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Co-Designing Transparency: Understanding Barriers and Opportunities in the Transition Toward a Transparent Shipbreaking Industry.

M Joseph, E Hodson & A Franconi, Royal College of Art, UK

Introduction

Globalisation has intensified waste circulation to regions that extract value from it, often worsening environmental inequalities. The shipbreaking industry exemplifies this, with South Asia—particularly Alang, India—handling 70% of global ship recycling [1,2]. While economically beneficial, it raises serious environmental and social concerns, such as hazardous waste mismanagement and unsafe working conditions [3]. This tension underscores the challenge of balancing economic development with ecological sustainability.

International regulations, including the Hong Kong Convention (HKC) and the EU Ship Recycling Regulation, aim to ensure safer, environmentally responsible ship dismantling [4,5]. However, industry opacity enables shipowners to bypass compliance by offloading vessels in unregulated regions [6].

Transparency—defined here as traceability, accountability, and operational visibility—is critical for aligning shipbreaking with circular economy principles. This research, initially developed as a master's thesis, examines barriers and opportunities for achieving a transparent shipbreaking industry, focusing on Alang, India, amid global policy shifts [7]. It will be expanded into a doctoral study at the Royal College of Art, funded by LAHP and in partnership with Sustainable Shipping Initiative.

Methodology

A system-mapping approach identified key stakeholders—shipyard owners, workers, regulators, NGOs, and policymakers. Seventeen semi-structured interviews revealed gaps in regulatory enforcement, material tracking, and potential technology-driven interventions. Material flow mapping exposed inefficiencies in data sharing, particularly in hazardous material handling. The absence of integrated tracking systems was also identified. Futures methods such as scenario planning, roadmap development, and backcasting were employed to envision pathways toward a transparent and circular shipbreaking industry. Based on stakeholder feedback, transition frameworks were developed across three distinct time horizons:

- Short-term (H1, 0–5 years): Policy and technological interventions.
- Medium-term (H2, 5–15 years): Systemic regulatory and infrastructural shifts.
- Long-term (H3, 15+ years): Industry-wide transformation through digital innovation and global policy alignment.

Barriers to Transparency

This research identified six key barriers to achieving circularity in the shipbreaking industry. However, for the scope of this paper, we focus on three critical challenges that significantly hinder progress, while also exploring potential opportunities to mitigate these barriers.

- Regulatory Challenges: Weak enforcement of international standards like the HKC allows shipbreaking yards to operate in regulatory grey zones.

- **Fragmented Data Systems:** The lack of standardized data-sharing mechanisms prevents efficient hazardous material tracking.
- **Economic Constraints:** Low-profit margins and high costs deter investment in transparency-enhancing technologies and infrastructure.

Opportunities for Transparency

- **Digital Product Passports (DPPs):** Blockchain-based DPPs enhance material traceability, ensuring hazardous materials are responsibly handled and compliance records verifiable.
- **Integrated Bookkeeping Software:** Digital platforms improve shipbreaking documentation, increasing efficiency and regulatory compliance.
- **Cross-Sector Collaboration:** Partnerships among NGOs, governments, and industry stakeholders promote knowledge exchange and best practices.

Conclusion

This research identifies key barriers and opportunities in developing a more transparent and accountable shipbreaking industry through the use of futures methods. It identifies traceability, accountability, and operational visibility as transformative tools for sustainable shipbreaking. Looking ahead, the proposed interventions, such as blockchain-based Digital Product Passports (DPPs), provide scalable proposals for material traceability and compliance. The shipbreaking industry has the potential to become a global model for circular economy practices, influencing not only its immediate stakeholders but also inspiring systemic change in other resource-intensive sectors. This research demonstrates the potential of design-led methodologies to co-create actionable and preferable business futures.