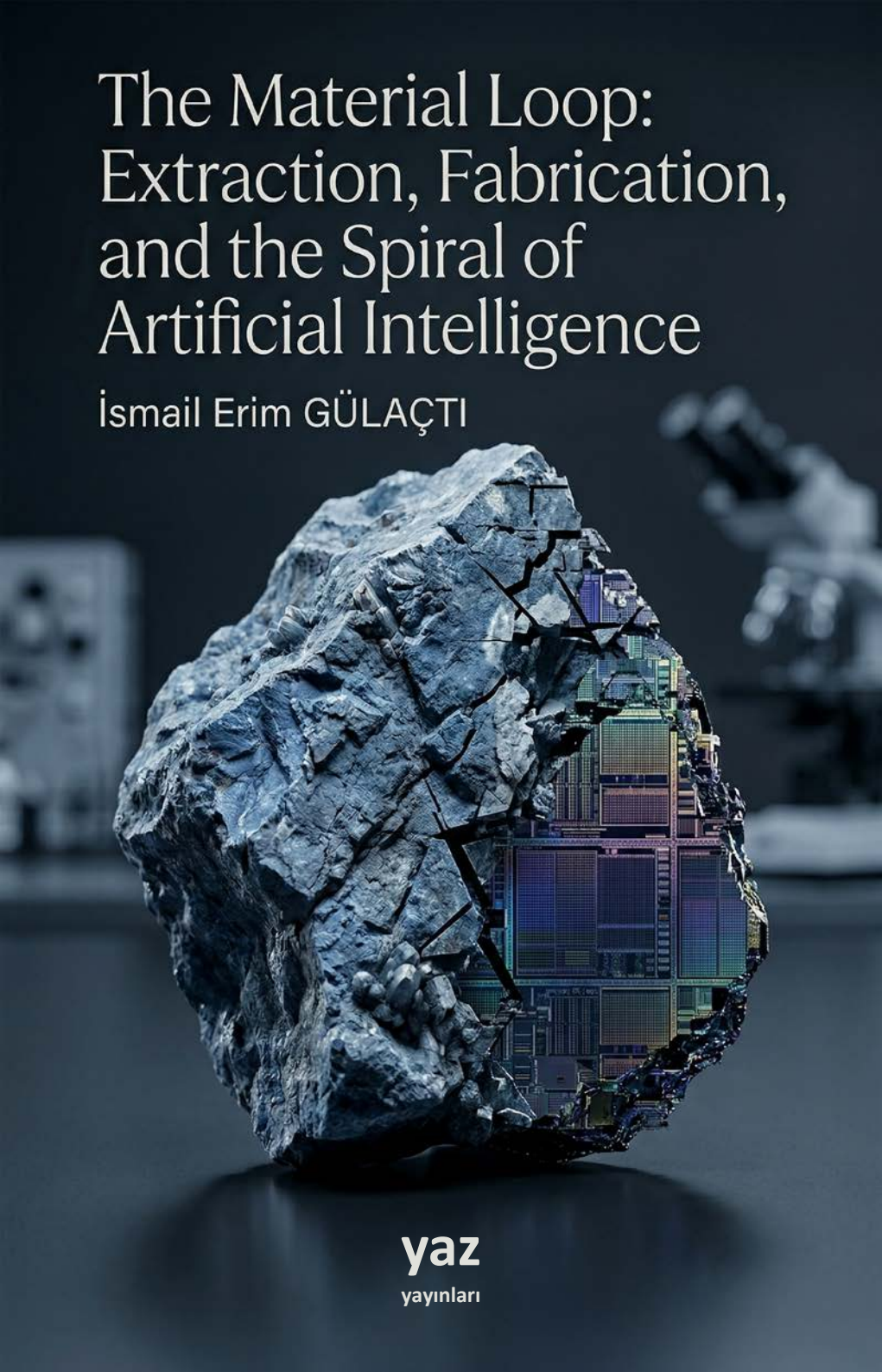
The Material Loop: Extraction, Fabrication, and the Spiral of Artificial Intelligence

İsmail Erim GÜLAÇTI



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PREFACE

This book began in a room full of screens. In 2025, curating an exhibition, which had countless instances of AI-generated imagery, for a digital art festival in Istanbul, I found myself surrounded by the outputs of systems I had spent years theorising as visual phenomena, and unable to answer a simple question: What are these things made of? Not computationally, but physically. What was mined, refined, assembled, powered, cooled, and eventually discarded so that these images could exist? The question did not come from engineering. It came from standing in a city where the water table is falling, where data centers are being built on contested agricultural land, and where the semiconductors inside every device arrive through supply chains that no local institution controls.

That question became *The Material Loop*. The book traces artificial intelligence through seven stages of extraction, manufacturing, infrastructure, operation, application, governance, and the return to extraction, not as a metaphor but as a material circuit whose structure, I argue, determines much of what governance can and cannot achieve. Each chapter follows a node in that circuit. The final chapter asks what happens when the circuit closes.

The project has a companion, *The Infrastructural Image* (2025), which examines how images operate as sites of power in computational systems. This book asks what sustains that power physically: the rocks, the water, the labor, the waste. The two works approach the same problem from different registers; each is designed to stand alone.

Several debts require acknowledgement. The intellectual foundation of this work draws on Kate Crawford, James Bridle, Tung-Hui Hu, and Lisa Parks and Nicole Starosielski, whose writing demonstrated that infrastructure is never merely technical. The methodological commitment to a mixed evidentiary archive, moving between peer-reviewed scholarship, policy documents, technical reports, and investigative journalism reflects the object of study: an infrastructure that does not sit neatly within any single disciplinary frame. I am grateful to my colleagues at Yıldız Technical University's Faculty of Art and Design for the institutional conditions that made sustained research possible, and to the students and collaborators whose questions sharpened the argument at every stage.

A final note on position. This book describes a global system from a specific location. Istanbul sits between the supply chains it maps. It is dependent on minerals it does not extract, chips it does not fabricate, and platforms it does not govern. That position is not neutral, and I do not claim it as such. It is, however, a position from which certain asymmetries become difficult to ignore. The reader will judge whether seeing the loop from its middle proves analytically productive.

A NOTE ON SOURCES AND METHOD

This book draws on a mixed evidentiary archive. Peer-reviewed scholarship, policy reports from international organizations, government white papers, technical standards documents, NGO investigations, corporate sustainability disclosures, investigative journalism, and legal instruments all appear in its pages, sometimes within the same paragraph. This methodological note explains why that mixture is necessary rather than convenient, and how the analysis weights its sources.

The material loop does not reside within a single discipline. Its extraction node is documented by geologists, development economists, and human rights investigators. Its manufacturing node is mapped by semiconductor engineers, trade policy analysts, and export control lawyers. Its infrastructure node is measured by energy researchers, hydrologists, and telecommunications specialists. Its application node is assessed by security analysts, electoral law scholars, and labor economists. Its governance node is contested by international lawyers, political theorists, and diplomats. No single disciplinary archive covers the complete chain. An analysis that follows the loop through every node must follow the evidence across the institutional boundaries that produce it. The mixed archive is not a methodological weakness; it is the methodological consequence of the object of study.

The analysis applies an informal but consistent hierarchy of evidentiary weight. Peer-reviewed research and data from established international organizations, the International Energy Agency, the United States Geological Survey, the OECD, the United Nations

system, and comparable bodies, anchor the empirical claims. Where peer-reviewed sources exist, they are preferred. Where they do not, the analysis draws on the next most reliable source available for that specific claim: government policy documents for regulatory positions, technical reports for engineering specifications, NGO investigations for labor and human rights conditions, and corporate disclosures for operational data that firms alone possess. Investigative journalism enters the analysis where it provides empirical findings, facility-level water consumption figures, undisclosed infrastructure counts, or forensic documentation of conflict events, that no other source category has produced. In each case, the source is cited not for rhetorical decoration but because it carries a specific empirical or analytical load that no alternative source in the available literature could bear.

Two categories of source require particular transparency. First, corporate sustainability reports are treated throughout as self-interested documents whose claims require corroboration. Where the analysis cites a corporate figure, it does so either because independent sources confirm it or because the figure is used to demonstrate what the corporation itself acknowledges, a rhetorical function that does not depend on the figure's accuracy. Second, government statements and military briefings, particularly those cited in the analysis of the May 2025 India-Pakistan crisis, are treated as positional documents reflecting sovereign claims rather than verified facts. The analysis distinguishes explicitly between what these documents assert and what independent evidence supports.

The register of the analysis is diagnostic rather than predictive. The book identifies structural mechanisms, traces material flows, and documents governance failures. It does not forecast outcomes or

prescribe policy solutions. Where the argument characterizes conditions as "structural" or "self-reinforcing," these are analytical claims derived from the evidence presented, not deterministic predictions. The loop is a finding, not a fate.

CONTENTS

CHAPTER 5

Application *- Weapons, Deepfakes, and the Displacement Engine*

For my brother, Engin Gülaçtı.

The other half of what they left us.

Artificial intelligence is discussed in the language of the immaterial: models, parameters, intelligence itself. Yet it is physically impossible without cobalt mined in Congo, water drawn from stressed aquifers, and semiconductors fabricated through the most concentrated supply chain in modern industry.

The Material Loop follows this infrastructure through seven stages: extraction, manufacturing, infrastructure, operation, application, governance, and the return to extraction to argue that the material circuit of artificial intelligence is not incidental to its politics but constitutive of them.

Drawing on cases from semiconductor export controls to autonomous weapons deployment, from data centers sitting in water-scarce regions to the global e-waste economy, İsmail Erim GÜLAÇTI shows how each rotation of the loop intensifies the contradictions it generates by concentrating wealth, degrading governance capacity, and accelerating the epistemic conditions that make oversight structurally difficult.

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