From this perspective, the abolition of slavery in 1848 marks a decisive turning point because it allows us to formulate a set of problems: how to move and control a wholly particular commodity — labour power — without reintroducing illegitimate coercion on the bodies that bear it? What relation holds between the circulation of labour and the circulation of capital? Moreover, finally, what frictions characterise processes of synchronisation and encounter between capital and labour?

1. 4. 2 The State, the Immigrant (1852–55)

An examination of the archives of the parliamentary commissions concerning the abolition of slavery exposes a dire financial predicament. Antillean lands were mortgaged far beyond their value and the only remaining guarantee of solvency for planters was enslaved people. As the Schoelcher Commission wrote, "credit is trust, and on the part of both commerce and the colonists, this essential element does not exist." In the French Antilles, the abolition of slavery signified a radical de-synchronisation (Sacchi Landriani, 2020): it freed the bodies that underpinned global sugar production, and it aggravated the cash crisis by imposing wage payments. While these two

problems were historically linked, the effects of this shift are still vivid in the islands of Guadalupe and Martinica.

Between 1852 and 1880, administrative corridors of migration were opened to direct engagés (contract workers) from Europe, Madeira, Africa, China and India to the plantations (Eggimann, 1851). Colonial administrations proceeded experimentally, encountering material limits and diplomatic tensions, until a relative stabilisation of coolie migration from British India after the international convention of 1 July 1861 (Flory, 2015; Schnakenbourg, 2005).

If the double shortage of enslaved labour and cash defined the terms of a systemic crisis in colonial society, the implementation of credit and immigration infrastructures was the attempted remedy when abolition placed substantive limits on labour exploitation. First, we observe a reformulation of credit chains that shipowners had largely managed through individual agents. In fact, these credit lines -including European states 'reparations' to planters and colonial brokers – channelled fixed capital into the market of new infrastructures –railways, shipping lines, production plants, mine caves, deposits- that supported the Industrial Revolution (Benton, 2005; Hall, 2020). Second, I analyse colonial labour brokerage in the deep continuities with present regimes of manufacturing work in EE EPZs in Malaysia (in article IV).

The response to the conjunctural crisis opened new infrastructures of credit—facilitating the circulation of capital—and of migration—enabling the circulation of labour—two often-overlooked pillars of the Industrial Revolution. At these interstices, brokers synchronized capital and labour flows, shaping the labour regimes that sustained the Industrial Revolution as a disjunctive conjuncture, in which enslaved, indentured, and waged workers alternated and coexisted within a temporal geography of uneven development.

The issue of financing transportation operations is also embedded within a broader reorganisation of the productive landscape, paralleling the current dynamics of political economy in the field of automation. For historians and scholars specialising in world-system theory, in crisis conjuncture of mid-nineteenth century, credit has historically held a pivotal role: initially, as short-term investments required to cover wages via Colonial Banks, and subsequently, as long-term investments aimed at industrial modernisation through the Crédit Colonial (later Crédit Foncier) Colonial) (Adelaide-Merlande, 1980; Schnakenbourg, 2005).

The joint-stock company form made it possible to aggregate the large capitals required for both transport and production operations. By way of example, the involvement of major metropolitan capitalists in the construction of the first refining factories in Guadeloupe through the Société des Antilles is significant (Sacchi Landriani, 2020), as is metropolitan participation in the transport of coolies by the Compagnie Générale Maritime until 1861. The phenomenon, however, became global as the British empire drove the hegemonic cycle through expanding capital financialization (Arrighi & Silver,1999). "Capital," Lepelletier Saint-Remy wrote in the Revue des Deux Mondes, "encountering today a great number of very productive employments, no longer localises: it seeks throughout the world the most advantageous place to be invested" (Le Pelletier, 1858).

Catherine Hall's project, "Legacies of British Slave-Ownership", elucidates the complicity within structures of slavery and industrialisation (2014; 2020). In 1833, the British Parliament formally abolished slavery in the Caribbean colonies, and the £20 million paid to taxpayers as "compensation" contributed to the development of Britain's material, geophysical (including railways, mines, and factories), and imperial infrastructures, as well as its colonial enterprises (Hall, 2014). A considerable portion of these funds was allocated to the railway network connecting London and Birmingham- centres of cotton production and firearms manufacturing for plantations- along with Cambridge, Oxford, Wales, and the Midlands, regions associated with coal extraction. As the project empirically substantiates, these colonial slavery legacies continue to influence contemporary Britain. Nonetheless, for the purpose of this research, it is beneficial to concentrate on two key figures that fixed the synchronization of labour and capital within the infrastructures of the Industrial Revolution: namely, the insurance companies (financial brokers) and colonial labour brokers (ivi).

According to Hall (2014, 187), "insurance companies flourished and investments were made in the Great Western Cotton Company, for example, and in cotton brokers, as well as in big colonial land companies in Canada (Canada Land Company) and Australia (Van Diemen's Land Company) and several colonial brokers". Investments were made in the development of metal and mineralogical technologies: Tyne Iron Co. Iron Works; Llynvi Iron Works; Dalnotter Iron Co.; New Shotts Iron Co.; Ynyscedwyn Iron Co.; J. J. Cordes; the Smithfield Company; Bristol Brass Wire and Copper Co.; Pendleton Colliery; Thomas Whitby & Co. coal, iron, and marble company; Castles and Rudgeway coal company; Arigna Iron and Coal Mining Co.; Company for the Working of Mines, Minerals and Metals; Port Philip and Colonial Gold Mining Co.; Potosi La Paz and Peruvian Mining Association; Annotto Bay Mining Association; Alpujarras Lead Co.; and Trinidad Petroleum Co. Other funds were reinvested into Plantations Caribbean, sugar brokers and refiners, tobacco brokers, West Indian merchants, and Dominica merchants (Hall, 2014; 2020).

These two figures -labor and capital brokers- are pivotal in fixing the syhncronization of capital and labour turnover according to the new 'globalized' geography of extraction, logistics and finance. As the British parliament amendment suggests, the colonial states played a pivotal role in providing the constant reproduction of capital in the conjuncture. In Marxist terms, the state represent a contingent yet historical moment of capital whose role is to sustain three functions in the capitalist mode of production: a) creating the socially necessary conditions for ongoing capital accumulation; b) ensuring a degree of social reproduction beyond the 'strictly economic' dimension of capitalist social relations; and c) generating the political and ideological mechanisms of cohesion, through which capital accumulation and social reproduction are represented and articulated. As for the first function, the state provides the physical, legal, and intellectual infrastructure through which different capitalist class fractions can compete in the accumulation process, thereby serving as a stabilizing node for perpetuating the M–C–M' chain of the production and circulation of capital. In this manner, the state is rendered, in Engels' famous phrase, as the

‘ideal personification of the total national capital’ or the ‘ideal total capitalist’ (Engels, 2010, 319; Walker, 2016)

This theoretical point helps see the linearities between British and French in the context, as, to Sacchi Landriani’s account, the fraught constitution of colonial capital is widely understood as the necessary precondition for efforts to synchronise and mobilise capital and labour (2020). Here, these efforts, he argues, materialised in concrete logistical arrangements that, in the French context, positioned state mediation as a central coordinating mechanism (ivi). From the 1860s onward, the expansion of credit—coinciding with the abolition of the *Exclusif*—had an ambivalent outcome: it stimulated production while simultaneously tightening its subordination to the pressures of the world market. (ivi).

Against this background, we can observe the consolidation of the social figure of the immigrant. The legal formulation of the immigrant emerges in the decrees that re-organised the politics of labour between 1852 and 1855 (Arrêté Husson, 1859). It codifies and scales up the attempts to import labour that were in fact already present at the origins of colonisation (Debien, 1952).

An *immigrant* is defined as any non-resident who arrives in the colony holding a labour contract or intending to sign one. While in Europe as Marx and Engels note, the industrial machines spread over as tools to overcome labour shortages and suppress strikes, the figure of the ‘immigrant’ was deployed by the French and British empires as an institutional technology of the colonial administration sought both to break the resistance of former slaves to wage labour and to create the conditions under which capital could be realised (Sacchi Landriani, 2020).

The *immigrant* functions as a figure aimed at regulating labour circulation within a regime of mobility that aligns with capital turnover, especially during the period between abolition and the Second Industrial Revolution's rise. However, I argue that the migrant best exemplifies how the interplay of these factors- particularly in the context of automation politics and cloud infrastructure- created a disjointed conjuncture. Analysing this is not merely anecdotal but essential to understanding the current makeup of work within the global supply chain and the (geo) politics of automation, exemplified by EE EPZ manufacturing sites in Malaysia. This approach links historical roots to modern labour regimes shaping the digital era.

According to Neilson (2012), logistical operations involve a production of subjectivity that occurs across a political space in which labour and capital are unevenly aligned and even susceptible to merging. The heterogeneous body of living labour is frequently presented as a form of fixed capital that is essential to the upkeep of smooth patterns of circulation. At the same time, it can fluster or sabotage the system, leaving logistical forms of power unable to reproduce the framing of their operations (Neilson, 2012, 337).

Formally, colonial e*ngagisme* consisted in the export of a particular metropolitan form of free-labour contracts, under which a worker’s mobility could be legitimately restricted for a specified period in exchange for advances on travel expenses (Stanziani, 2013). It is the contract that enables, in this phase, the regulated movement of labour: both in terms of the transferability of contract and

worker to third parties, and in terms of fixing the worker to a single proprietor for the stipulated period (ivi).

The institutional figure of the *immigrant* thus appears as a market-adjustment variable, albeit formally "free"—endowed with rights and obligations. However, the rigidity of such contractual framing collides with the contingency of the world market, reopening the question of synchronisation between capital and labour and thereby situating the immigrant as a subject of disjunctive conjuncture.

Contingency, as Rossiter (2012, 26) reminds us, 'is the nightmare of logistics' against which capital shapes labour subjectivities and new infrastructural spaces (Neilson, 2012, 338). In the following paragraph, I examine colonial *feritoias*—slave prisons/warehouses—as logistical zones where, at the time, the synchronisation of labour and capital turnover was dynamically fixed.

1. 4. 3 Feritoias as Zones of Synchronisation (1875–1876)

Countering logistical contingency, the immaterial infrastructures of credit and the material infrastructures of administration that sustained migratory supply chains intersected most visibly within spaces of waiting, selection, and distribution — such as recruitment centres, anchored vessels, and migrant depots. Colonial feritoias (slaves and indentured labour warehouses) have been acknowledged to represent the antecedents of contemporary warehouses and data centers (Mezzadra & Neilson, 2019; Neilson & Notley, 2019). These were both hotspots of migrant work and warehouses of merchant capital; moreover, they were also the first 'points of presence' of the telegraph cables which were placed by following the routes of slaves and indentured labour brokers. As the same routes were incrementally followed by the telephone and fiber optics lines, emergent literature in postcolonial and media studies recently acknowledged cloud infrastructures as historically aligned with these colonial formations. However, although data centers and fiber-optic points of presence are geographically situated in the very locations that once hosted colonial free trade ports—the historical continuity between *feritoias* and data centers can be further examined in relation to the specific operations of capital they have enabled across different epochs.

According to the inbound and outbound port logs of Luango, in Congo (Blotta, 2025), and of Martinique (Sacchi Landriani, 2020), slave and later indentured labour brokers developed temporal charts of ports, feritoias, and ships at anchor—constituting a system of temporal management of labour directly tied to the operations and circulation of capital. Here, inbound times were shaped to avoid insurrections —between the need to wait for inbound slaves with different idioms and the need to leave quickly, as hygienic conditions aboard would have increased the risk of joint insurrections by crew and captives, as shown in the third article (Blotta, 2025).

Crucially, in the crisis conjuncture, colonial states deployed hoc censuses: alongside transport and repatriation costs, to assess the effectiveness of migration policies, the State compared evaluations of the productive capacities of different "races" with forecasts of the reproductive costs of individual migrants, that is, with the probability that they would fall ill and thereby become a

charge on public finances. This is a historical precedent in which surveillance and the forecasting of migrant labour reproduction conditions become the core of a *low-latency* migration-management system whose inbound-outbound timings were synchronized between the temporalities of capital reproduction and predictive analyses of the cost of workers' social reproduction.

I examined how today, contemporary data centres organise labour and capital, serving as the contemporary archives of information, as cloud computing abstracts social cooperation into data, thereby shaping cloud computing as the current paradigm of digital knowledge. I argued that in these current archives—servers —lies the way in which the politics of cloud infrastructures entangle the current distribution of labour (the politics of automation) as an asynchronous synchronicity.

At the same time, archives from port logs in colonial feritoias show that, essential to the drafting of these reports —that I called logistical media —was a regime of knowledge born of collaboration among colonial brokers, physicians, scientists, insurance traders, and the colonial intelligentsia. Here, in the conjunctural crisis that accompanied the formal abolition of slavery, colonial states turned to the infrastructures managed by financial and labour brokers to address a crisis of capital reproduction (Hall, 2014; 2020; Inikori, 2020). Unlike enslaved workers, indentured labourers were expected to reproduce their own labour power. Thus, to fulfil the socially necessary conditions for the continued accumulation of capital, colonial administrations were compelled to guarantee a minimal degree of social reproduction.

Vessels were known to be floating machines of a slow-motion death. It is not a metaphor: on board ships, the organisation of both speed and hold space responded to the need to reproduce workers' value in transit by slowing their upcoming death, with an affordable mortality set according to the needs of the labour market (Blotta, 2025). Time was central. While the speed was determined based on real-time predictions of insurrections and joint insurrections aboard, the hold space was configured in accordance with sanitary, alimentary, and disciplinary requirements.

Finally, medical personnel accompanied the immigration commissioner on the convoy once it lay at anchor in the Caribbean. The system that emerges was built on feritoias as strategic logistical nodes for lowering the latencies between the synchronisation of both labour and capital circulation: a new standard capable of accelerating overall turnover and of covering the solvency of investments in the transition from slavery to contract labour—systems that alternated and overlapped depending on the geographies of the upcoming new Industrial Revolution.

In fact, historians report that when planters lacked the funds to hire new wage labourers, entire consignments of migrants could be dispatched only to a limited extent. Notably, during the same period, 272 migrants from the Canadienne were compelled to remain in the depot because only one-fifth of the proprietors registered to acquire workers appeared to collect their lots, while the remaining proprietors abstained "for lack of money" (Sacchi Landriani, 2020). Nevertheless, the system did not lack friction or interruptions in synchronicity.

Although the English and French states legally institutionalised the figure of the migrant worker to synchronise capital turnover with new cycles of labour after the abolition of slavery, the feritoias—functioning as warehouses of "dormant" yet readily available labour—nonetheless exposed persistent asynchronies between the availability of capital and the supply of labour.

Among the Martinique archives there appear numerous criticisms by the British consul Lassless of the disciplinary uses to which migrant health and logistical infrastructures were put: from confinement in infirmaries to the night-time closure of depots (ivi). Beneath these disputes over the regulation of mobility lay a structural problem: the engagement contract — so effective at binding labour to a proprietor — ultimately became, in conditions of stalled worker placement due to cash shortages, an obstacle (indeed a source of obligation) for the colonial administration itself. Such blockages in the placement of coolies attested to the insufficiency of the synchronization operations: demand for new hands increases while, at the same time, workers remain in the depots.

Circulation *is* crisis, wrote Marx (1885). In response to the slowness of labour mobilisation relative to market rhythms, the zones of waiting perform a compensatory function. The case of the Canadienne is instructive, as the cargo of migrants from the ship not taken up by planters was confined in depots: feritoias. Still "temporarily," they were to be placed on plantations without imposing their transport fees on proprietors -which would have initiated their employment- but "reserving to the administration the right to reclaim these workers as their definitive placement is found, according to the regulatory rate for the transfer of contracts" (ivi). Ports, ships, and depots formed a system not reducible to a set of arrival or departure points. Through their flexibility — their adaptation to the material details of administration rather than to the principles of law — these zones served as regulating valves for a migratory flow that, however hetero-directed, was always untimely with respect to market oscillations.

As a ledger, the slaveholders financial reparations reshaped the world to provide the material preconditions for the Industrial Revolution and the metamorphosis of capitalist forms. As the Legacies project evidences and Silva argues, if we pay attention to the refiguring of the commodity in the consideration of colonial expropriation, "against the conventional view that places slavery in the prehistory of capital", a case can be made in this instance for how the total value historically produced by slave labor continues to sustain global capital through accumulation and legacy (Hall, 2014). In this ledger of investment and the materialisation of industrialisation and empire sits an unseen, unrecorded history withdrawn from view in the syntax of slavery that foreshadows and reinscribes across all these relations of the globalisation of capital.

However, do these infrastructures shape the actual politics of automation? And how? What is the relation between the labour brokerage of the mid-nineteenth century and the current regimes of work? How does this colonial debris (Stoler, 2016) keep impinging on labour subjectivity in the age of automation?

1. 5 Cloud Atlas.

The fourth and final article examines the contemporary migrant dormitory labour regime (DLR) in Johor's semiconductor Export Processing Zones (EPZs) as part of a current spatio-temporal fix at play in the (geo)politics of automation.

While siting this case study along the developments of the Chinese Belt and Road Initiative, I analyse the debt brokerage infrastructures in the Johor DLR within a longer world-historical arc that binds colonial slavery to indentured servitude and, ultimately, to contemporary forms of coerced mobility and infrastructural enclosure. This last genealogical study integrates Atlantic lines into a global analytical framework. This shift stems for a broader conceptualization since, rather than treating the Black Atlantic as the singular "prehistory of capitalist modernity, could follow world-system perspectives to read historical capitalism as a sequence of expansions and crises in which multiple labour regimes—plantation slavery, Asian indentures, convict labour, and today's brokered migration—have been articulated to sustain accumulation across shifting cores and peripheries (Arrighi & Silver, 1999).

Moreover, a focus on contemporary and historical labour brokers help grounding migrant workers and their intermediaries not merely as victims of a "systemic change" (Lindquist, 2017; 2025). In contrast, the shift in perspective helps "opening the black box of channelled migration": their collective refusals, mobilities, and infrastructures have recurrently forced reorganisations of production and governance (Lindquist et al., 2012).

Placing indenture alongside slavery is crucial for grasping how capital repeatedly externalizes costs of social reproduction while widening the frontier of commodified labour. Across the nineteenth and early twentieth centuries, Asian indenture circuits (kongsis, kangani and contractor systems) relocated the burdens of recruitment, subsistence, and discipline onto households, community associations, and intermediaries, thereby enabling firms and states to expand without generalizing metropolitan welfare compacts.

A second through-line follows the infrastructures of capital at play: capitalist expansions are repeatedly stabilized by large investments in fixed capital that reorganize time–space relations. Drawing on Polanyi and Harvey, Arrighi characterizes these episodes as spatial–temporal fixes in which state and finance mediate the conversion of surplus capital into transport, communications, and urban infrastructures—projects that both absorb overaccumulation and lay down new territorial circuits for valorization (Arrighi, 2007, 222–23). From the late twentieth century onward, the "logistics revolution" expanded this logic: containerization, just-in-time coordination, and logistics urbanism reoriented accumulation toward the sphere of circulation, embedding vast stocks of fixed capital in corridors, ports, and zones while compressing turnover time (Danyluk, 2018). Seen in this light, contemporary special economic zones, cross-border growth triangles, and migrant dormitory regimes represent infrastructural ensembles that couple labour control to circulation-centred profitability.

The Johor case is an exemplary of this longue durée. As Malaysia consolidates its role in semiconductor supply chains—now pivotal to AI—and as SIJORI's logistics-industrial ecology deepens, brokered dormitory regimes emerge as a reflux of older colonial techniques: they transfer

reproduction costs onto migrants and their networks; they synchronize bodies to export-oriented production schedules; and they anchor capital in dormitories, factories, corridors, and zones that collectively act as a spatial–temporal fix for crisis tendencies.

1. 5. 1 The Kangchu System in the Straits Settlements (1875-1914)

From the early nineteenth century through the mid-twentieth century, Chinese secret societies and kongsi federations operated as pivotal intermediaries linking South China treaty ports to frontier extractive zones in the Malay Peninsula. Acting as labour contractors, security providers, and communal administrators, kongsi coordinated the recruitment, transport, housing, and discipline of migrant gangs for tin mines and plantations, often under dormitory-style arrangements that fused work, residence, and provisioning (Trocki, 1990; Yen, 1986). Trocki shows how kongsi and allied associations governed everyday life and labour discipline, while Yen details their institutional ecologies in Singapore–Malaya (Trocki, 1990; Yen, 1986; Lockard, 1988). Subsequent research underscores how kongsi power was exercised through competing secret societies that struggled to control mine labour and territory (Tojo, 2014).

Recruitment ran through two overlapping channels: kinship-based networks and the "credit-ticket" system embedded in the coolie trade. Chinese- and Western-owned agencies at Amoy/Xiamen, Shantou/Swatow, Hong Kong, and later Macao—among them Hee Kee, Yeong Seng What, and Ty Chaong & Co.—worked with khehtau brokers and local crimps to assemble migratory flows routed via Singapore's Baba Chinese and British firms into the western Malay States and adjacent tin frontiers (Yen, 1986, 7; Pan, 2000; Kaur, 2012; Kaur, 2018). In Kaur's formulation, labour brokers financed passages, matched gangs to employers, and managed dormitory accommodation—functions that made the broker the key hinge between migration circuits and regimes of work (Kaur, 2012).

The financial architecture of migration translated passage costs into enforceable obligations that bound labour time to employers' production schedules. Prospective migrants typically faced three options: self-financed passage; sponsorship by kin or local brokers under the credit-ticket system (repayable with interest upon arrival); or assisted transport under a formal indenture that tied the worker to an employer for a fixed term.

By the 1850s, the line between credit-ticket and indenture had collapsed mainly in practice: shipowners and coolie brokers detained migrants until employers redeemed their costs, after which the sinkeh/xinke could not change masters until debts were extinguished (Kaur 2012, 2018). On site, kongsi and mine owners extended control through irregular wage payments, in-house provisioning, and store credit (the "truck" system), keeping workers in a revolving cycle of indebtedness—effectively converting reproduction costs (food, lodging, tools, medicine) into levers of labour discipline and availability (Kaur, 2017). Where abuses multiplied, the colonial state moved fitfully: the Chinese Protectorate introduced agent licensing and contract registration,

followed by broader immigrant regulations that curbed some practices but ultimately facilitated higher-volume, more tightly policed migration (Sai, 2023).

Chinese entrepreneurship dominated Western Malayan tin not only through mining innovations—the chin-chia chain pump and water wheel for dewatering, improved palong sluices, and the shift from lampan to lombong open-cast methods—but also because kongsi organisation secured and synchronised a scarce, labour-intensive workforce while minimising fixed-capital outlays. By 1906, wages comprised over 80 per cent of mine operating costs; Kongsi control over recruitment, dormitory provisioning, and credit made that volatility governable and aligned labour turnover with ore cycles (Jackson, 1969, 45). Here, the way brokers could align labour and capital turnover stems from an asynchronous synchronisation of contracts. Wage regimes combined kongsi-*kung* time rates for skilled tasks, *naik chiang* piece rates for unskilled overburden removal, and the *hun* (share/tribute) system—arrangements that tethered pay to mine rhythms and reinforced dormitory control (Yip, 1969, 82–86; Wong, 1975, 43–49). The role of British Empire lied in parallel, as the British regulatory consolidation formalized mineral titles, leases, and "mutual rights and obligations," stabilising a governable labour–land regime even as everyday management remained broker-driven (Kaur, 2017).

Measured at the scale of world markets, these techniques made the Indo-Malayan region a crucial infrastructural hinterland for British industrialization and, more broadly, a spatial–temporal fix in the world-system. Malaya, Indonesia, and Thailand together formed the core of the Southeast Asian Tin Belt, a district that long supplied a dominant share of world output (Schwartz, 1995). Kaur's statistical reconstructions show that, across 1913–1937, the region consistently accounted for the bulk of global production; in Malaya, tin remained a leading export into the interwar years and still represented 19 percent of export value in 1970 alongside rubber (Kaur, 2018).

1. 5. 2 The Return of a Spatial-Temporal Fix.

Drawing on labour regime theory and transnational labour process analysis, I conceptualise Johor's dormitory labour regime (DLR) in semiconductor export processing zones (EPZs)—Nusajaya, Kulai, Iskandar Puteri—as a *brokered apparatus* that synchronises migrant social reproduction with just-in-time production schedules and capital turnover (Burawoy, 1976; Smith et al., 2018). Following Burawoy, the key analytic move is to separate "maintenance" from "renewal": with migrant labour, the latter is geographically externalised to sending regions, making class formation intrinsically transnational (Burawoy, 1976, 1051–53). Contemporary chains therefore operate as point-to-point "labour transplants" (Xiang, 2012), embedded in regional circuits like SIJORI and mediated by state and private brokers (Hanieh, 2015, 66–67).

Malaysia's Electronics and Electrical (EE) sector is integrated into vertically disintegrated production networks: component manufacturing in Southeast Asia, final assembly often in China, and design/markets in the United States, Europe, and East Asia (Choong & Lam, 2010; Sjöholm, 2013; Athukorala & Kohpaiboon, 2015; Athukorala, 2016). Johor leverages EPZ/SEZ incentives,

wage differentials, and proximity to Singapore to attract FDI and function as a complementary manufacturing base of the SIJORI Cross Border Region (CBR): a "Triangle of Growth" built in 1989 linking Johor, Singapore and Riau Islands, in Indonesia (Devadason & Meng, 2014; Raj-Reichert, 2020). Between 1985 and 2009, the share of foreign investment in manufacturing rose from 17% to 72% of total capital formation, while the share of migrants in unskilled employment jumped from 2% to 38% (Devadason & Subramaniam, 2016; Bastide, 2021). Migrants now account for roughly 30% of the national workforce—about 2 million documented and 1–3.5 million undocumented by 2019—with two-thirds of foreign workers employed by export-oriented manufacturers; migrants earn on average 32% less than Malaysian counterparts (World Bank, 2015, 38; Bastide, 2021).

Dormitories are integral components of the labour regime, extending managerial control from factory to living space (Goodburn & Mishra, 2023; Jones et al., 2024). In Johor, federal rules tie work permits to employer sponsorship (a Gulf-style kafala adaptation), prohibit private renting, and make employers responsible for housing—policies that enable passport retention and discipline via housing and mobility controls (Gardner, 2010; Piper, 2022; Franck & Anderson, 2019).

In Johor, the volunteer corps RELA polices dormitory zones and immigration status, augmenting employer surveillance with state paramilitarised enforcement. Workers are segregated by nationality; movements are channelled via company buses (bas pekerja), curfews, and security protocols, with credible threats of detention and deportation (Nah, 2012; Franck & Anderson, 2019).

In Johor EE EPZs, two broker figures structure labour (im)mobility thorugh debt: (1) agents (contractors) who recruit, confiscate passports/contracts, and manage shifts/turnover, and (2) *kaadar* (shop-based credit brokers) who extend micro-credit for groceries, dorm fees, and transport, thereby enclosing social reproduction in a captive market (Kaur, 2014; Goodburn & Mishra, 2024). These roles convert *deceptive recruitment* and fee-based migration into *forced overtime* and high-frequency turnover. According to Verité's landmark study, ~70% of EPZ electronics workers are migrants and ~35% experienced indicators of forced labour; 92% paid recruitment fees, 77% borrowed to do so, and many reported deception about wages/hours and compulsory overtime beyond the 72-hour weekly legal cap (Verité, 2014). Workers report that debt functions as a programmable capacity variable: "rush orders" mandate compulsory overtime that workers cannot decline, while agents and kaadar adjust liquidity and subsistence to ensure disposability (ILO, 2012; Verité, 2014).

The result is a *real-time* labour intermediation system (Jones et al., 2024; Lindquist, 2015; Liu, 2022): legal channels (sponsorship) and informal practices (document confiscation, debt spirals) create a state of permanent precarity that can be *recursively tuned* to export cycles. With U.S.–China techno-rivalry and China's *dual circulation* strategy redirecting semiconductor geographies, Johor's DLR provides an operational fix in SIJORI that compresses aggregate turnover time in the sphere of circulation while absorbing capital into fixed infrastructures of the geopolitics of

automation (Athukorala, 2016; Mezzadra & Neilson, 2021; 2024; Raj-Reichert, 2020; Rossiter, 2021).

In this setting, migrant social reproduction is made calculable and governable—synchronised with demand spikes for AI-related chips and electronics—through the combined action of state policy, brokers, and dormitory management. In the present conjuncture—U.S.–China rivalry, China's *dual circulation*, friend-/near-shoring—the SIJORI corridor operates as a contested spatial–temporal fix for semiconductor value chains. As in the tin era, fixed investments (EPZs, dorms, cross-border logistics) absorb capital, while debt-anchored dormitory systems compress turnover in circulation (Athukorala, 2016; Raj-Reichert, 2020).

Reading across the two moments—*kongsi* and contemporary DLRs—reveals a longue durée politics of accumulation in which *boundary-making* (citizenship, sponsorship, dormitory walls), *infrastructural investment* (ports/EPZs/dorms), and *subaltern struggle* repeatedly remake the geography of work and reproduction in colonial and postcolonial times.

1. 5. 3 *Reflux*: From Kangchu to Johor's Contemporary BDLRs

How do the politics of the brokered dormitory regime (BDLR) intersect with those of cloud infrastructures?

Stoler's account of *imperial formations* as durable, reactivatable "debris" helps explain why brokered dormitories recur under new guises (Stoler, 2008; 2016). Quijano's *coloniality of power* and Mignolo's "dark side of modernity" name the epistemic and racial hierarchies through which such forms persist (Quijano, 2000; Mignolo, 2011). In digitalised supply chains, Madianou's technocolonialism describes how data practices and emergency logics, rework dependency, rendering migrants' reproduction and mobility an extractive substrate for just-in-time production (Madianou, 2019; 2021).

Johor's DLR may exemplify this reactivation: agents and kaadar extend the credit-ticket logic into micro-credit for food/transport; dormitory segregation by nationality reinscribes differential inclusion; immigration policing supplies the coercive edge. However, the form returns not as a copy but as reflux—a feedback-conditioned rearticulation under contemporary circuits of capital.

If *kongsi* dormitories bound migrant reproduction to mine cycles via debt and accommodation, Johor's semiconductor DLRs do so through a system of sponsorship, surveillance, and real-time intermediation: employer/agent passport retention, RELA patrols, and brokered transport/dorms feedback instant signals about labour availability into shift scheduling and overtime targets (Verité, 2014; Franck & Anderson, 2019; Nah, 2012). However, in the politics of automation, the notion of feedback is interesting, as it signals the internal communication between servers and clients.

In Marx's terms, the *manner of the reflux*—how circuits return as profit and reinvestment—*is determined by the specific forms of circulation* (Marx [1894] 1981). In data centers, those forms are informational and instantly mediated by high technology at the speed of light. Yet, if we extend the notion of feedback to the circuits of debts –overtime–payroll deduction–new debt, we grasp

the *feedback loops* that underpin the work regimes that manufacture the same micro-chips that run data in cloud infrastructures. However, as well as the politics of cloud infrastructures are sedimented on a longer genealogy - as seen in logistical media theory- the contemporary regimes of labour at semiconductor manufacturing present recursive lines of a more extended temporality. Here, the same capital and labour brokers that fixed the crisis conjuncture of the mid-nineteenth century seem to *hunt* contemporary migrants in feedback loops of indentured labour.

The exploitation of these workers is a feedback: a "reflux" that synchronises capital and labour turnover between just-in-time work shifts and export peaks. Here, since labour and capital turnover in EE EPZs are currently shaping SIJORI as the spatio-temporal fix of the digital economy of the current hegemonic conjuncture, these labour regimes are integral in shaping the politics of automation as the asynchronous synchronisation of a disjunctive conjuncture.

In the previous articles, I argued that the real technology of cloud and automation politics is the time; with the Marxian notion of the 'reflux', I thus comprehended both short-term and historical feedbacks that bridge heterogeneous synchronicities of this analysis.

Yet, the genealogical research into the BDLR in Johor builds on a different use of time as a political technology, positioning the dormitory as an archive that sheds light on contemporary and former labour regimes and work struggles. Building on Marxist theory, the article argues that historical lineages can inform the analysis of the electronics manufacturing supply chain and its labour regimes in Johor, Malaysia, thereby aligning the BDLR with the historical dynamics of global capital.

The conditions of coolie labour rank among the most insecure and super-exploited of all historical work groups. Nevertheless, recent processes of manufacturing outsourcing and labour recruitment—alongside the expansion of labour brokerage and human trafficking in countries targeted by foreign capital—have reproduced working conditions similar, if not analogous, to those of indentured labour (Ngai & Wilson, 2017; Rioux et al., 2020). Consequently, a limited body of scholarship has begun to examine contemporary labour regimes (LR) through the historical lens of coolie labour, questioning whether coolies constituted an early form of the precariat or, conversely, whether such comparisons risk obscuring important historical specificities (Fink, 2017). Other studies, instead, emphasised rising capital structures, drawing a historical parallel between the circulation-based economy surrounding the recent data centres in Johor and Singapore, which hosted 50% of the data centres in Asia, and the colonial revenue farms - a primary former business for the Straits Settlements - asking whether both should be understood as politico-logistical institutions of two phases of historical global capitalism (Neilson & Notley, 2019).

In this context, the history of international labour—especially when integrated with sociological and ethnographic studies—becomes essential to academic and political commitments.

This perspective contributes to an emerging scholarly debate on the need to reassess unfree labour regimes as constitutive mechanisms of value formation during cyclical periods of capitalist expansion (Arrighi, 2004; Brass, 1994).

From this standpoint, global labour history offers a distinctive lens through which to analyse contemporary dynamics of digital capitalism, foregrounding the central and historically grounded role of migrant workers worldwide in processes of industrial and technological transformation. Further research may build on this approach to examine past and future trends of an increasingly interconnected global society.

1. 6 *The Politics of Cloud Infrastructures.* A Global Analysis.

Through comprehensive document analysis and participant observation, the thesis employed a genealogical perspective to examine how, at the onset of the current crisis conjuncture, cloud infrastructures influence the politics of automation by mediating interactions with capital, states, and transitional labour regimes.

Using the concept of a Cloud Atlas, I emphasise the importance of creating a historical and geographical framework to analyse the complex interactions between the politics of automation- shaped by different logics, geographies, and aesthetics- and the politics of cloud infrastructures, which involve the asynchronous synchronisation of capital and labour. These form disjunctive conjunctures within the long history of global capitalism.

The theoretical framework explores how digital techniques that accelerate capital circulation function as strategic investments in the accumulation process. Notably, Engels's and Marx's analyses of turnover time are central: decreasing circulation time boosts the surplus value generated within a given period, counteracting the declining rate of profit (Marx, 1894; Engels, 1878). Within this context, the thesis offers a methodological account to observe the phenomenon from the standpoint of processes of state and capital restructuring (Chapters 2 and 3), as well as of historical and contemporary labour regimes worldwide (Chapters 4 and 5).

The thesis expands the valence of what is often called "infrastructure capitalism" by applying a global genealogical lens to the temporal relations that infrastructure assemblages instantiate and mediate. Drawing on Marx's account of circulation and the reproduction of value to define cloud computing as a logistical apparatus, I treat infrastructures of circulation as temporal regimes that structure the realisation of value across successive circuits. At the same time, and following the literature on social reproduction (SRT), I foreground infrastructures of social cooperation, welfare, mutual care, and domestic reproduction as distinct temporalities whose rhythms and crisis tendencies intersect with—but do not simply align with—value-circulation times.

As discussed in Chapter 3, although social slaves' cooperation was recorded in timelogs and vessel charts to overcome contingent and structural crises of capital reproduction (to mitigate the risk of revolts on every voyage and to accelerate travel speed to reduce costs and increase turnover), the result was always a contested and precarious *failure*, as the synrchonisation between infrastructures spatially and temporally displace and defer contradictions, producing disjunctive conjunctures in which crises are postponed, reconfigured, and redistributed across space and time.

Reading these unevenly entangled temporalities genealogically (i.e. as historically produced, contingent synchronisations) reveals how, beyond the current sociotechnical paradigm, state and

capital deploy infrastructural projects (data centres, warehouses, dormitories, and former *feritoias*) to orchestrate asynchronous synchronisations across circulation, reproduction of labour, capital formation, and state reproduction. The thesis argues for the need to examine historical continuities to test this hypothesis, thereby framing cloud infrastructures as the current sedimentation of the logistical power to employ time as a technology to organise labour and capital circulation across a disjunctive conjunctures resulting from contingent yet historical asynchronous synchronisations.

The *politics* of cloud infrastructure reside, then, in the asynchronous synchronisation of capital and labour mobility across successive moments of capital. This synchronisation is not novel but is a core capacity of logistics, which remains *latent* until states and capital deploy it as a *reflux* to surmount cyclical crises. At the moment of such synchronisation, an infrastructural fix is produced as the outcome of capital's operations, mediated by states and subaltern resistance. Read in this way, the politics of cloud (i.e., the politics of logistics/computation) encompasses a multiplicity of issues—the segmentation of labour, the constitution of infrastructural spaces, and so forth—and makes time itself the principal political technology at stake. This brings us to the last theoretical point.

This original perspective can thus inform studies on labour, society, technology and automation. While Chapter 5 illustrates colonial brokerage in Malaysian DLRs' microchip manufacturing, the Atlantic genealogy in Chapter 4 shows that the politics of automation derive from labour resistance. In particular, the contemporary logics, aesthetics, and geographies of automation are a live *archive* of the acts of resistence of migrant workers in BDLR EPZs, as well as in former slave ships and colonial plantations (in kongsi and kangani regimes) against the synchronising valves between labour and capital circulation, be they the data centre, the dormitory, the slave ship or the feritoias.

Following the logistics "dream to do without the subject", I contend that rather than substituting labour, the former and current politics of automation are set to learn from (abstract) and to make labour refusal redundant. This analytical step further informs us that, in times of automation, labour is not eliminated per se but rather abstracted, positioning the politics of automation as neither coincidental nor novel. Instead, it is embedded historically in the procedures implemented during the transatlantic and Pacific trade periods and subsequently reproduced cyclically during times of crisis.

Building on this framework, future research on the evolving politics of automation may productively adopt a genealogical methodology attentive to infrastructural temporalities, in order to trace how state and capital continuously recalibrate the mediation of labour, accumulation, and governance by deploying automation as a historically sedimented strategy for managing crisis, resistance, and the uneven reproduction of capitalist social relations.

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CHAPTER 2

DIGITALIZATION OF WELFARE SYSTEMS: TOWARD NEW OLIGOPOLIES? THE CASE OF AMAZON WEB SERVICES

In Blotta, D. (2023). Digitalizzazione dei sistemi di welfare, verso nuovi oligopoli? Il caso di Amazon Web Services. Social Policies, 10(2), 293–314.

Introduction

In recent decades, Italy's public welfare has faced multiple challenges. Parts of the sector have proven at times immobile—or in any case significantly lagging—relative to the needs of a rapidly changing world. Among the responses that have emerged to address these difficulties are the growing role of private-market actors and various social innovation initiatives (Longo & Maino, 2021). In a welfare system under heavy pressure, new service-delivery arrangements have also been tested, sometimes through the use of unconventional actors and resources.

These initiatives include digital innovation projects that treat technology as a vehicle to expand provision, innovate management practices, and simplify access channels to social benefits. This is unfolding within a policy framework defined at the European level as well. To mention only a few milestones: in March 2010 the European Commission launched a strategy for European growth driven by a European Digital Agenda; in 2014, with a market-oriented view of digitalization, Jean-Claude Juncker (2014, 5) extended the EU's objectives by proposing the Digital Single Market. Since 2018, the GDPR and the Data Governance Act (DGA), together with the White Paper on Artificial Intelligence, have enriched the regulatory landscape (Allegri, 2021, 9). More recently, the 2020 European Data Strategy, the 2022 Declaration on Digital Rights and Principles, and the 2023 'Digital Compass' communication have charted guidelines for the European Digital Decade 2020–2030 (EU, 2023).

With the maturation of a capitalism propelled by platform economies, the adoption of NextGenerationEU, and the National Recovery and Resilience Plans (PNRR), the digital transition is increasingly described as a veritable 'revolution'.

On the one hand, the COVID-19 pandemic exposed fragilities in health, social-care, long-term-care, and education systems (Pavolini et al., 2021); on the other, it highlighted the potential—and at times the effectiveness—of digital and platform-based solutions for both public and private

providers (Agostini, 2022). The tentative opening of services to digital innovation was driven primarily by cost-saving considerations (Perobelli & Rotolo, 2021). Inexperience with technological tools, generational and geographic divides in access to devices, the difficulty of system-wide modernization, and the lack of preparedness among sectoral workers are only some of the problems that emerged.

In this context, particular attention should be paid to platforms capable of addressing shortfalls in take-up, enabling services to reach new user bases precisely through digital tools. Paraphrasing Graham and Marvin (2001), we are witnessing a splintering of traditional sociotechnical infrastructures in which platforms intermediate between needs and services in a society in transformation.

The literature on these issues is expanding, with specific studies and increasingly mature reflections that help us grasp the strategies, visions, and technical capacities of platforms operating in welfare markets.

Building on Davis and Xiao (2021) and Van Dijck et al. (2019), we can analyze platform capitalism by distinguishing among platform types and the hierarchies that relate them. The platform ecosystem consists of an oligopoly of 'infrastructure platforms'—Alphabet (Google), Meta (Facebook), Amazon, Apple, Microsoft (GAFAM), along with Alibaba, Baidu, Tencent (BAT)—and a ring of sectoral platforms that, leaning on the technical services offered by the former, can operate across many domains of the connected society (education, leisure, health, mobility, etc.).

This contribution develops an initial reconnaissance of Amazon's pervasiveness—as an infrastructure platform—in the digitalization of Italy's public economy. If we adopt an infrastructural conception of power, once a prerogative of nation-states, these platforms now penetrate the connected society by logistically implementing political decisions (cf. Mann 2012, 170) thanks to their capillarity (Valdez, 2023) as intermediaries among a range of actors.

After showing how the Amazon ecosystem has operated in U.S. welfare—where Amazon has recently developed subsidiaries in medicine and care—we focus on Italy. Here, the U.S.-style subsidiaries are absent for regulatory reasons, but there exists a technological services ecosystem, managed by Amazon Web Services (AWS), that involves many actors across public and private welfare: firms, platforms, public bodies, institutions, oversight agencies.

To observe the Italian context we consider several agreements signed between Amazon and the Italian government at the onset of the COVID-19 pandemic, as well as contracts with large companies and public administrations operating in health care, community medicine, and genome analysis.

The final section sketches AWS's pervasiveness within the digitalization process driven by the PNRR, with particular reference to the Strategia Cloud Italia which, in line with the PNRR, defines the migration path to cloud for the public administration's data and digital services.

The results are discussed to outline the dynamics of welfare digitalization shaped by infrastructure-platform ecosystems, also to inform future systematic research on these themes. In

particular, in relation to rights to care and to information, we trace several interpretive lines for interrogating the growing entanglements among Big Tech, welfare institutions, and pharmaceutical companies.

2. 1 Platform Welfare: An Interpretive Scheme

Platforms position themselves between heterogeneous users as the terrain on which their activities take place—often free of charge (Srnicek 2017, 43). Whether individuals, firms, or institutions, users not only consent to the tracking of their activities but also accept the platform's terms and conditions for data development. Collected and valorized, such data become the generative architecture that users inhabit (ibid.). A case in point: through GPS, Uber helps the user find a ride while simultaneously predicting driver demand by area; this enables the company to raise prices prior to a transaction or to show 'phantom' taxis to create the illusion of greater supply (Hwang & Elish, 2015).

Driven by network effects (vertical and horizontal extensions to attract more data), platforms deploy generative architectures that, through cross-subsidies (offering one service for free to sell another), aim to build proprietary ecologies for data extraction and valorization (Srnicek 2017, 84). The digital-platform ecosystem is nonetheless marked by dependency (high switching costs) and structural convergence (platforms tend toward closed systems and come to resemble one another), generating a strong oligopolistic tendency (ibid.).

Analyses of critical ICT nodes show that over the last two decades, a cluster of network platforms has come to dominate the gateways of digital connectivity (Van Dijck et al., 2019). Serving as gateways for data-flow management, Amazon, Google, Meta, Apple, Microsoft (GAFAM), Baidu, Alibaba, and Tencent (BAT) are considered infrastructure platforms that, through search engines, data servers, advertising networks, e-mail services, instant messaging, cloud computing and storage, social networking, app stores, payment systems, identity services, data analytics, video hosting, geospatial navigation, artificial intelligence and machine learning, radiate across entire planes of operation in the connected society (Davis & Xiao, 2021; Srnicek, 2017; Van Dijck et al., 2019).

Across the world, platform society permeates public and private entities. Lacking investments in fixed capital, they are drawn by cross-subsidies to an oligopoly of core infrastructures central to information flows (Ozalp et al., 2022; Schuhmacher et al., 2022). Subject to the 'tyranny of convenience' (Wu, 2018)—the growing need, rather than the choice, to strike deals with major tech companies—welfare systems confront path dependency, lock-in, and indirect control over information flows (Srnicek, 2017; Van Dijck et al., 2019, 190).

The largest technology actors in China and the United States have developed proprietary toolchains that afford archiving, processing, and development capacities for health data that far exceed what public or private health systems have historically extracted, stored, and analyzed (cf. Van Dijck et al. 2019, 189).

Automated harvesting of individual data—often by circumventing conventional institutional filters—and the ingestion of such data into a complex ecosystem (Ragaglia & Roma, 2015) where information is combined and aggregated on the basis of proprietary algorithms opaque to external inspection (Van Dijck et al., 2019) allow infrastructure platforms to secure a significant advantage in the 'data economy'. In the realm of health information, for example, platform-based collection of genomic data—donated or unknowingly shared—can be used in ways adverse to users' interests. As specified by clauses of 23andMe, a leading genomics platform linked to Google, there is a risk of sharing information with life insurers, employers, or landlords—actors potentially interested in selecting people based on high-risk or high-cost conditions (Van Dijck et al., 2019, 200).

Hence the ethical issues raised by the digital disruption of medical research and care (Van Dijck et al., 2019; Boltanski & Thévenot, 2006). To ensure that policies of digitalization actually improve efficiency and quality of care, the risks must be considered: loss of independence in research; diminished public access to knowledge in domains with sensitive data; and weakened control over standardized measurement techniques that inform social policies meant to respect rights to care and health (Van Dijck et al., 2019, 209). Indeed, unlike welfare systems whose social and economic raison d'être centers on patient care, platforms' interests—for contractual reasons—are limited to collecting and valorizing data (ibid.). This distinction matters. While the volume of medical data stored in clinical systems increased globally by 500% between 2016 and 2020, Big Tech—Amazon, Apple, Google, and Microsoft—were the principal users of those data to identify drug targets, predict real-time pharmaceutical demand, and develop technologies for patient monitoring and electronic health records (CB Insights 2022, 7).

2. 2 The Case of Amazon Web Services

Although all major infrastructure platforms finance the pharmaceutical and health sectors—research, clinical development, manufacturing, supply chain, commerce, and monitoring of medical conditions (Ozalp et al., 2022; Schuhmacher et al., 2022; Thomason, 2021)—Amazon stands out globally for major investments in data collection for personalized care (followed by Google, Samsung, Sami, and Apple), as well as in logistics for manufacturing, pharmaceutical supply chains, and home delivery. Health systems, research institutes, and pharmaceutical companies such as Moderna, AstraZeneca, BioNTech, Pfizer, and Novartis benefit from this expertise (CB Insights, 2022). As noted on 25 June 2023 by Tehsin Syed, General Manager of AWS Health, AWS already handles the data of nine of the world's ten largest pharma companies. In the United States, Amazon has gone further, constructing a proprietary ecosystem of subsidiaries in health care, pharmaceuticals, clinical services, and assistance. In Italy, where current law does not allow expansion of such subsidiaries, AWS is increasingly powering the

digitalization of public administrations, firms, platforms, and actors in public and private welfare. These connections are deeply implicated in the implementation of the PNRR.

With the impending decommissioning of nearly all PA data centers (local health authorities, schools, etc.), AWS—having won the first PNRR funding lot of the Strategia Cloud Italia—aims to become an essential infrastructure for cloud-first digitalization of welfare systems, configuring within its networks the migration of data from institutions, companies, research institutes, and public- and private-service entities. The following sections trace how these dynamics are unfolding.

In 2018, Amazon launched Amazon Care in the United States, a primary-care service based on tele-medicine and tele-assistance. Initially designed for company employees and their families, in 2019 the project expanded to in-person services in seven cities and tele-assistance available in all 50 states. That same year, Amazon acquired PillPack, a pharmacy chain headquartered in Manchester. The consequences materialized two years later with the creation of the subsidiary Amazon Pharmacy. On the day it launched, the market capitalization of the pharmaceutical-retail sector dropped by $22 billion. In a context where average annual per-capita spending on prescription drugs in the U.S. is about $1,300, Amazon Pharmacy and its RxPass subscription offer unlimited quantities of 50 common generics for over 80 frequent conditions for $5 per month. Also in 2018, CNBC reported on Amazon labs in Seattle where, since 2014, a team of fifty had been designing a skin-cancer vaccine via machine learning and building Project Hera: an AWS-powered compute network capable of detecting and correcting miscoded entries (or misdiagnoses) from unstructured electronic medical records.

In 2020 Amazon launched Halo, a wearable bracelet that records users' voices, analyzes tone, and infers mood. Tracking heart rate, temperature, and fatigue, the device was marketed as a fitness coach; accordingly, it asks purchasers to upload minimally clothed photos and continuously records voice. In April 2020—two months after COVID-19 spread to the West—Amazon began building its first pilot laboratory to produce tests for infection tracing. AWS President Andy Jassy became Amazon's CEO on 5 July 2021. In a leaked audio message, Jassy described health care as a top priority and a domain in which Amazon sought to be 'disruptive'.

In 2022 the triad of Amazon Pharmacy, Amazon Care, and Amazon Diagnostics was reshaped: Amazon shut down Care. A few months later Amazon acquired One Medical for $3.9 billion, adding roughly 815,000 patients and their medical records across 200 clinics in 26 markets.

Consequently, on 15 November 2022 Amazon launched Amazon Clinic, a virtual platform to log symptoms and request in-person or remote visits, obtain prescriptions, and—through Amazon Pharmacy—receive home delivery.

While Amazon is best known for retail, streaming, and e-commerce, its other half—AWS—is equally important. Put simply, if Amazon is the Western leader in the logistical distribution of goods and services to consumers, AWS is the global leader in distributing technological services to companies, public entities, and governments on every continent.

AWS leases its systems to about 1.5 million clients worldwide and, in 2023, held 32% of the global cloud market, matching Microsoft and Google's shares combined (23% and 10%, respectively). It provides IT infrastructure to entities across sectors: from aerospace research to human-genome sequencing; from automotive and energy to education, agriculture, marketing, defense, law enforcement, tourism, media, manufacturing, commerce, and finance.

In the absence of a dedicated public repository and comprehensive public communication, fully mapping AWS's connections in welfare alone is difficult. What is known is that giants such as AstraZeneca and the U.K. National Health Service rely on AWS, as do numerous platforms for human-genome analysis and health enterprises across continents. From wearable apps to diagnose neural conditions (BrainPower), to molecular treatments for leukemia and lymphoma (Munich Leukemia Laboratory), to genome reading and analysis (Illumina, Fabric Genomics, Dante Labs), to application systems for medical trials (National Institute for Health Research), to health assistance (Medisanté, Cerner, Juniper, the NHS, Halodoc, Doktor Raksa, Doctor Anywhere), to surgery (Axial 3D, Cydar), to clinical-database reading (Gov Chat, Huma), to telemedicine (HealthDirect Australia), and COVID-19 diagnostics (M3i GmbH, Hyrax Biosciences): there is virtually no domain of tomorrow's medicine in which AWS does not seek to be a fundamental data-analysis infrastructure.

In Italy, Amazon's cloud infrastructure powers activities at companies such as Ferrari, Nexi, SisalPay, Sky, and Enel; platforms such as Musixmatch; and Italian joint-stock companies including Alperia, Amiu, Hera, Ansaldo Energia, A2A, and Iren. AWS also provides indispensable services to the Department of Civil Protection, SIAE, the National Institute for Astrophysics, the National Research Council (CNR), the Court of Auditors, IcaTributi, and many Italian public and private universities. Finally, AWS serves local governments such as Turin, Florence, Brindisi, Cagliari, Gallarate, Bologna, and Codogno, as well as the Consorzio dei Comuni Trentini.

A noteworthy case is the Municipality of Codogno, assisted by Amazon to manage public-administration communications. An agreement signed by the government during the earliest phases of COVID-19 enabled the municipality to install an Amazon Connect cloud call-center. Through machine learning, it handled and responded to citizens' requests to Civil Protection, as well as municipal, regional, and national bodies, including requests for food vouchers and social-service support.

In education, AWS powers Madisoft and ArgoSoftware—the main providers that manage distance learning for over 5,000 schools—along with 'Nuvola'-suite registries, student portals, and electronic gradebooks certified by the Ministry of Education and Research (MIUR).

In research, AWS partners with the Universities of Padua, Trento, Sapienza Rome, and Cagliari, the Conference of Italian University Rectors (CRUI), Politecnico di Torino, Politecnico di Milano, the Institute for Electromagnetic Sensing of the Environment (IREA), and the online universities Pegaso and UniNettuno, in addition to INAF and CNR already mentioned.

Many Italian PAs have migrated systems to AWS, including Lombardy Region (ARIA), Sardinia Region, and Lazio Region. AWS organizes hundreds of webinars, conferences, and

summits aimed at public administrations and public bodies worldwide to propose and train the use of its technologies in the public economy.

Among AWS's Italian health-sector partnerships are Dante Labs, ItaliAssistenza, Centro Medico Santagostino (Milan), GPI (Trento), Dedalus, Elco, GekLab, Dottori.it, and VitaEver.

These firms lease software to upload health data and monitor the conditions of assisted patients; they also host electronic medical records in the cloud, enable sharing, and program work platforms for on-demand service delivery. Patients can upload data and request services through platform interfaces with chatbots and algorithms trained by Amazon Lex, the machine-learning software that powers Alexa. To date, Amazon's infrastructures and data-center locations comply with GDPR regulations for processing sensitive data, which must be located in national data centers.

For Dante Labs, a company specializing in whole-genome sequencing (100% of DNA), AWS provides storage and compute services. Access to clients' genetic predispositions enables personalized diagnostic and therapeutic solutions—a rapidly growing service. Consider that if sequencing the first human genome (about 100 GB) cost €2 billion, leading hospitals now offer the service for €5,000–€6,000. Since 2021 in Italy only one hospital—Verona—has offered it at a similar price. Enter Dante Labs (Abruzzo, 2016), which ships a saliva-collection kit for under €1,000 to enable cloud-based genome reading and machine-learning solutions for prevention of hereditary diseases. Whole-genome sequencing not only 'shifts health management from treatment to prevention' but also channels huge volumes of genomic data to AWS, which offers its own DNA-reading software, Amazon Omics. The partnership with Seattle underpins conservation and development of data collected from millions of participants in 97 countries who interface with the Italian startup.

Although elsewhere there are direct agreements between infrastructure platforms and national welfare systems—think Google's Genomics Cloud and the U.K. NHS, or AWS and the Australian and South African national health services—AWS is so far absent from Italian hospital companies but present in startups and platforms that harness digital practices to design market-oriented, platform-based solutions for clients. These cases echo elements explored internationally by Van Dijck et al. (2019): platforms in welfare position themselves within gaps in public provision, intercepting 'participatory' and 'knowledge' needs more than strictly assistential ones.

In mid-December 2022, AWS signed a global agreement in Italy with Dedalus—the leading European provider of healthcare and diagnostic software, serving 6,700 facilities and 540 million users in 40 countries. Handling four billion diagnostic results per year and already the main EHR provider in U.S. hospitals, Dedalus agreed to store health data in AWS data centers in Milan. Amazon is not alone: in March 2023, Microsoft Azure concluded an agreement with Dedalus to begin hosting EHRs in its Italian cloud region and 'relaunch the country's digital transformation'.

2. 3 AWS and the Digitalization of Public Administrations, Local Health Authorities, and Schools under the Strategia Cloud Italia

Europe's digitalization drive requires technologies that can store and process public-administration data efficiently. In the absence of national or European public infrastructures, data migration proceeds to the most advanced private clouds in the world—Amazon, Google, Oracle, and Microsoft. AWS's pervasiveness within welfare will thus be conditioned by its position in the country's digitalization process as prescribed by the PNRR and the Strategia Cloud Italia, and by the role of the National Cybersecurity Agency (ACN), the authority qualifying cloud providers for public-data migration.

Some facts: on 13 May 2021 Fincantieri signed a cooperation agreement with AWS to accelerate Italy's digital innovation and technological development through joint projects for the 'Italia Digitale 2026' agenda, part of the PNRR. According to Fincantieri's press release, the agreement integrates AWS and Fincantieri across defense, electronics, advanced systems, IT, and national cybersecurity. On 14 July 2022 the Court of Auditors outlined the digitalization strategy for Italian PAs and Local Health Authorities: because '95% of the roughly 11,000 data centers used today by Italian public bodies fail to meet minimum requirements for security, reliability, processing capacity, and efficiency,' digital transformation follows a 'cloud-first' approach aimed at migrating each administration's data and applications to a cloud environment. The document indicates two complementary models: central administrations may migrate to the Polo Strategico Nazionale (PSN)—a new dedicated cloud infrastructure (fully private or hybrid), located in Italy and at the forefront of performance and security—or to the public cloud, i.e., commercial cloud offerings available on the market.

The goal is to eliminate 10,000 physical data centers and, by 2024, relocate public-entity data to cloud environments hosted by qualified firms. The 2023 roadmap of the Strategia Cloud Italia foresees creation of the PSN: a cluster of multiple data centers belonging to Italian firms such as Leonardo, TIM, Sogei, and Cassa Depositi e Prestiti, powered by Google, Oracle, and Microsoft, set to become the destination for the country's strategic data. However, building a national cloud infrastructure so quickly is difficult. France has repeatedly tried, but projects have failed. Hence data migration for LHAs, schools, and other PAs to public clouds—where 'public' means commercial clouds (Google, Microsoft, Amazon) rented by the public sector via subscription—was envisaged.

AWS's future pervasiveness in the public sector will therefore depend on this strategy and the role it secures within Italy's digital landscape. What is certain is that the Court of Auditors began dismantling its data centers in 2015, migrating its work applications to AWS servers. Long before the PNRR guidelines, cloud computing offered an opportunity for cost externalization for private and public entities alike. Enel, for instance, shut down its data centers and migrated all data to AWS in 2019. With the retirement of proprietary data centers and a contract with AWS, the Court of Auditors followed a broader policy of public-sector downsizing—so stated by its IT lead in an exemplar interview published by AWS.

2. 4 The Role of the PNRR

Until January 2023, digitalization of PAs required that MEPA-listed providers obtain suitability certifications from the Agency for Digital Italy (AgID). Subsequently, with the designation of the National Cybersecurity Agency (ACN) as the qualifying authority for cloud providers suitable for PA migration, the government took an important step. A government body now certifies commercial cloud providers—Italian and foreign (Aruba, Microsoft, Amazon, Google, Fastweb)—as secure for public-data migration. As of 18 January, ACN had confirmed qualification for all 1,803 applications submitted.

On 2 February 2023, ACN signed an agreement with AWS—the Government Cybersecurity Program (GCSP)—under which AWS trains the public authority on cybersecurity. On 7 March 2023, in Rome, at AWS Initiate for Italy's public sector, AWS directors presented guidelines for migrating PA data onto Amazon's servers. The Consip framework agreement for public-data migration via MEPA was won, in the first €390 million lot, by Almaviva and Engineering—two Italian companies with which AWS entered a temporary association to access the public market.

Almaviva—an AWS 'top-tier' partner—at the time leased infrastructure services to the Prime Minister's Office and the Ministries of Justice, Defense, Foreign Affairs, Transport, and Interior, managing 1.5 million passports and five million residence permits in electronic format, along with data from 240 naval units for maritime patrols. Although successful as an Italian cloud provider (operating in Russia, Saudi Arabia, Egypt, Tunisia, Romania, Brazil, the U.S., Colombia, the Dominican Republic, and Brussels), the agreement with AWS for the Consip framework has Almaviva acting as a mere reseller of AWS cloud services.

Closely tied to the 2023 Strategia Cloud Italia, the PNRR thus plays an ambivalent role in digitalizing the country's public-welfare systems. On the one hand, it catalyzes social-innovation policies—as the PSN project, Italy's first 'sovereign cloud', suggests. On the other, interfacing with a powerful oligopolistic private market and public-sector infrastructural shortfalls, it channels the structural hierarchies of platform capitalism.

Under the Strategia Cloud Italia, whether PAs proceed via MEPA or the PSN, AWS (via Almaviva, Engineering, and Fastweb) and Google, Microsoft, and Oracle (via TIM, Sogei, and CDP in the PSN) are indicated as the primary destinations for public-data migration. As the framework agreement's regulatory provisions make clear, price competitiveness is the main discriminator for Italy's data transfer decisions.

The archiving of public health and administrative databases thus converges with what Perobelli and Rotolo (2021) reported regarding welfare digitalization: at a still-immature stage in public-sector digitalization, the operative logic across entities, firms, and institutions is cost-saving rather than a long-term vision. This is crucial. If we combine this problem with consolidated readings of platform economy, we can show that, absent an overall vision of digitalization, welfare systems are drawn—by the 'tyranny' (Wu, 2018; Van Dijck et al., 2019, 190)—into the hierarchies of platform capitalism, where a few infrastructure platforms extend themselves through 'rhizomatic connections' to occupy key nodes in the connected society (Srnicek, 2017, 89). Here lies the PNRR's role: to fuel, transform, or reverse an ongoing phenomenon. While a public debate on

welfare digitalization is necessary, recent institutional statements on designing a European cloud remain too immature to counterbalance a market tilted toward oligopolies.

2. 5 Continuing the Research

In strongly integrated health systems where social innovation is propelled by information-technology vectors, the fusion of medicine and information—and of information and modernization (Botrugno, 2020, 34)—has encouraged the belief that transforming information flows in health care would automatically improve service quality (Mort et al., 2009, 10). While technological innovation can reach levels of accuracy close to the modern drive for certainty (Sassower, 1986), the implementation of new technologies in social-policy domains is neither neutral nor without consequences. Note that the mantra of the 'centrality of the patient'—a core formula of technological-innovation policies over the last three decades—also served as a vehicle for the neoliberal policies that, around the 1980s, pushed privatization of health care (Botrugno, 2020, 34).

If we are to problematize the rhetoric and practices of contemporary innovation, we must ask whether 'technological solutionism' (Suchman & Bishop, 2000) is obscuring the criticalities posed by platform-society hierarchies.

We should therefore examine whether, beyond the rhetoric of client centrality, the 'centrality of data' risks unsettling not only the triangulation among state, public entities, and enterprise in delivering social policies, but also the very enjoyment of universal rights such as health and information.

Within the adopted theoretical framework, some platforms aspire to own the essential information infrastructures of the connected society (Plantin et al., 2018; Srnicek, 2017, 80). The digitalization of welfare through data extraction and development by these companies (Ozalp et al., 2022; Schuhmacher et al. 2022)—often resistant to professional standards typical of medical research (Van Dijck et al., 2019)—is reaching levels of pervasiveness that raise moral and ethical issues (Lee & Qiufan, 2021; Van Dijck et al., 2019, 207) regarding privacy, accuracy, and transparency of collected and combined data, with substantial consequences for dependency and influence in medical research, health-care delivery, and social policy more generally.

Infrastructures are powerful political instruments (Easterling, 2014; Larkin, 2013; Mann, 2012): if the Cambridge Analytica scandal involving Facebook in U.S. elections exemplifies the problem, it is enough to recall that Google's and Amazon's clouds are already involved in activities that violate human rights.

Moreover, as long as the proprietary algorithms of the main platforms remain closed to external inspection (Van Dijck et al., 2019), a complete reading of the issues will be impossible. This attention becomes particularly important for one further reason: the cloud is only one layer of the

digital environment (Bratton, 2016; Shapiro, 2018; Zuboff, 2019). Data stored and processed on this plane feed proprietary datasets for the algorithms at the next level of abstraction—e.g., artificial intelligence. Drawing on their own cloud data, Google, Amazon, and Microsoft are already training AIs for automated discovery of drugs and vaccines, for surgery, and for diagnosis (Schuhmacher et al. 2022, 4). In 2020, leveraging 3D protein-structure databases, AlphaFold 2—an AI trained by Alphabet (Google)—began synthesizing novel protein structures, marking a scientific advance that would otherwise have taken decades (Lee & Qiufan, 2021). In 2021, Insilico announced the first AI-identified medicine for idiopathic pulmonary fibrosis, cutting expected discovery costs by 90% (ibid., 171). Rather than mass-producing generalized drugs (ibid., 172), AI is optimized to facilitate prevention and personalize treatment thanks to growing access to wearables and cloud-hosted health information (family medical history, genome sequencing, etc.). Since they have amassed datasets larger than any health system (Van Dijck et al., 2019), infrastructure platforms—especially China's BAT—are central to AI training in the sector (Lee & Qiufan, 2021) and are steering the migration of welfare systems toward digital health (Schuhmacher et al., 2022, 7; Thomason, 2021).

The reconstruction presented here makes clear the need to continue studying the phenomenon through research questions that help analyze these criticalities. A few examples follow.

Once public data become part of proprietary assets, who will be able to control, verify, and assess the processes of extraction and development? What role will providers play if the programming of social policies increasingly depends on—or is automated by—the proprietary algorithms of a few major actors?

If allowing inspection of their measurement methods would cause platforms to lose competitive advantage in the ecosystem (Davies et al., 2017)—thus reconfiguring relations with states and regulators—what would prevent health-data providers from assuming the role that Big Pharma occupies today in medical and pharmaceutical research? (Kitchin, 2014, 61; Schuhmacher et al., 2022; Van Dijck et al., 2019, 279).

If platform architectures are demonstrably not immune to reproducing discrimination and ethnic profiling (Meijer & Thaens, 2013; Benjamin, 2020), how can accountability and trust be restored within the digital-innovation ecosystem? Can the state guarantee the creation of shared infrastructures that generate democratic—beyond economic—value? (Mazzucato, 2020; Jacobs & Mazzucato, 2016).

2. 6 Conclusion

No matter how advanced privacy regulations on data transparency may become, the new geography of the right to health (Botrugno, 2020) will hinge on the divide between those with direct access to—and control over—information and those who require others' tools to store, manage, and analyze their own data (Andrejevic, 2014). If digitalization increases dependence between public entities and private IT, it will be necessary to articulate the capacity to build

independent social policies that can grow within a horizon of public access to knowledge and care, also by leveraging the most modern technological tools.

By combining further inquiries into platform connections across the public-service branches, we can deepen and test the geography of influences over national social-policy programming. Research agendas that wish to grasp vulnerabilities of social rights can arise from analyzing data flows among digital platforms, tech firms, pharmaceutical companies, public institutions, and digitalized welfare systems. By expanding research on the growing pervasiveness of infrastructure platforms such as Amazon in the extraction, accumulation, and valorization of sensitive data, we can generate an up-to-date, synoptic view of contemporary transformations in public social policies and the rights linked to them.

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CHAPTER 3

A NEW SYSTEM? CRISIS, STATE, AND CAPITAL FOR ITALIAN DIGITAL SOVEREIGNTY

In Blotta, D. (2024). Un nuovo sistema? Crisi, Stato e capitale per la sovranità digitale italiana. Sociologia italiana, (26).

Abstract

The article shows how, by acquiring clients among European and national political–legal institutions across the polycrisis from 2019 to 2024, Google, Amazon, and Microsoft have become both market monopolists and "sovereign solutions" for the Italian state cloud: a technical system financed by 27% of Italy's NRRP (PNRR) funds, within which the public administration's data have been dismantled, transferred, and reconfigured from 2022 through 2039. Through covert observation and documentary analysis, the article examines the joint role of state and capital in designing—within the anti-market zone—a system in which their technologies are recognized, exchanged, and made interoperable.

Keywords: cloud; Big Tech; digitalization; PNRR; infrastructures

Introduction

Since the 2010s, Western sociology has observed the global rise of a "digital" capitalism driven by just-in-time, on-demand computational services provided by an oligopoly of so-called platform-infrastructure firms: Google, Amazon, Facebook, Apple, Microsoft (GAFAM), and, in China, Baidu, Alibaba, Tencent (BAT) (Davis & Xiao, 2021).

Recently, analyzing monopolies as a cyclical tendency of the capitalist mode of production—a situation aided by crises and state regulatory action—the relationship between crises and the development of sectoral platforms (Airbnb, Uber, Netflix, etc.) has been interpreted as capital's domination over the market. The resultant "platform society" would mark the conjuncture of a transformation of capitalism (Peck & Phillips, 2020; Soskice, 2020; Van Dijck et al., 2018).

With a processual emphasis, this article observes and analyzes how, amid crisis and war from 2019 to 2024 (Mezzadra & Neilson, 2024), Amazon, Google, Microsoft, and Oracle in Italy became the "sovereign solutions" of the Italy Cloud Strategy: the technical system for dismantling, transferring, and configuring the public administration's public, critical, and strategic data through 2039. The project is financed by 27% of the European funds of the National Recovery and Resilience Plan (PNRR) to achieve "the country's technological autonomy" by 2026 (Agenzia Nazionale di Cybersicurezza, 2024).

Continuing dynamics visible since 2007 in the market sphere—and in capital circulation—the infrastructuring of U.S. Big Tech for the systemic management of state data is unprecedented outside the United States and remains largely overlooked in the social-science literature (Blotta, 2023).

Analytically, the essay adopts Braudel's (1992a) theory of the anti-market, deepening—via covert observation—the interpretation of Peck and Phillips (2020) according to which "platform power relations," rather than stemming from technological disruption or network effects, are defined in a series of "placeless places" where apex predators of market and politics "meet in the cloud" (93).

The research proceeds critically from this point. For if, for those authors, this suffices to cast "platform power" as "a new business model of capitalism" (ibid., 92), it is instead essential to understand the cloud technically as a mode of computation whose hyperscale regime—now a paradigm of the twenty-first-century economy (Narayan, 2022)—is both the outcome (Hu, 2015; Soskice, 2020) and the origin of novel relations between Big Tech and the state (Kushida et al., 2015).

The essay is structured within this analytical arc. Section 1 introduces cloud computing as a method, highlighting the American state's role and the role of crises in the developmental phases and diffusion of U.S. providers now monopolizing the global market (Hughes, 1983). It then examines their operations in the legislative context of Europe's New Economic Policy amid crisis (2019–2024) (1.1). On this basis, it turns to Italian public-sector digitalization through partnerships among Big Tech, institutions, technology firms, and public-spending review from 2015 to 2023 (2) and from 2023 onward (2.1).

Drawing on observation "in the clouds"—namely, the meetings and cloud data centers established by Italian and European institutions and U.S. Big Tech—and substantiated by secondary sources, the article analyzes a joint process among European institutions, the Italian state, and capital whereby Amazon, Google, and Microsoft clouds are transformed from technologies into infrastructures, and from infrastructures into a system for processing Italian state information. Methodologically, it applies STS approaches to identify phases of development, diffusion, and consolidation of public-service networks (LTS) such as electricity, to which the cloud is cautiously compared.

Far from signaling a state "return" or "retreat," the analysis identifies, within the anti-market zone (Braudel, 1992a), the scripting of a project in which state and capital recognize and braid their technologies into a single system—an exchange whose consequences—across debt, automation, artificial intelligence, and cybersecurity—remain opaque.

3. 1 The Cloud: Origins, Development, and Diffusion

Cloud computing is a model for managing computational resources based on virtualization and the pay-per-use, just-in-time, and on-demand provision of computing, storage, and data-processing

services between a cloud provider and its client. Analogized to centralized electricity distribution, the cloud is deemed an enabling technology because, whereas a standard IT architecture saturates as data loads grow, hyperscale clouds provision virtual machines capable of abstracting data into virtual containers whose "weight" is offloaded onto a distributed infrastructure according to usage. This logistical operation is a driving force of the twenty-first century (Narayan, 2022).

By converting computation from a scarce to an abundant resource, the system has, since 2007, transformed the ICT market's business model, marking the onset of platform capitalism and the highest centralization of information in history (Kushida et al., 2015; Kenney & Zysman, 2020; Narayan, 2023).

As of 2024, Amazon (32%), Microsoft (22%), Google (11%), Alibaba (4%), and IBM (3%) together hold 72% of the global cloud market; 77% of the market is controlled by just ten private actors. The hyperscale market was valued at USD 590 billion in 2023 and is projected at USD 1.062 trillion for 2028. Rents in this regime are underpinned by virtual machines dominated by an absolute monopolist, VMware, with roughly 80.7% global share, trailed only by IBM at 5.3%.

Braudel conceptualized capitalism as a system—the anti-market—wherein the zone of commercial exchange (the market) is historically subject to monopolistic forces (capital) that mature within a zone of concentration (the anti-market), where, "then as now," the highest profits—from non-specialized, long-distance commerce—can be reproduced at very high intensity (Braudel, 1992b, 408; Wallerstein, 1991, 355). For Braudel, monopolies come in two forms: those forged through "continuous cooperation with the state" (1992b, 421) and those "taken so much for granted as to be almost invisible to those who benefit" (423). The cloud fits both definitions, because the state plays a constitutive role at every stage of this technology.

Born in 2006 to manage Amazon's user-traffic spikes, Amazon Web Services (AWS)—the world's first cloud—began diffusing as a tool for digitalizing public governance at the dawn of the 2008 crisis, handling civil and military U.S. e-government data for the NSA, NASA, and CIA (2013)—a diffusion phase—after testing operations—in the development phase—in the 2011 Libya campaign (Bratton, 2016; Hu, 2015), in Syria (Hu, 2015), and in migrant surveillance during the U.S.–Mexico border crisis (Biddle & Fang, 2020).

Crises are the privileged terrain of this technology (Hu, 2015). Today, while AWS processes data for nine of the world's ten largest pharmaceutical companies—such as Pfizer, Moderna, and AstraZeneca, helping explain the speed of COVID-19 vaccine trials—Microsoft Azure controls information—stored offshore—of 16 of Ukraine's 17 ministries (Soesanto, 2023).

War profits override rivalries among competitors. Google, together with AWS, manages data for Israel's Defense and Interior ministries under a contract signed in 2021, both to test AI models for mass and extrajudicial surveillance in Palestine and to encrypt evidence of war crimes in the event of access requests by the International Court of Justice and the International Criminal Court (Blotta & Monti, 2024).

If Braudel called the anti-market zone a "jungle of great predators" where "true" capital "reigns only if it identifies with the state," which "guarantees hegemonic power" (Braudel, 1992b, 64),

then today multiple schools observe in Europe the rewriting of relations among state, capital, and market under a New European Industrial Policy marked by crisis—a structural tendency of capitalism (Gramsci, 1975).

In Europe and Italy, the cloud diffuses and standardizes alongside a paradigmatic shift in European economic policy: from a neoliberal and neo-mercantilist market approach (1980–2019) to Franco-German-led interventionism aimed at "sovereign" acquisition of "key technological areas" in the international supply chain (Schneider, 2023). The next subsection considers the European case, before turning to Italy.

3. **1. 1 The European Political and Regulatory Framework**

Across the arc of the polycrisis (2019–2020), Microsoft, Oracle, and AWS established clusters of data centers located in Europe to handle member-state data, configuring them with standards that anticipated and effectively substituted for EU "digital sovereignty" projects.

This process has generated an oligopoly that is neither the product of regulatory absence nor of standards technically inaccessible to the market. On the contrary—as the Italian case will show—it is the outcome of a project drafted, within the anti-market zone, by states and capital, sustained and tested through dense clientelist networks linking U.S. cloud providers and public-policy institutions. U.S. cloud activity in Europe is governed by frameworks including the GDPR (2018) and the Trans-Atlantic Data Privacy Framework (2023), which regulates EU–U.S. data flows after the Court of Justice of the European Union (CJEU) invalidated Safe Harbor (2000–2015) and the Privacy Shield (2016–2020) due to U.S. surveillance.

Responding to the CLOUD Act (2018)—allowing U.S. access to data held by U.S. cloud firms abroad—the EU debated measures to temper Big Tech pervasiveness; in 2020, such data traffic was deemed unlawful (Rojszczak, 0).

Between 2021 and 2022, Big Tech came under scrutiny for espionage, unfair competition, and antitrust (Meyers, 2023), and Gaia-X—the mooted European cloud—was called before the European Parliament due to the participation of those same firms and Palantir.

EU institutions—reshaped by a Franco-German policy shift (e.g., Germany's 2019 National Industrial Strategy 2030) and a cascade of shocks (COVID-19, the energy crisis, the war in Ukraine)—have moved toward a geopolitically and militarily inflected industrial policy (McNamara, 2024; Schneider, 2023). The digital value chain becomes a strategic asset safeguarded by the EU Chips Act (2022), the European Critical Raw Materials Act (2023), and Important Projects of Common European Interest (IPCEI), which—departing from traditionally laissez-faire single-market governance—support EU supply chains for batteries, hydrogen, semiconductors, rare minerals, and the cloud (ibid., 2378).

Part of a decade-long renewal of EU initiatives, these measures—linked to new environmental, energy, and military orientations (EU 2030) and to a return of eighteenth-century regulatory tools such as tariffs—lock in market conditions to reach innovation scales aligned to geopolitical goals (Adler-Nissen, 2024; Håkansson, 2024; Bunnell & Coe, 2001).

As Polanyi argued (2002), in times of crisis the system's general traits and contradictions persist while assuming a new form—no longer liberal but corporatist: a "process of transformation" marked by "technical-scientific concentration and capital centralization," wherein "industrial rationalization goes hand in hand with social peace" (Cangiani, 2019, 18).

It is amid this heightened institutional protagonism—not absence (Bania & Geradin, 2024)—that the European market, represented by Gaia-X, was first stalled due to Big Tech's presence and subsequently abandoned. In this conjuncture of apparent paradoxes, U.S. clouds become not mere oligopolists of a European free market but the very "sovereign solutions" for member states' "technological independence."

Following the new sovereign industrial policy, Big Tech responded by producing ex-novo technical standards of data sovereignty. Formally circumventing the CLOUD Act, in June 2022 Microsoft partnered with Leonardo to establish EU data centers whose encryption keys—the source codes enabling decryption and hence reading of client data—were handed to the Italian firm.

Though Leonardo had just suffered an internal breach of 400,000 documents over two years, the strategy proved effective and was emulated by Oracle and Amazon. On 25 October 2023, AWS inaugurated in Germany the first European Sovereign Cloud, part of the AWS Digital Sovereignty Pledge (2023).

If, in both the society of law and that of platforms, code is law (Lessig, 2000), states and Big Tech have co-written standards enabling member states to access U.S. hyperscale in exchange for collaboration.

Indeed, endorsements at the AWS European Sovereign Cloud launch included key German government institutions—leading a cohort of Eastern European countries which, after Russia's invasion of Ukraine, sought a swift server transfer. Present were Germany's Federal Interior Ministry—already an AWS client—and the Transport Ministry, alongside Dedalus, Almaviva, and Deutsche Telekom (AWS partners). Also in attendance were Finland's Finance Ministry and the national cybersecurity agencies of Germany, the Czech Republic, and Romania.

In this context, the pivotal EU–U.S. data-protection accord (TADPF) was signed. The controversy with the CJEU was resolved by a U.S. presidential executive order rather than new legislation or changes to CLOUD Act surveillance (Meyers, 2023).

The legal question remains open and provider diffusion so extensive that, even as MEPs debated alternatives to Big Tech, the session data were stored and managed on AWS virtual machines. In 2022, the European Parliament had entrusted AWS—via PwC—with the management of 450,000 documents, and the European Commission itself faced suit for violating its own data-protection law. Based on these two forms of partnership, the following section reconstructs the infrastructuring of hyperscalers in Italy. Two phases—also visible at EU level—are delineated: diffusion and standardization (Hughes, 1983).

3. 2 The Italian Case

Among AWS's first Italian public-sector agreements was one with the Court of Auditors in 2015, signed "for reasons of convenience and public-spending savings, given sector cuts," according to the IT department director. From 2020 onward, numerous others followed—too many to list. Notable, amid the energy crisis (2021–2023), were AWS contracts with Fincantieri and major Italian energy companies.

In the public sector, AWS gained clients such as Poste Italiane, the Lombardy (ARIA) and Umbria regional authorities, as well as CRUI, CNR, INAF, and Autostrade per l'Italia, the Transport Ministry, and the Interior Ministry—the latter via partnership with Fastweb (Blotta, 2023).

Big Tech permeates Italy's public sector by partnering with global consulting–audit firms and top domestic tech companies (ibid.). The former sell cloud services to PAs with a rhetoric oscillating between the urgency of public security—compromised by state IT vulnerabilities to failures, cyberattacks, and natural disasters—and the opportunity to "join the AI revolution," whose paid services, once data are migrated and reconfigured, would cut PA costs by up to 80% by effectively automating work. This is a semi-coercive pressure continuous with the "big con" binding states to consultancies in the post-pandemic phase (Mazzucato & Collington, 2023).

Domestic tech firms, for their part, manage institutional clients for Big Tech in critical sectors—a business accounting for between 20% and 50% of Amazon's, Google's, and Microsoft's entire Italian revenue. Key partners include Leonardo for Microsoft, SAP and TIM for Google, and—supporting AWS—Aruba, Fastweb, Dedalus, Engineering, and Almaviva (Blotta, 2023).

These clients are far from marginal. Operating in eight countries, Almaviva manages data for the Presidency of the Council of Ministers; the Ministries of Defense, Justice, Foreign Affairs, Transport, and Interior; the armed forces and police; the State Mint and Polygraphic Institute; military communications for six NATO countries; and 240 naval patrol units. All these data are processed on Amazon's virtual machines.

Polanyi argued that "the graver the crisis, the more the dominant class demands exclusive control over the necessary reforms—their quality, scope, and management" (Cangiani, 2019, 18). Such demands, to cite Braudel (1992a, 23), unfold within the "opaque zone of the anti-market," where "privileged actors are engaged in circuits and calculations" "of which ordinary mortals know nothing."

Accompanied by partners, AWS representatives move across Italy organizing promotional meetings eagerly attended by PAs and representatives from sectors as diverse as health care and the military. Amazon delegates rarely speak; instead, PA clients proclaim "we are at a crossroads": if "without AWS we would never have overcome the COVID-19 pandemic," now is the time to "make a system."

The task is not easy, they repeat. If the cloud has revolutionized the "technological paradigm of the market," the PA "must prepare to embrace a new cultural paradigm" in which "data," they say, "is not necessarily something to hide," and, as for sovereignty, "there is a direct relationship between power and security." These are elements of neoliberalism ("there is no alternative")

combined with economic interventionism anchored to innovation scales (Bunnell, 2001), whose imperative—tested during COVID-19 lockdown and situated among biological and geopolitical threats (Halpern & Mitchell, 2023)—is used to tighten the corporation between capital and state.

Senate President Ignazio Benito La Russa explicitly employs the term corporation to describe the work of "an old friend with peculiar ideas," Under-Secretary to the Presidency with responsibility for innovation, Hon. Alessio Butti, who—steering the digital transition—organized a singular meeting at Villa Erba on Lake Como to discuss the Telecom dossier, cloud, and AI: a "Copernican Revolution" to be financed with "good debt."

The conjuncture of pandemic, energy, and war (Mezzadra & Neilson, 2024) rekindled enthusiasm among Italian, European, American, and Israeli political and industrial elites who convened in Cernobbio on 5–7 October 2023 to discuss a "New Humanism." Also present were two "dissonant" voices: Cingolani, CEO of Leonardo, and Father Benanti, the Pope's AI envoy. The former, professing fear of his own Big Tech partners, compared—on a slide—the cognitive capacities of two of his "children": the Leonardo supercomputer and a child, concluding that the latter is more efficient at equal energy cost. The Vatican envoy countered the Prime Minister's cloud strategy by citing Lenin's five-year electrification plans as a model of social virtues.

AWS grew exponentially during COVID-19, a period in which the firm cultivated political relationships: first by replacing the switchboard operators of the Codogno Municipality in aid of government, then by managing vaccine bookings for client regions.

Health care is a priority field for AWS's disruptive ambitions. Between 2020 and 2023, AWS (2020), Google (2022), and Microsoft (2023) each built Italian Regions (cloud regions): data centers prepared to handle state-critical data. From technologies, U.S. private clouds became infrastructures (Hughes, 1983) for delivering public services in Italy.

The next subsection shows how, once linked to public institutions controlling the central state digitalization plan, U.S. firms moved from governing a diffusion phase to governing a standardization phase, evolving from infrastructures to a large technical system (LTS). From Italy's 2016 Digital Agenda to the Italy Cloud Strategy (2022–2026), this status systematizes—through 2039—the corporate management of state data.

3. 2. 1 The Italy Cloud Strategy (2022–2026)

According to Hughes (1983, 201), the LTS standardization phase is marked by a regulatory environment that consolidates an infrastructure's technological moment so that it becomes autonomous from its originating milieu and thus the system of a new one. This transition—from infrastructure to system—recalls the constitutional moment of states, where a charter formalizes and replaces constituent power. The Italy Cloud Strategy is read in this light.

In August 2016, Diego Piacentini, Amazon's Senior Vice President International, was appointed as an Extraordinary Commissioner to implement the Digital Agenda by Prime Minister Matteo Renzi. Under his mandate, between 2017 and 2019, AgID conducted the first census of 927 data centers out of the PA's 55,000. This was the first step toward the Cloud Strategy: a

regulatory phase of the Digital Agenda featuring stringent standards—such as ISO 27001 "24/7 watch"—that slated 95% of the inventoried data centers for decommissioning and, more generally, mandated cloud migration for all PAs.

Standards act as technical-political agents of the government strategy which, as part of "Italia Digitale 2026," envisages cloud adoption for 75% of public services and 100% of PAs by 2026—anticipating the orientation of "Europe 2030," itself crafted to overtake the United States. In 2021, Italy—last in the EU for digitalization alongside Bulgaria, Greece, and Romania—ranked among the world's leaders in digital identity and signature coverage.

We can thus outline the constitutive phases of a process that is neither belated nor schizophrenic but traversed by operations of splintering and subsumption of state technologies: those of the PA.

Drawing on 27% of PNRR resources, AgID devised two pathways for migrating PA data to the cloud: funding both the construction of the Polo Strategico Nazionale (PSN, National Strategic Hub)—the seat of the new "sovereign" cloud—and the migration of PAs through a regulated open market certified by Consip framework agreements and the National Cybersecurity Agency (ACN).

The latter comprises tenders dedicated to Italian tech firms for handling critical data (e.g., those of the National Health Service). It is dominated by Big Tech, which, by participating in temporary business groupings (RTI) with Italian partners, secured PNRR funding worth €540 million each. Let us turn to the "sovereign" cloud.

On 26 August 2022, the PSN was awarded via a €4.4-billion contract between the Department for Digital Transformation (DTD) and a company jointly owned by TIM, Leonardo, CDP Equity (Cassa Depositi e Prestiti), and Sogei. The PSN is hosted across two Tier-4 (maximum security) data centers in Acilia and Pomezia, and two in Rozzano and Santo Stefano Ticino. The latter pair belongs to the Cloud Region of "G.": a well-known tech firm that PSN employees, it is said, cannot name—even among themselves.

Indeed, just as Aruba and Fastweb joined the tender as an RTI with AWS, the TIM–Leonardo–CDP Equity–Sogei consortium partnered with G., Microsoft, and Oracle. In the vehicle company, CDP acts as financier; Sogei trains PAs in cloud adoption; Leonardo, a Microsoft partner, manages cybersecurity; and TIM—linked to G.—became the Italian Noovle, responsible for setting up and running the PSN's data centers.

PSN–PA contracts last thirteen years. With this step, hyperscalers move from governing the "chaotic" competition of the market, typical of the LTS diffusion phase, to consolidating positions matured in the anti-market, whose operations—between state and capital—are "hidden or incomprehensible to ordinary mortals."

And indeed, AWS—despite losing the PSN tender (and lodging an appeal)—entered anyway: the Presidency of the Council of Ministers crafted an ad-hoc concession.

On 19 January 2023, ACN replaced AgID as guarantor of the Strategy and, twenty days later, signed an agreement with AWS to be trained in its domain: public cybersecurity. In a single year, Italy's PA had been the target of 174,608,112 malware attacks—the third-highest figure globally.

Collaboration between controller and controlled proceeded to mutual benefit. On 26 September 2023, the day before AWS and Agenas signed to design the first national telemedicine platform, ACN authorized AWS to host critical data.

3. 3 A New System? State and Capital in the Project of Digital Sovereignty

This research has identified, in Italy, a constituent tension between state and capital around the development, diffusion, and standardization of a technology: the cloud. The process unfolded amid crisis and institutional renewal in Italy and Europe.

As of 2024, the dismantling, transfer, and configuration of 233 PAs' data into the virtual machines of Google, Amazon, Oracle, and Microsoft within the PSN is underway, slated through 2026.

The expected outcome echoes the reconfiguration of factories with electrification, when machinery, migrating from steam-engine circuits, was reorganized around electric-motor networks—a process that took 50 years yet exponentially raised productivity and changed capitalism's history (Kushida et al., 2015).

Unique outside the United States, post-COVID-19 Italy—shaped by the PNRR—has become a testing ground for a transformation now spreading across Europe (Rone, 2024).

If, in the market, the infrastructuring of U.S. clouds produced an asset-light platform capitalism dependent on the computational systems of five unassailable firms (the hyperscalers), the effects of a mirror process governing state data remain unknown. How, then, should we read this transformation?

Negri argued that evolutions in productive systems are followed by mutations in political constitutions (1977, 23).

Amid crisis (2019–2024), state and capital have assembled a system soldering their technologies to achieve innovation scales that exceed the nation-state. The establishment of "sovereign," hyperscale data centers is part of a double movement: on one side, the state subsumes platform technologies to access hyperscale systems; on the other, platforms scale down—from Atlantic to European to national—to splinter and subsume state technologies: the public administration.

New research avenues open. Statistics is the technique common to both—"a knowledge whose characteristic, since the birth of the modern state, is to overstep the univocal character of sovereignty" (Sofia, 2019, 50). The resulting configuration is structural as well as functional (Ricciardi, 2024, 28), since in the history of administrative power, function creates the organ, not vice versa (Sofia, 1994). Thus, while state information becomes rent-bearing capital for Big Tech—an asset of platform capitalism (Sadowski, 2019)—the state leases automation technologies because, in the words of one councilor for innovation and simplification: "if we apply AI models" to PA data, "we innovate and cut costs—much to the chagrin of public-sector unions."

We now come to another key point: digital sovereignty (Pohle & Thiel, 2021). Can this state–capital system generate ruptures in sovereignty?

In economistic terms, one might say the system analyzed is the price the state pays to "innovate" its sovereignty at a time when sovereignty lies with platforms. This knot—between state and capital—is particularly fraught, because to conclude that a rupture is possible would be to claim that simply recombining their technologies, as Ignazio La Russa suggested, suffices to produce a sovereign form different from the one that, without interruption, governs the empire of global capital through state forms (Hardt & Negri, 2000).

Since sovereignty is not a fait accompli but a project of social-order reproduction (Ricciardi, 2024), the innovation aspired to by both appears—as a new order that nevertheless does not exceed what has long been named the "new world order of globalization" (Hardt & Negri, 2000). Let us return to social reproduction (Marx, 2013).

The matrix of this system would seem to be the crisis that, at least since 2007, has gripped both production and the reproduction of state and capital. Note the cloud's evolutionary stages. If hyperscale providers were born in the 2008 crisis and developed through U.S. "security" operations, their standardization amid pandemic, energy, and war conjunctures is emblematic: today they run services deemed vital to social reproduction.

In Italy, even as the state asserted protagonism via Leonardo and TIM's participation in the PSN, the government negotiated with BlackRock and U.S. fund KKR to purchase state shareholdings in both and to carve out TIM's internet infrastructure—already Noovle.

After COVID-19, scholarship often announced "the great return of the state" (Gerbaudo, 2021). This essay suggests that while state power never left the stage, its role cannot be taken for granted.

At the AWS Symposium, I asked a convention-center worker what he thought about Amazon managing Italian data via the PNRR. "Good, I agree," he replied. "If they handle it like parcels, I'm happy." "Yes… I know people say they exploit workers, but what exploitation? They have vacation and overtime!" "They have no idea what it means to break your back in this sector." He was a sixty-year-old subcontracted laborer, he explained, pointing at the stage in Rome's "Nuvola" Convention Center. On the stage, PA managers presented a panel reading: "The future is already here—just not evenly distributed."

From this line of tension follow research questions that, rather than merely signaling a return or retreat of state and capital, interrogate which kind of state and which kind of capital are at stake (Mezzadra & Neilson, 2024).

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CHAPTER 4

THE BLACK ARCHIVES OF AUTOMATION
LABOR, TECHNOLOGY, AND SPACE ABOARD AN ATLANTIC SLAVE VESSEL

In Blotta (2025) The Black Archives Of Automation
Labor, Technology, And Space Aboard An Atlantic Slave Vessel, in Urban Automation, I Quaderni di Into the Black Box (6) (2025)

Introduction

Over the last decade, the global economy has been significantly shaped by the development of automation technologies and infrastructures (Mezzadra & Neilson, 2024). In times where a widespread urban condition insists unevenly on the entire planet, the integration of digital artefacts into existing capital shifts brought to a "digital revolution" whose consequences are scattered across a geography of uneven urban development (Huang & Huang, 2024).

In this context, while new questions arise to understand the future of technology, labour and space, genealogy can be a powerful method to enable a critical view for contemporary urban theory based on the articulation of colonial and postcolonial lineages of knowledge (Cardoso, 2020; Schmidt, 2018; Vegliò, 2021).

What is automation? Where does it come from? How will automation shape labor? To answer these questions, I first recall the Marxist and Operaist literature to see how, on the opposite, the logics, the geographies and aesthetics of the current automation are rather shaped between the accumulation of *valorizing information* generated with the division of living labor and the workers struggles for their liberation (Alquati 1963, Dyer-Witheford, 1994).

Moving from Marxist labor theory, I refer to a *metric theory of automation* (Pasquinelli, 2015; 2023) according to which "techniques that are used to measure labour suggest the design of technologies of automation once the division of labour reaches a mature stage of development" (Pasquinelli 2023, 243). Then, taking the concepts of *abstract labor* by Hegel and of the *abstract machine* by Deleuze and Guattari (1980) I define how, with a double act of translation (Pasquinelli, 2023), automation technologies learn from an *environment* of collective intelligence.

According to this theoretical framework I thus follow the voyage of a slave ship, the 'Marie Seraphique' from Marseille to Luango to understand the logics, geographies, and aesthetics of earlier technologies of automation in the Atlantic trade.

By analyzing three archives of a slave vessel (a space diagram, a time diagram, a port system) I explore how behind the history of the European industrial revolution, slave ships can be framed as earlier machines set to enable the abstraction of labor value through the production of urban space. Thus, archives of trade value circulation are assumed as privileged analytical tools for a Black Atlantic archeology of urban automation.

The production sites of the Caribbean sugar mills and of the European industry have already been explored as antecedents of factory discipline, machine intelligence and earlier technical automation (Fiori, 2020; Ongweso JR, 2024; Whittaker, 2023). Moving from oceanic spaces of value circulation, the article shares an analytical framework toward an archeology of urban automation that can be developed on earlier logics, geographies, and aesthetics forged in the struggles between the slave trade 'eye of the master' and the slave rebellions of the Black Atlantic.

4. 1 On Labour, Machines, And Automation: A Metric Theory

According to Marx, machines serve as instruments to occupy and replace prior divisions of labor—a concept first articulated by Babbage's Principle. Quoted by Marx in The Poverty of Philosophy, Babbage's Principle states that "when, by the division of labor, each particular operation has been simplified to the use of a single instrument, the linking up of all these instruments, set in motion by a single engine, constitutes a machine" (Babbage, 1832, quoted by Marx, 1847). This principle defines machines as a form of fixed capital, or "dead labor," whose design derives from the information generated by the division of living labor (the workforce). This division segments labor into mental and mechanical operations, organized "with the same economy of time" (Babbage, 1832). As Andrew Ure, whom Marx called "the Pindar of the automatic factory," observed, the industrial apparatus thus emerges as "a vast automaton, composed of various mechanical and intellectual organs"—a definition that has been identified as foundational to Babbage's computing machines.

But can this definition be extended beyond industrial machines? To answer this question, it is crucial to see at the relationship between time, labor, and automation technologies.

Babbage's Principle reflects a form of work organization that consents the measurement and purchase of the exact quantity of labor required for production. According to Pasquinelli, this perspective allows us to understand automation as a logic that extends beyond the analysis of its physical artifacts. Pasquinelli thus proposes a "metric theory of automation," arguing that "once the division of labor reaches a mature stage of development," it is not automation itself that shapes labor but the "techniques to measure labor that shape the design of automation technologies" (Pasquinelli, 2023, 243).

In this context, machines are not autonomous agents, but, being the product of class struggles, they are shaped to be 'the most powerful weapon for suppressing strikes' (Marx, 1967, 562). Since it is not capital per se, but labour struggles that act as a primary actor in capitalism's technological advancements (Panzieri 1961; Tronti 1966), information produced by workers' knowledge and monitored by the *master* is the source of automation technologies.

This reversal of perspective explains how the technological change is not a neutral progress, but it expresses the capital's necessity to always develop new organizational forms to include workforce into production processes by controlling their unrest and refusal to cooperate with capital (Tronti, 1962).

In particular, as informational and industrial machines are designed to foster the workers cooperation in production, automation perpetuates the authoritarian structure of the factory according to the management's ability to gather *information* on the workers' knowledge – their *socialized intelligence* upon acts of refusal of labour (Tronti, 1966).

Automation technologies origin from here, where the monopoly over such *knowledge* is set by the master to "control of each step of the labour process and its mode of execution" (Panzieri, 1961; 1967; Braverman, 1974, 82). In fact, although Braverman and Panzieri' studies on the so-called 'incorporation processes' are a classic focus on Taylorist production in the 70s, their works are still crucial to grasp major processes in contemporary automation. In his study of contemporary warehouses, Alessandro Delfanti described how Amazon power is established upon a monopoly over the algorithmic control of workers' knowledge in fulfillment centres. To the author, its power relies on the apparatus of capture that feeds what he called a *machinic dispossession:* the translation of the workers activity into data by central software systems.

The informatic -once called the bureaucratic, now the digital or cybernetic- apparatus of the factory grows thanks to the forced contribution of workers' socialized intelligence (Alquati, 1963), but how the workers' knowledge becomes information?

Delfanti moves from Alquati' theory of *valorising information* by which it is calculation that makes it possible to *translate knowledge* into *information*, information into numbers, and numbers into *value*.

Echoing Babbage principle, automation thus emerges as an act of double translation, as stated by Pasquinelli (2023), that fulfills the transformation of the knowledge of the general intellect (the workers socialized intelligence to cooperate with and refuse labour) into constant capital, that is, with the words of Deleuze and Guattari, the transformation of a surplus value of code (knowledge) into a surplus value of flow (information) (1972, 232).

Drawing upon Marx' Groundisse notion of *abstraction,* Deleuze and Guattari developed the concept of the so-called *abstract machine* (1980). The concept has been pivotal to explain the algorithms[3] capacity to measure and turn living labour into *abstract labour*: a form of 'intrinsic' or 'absolute' value whose 'immanent' measure is labour time.

Moving from the literature on the machinic assemblage, this last concept has proved to be relevant both to extend the *metric theory of automation* to earlier processes of labour control and to foreground contemporary urban theory by "thinking space as a relationally overdetermined plenitude (Brenner et al., 2011, 237).

Following this theoretical framework, the article analyses three documents from the Atlantic slave trade to see how before and behind the European industrial revolution, the slave ships

between the XVI and the XIV century developed earlier technologies of automation to foster the reproduction of forced (slave) and waged (crew) labour. Taking into account the primacy of workers' unruliness for the development of machines, I see how slave ship technologies- defined in critical media theory as *logistical medias* (Peters, 2021; Rossiter, 2016)- were developed to learn from and exhaust the slaves socialized intelligence to cooperate and refuse forced labour.

The article follows the theoretical suggestion by Claudio Napoleoni (1972) and Riccardo Bellofiore (2016), that is to look at *circulation*, more than *production* sites, to look at how technologies rise from the capture of the abstract labour. As abstract labour is *immanent* in the moment of capital production and *manifest* in the moment of its circulation (ivi), I look at earlier technologies of automation in the analysis of colonial port systems, slave warehouses and slave ships as they represent *abstract machines* for the reproduction of labour in the Black Atlantic.

Moving from the mentioned theoretical framework, I analyse how, in the Atlantic trade, the slaves socialized knowledge for the refusal of forced labour gave the origins to what have later been defined as the logics and the aesthetics of automation (Pasquinelli, 2023; Neilson e Rossiter, 2019).

Therefore, as the slave trade routes still define the circulatory infrastructures at the heart of the 'digital revolution' (in the form of shipping routes and internet optics cables), the article shares an archaeology for a history of the capitalist production of the space that origins from the Black Atlantic of the global system. In times of planetary urbanization, the Black Atlantic *archives of automation* express how the *urbanization of sea* (Couling, 2020) is central, rather than 'peripheral', for an 'alternative genealogy of planetary urbanization' (Veglio`, 2021).

4. 2 Diagrams of space. The shipbuilding of the Marie-Séraphique

In 300 years, between the second half of the XV and the second half of the XIX century, "the kidnapping, registration and forced transportation of twelve millions of people has been a project so enormous, it reinvented, among the other things, ancient military and commercial logistics" (Zieger, 2021, 35; Harney and Moten, 2016). While colonial production sites have been recently acknowledged as antecedents of industrial "dark satanic mills" in the continent -see, for example, "The Plantation Machine" by Burnard and Garrigus (2016), or "The Sugar Machine" by Crowley (2016)-, the deep ocean and its infrastructures for the circulation of global value (slave ships, ports, and warehouses) are still underrepresented as critical sites for the development of systems of automation. Nevertheless, it was precisely in this context that the commercial and military discipline of logistics -whose Greek etymology "λογιστική" means "art of computation," - developed as the *fantasy* to *translate* the violence against black people into what has been defined a deadly art of *calculation* (Harney and Moten, 2016).

Looking at slave trade archives we can see how the ephemeral chimera of slave labor control let the origins to a set of operations of calculability that were recorded into shipping lists, bills of lading, ships' logs, letters, plantation logs and slavery diagrams (Young, 2021).

In critical media theory, these documents are framed as *logistical medias* (Peters, 2021) and analyzed as predecessors of contemporary software and algorithms that today 'move cargo, people, and information around the world' (Zieger 2021; Young, 2021; Munn, 2020).

This section takes a live painted slave ship diagram to underlie how the shipbuilding of slave vessels was set, on one hand, to learn from and forbid slave cooperation in the form of active and passive acts of resistance to forced labor while consenting, on the other, the reproduction of their *predicted* labor value.

The diagram of the Nantes ship Marie-Séraphique (ID 30910 in Slavevoyages.org), emerged in 2005, shows 307 enslaved people (189 men, 60 women, 49 boys, and 9 girls) imprisoned in a vessel from Loango to Saint Domingue in 1769/70 (Fig. 1). Unlike the supine "clones" of other diagrams written for parliamentary debates on slave regulation-, the slaves in the Marie Séraphique differ in height, build, and appearance as they were live painted by one of the officers on board (a woman with a baby at her breast, "seven captives wrapped in blue cloths lie in agony" (Eltis and Radburn, 2019, 548).

Moving from a metric theory of automation, the archives of the Marie-Séraphique are central to understand the inner logics of a slave ship as earlier logics of automation. With two masts instead of three to increase speed and save costs, the vessel of 1,637 square feet, was specifically converted from a goods carrier into a labor carrier.

In particular, as slave revolts were the nightmare of the slave logistics, the space diagrams of slave vessels as the Marie Seraphique were specifically designed to prevent both passive (as hunger strikes, or suicides) and active *resistance* by the hold (slaves) and the deck (the crew).

To host an average of 300 enslaved people incarcerated for 8-12 weeks, vessels as the Marie-Séraphique were built with a lower deck beneath the main deck, air ports carved out of the hull to led the cargo breathe, and nettings on the ship's rails to prevent that "slaves souls could go home to Guinea" jumping overboard in acts of suicide (Rediker, 2007, 145).

In the spatial diagram of a slave ship, captives were positioned lying on their right side—a posture considered "preferable for the action of the heart," as noted by a nineteenth-century sailor (Eltis and Radburn, 2019, 548). Men and women, chained together (the women, put close to the captain, were unchained only if they were in minority), were segregated into two rooms designed to "cram as many slaves as possible between decks," exploiting every available space to save costs, let slaves breathe, and prevent insurrection (ivi).

The hold diagram reveals a fence, known as a *barricado*, which was constructed midship to allow the crew to retreat behind it during feeding—one of the most perilous moments in the ship's routine. This design enabled the crew to "shoot down onto the bodies of the insurgents" in the event of an uprising (ivi, 159).

The *barricado*, first developed in the Portuguese trade, became a global standard in slave shipbuilding. It served a dual purpose: reproducing the value of slaves and consolidating the labor composition aboard within forced and waged labor. More than a physical barrier; it was a dynamic technology designed to enhance the value of the cargo by suppressing the social cooperation

necessary for resistance. For instance, instructions from the "Oeconomy of a Slave Ship" advised that "just three of the crew were before the barricado at any one time, otherwise the men slaves might seize half the crew on the sudden, and soon become *masters of the vessel*" (Smeathman, 1807, in Coleman, 2007, 141–142). Despite these measures, slave revolts occurred on average once every ten voyages, and the system was persistently undermined by what historians have termed "a 400-year hunger strike" (Rediker, 2007, 134).

Equipped with technologies like the *barricado* and the *speculum oris*—a tool used to force-feed hunger strikers—slave ships embodied Marx's definition of industrial machines as "the most powerful weapon for suppressing strikes" (Marx, 1867: 562).

A focus on the slaves' resistances helps understanding the logics behind the development of shipbuilding technologies as these were not merely industrial artefacts, but earlier logics of automation. In fact, to Neilson and Rossiter, what distinguishes automated systems from mechanized ones is the capacity to *adapt* to an "environment" of socialized intelligence -a *constitutive outside*- "according to the theatre of failure" of their operations (2019, 201).

What was the *environment* aboard?

In the ship, "when someone refused to eat, everyone understood what this meant" (ibid). As acts of active and passive resistance were the main unifying language of the enslaved -who had different linguistic backgrounds- these were also acts of communication, cooperation and revolt between the hold (the slaves) and the deck (the crew). The notion of environment -that presupposes a learning process and a dynamic configuration between the parts- particularly fits how, quoting Marx, workers "need both time and experience to *learn* how to distinguish between machinery and its employment by capital, and therefore to transfer their attacks from the material instruments of production to the form of society which use those instruments' (Marx, 1867: 554). Similarly, in the Atlantic trade it was the increasing standardization and intensity of work routine at the deck of slave ships that allowed, once understood by the hold, joint revolts and mutinies between forced and waged workforce. Once understood that slave ships were not just floating prisons, but *machines* shaped on the capital necessity to secure labour exploitation, the mutinies, -see for example the one of the *Zant* and the *Gambia Castle* in 1721, renamed *Delivery* "*Liberation*" were acts for the disruption of the inner *logics* and *aesthetics* of the whole Atlantic value circulation.

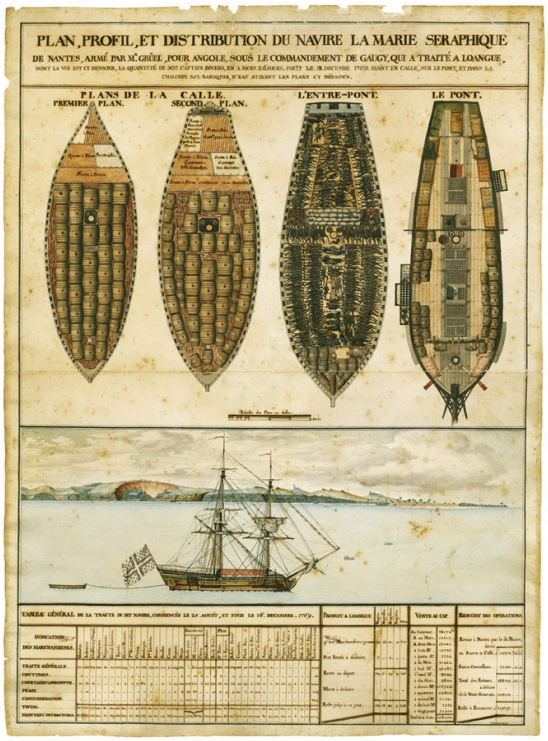
As vessels evolved into maritime industries marked by the first labor strikes—etymologically rooted in the "strike" of vessels sails in 1768 (Rediker, 1987, 189)—"the deck of pirate ships became the primary locus of *black power* in the 18th-century white world" (Kinkor, 2001, 108).

In response, shipmasters developed both despotic and subtle forms of control, including the concept of race. According to Linebaugh and Rediker (1990, 42), at African docks, where enslaved people and crew members shared similar living conditions, the two groups were reclassified into distinct categories to prevent joint revolts. Enslaved individuals from diverse ethnic groups were collectively labelled "negros," forming a single "negro race," while multi-ethnic crews, including those of African descent, were uniformly termed "whites"—to Rediker this division was not based on the skin colour but on the "control over technology", namely the ship (ibid.).

In the Atlantic trade, the concept of race developed in parallel with the one of waged labour. These were both turned into technologies to translate the *despotic* violence (see the use of the *speculum oris* for slaves and of the *forced conscription* for the mariners) into an episteme to foster the division between forced and waged labour into the organic composition of capital.

As a result, as long as slaves and crews transferred their attacks from the machine (the vessel) to what Marx called 'the ideological apparatus which regulate production relations' (ivi), the shipmasters used race to translate an earlier form of 'factory despotism'- typical of industrial labour - into a labour command written into 'cultural and political forces within and beyond the factory walls' (cfr. Delfanti, 2021; Burawoy, 1979). With this shift, the study of the slave ship echoes the 'augmented despotism' in contemporary logistics, confirming the Conway' principle (1968, 31) through which the design of automatic systems segments the workforce by mirroring "the relations of communication between the parts of the organization that contributed to it".

Moving from the study of the slave ship internal communication- what Harney and Moten called "the undercommons" (2013)- we can acknowledge how the convergence between soft and despotic commands on labour –"the two complementary strategies deployed by capital to subdue the workforce" (Delfanti, 2021, 44)- shaped earlier logics and aesthetics of automation. In fact, confronting joint mutinies by translating the inner communication of the ship into a racial language, the masters of the slave vessels shaped what in critical media studies has recently been defined as the 'logistical episteme' (Rossiter, 2025) through which the *aesthetics of automation* assert "who gets to speak and who remains silent" (Neilson and Rossiter, 2019). As long as joint revolts were undefeatable, we see, in the next section, how once at the slave docks, the acts of communication at the hold and the deck were monitored and translated into a system of *valorizing information* for the prediction, control and reproduction of the slaves labor value through the production of space. I assert that the monopoly of this knowledge turned ports, warehouses, and slave ships into 'informatic systems' for the circulation and reproduction of *abstract labor*.



'Tween deck of the ship La Marie-Séraphique. © Château des ducs de Bretagne – Musée d'histoire de Nantes, Alain Guillard.

4. 3 The Prediction of Time. Slaves *Inbound* in Loango

What is the relationship between the control of slave labour and the production of space?

While an international literature has explored the interconnections between the geography of contemporary submarine internet cables and the colonial telegraphic network (Starosielski, 2015), few studies analysed the role of the slave trade rebellions in the process (Mwema, & Birhane, 2024).

In this context it is important to unknowledge that, as for the vessel technologies, the slave trade circuits were shaped according to the *prediction* of joint revolts "between the hold and the deck" -see, the shift, in 1598, of the Spanish Empire Atlantic-Pacific trade chokepoint from Nombre de Dios to Portobelo, which brought Panama to be a contemporary critical corridor (Ducoin, 2000, 82; Ngou-mve, 2002).

This section sees the development of diagrams of time that set the *inbound* of slave ships in Loango: a "developed urban port" where slave traders of the eighteen century would "meet a fine-tuned infrastructure" (Gregg & Ruderman, 2021). Here, surgeons, cartographers and scientists developed a an "organized system" (ibid.) of slave warehouses coordinated upon *inbound times* set on the surveillance, the learning and the prediction of slave revolts.

"The success of slave trade depends very much on the good procedures, skills and measures of the surgeon" which, "if put in place to prevent diseases" "have a more certain result rather than those which are used to heal the sick" (Gallandat, 1769, 23). In *Necessary Instructions for Slave Trade,* David Henri Gallandat, a Swiss slave surgeon teaches how to distinguish and report slaves' emotions at the African shores in terms of standardized codes of prediction:

"It is therefore not surprising that such a slave, when he finds himself on board to be sold, and to say his last farewell to his land, that he is sometimes seized with violent emotion. This however is more common among the women than with the men, due to reasons known to all physicians and surgeons, and therefore unnecessary to report here." (ivi, 15)

As slaves' bodies were coded into standard vessel units of *space*, emotions were surveilled to fill diagrams of time to set the vessel speed according to the fear to "loose the cargo".

The Marie-Séraphique embarked in Loango, a Portuguese slavery harbor in Congo known to be a global trade hub crossed for 250 years by 2.5 million of slaves (Eltis and Radburn, 2019).

By the mid-1550s, Loango hosted a system of slave prisons/warehouses whose inbound and outbound operations were temporally coordinated according to surveillance of slaves and the prediction of revolts. Known as "a secure *environment* in which to trade and hold captives for extended periods of time" the system leaded Portugal to be a global hegemonic empire of the XVI century, setting a *standard* unreached by any of the European powers in 250 years (ivi, 551).

For each travel, slave ships used to anchor offshore between the Bight of Benin and Biafra stationing with empty cargoes from one to two years (Gregg & Ruderman, 2021). To reduce as possible the slaves' cooperation, the merchants used to change the pace of the vessels looking for "goods that speak different language idioms (Rediker, 1987, 55). At the same time, as waiting times increased the costs of feeding the human cargos -and so the risk of revolts (Gregg & Ruderman, 2021)- the slaves were gathered in fortified warehouses on islands or on the shores of Ouidah, Lagos, Aného, Grand-Popo, Agoué, Jakin, Porto-Novo, and Badagry, embarking only "when ships reached their full "complement," normally be just prior to departure" (Eltis and Radburn, 2019, 551). The system of Loango lasted until the 21st century and was renovated when steam powered vessels were deployed to outrun British naval cruisers to illegally transport "high-value *perishable* human cargoes" (ivi, 554).

The time diagrams translated the slaves knowledge -their socialized intelligence upon acts of refusal to forced labor- into *information* whose value, once standardized, became effective for the compression of time - of travel and cargo inbound-outbound- through space.

Hence, as well as in hold diagrams the slaves struggles for freedom were the primary concern for the development of the barricade, the nets, and other technologies of the slave ship, slave rebellions were the primary cause for its inbound times, shaping the geographies of the vessel circuits.

The organization of slave systems as the Loango urban port shaped the political, urban and economical "underdevelopment" of West Africa while acting as an extractive site for the accumulation of European industrial capital (Smallwood, 2007; Whatley, 2022). Indeed, a logic of space, time and information compression shaped the historical global corridors where the telegraphic cables and the network of contemporary digital and logistics infrastructures were built. Moving from the Marxian theory of abstraction, I analyze in the next paragraph how slave ships defined circuits of planetary urbanization as *machines* of *abstraction.*

4. 4 Machines of abstraction. Space, value, and automation in the Atlantic Trade

Can the slave ship be framed as a machine? According to Babbage (1832, 131-136), "when each process has been reduced to the use of some simple tool, the union of all these tools, actuated by one *moving power*, constitutes a machine". The theory -developed at the time of the steam engine- can be traced back to the Atlantic trade since all the mentioned processes, actuated by the moving power of the slave vessel, were set to augment the value of transit enslaved labour: the trade final product. In fact, moving from De Prony's algorithm theory, the mentioned definition by Babbage was implemented by his "method of difference" that stated that machines are *when* their division of labour also allows the precise computation of labour costs (Babbage 1832, 137).

While this industrial principle- called 'the Babbage principle'- became a cornerstone for computer prototypes like the Difference Engine and the Analytical Engine, the slave ship can be framed as a machine where 'environmental' and 'logistical medias' (Rossiter, 2016; Rossiter & Zehle, 2023; Zieger, 2021) were set according to earlier logics and aesthetics of automation for the production of labour as a commodity.

What was the value of slaves? A focus on this point makes clear the difference between the production of industrial factories and the one of slave ships.

According to the Asiento regulation, to the standards of 1713, one enslaved male at least 58 inches tall "with no defect" was one 'Piezas de Indias', women 0.8 and other people, like children, who did not meet this criterion and were 'cheaper to transport'. Nevertheless, as we saw in the last paragraph, the slave market did not have a single set price for enslaved people; "rather, the price of captives increased steadily over time, likely reflecting the pressures faced by the captain as he waited in the port of Loango" (Gregg & Ruderman, 2021).

Since for the merchants the cost of slaves increased per each additional month in Loango, once slaves embarked, the voyage of the ships was set to increase slaves value that was firstly related to the cost of shipping, then *augmented* through the mentioned informational systems, artefacts and organizational methods (as the race and the wage).

In the Marxian labor theory, the process through which labor is turned into a commodity is called *abstraction.* The term *abstract* does not refer to a mental generalization of work, but to a *real hypostatization* - "an 'inversion' of subject and predicate"- that takes form when labor is translated into market value (Bellofiore, 2016, 57).

Since before the moment of production, the hypostatization of labor value takes place in the circuits of labor market (Napoleoni, 1972), the slave ship, rather than an earlier form of industrial production, can be framed as a *machine* for the *abstraction* of labor value in the moment of its *circulation*.

Moving from the Marxian theory of value (M-C-M) the technologies of the slave ship *hypostatize* forced and transit labor value according to a circulatory move described by Napoleoni and Bellofiore: *"*from the final circulation closing the circuit of capital (the commodity market,

where abstract labor is *created*), to the moment of production as the central phase of the circuit" - where abstract labor is firstly "latent" and after circulation "confirmed"- (Bellofiore, 2016, 55).

But was labor value the sole product of these *machines*? How was it produced?

In the last paragraph I showed that, as late as the nineteenth century (1500-1850), rather than "close to societies known to have slaves' stocks" –"to which colonial traders possessed very little *knowledge*" - slaves' ports and warehouses were distributed according to correlations between the time and the cost of transporting goods (Whatley 2022, 412).

Although the term 'abstraction' may be misleading, the process was possible only through the production of infrastructural space: a contested field between capital and its resistances in the shaping of corridors within sites of capital circulation (the sea) and sites of production (as the Caribbean colonial plantations). We can affirm that as well as the industrial factories shaped value by turning territorial landscapes into matrix of centrality between urban agglomerations and their peripheries, slave ships turned seascapes into landscapes that were operational for the accumulation of abstract labor value through its circulation. How to frame this process?

Moving from the Marxian theory on abstract labor, Lefebvre defined the production of the urban space as a process of abstraction directly related to capitalist forms of modernization (Lefebvre, 2009 [1971]). From here, Brenner and Schmidt (2014) defined *operational landscapes* as sites where the metabolism of the urban condition is constantly produced within a dialectic of so-called *concrete abstractions.*

Recalling the Chakrabartian notion of History 1 (the history of capital), and History 2 (the history of its subjectivities) concrete abstractions instance the rising of a planetary urban condition as a historical result between "the production of *abstract space"*, where value is shaped "by capital circulation", "and of *concrete differential spaces* generated through local struggle and resistance" (Schmidt, 2018, 599).

By merging the Marxist and Operatist theory on automation with the Lefebvrian analysis of the production of urban space, slave ships can be considered machines of abstraction, where earlier technologies of automation translated the socialized intelligence of slave revolts into logics of space, time and information compression oriented at the production of urban space and the reproduction of abstract labor. In this context, documents on board can be framed as *archives of automation*, enabling Southern lineages for a Black Atlantic genealogy of the contemporary urban automation.

4. 5 Toward a Black Atlantic Archaeology of Urban Automation

Trough colonial archives, the article analyzes how, before the Babbage machine of the XIX century-the first industrial machine according to Marx, the earlier genealogy of automation lied in the coding, standardization and prediction of labor resistances in slave ships, as these were turned into *machines of abstract labor* in the sphere of *capital circulation.*

In fact, as vessels were turned from goods to forced labour carriers, the *logistical fantasy* of the deck -to deal with *automata*- clashed with the social intelligence and cooperation of the so called "living dead aboard" (Smallwood, 2007) inspired by the *hold dream* to resist and revolt (Harney and Moten, 2016).

According to a Marxist theoretical framework, the article shows how along the maritime circuits of the first global value circulation, the organization of the slave ship reflected the "twofold nature of violence in the capital's use of technology to control and diminish its dependence upon labour" (Panzieri, 1961, 63)

Building on the operatist analysis that positions labour struggles as a primary driver of capitalism's technological advancements (ivi), artifacts like the barricado can be analysed as environmental media (Rossiter & Zehle, 2023). The concept, as defined by Neilson and Rossiter (2019), describes contemporary learning systems (such as machine learning) at the core of automation technologies. In this context, the rise of organizational forms as race and wage can be analysed as a 'logistical episteme' to segment and exhaust the cooperation between waged and forced labour. This division shaped what has been later identified as the 'aesthetics of contemporary automation' (Neilson and Rossiter, 2019).

As a result, while these archives can be seen as precursors to what has been defined, within the sphere of production, as the inner "logics of automation" (Pasquinelli, 2023), slave ships like the Marie Seraphique should not be framed merely as prototypes of industrial factories. Instead, within the sphere of circulation, they functioned as machines for the abstraction of labour value through the production of urban space.

Although a comprehensive genealogy of automation would require further research, these *archives of automation* represent initial steps toward a Black Atlantic archaeology of the planetary urbanization. New research avenues can emerge from this context. While the legacy of colonial socio-spatial relationships has shaped the uneven global development (Schmidt, 2018), the centrality of slave revolts calls for further 'alternative genealogies of planetary urbanization' (Vegliò, 2021). This perspective shifts the focus to Global South's peripheries where seascapes, rather than continental cities, can serve as crucial "repositories of lineage" (Rezeire, 2017).

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CHAPTER 5

CLOUD ATLAS. THE POLITICS OF CLOUD INFRASTRUCTURES IN JOHOR, MALAYSIA.

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Introduction

With the rise of AI, machine learning, and automation, social-science literature has documented how digital technologies generate novel labour regimes and, conversely, how human tasks — microwork, platform driving and delivery, warehousing labour, and coding for logistics and computational systems — actively shape the design, operation, and profitability of these technologies (Benanav, 2019; Ekbia & Nardi, 2017; Gray & Suri, 2019; Scholz, 2017; Woodcock, 2017).

Building upon the concepts of "hidden labour" and "ghost work, " an expanding body of scholarly research has scrutinised how digital tasks—carried out "as a service" through fragmented, repetitive, and emotionally demanding micro-operations—form an integral yet often unseen layer of artificial intelligence and machine learning production (Berg et al., 2018; Irani 2015). By analysing roles such as verifiers, trainers, and imitators, this literature demonstrates how emerging technologies multiply and stratify global labour regimes, thereby reproducing new forms

of North–South dependency within the digital economy (Gray & Suri, 2019; Tubaro et al., 2020; Irani, 2015; Berg et al., 2018; Milan & Treré, 2019; Roberts, 2019; Ekbia & Nardi, 2017; Fuchs, 2014).

These studies are crucial for analysing how contemporary forms of labour interact with automation and for situating such interactions within broader patterns of capitalist exploitation, particularly in China and Southeast Asia (Pun & Smith, 2007; Qiu, 2016; Lee, 2016; Chang & Ling 2022; Chan 2021). Nevertheless, the majority of this scholarship concentrates on digital and platform-based work, while empirical research on automation and labour within manufacturing sites—especially electronics and semiconductor production—remains comparatively limited (Andrijasevic, Sacchetto, & Pun 2020; De Stefano & Aloisi, 2019). However, recent regional analyses indicate that East Asian labour regimes—particularly the Dormitory Labour Regimes (DLRs) associated with China's electronics industry—have been rearticulated within Southeast Asia's export-oriented manufacturing zones, including those in Johor, Penang, and Batam (Kaur 2012; Hutchinson & van Grunsven 2018; Ong 2010; Mazumdar 2021; Wright 2022). These reconfigurations illustrate not only the global geographic relocation of production in the current crisis of hegemonic conjuncture (Mezzadra & Neilson, 2024) but also the transnational reproduction of new forms of coercive and debt-mediated labour infrastructures behind just-in-time semiconductor and electronics manufacturing.

In this context, the Johor state, in Malaysia, as part of the SIJORI "Growth Triangle" -a Cross-Border Region (CBR) between Singapore, Johor, in Malaysia and Riau, in Indonesia-, has become a key node in AI-era global circuits of production. Its export processing zones (EPZs) attract multinational firms in microchip assembly, semiconductor testing, and data-center construction. The SIJORI CBR has long served a key role for Western EE GVCs (Grundy-Warr, Peachey and Perry 1999; Lee T.Y. 1991; Ooi G.L. 1995; Smith, 1997; Sparke et al. 2004). However, as AI semiconductors are part of a global accumulation strategy to overcome a crisis of capital reproduction (Mezzadra & Neilson, 2024), the state of Johor is currently being renovated as a contested spatial fix, wherein capital reterritorializes itself into new geographies of accumulation (Arrighi 2004; Castree & Christophers, 2015; Ekers & Prudham 2017).

To understand this capital shift, the article first employs labour-process theory and the labour regime framework to analyse debt-driven DLRs in Johor semiconductor EPZs as a spatial-temporal fix of the geopolitics of automation.

Most literature emphasises the immediate impacts of technology on labour and in the Global South, ongoing forms of work related to automation, such as semiconductor manufacturing, are not examined within the framework of traditional and colonial labour systems. In fact, while analyses from the Global North engage historically with their earlier models—Fordism, Post-Fordism, etc.—the debate on so-called "hidden digital labour" in the Global South is therefore characterised by a present-focused perspective that is detached from the historical labour systems where the same populations, whether migrant or resident, played a central role in both their local

and national economies, as well as in the global supply chain during previous technological revolutions.

Building on this literature gap, I analyse the current migrant labour regime supporting semiconductor manufacturing EPZs in Johor, Malaysia, in continuity with two colonial migrant labour systems—the kangani and the kangchu—that, between 1870 and 1914, transformed the Straits Settlements, including Johor, into a spatial fix of the Second Industrial Revolution.

In fact, unlike the Chinese DLR model, in Johor, what I define as the brokered dormitory labour regime (BDLR) is characterised by the pivotal role that migrant broker infrastructures play—namely, debt, deceptive recruitment, and restricted mobility —in synchronising labour turnover with the rapid turnover of capital required in JIT semiconductor production. In the BDLR, by managing workers' infrastructures of social reproduction through debt and deceptive recruitment, these brokers compel migrants to "recalibrate" their lives to the temporality of transnational capital (Sharma 2017: 133).

However, the system is neither new nor 'unique' but deeply embedded in the local historical context. I thus analyse the colonial-era coerced migration systems in the Straits Settlements, including Johor, focusing on the *kangchu* and *kangani* systems. In the 19th century, these systems connected Chinese and Indian workers to forced shifts at export-driven DLRs via intermediaries such as *kangchu*, *taukeh*, and *kanganis* thereby shaping the Strait Settlements as a spatial-temporal fix of the Second Industrial Revolution between 1870 and 1914 (Kaur 2012; Allen 2014; Brass 1994).

Malaysia is the leading labour importer in Southeast Asia, with most workers employed in export-led manufacturing and managed under a legal framework of temporary labour migration, a system that originated in the 1970s and has persisted to the present (Kaur, 2010; Kassim, 2014; Ananta & Arifin, 2004; Garces-Mascarenas, 2012).

Migrant workers are mainly employed in export-led manufacturing (36,7%), construction (18,6%), and agriculture (15.2%): sectors that have made Malaysia a global supplier of electronics, palm oil and, in the twentieth century, rubber (Raj-Reichert, 2020). However, as argued by the literature, Malaysia's position is not adequately explained by labour costs alone, as foreign labour reveals a complex, composite factor of production that cannot be easily reduced to wage levels (Bastide, 2021, 1257). MNCs in Malaysia thus seek to exploit a specific form of labour, which is legally, politically, and socially framed by capital, state, and intermediate actors. Focusing on labour regimes in Johor, Malaysia, allows us not only to analyse the so-called "hidden labour" of the contemporary "digital revolution", but also to align our studies with frameworks that examine neoliberal globalisation as a migration regime, as global migration is not its side effect, but the main one (Nail, 2019, 64).

This shift in perspective is highly significant for the context. In Malaysia, temporary migrant workers are the most marginalised community, a condition that is shared only with 800,000 descendants of the Empire's 'coolies'-indentured labourers from China and India. Their significant contributions to the nation's economy and capital accumulation, as well as their current struggles—

overlooked mainly in national and Western histories—require adequate representation in the current debate on global labour history (Selvaratnam, 2021, 170).

Building on this, I refrain from defining these labour exploitation forms "hidden work" in AI or "digital capitalism", as the underrepresentation of non-Euro-American labour regimes in Western scholarship doesn't make these works inherently invisible. They are often socially and institutionally visible locally—known to political and labour institutions, brokers, and regulators—but stay obscured in mainstream academic and policy discourses because of international, regional and local interests, as well as epistemic hierarchies and uneven knowledge production (Bhattacharyya 2018; Lin & Leung 2023). Instead, I stress the need to historicize these forms of labour in their own context, thereby situating colonial lineages that still reframe the transnational labour regimes in Johor and SIJORI. This comes from a methodological and yet political account, as the work of genealogy is especially significant within this context.

The working-class history has been treated in terms of the nation's isolated historical narrative rather than of the broader history of the development of capitalism in a world-historical context (Hobsbawm, 1969, 1981, 2015). Here, on the one hand, Global South genealogies are scarce in the existing critical literature on AI and automation. Conversely, as part of a broader colonial strategy aimed at governing through the division of the population into 'ethnic blocs', the predominant Malayan historiography chiefly emphasises sequential narratives of the ruling classes and their leadership during both colonial and post-colonial periods (Selvaratnam, 2021, 170; Stenson, 1980).

Given that both approaches overlook the roles of workers and migrant brokers in shaping the spatial and temporal arrangements of global capital, this research aims to adopt an alternative perspective. I contend that historical lineages can directly contribute to the analysis of the electronics manufacturing supply chain, where workforce and location are strategically arranged for Just-In-Time (JIT) export production, responding to cyclical demand peaks and necessitating contract manufacturers to maintain flexibility.

By defining the BDLR, the article aligns both with migration infrastructures and with literature that revisits dormitory labour regimes through time, as infrastructures of social reproduction are brokered to serve the formation of labouring subjectivities best suited for the temporalities of global production (Bair 2010; Pun 2005; Salzinger 2003; Wright 2003). However, as long-term genealogies – as the debt brokerage- play a pivotal role at synchronizing labour and capital turnover at different scales, framing the concept of a disjunctive conjuncture, I call for the need to develop a critical temporal perspective to analyse labour regimes behind the geopolitics of automation as an asynchronous synchronisation of heterogeneous temporalities.

5. 1 Johor: A Spatial-Temporal Fix in EE Manufacturing

Building on research on the dormitory labour regime (DLR) in China's export processing zones (Pun & Smith, 2006), this first section examines the relationship between capital, spatial fixes, and

labour processes. It intersects Harvey's notion of the spatial–temporal fix (Harvey, 2001) with labour process theory (Braverman, 1974; Thompson, 1989) and labour regime theory (Burawoy, 1985; Rioux, et al., 2020) to understand contemporary DLRs at semiconductor manufacturing in Johor's EPZs. The sections intersect with this analytical context within the literature gap in the social sciences on work and automation.

Literature on the current technological paradigm primarily focuses on examining the overall economic tendency towards the replacement of labour by capital factors, debating whether each sector of the capitalist economy should, can, and will become capital-intensive. Accordingly, Marxist and critical debates on technology and work are centred on automation, conceived as a technological fix —a term Marx used to describe the economic tendency to replace the production process of labour with capital in the form of machinery ("the replacement of living labour with dead labour")

Contrary to analytical views that define "digital" or "surveillance capitalism" as a break with the capitalist mode of production, an international literature has instead been highlighting the long durée of historical capitalism, analysing the current technological paradigm not as a rupture but as a result of the historical development of tendencies inherent in the laws of motion of capital. Here, building on Marxist analysis, authors acknowledged the rise of digital capitalism as the direct result of developing contradictions inherent in the capitalist mode of production: notably, as a process of radical reduction of turnover time operating in the field of value circulation (Lundvall, 2017; Soskice, 2020; Moody, 2018; 2019; 22).

Marx identifies two spheres of capital accumulation: circulation and production (Marx 1894, 164), with turnover time as their combined duration. Faster circulation increases surplus value by reducing turnover time, thereby countering the tendency of the rate of profit to fall—the ultimate barrier of the capitalist mode of production (Manzerolle & Kjøsen 2016, 159).

While historically, "the chief means of 'cutting circulation time has been improved communications" (Marx 1894, 164), authors examined the role of digital infrastructures in line with the requirements of circulation, thereby calling for the need to analyse their broader role as a digital fix of contemporary capitalism. This literature moves from the concept of a "spatio-temporal fix," through which authors such as David Harvey translated the Marxian notion of a 'technological fix' within the global geographical corollary, exploring how the physical distribution of fixed capital, in the form of infrastructure, can ensure that surplus value is temporarily maintained during (Harvey 2001; Harvey 2005).

Building upon this, scholars such as Kim Moody (2018; 2019; 2022) integrate logistical and digital analysis, asserting that the prevailing technological paradigm—powered by fixed capital such as fibre-optic cables, data centres, and automated machinery—can be understood as an endeavour to expedite overall capital accumulation within the domain of value circulation. Indeed, as the so-called "digital revolution" is predicated on the capitalisation of information, the associated automation technologies function as catalysts for the general acceleration of circulation speed and reduction of turnover time.

But how do these shifts in aggregate capital impinge on configurations of transitional labour? Crises of social reproduction for capital involve changes in the quantity or quality of labour power that threaten capitalist accumulation processes (Caffentzis, 2013; Fraser, 2014). Building on the analysis of the Chinese 'double circulation' model at the core of the Belt and Road Initiative– a strategy to overcome a crisis of capital reproduction by diverting capital accumulation in fixed infrastructures both inside and outside its borders, including Johor, in Malaysia- I firstly examine the labour systems, then capital shifts at stake.

The focus on the Chinese capital shift and its DLR explains the intersection of the two in Johor, as the Malaysian state is attracting global capital through an EE migrant labour regime previously experimented with in China's EPZs, where the country has long served as the global spatial fix for EE manufacturing.

Malaysia holds 13% of the global semiconductor market and aims for 15% by 2030. Most production is in Johor, part of SIJORI: a Growth Triangle linking Singapore and Riau, Indonesia, as a Western offshoring site for EE manufacturing. From 2021 to 2024, Western firms—including U.S., European, South Korean, Taiwanese, and Japanese—invested billions expanding EPZs for semiconductor assembly, packaging, and testing in Malaysia, especially Johor, where EPZs are connected through SEZs and FTAs with Singapore, the U.S., and Indonesia (Hutchinson & Coe, 2016).

These investments followed Johor's emergence as a strategic hub in the Belt and Road Initiative amid what has been described as the current crisis conjuncture of hegemonic transition—towards global multipolarity and reconfigured capital reproduction (Mezzadra & Neilson 2024). New entrants such as TongFu Microelectronics, Xfusion Semiconductor, and StarFive Semiconductor partnered with Malaysian manufacturers like Unisem, MPIC, and Inari Amertron Berhad to produce high-end semiconductors (GPUs) in the context of AI competition.

However, Chinese investments in Johor are not incidental but form part of an infrastructural turn in the accumulation system (Harvey 2001; Harvey 2010; Neilson et al., 2018; Rossiter, 2017; Mezzadra & Neilson, 2019; 2024). Notably, the acquisition of JCET Group in Singapore and the expansion of GDS International into Singapore, Johor, and the Riau Islands effectively revitalised the entire SIJORI CBR (Singapore–Johor–Riau) as a contested spatial fix in the geopolitics of automation.

The concept of the spatial-temporal fix serves to examine contemporary capital arrangements beyond mere geopolitical rivalry, offering a comprehensive analysis of how the aggregate capital actively interacts with transnational labour regimes. The two are discussed in EE China's capital and labour model, as other Southeast Asin states, such as Malaysia, follow the system. First, I proceed from the standpoint of labour relationships unfolding; secondly, from the perspective of shifts in the Chinese capital accumulation along a crisis of reproduction.

5. 1. 1 The Chinese EE EPZs DLR model (1990-2000).

Part of the electrical and electronics (EE) assembly, semiconductor manufacturing follows a cyclical pattern characterised by production peaks. Consequently, contract manufacturers have traditionally implemented adaptable labour systems that enable rapid expansion during times of increased demand and workforce reduction when order volumes decline (Pawlicki 2017). Besides low-cost recruitment, the ability to segment the local labour force into core and temporary workers is essential for the composition and geographical co-location of EE EPZs, as it enables aligning labour shifts with the JIT timelines of export-led production.

The peculiarity of both EE global production and market requires an adequate theoretical framework.

Crucial to understanding labour composition in EE EPZs are the interrelations of segmented labour markets, recruitment, conditions of employment, labour processes, and forms of enterprise authority and control, which come together into defined clusters with their own distinct logic and effects (Arnold, 2017; Arnold & Pickers, 2011; Bastide, 2021).

The notion of labour regimes, as conceptualised in an international literature, refers to the interaction between social relations and institutions that tie capital and labour together in a state of relative stability, albeit one characterised by tension, in specific times and places (Baglioni, 2022). The approach has been extended to the concept of labour process theory as a window onto these interactions in and through the coordinated, yet geographically distributed, functions of global production networks (Newsome et al., 2015). Taken together, the two approaches help explain how the colocation of export processing zones (EPZs) follows the interdependencies between workers' positionality in global production networks and the particular social and institutional milieux in which they live and work (ivi). This excerpt highlights key insights from social reproduction theory (SRT) on the functioning of labour regimes. The theory explains how capital accumulation and commodity production are linked to broader processes of class and societal reproduction, as discussed by Federici (2004), Bhattacharya (2017), and Fraser (2017). Here, authors like Mezzadri (2021) identify cyclical migrant and dormitory labour as specific strategies that employ social reproduction to subsidise wage labour.

Crucial for EPZs in EE manufacturing across Asia is the so-called dormitory labour regime (DLR): a system that extends labour relations into workers' compound dormitories, usually provided by employers or the state (Pun & Smith, 2007; Goodburn & Mishra, 2024; Chan & Pun, 2009; Yu, 2020; Xue, 2008). By limiting potential labour resistance and recycling the salaries of segregated worker populations into infrastructures of social reproduction, DLRs reduce production costs through regimes of (im)mobilisation of labour and value circulation (Pun & Smith, 2007).

Within the context of global EE export-led manufacturing, China’s DLRs in EPZs of the Pearl River Delta (PRD) emerged in 1990-2000 as an entirely new system forged on large yet temporary labour reserves of rural migrants, low labour costs, high worker control, and limited labour solidarity. The model was later exported to Mexico, Czechia, Jordan, Qatar, Saudi Arabia (Bruslé, 2012; Azmeh, 2014; Schling, 2022), Mozambique (Wethal, 2017), the Caribbean and Southeast

Asia, particularly in Thailand (Pearson & Kusakabe, 2012), Cambodia (Chang, 2022) and Vietnam (Cerimele, 2018).

Labour control at EPZ DLRs is principally guided by two primary strategies: the development of regimes of (im)mobility and the creation of infrastructures that facilitate capital reinvestment and the extraction of surplus value within the domain of workers' social reproduction (Schling, 2017). Here, temporal approaches to DLR theory examined how, by integrating the two with factory production quotas, DLRs can shape labour shifts, conditions, and turnover to Just-in-Time (JIT) production models, particularly suitable for electronics manufacturing (Andrijesevic, 2022).

The Chinese 'dormitory labour regime' (DLR) from the 1990s enabled foreign-owned export-oriented firms to take unprecedented advantage of the country's enormous internal migrant workforce, whose mobility was limited by the *hukou* system —a particular state residency control (Peng, 2011; Smith & Pun, 2006; Pun & Smith, 2007). First-generation rural migrants were housed in crowded factory dormitories, giving employers extensive control over both their productive and reproductive lives. Since the state did not allow migrants to remain in the city without employment contracts or to find alternative housing, rural migrant workers were dependent on the factory and dormitory for their continued urban existence (Cheng & Selden, 1994). As a result, in Chinese EE DLR in PRD EPZs, managers could impose overtime without notice, restrict collective organisation, and extend labour discipline into workers' living spaces.

Furthermore, while mainly employing female rural workers, the firms could maintain a highly flexible workforce by using a constrained "reserve" army of students during periods of peak EE production (Smith & Chan, 2015).

With low labour costs and high flexible productivity driven by hundreds of millions of internal migrants (≈292 million migrant workers as of 2020–21), the Chinese export-led manufacturing dormitory labour regime (DLR), particularly in the Pearl River Delta, became an integral part of China's development model and rapid industrialisation and is widely cited as a key element in China's rise to "the world's factory" (Pun & Smith, 2007; Pun, 2005; Smith, 2006; World Bank, 2021; Siu, 2018). In the field of EE manufacturing, China is a pivotal example, as the country has, for the longest time, served as a spatial-temporal fix to absorb and reinvest surplus capital from Western economies, with net foreign direct investment increasing tenfold (Harvey & Paik, 2019; Lee et al/, 2018; Pun, 2025; Yun, 2019; Zajontz, 2023; Zhou et al., 2018).

However, with the escalation of the capital-reproduction crisis from 1998 onwards, the EE DLRs expanded beyond Chinese national borders, as the model of "bringing in" shifted due to rising internal consumption and declining global exports (Yan 2021: 268–69; Sum 2019: 533).

5. 1. 2 Chinese Capital Shifts In The Reproduction Crisis.

In 1998, faced with persistent overaccumulation of capital and declining profit rates within the national economy, China's policy shifted as the state initiated large-scale debt-financed

infrastructure programmes to absorb increasing internal labour surpluses, thereby anticipating issues of systemic significance that would have later arisen (Harvey 2003: 122, 123; Arrighi 2007: 219).

Crucially, the meltdown of the global economy in the late 2000s following the global financial crisis of 2007–2008 caused a major accumulation crisis, as global demand for Chinese exports dwindled (Hung 2022: 27; 2025; Sum 2019; Taylor & Zajontz, 2020).

To accelerate turnover by diminishing the value cycle (Harvey, 1990), the development of extensive physical and digital infrastructures exemplifies a spatial logic of capital— the 'annihilation of time by space'—which is particularly utilised to address crises of social reproduction and overaccumulation. Consequently, in 2013, the Chinese government initiated a significant transformation of the country's accumulation system, identifying overseas infrastructure markets as "surplus valves" for Chinese overaccumulation. From a policy of *bringing in*, the state coupled slower but higher-quality growth with a new 'going global'- *zuo chuqu*- policy, aimed at addressing industrial overcapacity by linking Chinese firms with international markets (Yan 2021: 268–69; Sum 2019: 533).

By establishing trans-regional connectivity networks in Eurasia, the Belt and Road Initiative (BRI) emerged as the primary vehicle for the global expansion of Chinese supply chains (Gonzalez-Vicente, 2019; Mayer & Zhang, 2021; Schindler & Kanai, 2021; Sum, 2019; Taylor & Zajontz, 2020).

The reorientation of Chinese development alongside its new regime of accumulation positioned the country as a central competitor in the global search for new *spatial fixes*, challenging Europe, the United States, and the East Asian "tigers" (Ngai, 2025). Alongside the contraction of Western markets, the escalation of the U.S.–China trade war, and the circumvention of sanctions, Chinese firms entered existing export processing zones (EPZs) once dominated by Western electronics producers (Coe et al., 2023; Coe & Yeung, 2015). Following the relocation of the Chinese spatial fix in Southeast Asia, the following section turns to the Johor case. In fact, while investment in fixed infrastructure - such as data centres[4], fibre optic cables, and semiconductor EPZs[5] – is driven by the need to extract and accumulate capital by reducing turnover time in the sphere of aggregate value circulation, these infrastructures are being located in SIJORI to extract, at a smaller scale, value from the dispossession of migrant workers employed in manufacturing sites[6]: namely, from the brokering infrastructures that bound temporary migrant workers to dormitory regimes of forced work (Potkin & Ngui, 2021; Bastide, 2021; Verite, 2014).

[4] See: https://www.edgeconnex.com/news/edge-blog/johor-malaysia-the-rising-star-of-the-data-center-industry/m
[5] See: https://www.infineon.com/press-release/2024/infxx202408-133; see also: https://www.reuters.com/technology/intel-invest-7-bln-new-plant-malaysia-creating-9000-jobs-2021-12-16
[6] https://www.reuters.com/technology/intel-invest-7-bln-new-plant-malaysia-creating-9000-jobs-2021-12-16

5. 2 The Brokered Dormitory Labour Regime (BDLR) in Johor, Malaysia.

Labour at semiconductor manufacturing EPZs in Nusajaya, Kulai, and Iskandar Puteri, part of the Johor SEZs, is segmented, with 10-30% of Malaysian workers and 70% of temporary migrants from Indonesia, Bangladesh, Pakistan, and Nepal residing in dormitories (Verite, 2014). The DLR of the Chinese 1990-2000 model integrates both the kafala system and the historical Indo-Chinese system, wherein a colony-contractor referred to as *kaadar* operates a shop leased from the landlord, from which all groceries are required to be purchased at prices up to 30% higher than market rates (Kaur, 2014; Goodburn & Mishra, 2024).

In this paragraph, I analyse the role played by brokering infrastructures in Johor' DLRs of EE EPZs. In particular, I focus on regimes of labour immobility and debt to contend that the politics of social reproduction are used to regulate the access, cost and disposability of migrant labour, synchronised with the turnover of EE manufacturing and spikes in demand of the global supply chain. By providing a JIT supply of migrant forced labour, the DLR in semiconductor EPZs is turning Johor into a spatial fix for the digital economy.

Maintaining low labour costs, alongside free trade zones and financial incentives, the integration of the Johor state in SIJORI CBR has been vital in competing or partnering with Singapore (Devadason & Meng, 2014; Raj-Reichert, 2020), positioning Malaysia as the largest global supplier of electrical and electronics (EE) manufacturing (Raj-Reichert, 2020; Bastide, 2021). In this regional setting, the organisation of export-led manufacturing supported the emergence of what economists term 'vertical integration': a policy that fragments, distributes and coordinates assembly processes between different states according to complementary costs of location-based resources (Storper 2000: 135; Dunning and Lundan 2008: 34; Negi & Bardhan, 2018). Alongside the Western and Chinese market, Southeast Asia is part of wider, integrated production networks where it serves mainly as a manufacturing base, with a strong focus on electronics and electrical (EE) goods, from which parts and components are exported to China, Singapore or Taiwan for final assembly (Choong & Lam, 2010; Sjo¨holm 2013; Athukorala & Kohpaiboon, 2014; Athukorala, 2017).

Wage levels play a central role in locational advantage (Kinuthia & Murshed, 2015). Malaysia's initial industrialisation was driven by foreign capital seeking to relocate from Singapore (Choong & Lam, 2010), linking it to internal labour-market forces. Between 1985 and 2009, foreign investments in manufacturing increased from 17% to 72% of total industry capital formation. During the same period, the share of unskilled migrants in unskilled employment rose significantly from 2% to 38% (Bastide, 2021; Devadason & Subramaniam, 2016).

Migrants constitute 30% of the national workforce, approximately 2 million individuals with legal status and an additional 1 to 3.5 million undocumented workers as of June 2019. Export production, predominantly controlled by multinational corporations, employs two-thirds of the total foreign workforce in the manufacturing sector.

Today, while Malaysia's attractiveness to FDIs is linked to China's market size (Choong & Lam, 2010), manufacturing wages are kept artificially low through a steady, organised influx of

migrant workers who earn 32 per cent less than their Malaysian counterparts (Bastide, 2021; World Bank, 2015, 38). In this context, the key driver of Johor's EPZs EE economy is a workforce of temporary migrants mainly from Indonesia (40%), Bangladesh (28%), Nepal (16%), and other Asian countries (Bastide, 2021). With severely limited rights and no access to citizenship, they serve as a stable source of "on demand" exploitable labour, accounting for 70% of semiconductor EPZ workers, 35% of whom have been reported as forced (Verite, 2014). Deemed as the disposable people in the form of new slavery in the global economy (Bales, 2012; Griffiths & Bales, 2010), their condition of 'obscene inclusion' is not incidental, but the result of a precise 'legal production of illegality' (Liu, 2022).

I first examine the federal and state channels -the kefala- through which these workers are recruited within a specific regime of (im) mobility; secondly, I analyse the role of informal networks and actors who extend and exacerbate.

Going deeper, analysing the dormitory labour regimes of Johor EE EPZs, allows us to understand that the spatial fix of semiconductor manufacturing lies in brokerage infrastructures that play a crucial role in synchronising labour shifts and turnover at processing plants within a complex set of temporalities. With a genealogical paragraph, I define these as both short-term (JIT production peaks) and long-term timelines of the current (geo)politics of automation.

Regimes of (im)mobility constitute the institutionalised ensemble of laws, policies, infrastructures, and social practices that generate, facilitate, categorise, regulate, and occasionally enforce individuals' movement or immobility across spatial and temporal dimensions (Glick Schiller and Salazar 2013; Schewel 2020; Dahinden & Korteweg, 2023). ASEAN migrants enter the Malaysian labour market via highly racialised and gendered low-wage visa channels (Nah, 2012). Their differential inclusion (Mezzadra & Neilson, 2013) within the federation extends to the politics of social reproduction. With visas that prohibit access to citizenship — even for children born in Malaysia to holders of work permits — migrants are unable to bring their families, marry citizens, or legally give birth in the country, with pregnant women risking contract termination and deportation (Nah, 2012). Visas are permanently 'temporary', a form of institutionalised precarity (Piper, 2022), that keeps workers in a state of 'permanent' irregularity and institutional vulnerability (Franck & Anderson, 2019).

Nonetheless, formal institutional channels are not the sole mechanisms governing labour discipline, turnover, and mobility in Malaysian EE EPZs; illegal operations do not diminish the roles of the federal and national state authorities. In Malaysian EE EPZs, a complex network of subcontracting chains, migrant brokers, and recruiting agencies—supported by both institutional and informal infrastructures—constitutes what has been described as the 'logistics of neoliberal slavery' (Liu, 2022).

5. 2. 1 Brokerage infrastructures

In Malaysia, most temporary migrant workers initially enter legally but often become irregular due to delays by broker agents, document theft/loss, or false information regarding their status. As a result, migrants enter a system that utilises the production of their irregularity as a specific form of real-time labour intermediation (Sha & Khor, 2024), which confines workers to a cycle of (im)mobility across different scales (within the dormitory, the Johor state, the Malaysian federation).

As this condition must be managed and maintained by various channels, including national agencies, migrant brokers, patrolling forces and trans-local smugglers/human traffickers, a focus on these figures is essential to opening the black box of migration from the standpoints of their infrastructures (Lindquist & Xiao, 2012). Shaping institutional vulnerability through the work of brokering agents, both the state and capital exploit the differential inclusion of migrant workers to lower labour costs and profit from surplus value extracted in the sphere of their social reproduction. Two strategies are especially significant: labour immobility and debt traps.

In analysing the Johor EE DLR, I firstly focus on the role played by two brokers, the first so-called 'agents', and the second kaadar, in shaping both labour immobility and debt cycles. Both roles serve to configure a dormitory regime where labour shifts and turnover are synchronised with the timelines of export-led electronics manufacturing.

In the EE EPZs of Johor, every migrant worker has their 'agent': a local intermediary of employers to whom their mobility, accommodation and financial infrastructures depend. The relationship with these agents is highly unequal, as they control workers' pay, fees, deductions, and medical reports only after unlawfully confiscating their passports, documents, and labour contracts. Without passports, migrants are deemed 'undocumented', risking detention and deportation (Piper, 2022; Franck & Anderson, 2019). In Johor EE EPZ DLRs, cross-border (im)mobility integrates with the living and working (im)mobility regime, shaped by both labour intermediaries and institutional regulations.

Malaysian federal regulations exclude migrants from private rental accommodations and prohibit their residence without employment. Their employing companies are legally accountable for their welfare accommodation. This situation worsens in the Johor Sultanate, where the national government has institutionalised the kafala —a recruitment system used by Gulf Countries that ties migrant labour's cross-border mobility to employer sponsorship (Gardner, 2010).

In the literature, worker dormitories are considered integral components of broader labour regimes, and the labour control mechanisms exerted through them intersect with those observed into the wider state apparatus and firms (Goodburn & Mishra, 2023). In Johor, while employers can threaten those who report, complain, or attempt to live independently with deportation, this policy effectively makes employers act as 'landlords', thereby taking over migrants' 'private space' and broadening employers' oversight of their activities.

In Johor, dormitories for EE manufacturing are situated in industrial and technological parks, where companies use housing strategies to segregate their workforces by nationality, separating them from the local population and from each other (Verite, 2014). Living isolated by geography

and language and lacking any meaningful legal protection and under the threat of risking job loss, homelessness, and deportation, these workers reported abuses that extend from illicit deductions from pay to sexual violence. While inside, their activities are closely monitored by security or regulated by employer-imposed curfews, their movements outside the dorms are made highly visible as their daily commutes to work are arranged by their agents or other brokers driving bas pekerja, blue company buses (ivi).

Labour discipline and control at Malaysian DLRs differ from the Chinese model in two main functions, respectively carried out by two figures: the *Jabatan Sukarelawan Malaysia* (RELA) and the kaadar (ivi). Created in 1970 and reshaped in 2005 to fight illegal immigration, RELA is a volunteer armed corps of 3 million in charge of patrols and immigration detention centres. On curfews, RELA patrols EPZ and SEZ dormitories, restricting migrants' movement, demanding bribes, and threatening detention, violence, or intimidation.

While RELA exacerbates the workers' (im)mobility, maximising labour control in DLRs, the kaadar is a broker who turns workers' indebtedness by deceptive recruitment into spirals of debt. As a result, migrants have no choice but to accept permanent overtime and endure high turnover rates that fluctuate with peaks in EE production managed by their agents.

5. 2. 2 The synchronisation of capital and labour turnover via debt brokerage.

While Malaysian workers are excluded, foreign workers in Malaysia (92%) pay recruitment fees, with 77% borrowing to cover costs. In Johor, debt recruitment combines with deceptive recruitment: a condition where workers cannot refuse the job or insist on a different one upon arrival. According to the International Labour Organisation (ILO), these categories define forced labour: a condition that particularly affects workers in EE EPZ, where 75% of job seekers end up in debt due to fees. In the EE DLRs in Johor, debt turns deceptive recruitment into working regimes of forced labour: to the last reports, although most foreign workers reported simply not knowing what they had agreed to, lacking clear memories of deception, 29% of respondents observed being deceived about wages, hours, overtime, pay, or termination clauses (Verite, 2014).

In the EE EPZ DLR, debt spirals are employed not solely for recruitment purposes but also to regulate labour shifts and mitigate turnover, with the most prevalent issue being misinformation regarding overtime. However, to comprehend how labour flexibility corresponds with industrial peak periods, it is imperative to analyse the collaborative roles of two principal figures.

In this context, although the employers sponsor workers' passports and have them confiscated by their contractors or ‘agents, ' the migrants' consumption practices are informally overseen by an external third party outside the organisation. This broker, named “kadaar”, is characteristic of the dormitory labour regime in the Indian garment industry (Goodburn & Mishra, 2024). A figure both trusted and feared, *kaadar* means ‘pure heart’ in Hindu and ‘strong, powerful’ in Arabic. In this context, it refers to the owner of an ethnic grocery store located between the Industrial Parks and the dormitories. Since migrant workers arrive in Malaysia already in debt with their agent, the

kadaar initially provides them with credit, usually in groceries, and reinvests or loans funds for dormitories and transportation, shaping a captive market on the social reproduction of migrant labour.

Although these roles may ultimately converge within a single individual, what has been referred to as the Malaysian real-time labour intermediation is a complex DLR shaped by brokering infrastructures. Here, labour flexibility is forced by the agent and the kaadar. The first is exclusively associated with management, bearing responsibility for labour recruitment, overseeing shift schedules, and employee turnover. The second perpetuates the cycles of migrant indebtedness within the social reproduction sphere of workers, thereby linking the DLR to limitations on consumer practices that extend those cycles, forcing their continuous disposability to the agents (Verité, 2014; Amnesty International, 2010; Electronics Watch, 2024; AP, 2025).

In EE EPZs, debt brokerage is used to make overtime forced and systematic: since workers assert that it is impossible to settle debts without "regular overtime", their debt cycles are structurally employed to synchronise labour shifts with the production targets of EE EPZs (Verité 2014). According to the latest reports from Malaysian EE EPZs DLRs, 92% of respondents who had not paid off their debt felt compelled to work overtime hours to pay it off, thus working more than 72 hours per week, which is the legal limit in the federation (Verité 2014; Electronics Watch 2024). Workers assume, by contract, that they will work a minimum of 72 hours a week. When "rush orders come in", they are compelled to work overtime with no option for refusal. According to workers, the length of their overtime has no limit, but their ability not to faint, with quotas – and not legal limits – being the determining factor in levels of work (Verité 2014; Electronics Watch 2024).

5. 3 Colonial legacies. Debt brokerage and migrant labour in the Straits Settlements.

The contemporary BDLR at EE EPZs in Johor, Malaysia—characterised by layered recruitment systems, brokered labour intermediation, employer-provided accommodation, and merchant-credit relations—should be understood as a reconfiguration of much older infrastructures of circulation and control that have long shaped labour and commerce in the region. Migration infrastructures do not emerge ex nihilo but are assembled from enduring networks: as Hamashita observes, China-centred migrant networks have formed the backbone of East Asian connectivity since the early modern period and were repeatedly reworked to serve European colonial administrations and commercial interests (Hamashita 2013). Equally important is the region's maritime geography and intensive inter-island trade, which, together with the historical political integration of the SIJORI under the Riau Sultanate until the 1824 partition, produced longstanding channels of mobility, mercantile brokerage and local provisioning subsequently harnessed by colonial governance (Reid 1988, 2; Wee, this volume; Trocki 2007, 67). Contemporary practices—such as brokered recruitment, credit-based provisioning, and dormitory confinement—are transformations of existing migratory and commercial infrastructures repurposed to support export-oriented industry accumulation.

The Straits corridor played a crucial role in Malaysia's integration into the global economy during the late nineteenth century, as the country's development trajectory under British rule aligned with the demand for imperial commodities and the advancements of the Industrial Revolution in the Western world. Before British rule in Malaya, the English East India Company established port settlements in the Straits of Malacca, known as the Straits Settlements, comprising Penang, Singapore, and Malacca, whose economy depended on imported Indian slave and convict labour7. However, the cross-border region only became a spatial fix for global rubber demand after the development of the Chinese indenture regime, the kangchu system, and the Indian recruitment system, known as the kangaani. Both the kangchu and the kangani were local variants of the indenture system, as in effect, the debt–bondage relationship between servant and master still remained, although indirectly' as argued by Arudsothy (1986, 75). At the beginning of the twentieth century, these two labour regimes drove the expansion of first the Second Industrial Revolution, and then the automobile, the telegraph, and related industries in the United States, along with American dominance over the Brazilian rubber supply.

In colonial and postcolonial Malaya, governance of plantations and public projects has been primarily based on the role of migrant workers and brokers in labour compounds. Both systems shared debt as an infrastructural fix, resulting in a near total of 2 million (1,910,820) South Indian 'coolies' (Sandhu, 1969: 305) and about 2.4 million Chinese by 1941 (≈43% of the population) (Purcell 1948; Saw 1967). Based on debt bondage, the system drastically reduced the cost of procuring the 'coolie' from $47.50 to $29.39 between 1903 and 1938, raising rubber exports from 6,500 tonnes to 204,000 tonnes between 1910 and 1919, thereby turning Johor into a spatial fix for the Second Industrial Revolution (Kaur, 2014).

5. 3. 1 The Kangani Labour System.

Employed in the Straits Settlements, the kangani emerged in the mid-nineteenth century as a system for recruiting Indian migrants to facilitate the extraction of surplus value and capital accumulation within a despotic, race- and class-based hierarchy of hegemony and a coercive labour organisation modelled on a military/industrial line (Kaur, 2014). Crucial to the system, the kangani — whose name, derived from the Tamil word "kan" meaning 'eye', signifies 'overseer' or 'foreman' — was addressed both as a broker and a supervisor: the eye of the master of colonial plantations. The kangani recruited workers from his local area and helped them settle into their jobs in Malaya. Earning 'head money' for each day they worked, he had a personal interest in

[7] The Company and British merchants initially depended on imported Indian slave and convict labour for sugar and coffee estates established around the same time and for government public works projects. The abolition of slavery, the collapse of the Company in 1858, the separation of the Straits Settlements from India in 1867 and the prohibition of labour migration to the Straits subsequently foreshadowed the establishment of new arrangements for recruitment of Indian labour.

ensuring they remained (Sandhu 1969, 101; Kaur 2012, 232–4). However, the kangani was also a plantation storekeeper and moneylender, and workers were frequently in debt to him.

The system was employed to indebt workers at their arrival while lowering wages far below the level necessary for workers' daily survival and to repay their freedom. The kangani lowered labour costs and recycled profits, while rendering the workforce helpless against the brutal exploitation of colonial capitalism and the colonial state (Amrith, 2010: 240). Crucially, as workers were rendered unable to free themselves by buying their own freedom, their labour shifts and turnover could be forced to synchronise with the sole necessities of export production. This last lineage directly shapes the current BDLR at EE EPZs in Johor —thereby framing a continuity in the real-time management of capital and labour turnover through synchronisation via brokered debt-infrastructures.

In fact, this colonial regime of work was driven by the integration of the kangaani debt infrastructures into circuits of workers' social reproduction: a move that has been possible only by turning workers' accommodation as integral to the labour process. According to international historians (Gamba, 1955, 24; Jain, 1970), the provision of housing and other amenities by planters was a built-in mechanism for social control, turning the rubber plantation system into a ‘community subsystem’ that served as a ‘total institution’. Labourers living in estate housing whose rent was deducted from their wages at source. Consequently, like contemporary migrants in Johor’ EPZs, if they were dismissed, they faced both eviction and expulsion. For Indian workers on the Malayan frontier, the plantation became the ‘boundary of existence’, where they were trapped in an unending cycle of dependency, poverty, and vulnerability exacerbated by their language and spatial and institutional segregation.

Nevertheless, the European and Asian capitalists discovered that the stabilization of the plantation population could not be supported solely by vagrancy laws and the provision of essential facilities by the kangani (Arasaratnam 1970, 63). In fact, although wages under the survival level were profitable, the production regimes within workers' social reproduction were a delicate equilibrium between life and death. Soon, both colonial and chinese capitalist faced a crisis in capital reproduction as diseases —largely malaria —poor diet and harsh working conditions limited labour stabilisation, raising costs. While seditions and marronages have always been incessant, the mortality rates were huge, as many as 60%, rising to 90% of the labourers died within a year of their arrival (Sandhu, 1969: 171). As nascent European enterprises needed an insatiable supply of cheap, unfree, malleable, and readily expendable workforce, labour shortages – whether due to sedition or deaths - would have raised wages, squeezed profits, and stunted capital accumulation.

The problem was fixed by Chinese foreign capitalists -called Kongsi- not by ameliorating labour conditions, but by employing a particular labour regime that could directly synchronise the workers' health with the turnover of capital: the kangchu system.

5. 3. 2 The Kangchu Labour System.

Similar to the kangani, the kangchu system was used to recruit workers from China, including Hoklo, Hakka, Hailam, Teotjoe, Leotjo, and Kongfoe, to pepper, gambier, sugar, rubber plantations in the Straits Settlements (Johor, Singapore and Riau), gold-mining plants in Borneo and the tin-mining enterprises of Bangka and the Malay Peninsula. Managed by Chinese secret societies, the system tied capital, labour and specific commodity production systems to opium: a biopolitical fix that served as the first and most effective means of accumulation in nineteenth-century Southeast Asia. In fact, it was only with the labour regimes based on opium-based kongsi, that Johor, Singapore, Riau (SIJORI) and the Straits Settlements turned into a spatial fix of global capitalism, with Chinese workers as the first real source of free wage labour in Southeast Asia (Trocki, 2002).

Without knowing the destination or the nature of the work, Chinese workers were recruited at "kedeh nasi" (local food courts). They arrived in Malaysia under a credit-ticket scheme, in which the coolie broker who recruited, the 'tukang jual orang' (trader in human beings), paid for their transportation from China via *nakhoda* (skippers) on their wangkang or tongkang (Hokkien vessels). Once arrived, labourers were housed in dormitories ''kongsi lines'' or long attap sheds located near their work sites. These were compounds managed by the kongsi: a Hokkien transcription of a Chinese term meaning "company". Workers reached plantations, mines, or *longtong* (timber warehouses), with an initial debt of £10-£15—about a year's wages—to be paid to their taukeh for transport, entry fees, and expenses, which were later deducted from wages to prevent escape. By sliding workers deeper and deeper into debt, *taukeh* were either Hokkien or Cantonese brokers who played a crucial role in shaping a labour control system based on workers' social reproduction.

As for the kangani recruitment, debt infrastructures formed the core of the kangchu labour system, not an addition. Although tin mining provided consistent export earnings, the primary income came from kangkar shops and the broader retail sector, which kept coolies trapped in cycles of debt-driven consumption with the kangchu -the headman (Smyth, 1898, 328). In the kongsi, investors funding the labour also held concessions in pork, prostitution, gambling, and especially opium, ensuring that wages of $3–4 per month were mainly reinvested into their captive market.

In an environment marked by malaria, dengue, typhoid, dysentery, and parasitic infections—and with no formal medical care—British and European medics posted overseas to monitor labour supplies argued that without stable opium rations large shares of workers would have deserted, as the drug dulled pain, masked fevers, and prophylactically reduced diarrhoea (Straits Settlements Opium Commission, 1908; British Malaya Opium Committee, 1924; Warren, 2003; Choy, 2023). Mortality in kongsi-lines attests to deadly working conditions, with reports from Southern Siam indicating exceptionally high death rates among mining coolies (Alatas, 1977; Sng & Bisalputra, 2022). Opium thus functioned both as a work drug and as a "precious medication" for tropical illnesses (Warren, 2003; Choy, 2023). By managing supply, Chinese secret societies turned the drug into an infrastructure of social reproduction, stabilising early-arrival mortality and securing the labour force (Trocki, 2011; Sng & Bisalputra, 2022).

Historians concur that the system was designed to trap labourers into debt, as they earned five dollars a month, spent three dollars in a day on opium, and survived on opium for two months within just eighteen days. (Brook & Wakabayashi, 2000, 89; Descours-Gatin, 1992, 103-4). While addressing crises of labour shortage, the drug was both a stimulant and a relaxant, an analgesic, and a sleep aid. Once integrated within the kongsi lines, it also evolved as a capital fix extending working shifts, accelerating capital turnover, and binding workers to captive relations of debt (Trocki, 2002; 2011).

According to historians, the kongsi system played a pivotal role in shaping the Singapore–Johor–Riau (SIJORI) region as a spatial fix for the second industrial revolution (Trocki, 1990; Lim 1998; Bowring, 2018). In fact, if the cost of employing labour were not recaptured in kongsi and recycled in opium through the kadeh, as it were, there would have been no profit (Trocki, 1990; Willis 1993; Hamashita, 2013; Pohl, 2021). Instead, by exporting tin, pepper, rubber, and gold at extremely low prices, the system served the needs of the European industry in its search for strategic commodities. Turning opium into revenue farms and enforcing indentured labourers in one of the earliest export-led zones of the second industrial revolution, the so-called opium regime facilitated new cycles of value circulation at various scales, thereby establishing the primary infrastructure for the development of Chinese capitalism and European colonial states (Trocki, 2002; 2011).

5. 4 Recursive Infrastructures. The Politics of Time in Johor.

Based on a just-in-time (JIT) model, export processing zones (EPZs) of electronics and electrical components (EE) depend on meticulously designed labour systems—encompassing temporal, spatial, and institutional configurations—that render labour supply politically divided, economically fragile, and readily mobilised within transnational production networks. Besides low-cost recruitment, essential for the composition and geographical co-location of EE EPZs is the ability to segment the local labour force into core and temporary workers, enabling their shifts to be aligned with the timelines of export-led production.

Framed within migration infrastructures, critical geography, and labour-process analysis, this study therefore conceptualizes Johor as a renewed spatial fix: a site where capital’s material investments in export processing zones, logistics, and cloud infrastructures are complemented by social technologies of worker control. By historicizing brokered debt and its spatialized mechanisms of management, the research demonstrates how the digital economy and the automation of work are supported by coercive migrant labour. In doing so, it advances debates on automation and artificial intelligence by shifting the focus from machines-humans' relationships to colonial genealogies of migrant labour systems in Southeast Asia.

At the surface, AI-era cloud infrastructures appear to be at the forefront of accumulation; beneath the surface, they are the outcomes of transitional labour regimes, including semiconductor manufacturing, whose role in accumulation is to reduce the turnover time within the sphere of

circulation (Manzerolle & Kjøsen, 2016; Storper, 2000). At the core of the global acceleration of aggregate capital turnover driven by cloud infrastructures, semiconductor manufacturing in Johor involves a reconfiguration of established political–economic frameworks and labour structures.

Furthermore, these infrastructures are underpinned by an additional array of support systems—such as migration-broker infrastructures encompassing visa sponsorship, debt recruitment, employer-tied housing, and dormitory compounds—which serve to rejuvenate colonial-era mechanisms. These systems effectively transfer the reproductive costs onto migrant households, as cited in Kaur (2012, 2014), Verité (2014), and Pun & Smith (2007).

I call the conceptual thread binding these layers an asynchronous synchronisation, where asynchrony does not refer to a temporal discrepancy between "linear" technological developments and historical forms of labour; rather, it results from what Marx (1894) called a reflux (Rückfluss). Analysing crises of capital production, Marx defined reflux as the ability, for a circuit of circulation, to "turn back upon itself" through repayment and reinvestment. Analysing the BRI, Mezzadra and Neilson (2024, 204) expand upon this concept by correlating reflux with feedback mechanisms, illustrating how states, confronted with diminishing abilities to ensure reproduction and turnover internally, attempt to leverage transnational circulation—establishing corridors and fixed assets while imposing stricter controls over labour mobility within the realm of social reproduction.

Placing Johor within the SIJORI cross-border region clarifies the process in a historical-geographical corollary. SIJORI historically operated as a spatial–temporal fix for global manufacturing (Lee, 1991; Sparke et al., 2004). Today, renewed investment in packaging, testing, and data-centre capacity renovates SIJORI for the AI boom, aligning fixed capital with circulation-enhancing infrastructures (Raj-Reichert, 2018; Sum, 2019; Taylor & Zajontz, 2020). However, this renovation is sustained by a brokered dormitory labour regime that convert the precarity of market flows in orders into "certainty" of coerced work relationships, thereby synchronizing the turnover of capital and of labour through debt, document confiscation, sponsorship-dependent residence, and dormitory control (Pun & Smith, 2007; Verité, 2014; Schling, 2017).

I recast this asynchronous synchronization through the engineering grammar of real-time, as this notion frames how communication internal to servers in computing infrastructures shape the turnover of capital (in the form of speed in data exchange) of the current technological paradigm. Real-time is not an instantaneous present; it is the operational envelope generated by the relation between run-time—the phase of effective execution under deadlines—and down-time—the intervals of unavailability that must be minimized, buffered, or routed around in electrical, cloud and computing infrastructures. In technical systems, the former is secured by schedulers and resource provisioning, the latter bounded by reliability practices and redundancy (Liu & Layland, 1973; Kopetz, 2011). Yet, this mapping clarifies the socio-economic stakes: run-time corresponds to the sphere of production and productivity, while down-time names the infrastructures of social reproduction that serve to restore, sustain, and re-enter labor power into phases of production (Fraser, 2016; Bhattacharya, 2017). The so-called "real-time" connectivity run by semiconductors

is therefore a composite temporal regime in which production and reproduction are jointly organized so that value can be realized with bounded delay. Situated in this frame, Johor's transformation is driven by the calibrated coupling of different temporalities. While the production of cloud infrastructures—data centers, fiber optics, semiconductors,—compress run-time latencies worldwide, their manufacturing in Johor is driven by migration channels, debt brokerages and dormitory infrastructures whose politics—employer-tied visas, debt-financed recruitment and labour turnover, segregated housing—render down-time predictable and exploitable, turning restoration and return into schedules of export peaks. These are in turn synchronised with workers shifts, as their brokers can manage labour turnover via the durability of colonial systems of recruitment and labour control, thereby shaping a just-in time model of coerced work.

In Johor' BDLR, time is the very political technology, as coordination is achieved through managed non-synchronicities—contracts, compounds, credit, curfews, but also colonial lineages and "debris". This is the operative content of asynchronous synchronization: a mode of governance that keeps different temporal orders linked enough to co-produce outcomes yet disjoined enough to resist translation into a single metric of time.

Reframed through cybernetics and media-systems, the politics of automation result from a disjunctive conjuncture reproduced by the entanglement of short term and long-term feedback -or reflux- rather than by equilibrium. Johor functions as a spatial-temporal fix that postpones a capital reproduction crisis in one part of the world market (its global supply chains are linked both to U.S., European and Chinese capital) by producing a disjuncture elsewhere – notably, a crisis of social reproduction in Johor' EE SEZs - along the paths of Marxian reflux. In fact, within the Johor BLDR, each circuit turn initiates infrastructural recursion that synchronises capital and labour turnover by desynchronizing workers' social reproduction with their needs.

Three implication follows. First, from a theoretical perspective: automation need to be reconsidered within the politics of circulation, where fixed capital and social reproduction infrastructures together form the process of value realisation (Harvey, 2001; Manzerolle & Kjøsen, 2016). Secondly, from a historical perspective: dormant and colonial infrastructures influence the politics of automation — namely kangani and kangchu/kongsi —, integrating wage extraction with merchant credit and residence management; these are not just analogies but real genealogies that persist and are reconstructed within modern contexts (Reid, 1988; Trocki, 1990, 2011; Kaur, 2012). Third, methodological: tracing reflux/feedback across scales—compound, industrial park, cross-border corridor—allows us to specify how circulation fixes are built on the governance of mobility in social reproduction, and to identify the precise interfaces (recruitment contracts, dorm tenancy rules, transport rosters) where synchronisation of labour and capital turnover is produced.

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6 CONCLUSIONS

"Repetition produces value, and memory, which once promised to save us from time, makes us out of time by making us respond constantly to information we have already responded to, to things that will not disappear".

(Chun, 2016, 96)

"It took both time and experience before the workers learnt to distinguish between machinery and its employment by capital, and therefore to transfer their attacks from the material instruments of production to the form of society which utilises those instruments."

(Marx, 1976, 544)

Through document analysis and participant observation, the thesis employed a genealogical lens to examine how, at the unfolding of the current crisis conjuncture, cloud infrastructures shape the politics of automation by mediating with capital, states and transitional regimes of labour.

With the concept of a *Cloud Atlas,* I call for the need to develop a historical and geographical grid to analyse the entanglements between the politics of automation (framed in logics, geographies and aesthetics) and the politics of cloud infrastructures (*asynchronous synchronisation* of capital and labour) as *disjunctive conjunctures* in the long durée of global capitalism.

The theoretical framework investigated how digital techniques that expedite circulation function as strategic investments within the dynamics of accumulation. Significantly, Engels's and Marx's analyses of turnover time serve as the analytical pivot: reductions in circulation time accelerate the surplus value realised within a specified period, thereby serving as counteracting forces to the declining rate of profit (Marx, 1894; Engels, 1878). Nevertheless, the acceleration of circulation enabled by digital infrastructures does not act as a universal remedy for the reproduction crisis of capital. Instead, as noted in the pandemic conjuncture, the platform-led digitalisation postpones the crisis by synchronising capital's circulation along a temporal axis disjunct from the rhythms of social reproduction.

The historical and empirical implications of this diagnosis are twofold. First, the digitalisation of circulation produces an asynchrony in which, if on one hand, the velocity of capital's movement is synchronised to algorithmic rhythms, on the other, the social reproduction of labour — wages, care, health, household provisioning — remains governed by slower, material processes that neither the capital or the state can afford to fully 'harmonise'. Second, this disjunction produces a fragile equilibrium: while circulation may be accelerated, enabling temporary profitability gains, the structural deficits in social reproduction persist and can re-emerge as crises (public-health shocks, labour shortages, fiscal constraints) that expose the current moment as a disjunctive conjuncture for both the state and capital (Fraser, 2017; Kjøsen, 2016; Fuchs, 2017).

Nevertheless, what is the relation between cloud infrastructure and labour? Caffentzis (2013, 252) argued that "the crisis of reproduction is not a by-product of automation, but its precondition". Cloud infrastructure results from and yet shapes transnational regimes of labour. This occurs within an asynchronous synchronicity that defers the crisis by addressing the reproduction of capital. This analysis is supported by genealogical research, particularly on the labour and capital infrastructures of the Atlantic slave trade and Asian opium farms in the mid-nineteenth century, integrated with document analysis and participant observation (in Italy), thereby framing a mixed-methods approach that echoes the extended case study approach by Burawoy (1998). A method that extends micro-level interactions to encompass historical, institutional, and global structures, and traces backwards in time to elucidate how past development processes have influenced current conditions. Here, following Arrighi (1999), I expanded my case studies both "backwards" and "forwards" by engaging with a constellation of temporalities that, instead of following a linear structure, reveal the uneven and contradictory synchronisation of disjunctive conjunctures. Yet, the analysis of multiple labour regimes helps transcend how, globally, the politics – the logics, geographies, and aesthetics- of automation are situated in a historical and geographical context whose *memory* results in *feedback, reflux*, or acts of sabotage and resistance. It is in this sense that, in Cloud Atlas, time is the very political technology at stake.

As for labour, in the 70's, containerization and the so-called total-cost analysis enabled the international division of labour, allowing global firms to address the crisis of capital reproduction by taking advantage of largely unregulated, and therefore low-cost, labour in the Global South. Although we should be wary of tracing easy parallels, today, while one part of the world *waits* for

the arrival of robots (Casilli, 2025), the politics of automation is distributed unevenly, locating spatio-temporal fixes where *dormant infrastructures* are *waiting* to *return.* These acts of return can be interpreted as linking Marxist and cybernetics terminology.

In cybernetics, feedback loops are regulatory mechanisms in which a system's output is fed back as input to correct or amplify subsequent behaviour (Wiener, 1961; Ashby, 1956). Feedback loops are the timing "glue" in many asynchronous synchronisation schemes; they shape circulation not as a linear sequence but as a recursive process of measurement–control–correction.

To return, feedback follows *existing circuits.* Feedback mirrors the notion of reflux as the return of capital upon itself—repayments, circulation of credit, and reinvestment—that closes and reopens valorisation cycles (Marx, 1991/1894). However, feedback does not simply build spatial-temporal fixes; it recursively recalibrates the conduits of circulation—rates, corridors, labour-mobility regimes, and devices of social reproduction. Yet, feedback does not resolve anything, because circulation *is* a crisis (Marx, 1885).

This is the operational logic I used to conceptualise the so-called politics of cloud infrastructures as asynchronous synchronisation: feedback does not remove asynchrony; instead, it turns it into a political uneven distribution of *traces* such as violence, debris, and *memory*- forming a constellation of *disjunctive conjunctures*.

Building on Peter Osborne's concept of disjunctive conjuncture in *Crisis as a Form* (2022), I refer to historical configurations in which, in the current crisis conjuncture, past and contemporary heterogeneous temporalities and social processes are articulated without being homogenised. In Stuart Hall's sense, a conjuncture is the contingent stitching of multiple determinations—economic, political, cultural—into a provisional configuration of forces (Hall, 1988); in Arjun Appadurai's register (1990), globalisation generates "disjunctures" among partially incommensurate flows of finance, technology, media, migration, and ideology. Bringing these strands together, a disjunctive conjuncture is a situation in which non-aligned flows are nonetheless bound into a working arrangement: linked enough to co-produce outcomes, disjoined enough to resist translation into a single temporal logic (Osborne, 2013; 2022).

Although not comprehensive, this thesis contends that cloud infrastructures influence labour by shaping the politics of automation via an asynchronous synchronisation. Coordination occurs not by eliminating time differences but by operating through them. It synchronises swift systems like finance, logistics, and computation with slower, dormant, or "hidden" social reproduction infrastructures—such as dormitories, borders, debt traps, migratory routes, and recruitment chains—using brokered interfaces like contracts, corridors, compounds, and credit. These interfaces transform short-term and long-term temporalities into tools for coordination, ensuring that the conjuncture functions effectively precisely because it is inherently disjunctive; an acceleration within the realm of circulation thus results from orchestrated misalignment rather than its elimination (Mezzadra & Neilson, 2019).

Here lies the need to go beyond the standard literature on platform society and to trace a political history of computing that transcends the narrative of linear technological development. Here, a

non-exceptionalist reading of computation requires that we situate ubiquitous computing within a longue durée of calculative projects that preceded digital machines and helped to constitute them. What is at stake is not "computers" but computation: the historically recurrent techniques that discretise the world, render people and things calculable, and fold spatial and temporal variation into an informational system. These techniques do not originate with von Neumann architectures; they are continuous with imperial infrastructures of knowledge whose task was to prefigure the future while conserving dominant power. Contemporary and historical logistical media, such as ship logs, vessel charts, and knowledge institutions like colonial botanical gardens, museums, archives, and statistical offices, exemplify this regime. As imperial obligatory passage points, they centralised collection, comparison, and coordination on a planetary scale; they implemented a universalising scientific perspective; and they transformed living worlds into standardised, portable units—specimens, ledgers, maps, and "facts"—that could be circulated to facilitate extraction.

From a genealogical perspective, contemporary cloud infrastructures build upon this formation. In the prevailing socio-technical paradigm, data centres serve as resemblances of the imperial clearinghouse: a singular point of access through which the world is indexed, organised, and controlled. The aphorism that "information wants to be free" recasts, in informational terms, older fantasies of frictionless circulation—where central nodes claim rationality and order while value and materials flow inward. Data centres serve as obligatory passage points for contemporary knowledge and information; as such, they represent the political institutions of the present.

As Foucault (1967) reminds us, projects of categorisation, such as those we associate with the knowledge institutions of empire, are fundamentally linked to historical endeavours of counting and measurement. If a universalising logic underpins these efforts, then numbers represent the most universal framework of all. It is no coincidence that the first archive to be automated in the cloud is the most critical one: the State. Since the progress of statehood drove the growth of statistical analysis, the origin of the term "statistics" traces back to this political entity that emerged during the crisis conjuncture of the mid-nineteenth century. Needless to say, at the time, the colonial power necessitated the adoption of new measurement techniques for regulation (Dourish & Mainwaring, 2012).

In "Crisis, Crisis, Crisis, and the Sovereignty of Network", Wendy Hui Kyong Chun (2011) wrote that crisis allows us to move from the banal to the crucial (96). From this vantage point, the task for social research is not only to analyse devices, services, and practices but also to interrogate computing as a project—specifically, *a project of crisis*—in the words of Manfredo Tafuri (1990), including its discourses of future-making, its institutions, and its inheritances. The rhetoric of perpetual novelty is itself part of the problem: it enshrines rupture, induces historical amnesia, and licenses the periodic reinvention of theories that forget what they displace. By contrast, the program proposed here is diagnostic and genealogical. It re-orders chronologies to connect "the factory floor, the slave ship's manifest, the spreadsheet, the stock exchange," and today's cloud control rooms; it tracks how calculative architectures travel across media and eras while preserving

their distributive consequences; and it reads current cloud infrastructures into the broader arc of historical and global capitalism, where standards are instruments of rule and crisis management.

The aim, therefore, is not to celebrate a "new age," nor merely to chart alternative paths, but to sharpen our vision of the present by recognising the path "we" have been following. Cloud Atlas is not a vision of the future; it is a call to see, with greater precision, where contemporary computing now stands and how it came to be where it is.

Here, while the thesis is not comprehensive, Cloud Atlas does not intend to suggest a repetitive or deterministic structure; on the contrary, its genealogical lens aims to remind us that the politics of circulation are always mediated by social struggle. We may conclude that automation, today as yesterday, follows the dream of logistics to "do without the subject" (Harney & Moten, 2013). Yet, as its logics, geographies, and aesthetics recall — from the Atlantic Trade to the present — automation results from complex regimes of knowledge, distribution, and coordination that have historically sedimented within the *fantasy of the hold* to cooperate and revolt against dominant futures. Here, the fugitive acts of collective life in the Caribbean— the *marronages* —teach us that logistics always belong to the people, specifically the oppressed. As Harney and Moten (2013) remind us with the notion of *undercommons*, logistics is a *sociality of fugitivity* in which embodied practices of mutual care, clandestine learning, and antagonistic planning produce alternative forms of belonging and knowledge against the logics of colonialism, dispossession and disciplinary reproduction. Today, as during the Vietnam War of liberation (1954-1975), logistics —the art of computing —is the ability to organise always-new forms of solidarity, to think alternative routes of supply, to turn a wall into a tunnel. There is no need to provide other examples; history will do.

Temporalization is a subjectivation (cfr. Osborne, 2022): this is the message of logistical media.

As Marx stated (1976, 544), time and knowledge are the two tools that enable workers "to learn to distinguish between machinery and its employment by capital, and therefore to transfer their attacks from the material instruments of production to the form of society which utilises those instruments." Here lies the *message* of Cloud Atlas. As someone once said, the only thing in history that constantly repeats is revolution.

6. 1 Bibliography

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