SciencesPo

Which (sustainability-, design-, and lifecycle-related) data is technically feasible for smartphone manufacturers to provide to a Digital Product Passport, and where do feasibility limits emerge across the supply chain?

By Ava Worthington & Joseph Devin

12/05/2026

1. Introduction

1.1. The Need for Digital Product Passports

The rapid growth of electronic waste, increasing regulatory pressure on supply-chain transparency, and the transition toward circular economy models have accelerated international efforts to improve the sustainability and traceability of electronic products. According to the Global E-waste Monitor, the world generated more than 62 million tonnes of electronic waste in 2022,[1] making e-waste one of the fastest-growing waste streams globally. At the same time, global smartphone production continues at a massive scale, with more than one billion devices produced annually through highly complex and geographically fragmented supply chains.[2]

These dynamics place the ICT sector at the centre of emerging sustainability and governance challenges. Smartphones in particular rely on extensive global value chains involving raw material extraction, refining, component manufacturing, assembly, logistics, repair, refurbishment, recycling, and waste management across multiple jurisdictions. A single smartphone may contain more than sixty different raw materials,[3] including several critical minerals associated with environmental pressures, geopolitical dependency, and human rights concerns. Furthermore, the majority of a smartphone's lifecycle environmental impact is concentrated upstream during production stages rather than during product use,[4] making supply-chain visibility and lifecycle data increasingly important for sustainability governance.

In parallel, regulatory frameworks related to environmental, social, and governance (ESG) reporting, corporate due diligence, circular economy policy, and sustainable product design have expanded significantly in recent years. Within the European Union, the Ecodesign for Sustainable Products Regulation (ESPR)[5] represents a major development by introducing the Digital Product Passport (DPP) as a mechanism for improving the accessibility, interoperability, and transparency of sustainability-related product information across value chains. A DPP is a structured digital system designed to make product-related information accessible throughout the lifecycle of a product, enabling actors, including manufacturers, repairers, recyclers, regulators, and consumers, to access sustainability-, design-, repair-, and lifecycle-related data through shared identifiers and interoperable standards.

More broadly, DPP-related discussions are increasingly connected to international efforts surrounding responsible sourcing, waste traceability, lifecycle accountability, and circular economy governance, including frameworks such as the Basel Convention.[6] In this context, DPP's have emerged not simply as technical databases, but as governance and interoperability infrastructures intended to facilitate the structured exchange and usability of product-related information across fragmented value chains.

The ICT sector represents a particularly important field for this development. Due to the complexity of ICT supply chains, the rapid pace of technological renewal, and the strategic role of electronics within

[1] International Telecommunication Union & United Nations Institute for Training and Research. (2024). The Global E-waste Monitor 2024.

[2] International Data Corporation. (2025). Worldwide smartphone shipments grew 6.4% in 2024, despite macro challenges, according to IDC.

[3] European Commission, Joint Research Centre. (2017). Critical raw materials and the circular economy : background report. Publications Office.

[4] Fairphone. (2026b). The impact of consumer electronics on nature and biodiversity.

[5] European Parliament and Council. (2024). Regulation (EU) 2024/1781 establishing a framework for ecodesign requirements for sustainable products.

[6] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. (1989). United Nations Environment Programme.

global sustainability transitions, the implementation of interoperable lifecycle information systems within this sector presents both significant opportunities and substantial operational challenges. Smartphones therefore constitute a particularly relevant case study for assessing the practical feasibility of DPP's in real-world industrial conditions.

1.2. Positioning This Report Within the ITU DPP Work

This report is situated within the development of ITU-T Recommendations L.1070 and L.1071, which together establish the conceptual and technical foundations of DPP's for ICT goods. Recommendation L.1070 defines the scope of sustainability-related information across the product lifecycle, including material composition, manufacturing, energy use, repair, reuse, and recycling.[7] Recommendation L.1071 further develops this framework by proposing structured data models and interoperability principles enabling lifecycle information to be organised and exchanged across actors.[8] Together, these recommendations represent an important step toward the development of interoperable DPP systems for the ICT sector. However, they primarily address the question of what information should ideally be represented within a DPP architecture. Less attention has been devoted to the operational question of what data can realistically be generated, accessed, verified, and shared across fragmented global supply chains.

This report addresses that implementation gap by introducing a feasibility-oriented perspective grounded in primary research across the smartphone value chain. Rather than proposing an ideal DPP architecture, the report focuses on the practical conditions under which DPP-relevant data can be generated, structured, accessed, and disclosed across lifecycle actors operating under real-world technical, commercial, and organisational constraints.

1.3. From Mine to Governance: Primary Research and Methodology

This research adopts a qualitative methodology combining semi-structured expert interviews, literature review, and a structured manufacturer questionnaire to assess the feasibility of DPP data generation, organisation, and disclosure across the smartphone supply chain. The interview programme was designed on the premise that DPP feasibility can only be properly assessed by understanding where lifecycle data is generated, where it becomes fragmented, and where structural limitations emerge across the value chain.

Expert interviews were conducted between March and May 2026 with stakeholders spanning the smartphone lifecycle from upstream extraction to governance and interoperability frameworks. Interviewees were deliberately selected to capture perspectives across the mine, trading layer, manufacturing stage, regulatory environment, and governance architecture simultaneously, enabling the research to identify where DPP implementation remains viable and where it structurally breaks down. The interview sample included specialists in mining certification and artisanal extraction, investigative journalism, commodity trading, smartphone manufacturing, OEM battery sourcing, large-scale manufacturer data infrastructure, EU regulatory policy, and international DPP governance and interoperability design.

The interviewees included:

[7] International Telecommunication Union. (2023). Recommendation ITU-T L.1070.
[8] International Telecommunication Union. (2024). Recommendation ITU-T L.1071.

1. **Uwe Naeher:** Field Geologist and Conflict Minerals Expert, former Project Manager for the German Federal Institute for Geosciences and Natural Resources (BGR), DRC (mine certification and artisanal mining)
2. **Nicolas Niarchos:** Investigative Journalist and Author, The New Yorker (on-the-ground supply chain research, DRC cobalt)
3. **James Nicholson:** Former Global Head of Social Responsibility, Trafigura (commodity trading and responsible sourcing)
4. **Brooke Lawson:** Head of Impact Innovation, Fairphone (smartphone manufacturing and circularity)
5. **David Tobon:** Industry Development Manager and Lead Robotics Expert, Huawei Technologies (large-scale OEM data infrastructure, DPP strategy and geopolitical risk)
6. **Pierre Leturcq:** Founder, Alternative Solutions Consulting; Consultant, IEEP (EU trade and regulatory policy)
7. **Larissa Van Der Feen:** Product Sustainability Data Specialist, UNEP (International DPP governance and Global South inclusion)
8. **Nathalie Paust:** Researcher, Wuppertal Institute (DPIS framework design and interoperability)

The interview series deliberately linked field-level evidence to governance-level design. The combination of mine certification experience, field reporting, commodity trading expertise, smartphone manufacturing evidence, OEM sourcing practices, manufacturer DPP strategy, and international governance perspectives made it possible to assess whether DPP data fields are feasible at the point where they are supposed to be generated, rather than only at the point where they are intended to be displayed.

NB: The views expressed in these interviews are those of the interviewees in their individual expert capacities and do not represent the official positions of their respective employers.

To complement the interview evidence with manufacturer-side operational data, a structured questionnaire was administered to senior representatives of smartphone manufacturers operating in the European market. The questionnaire addressed data availability, system organisation, and disclosure constraints across nine thematic areas spanning the product lifecycle. Two manufacturers were engaged at different points on the transparency spectrum. Fairphone provided the most substantive response thanks to Brooke Lawson, Head of Impact Innovation at Fairphone, supplemented by interview evidence and references to the Fairphone Impact Report (2025) and Nature Report (2026), making it the primary manufacturer case study. Huawei participated through both the questionnaire and a dedicated interview with David Tobon, Industry Development Manager at Huawei, providing the perspective of a large-scale global OEM operating under significant industrial and geopolitical constraints. Together, these cases provide a deliberate contrast between a transparency-oriented manufacturer and a high-volume industrial actor shaped primarily by compliance, scale, and geopolitical considerations.

Smartphones were selected as the primary case study due to the complexity of their supply chains, the diversity of lifecycle actors involved, and the strategic importance of the ICT sector within ongoing DPP standardisation efforts. A complete table of interviewees and institutional affiliations is provided in Appendix A, and the full manufacturer questionnaire is available in Appendix B.

1.4. From Data Models to Data Feasibility

The central gap identified in this research lies between normative DPP data models and operational reality. While current DPP frameworks define increasingly comprehensive categories of lifecycle information, the existence of a theoretical data requirement does not necessarily imply that such data can be reliably generated, standardised, verified, or shared across complex global supply chains. The findings of this research suggest that DPP feasibility depends less on the breadth of information categories theoretically defined within standards than on three operational conditions: whether data already exists within actor systems, whether it can be accessed and exchanged across fragmented supply chains, and whether it can be disclosed without conflicting with commercial, legal, or strategic constraints.

In this context, the report argues that DPP's should not be understood as mechanisms capable of delivering total lifecycle transparency in the short term. Rather, they should be approached as evolving interoperability and governance infrastructures operating within structurally fragmented data environments. The challenge is therefore not only technical, but systemic: designing DPP frameworks that remain credible, implementable, and globally relevant despite uneven data availability, fragmented infrastructures, and competing economic incentives across the value chain.

2. How DPPs Actually Work: Beyond Data to Systems

2.1 DPP as System Infrastructure with DPIS

A DPP does not function as a standalone dataset, but as part of a broader infrastructure combining data, systems, and governance. Rather than a centralised database, the report '*Blueprint for a Global Digital Product Information System (DPIS) Framework*'[9] suggests and puts forward global rules for the emergence of a decentralised DPIS, where data remains sovereign but accessible; *"allowing actors to use data to unlock new circular business models and support sustainable supply chains."*[10] This architecture positions itself as a more realistic DPIS as it seeks to reflect the structure of the smartphone value chain: data is generated at multiple points, from raw material extraction to manufacturing, use, repair, and end-of-life, but is stored across different organisations, systems, and formats.

2.2 Interoperability and Lifecycle Discontinuities

Interoperability is therefore the core enabling mechanism. Frameworks such as the DPIS do not aim to centralise data, but to define common rules for how data can be structured, accessed, and exchanged between actors. This includes shared data categories, harmonised definitions, and technical protocols allowing systems to communicate without requiring full data integration. The caveat being that these frameworks operate on top of existing systems that were not originally designed to function together.

Interoperability remains a significant challenge due to uneven distribution of data, inconsistent granularity, and lack of continuity across lifecycle stages; manufacturers typically maintain structured, product-level datasets, including bill of materials, design specifications, and performance metrics, while upstream suppliers often hold aggregated or non-digitised material data, and downstream actors (repairers, refurbishers, recyclers) generate operational data that is rarely captured in a structured or transferable form.

As a result, data exists in isolated pockets rather than as a continuous lifecycle dataset. Breakpoints occur:

- upstream, where traceability is lost due to aggregation and commingling,
- at organisational boundaries, where data is not shared across firms,
- and downstream, where data is generated but not reintegrated into product-level systems.

[9] UNEP. (2025). *Blueprint for a Global Digital Product Information System (DPIS) Framework*.
[10] Paust, N. (2026, April). Interview on DPIS framework design and global interoperability [Interview]. Sciences Po Capstone Research Team.

Interoperability frameworks can facilitate access to existing data, but they do not resolve structural discontinuities. As Van Der Feen, Product Sustainability Data Specialist at UNEP notes, the issue is less about generating additional data than ensuring that existing data can be *"shared and used across the different stages of the lifecycle"*[11] which remains limited in practice.

In this context, a DPP does not create a unified or complete representation of a product's lifecycle data points. It connects partial datasets that differ in quality, scope, and reliability, and operates within a structurally fragmented data environment. A DPP therefore should be understood as a coordination mechanism across incomplete and uneven data systems.

2.3 Battery Passports as a Regulatory Precedent

The battery sector illustrates this architecture before smartphones. Regulation (EU) 2023/1542 requires relevant batteries to carry an electronic record, the battery passport, from 18 February 2027, including light means of transport batteries, industrial batteries above 2 kWh and electric vehicle batteries.[12] The Battery Pass consortium has translated this legal requirement into detailed implementation guidance and a data longlist of approximately 90 attributes, showing how DPP policy becomes an operational data architecture rather than a simple disclosure exercise.[13]

For smartphone manufacturers the battery passport acts as a regulatory precedent as well as a stress test. It shows manufacturers what the process looks like: identification, data ownership, attribute definition, verification, access rights and lifecycle updates. For this reason, the representative from Huawei stressed that smartphone DPPs should begin incrementally, not as a sudden obligation to comply with an exhaustive list of data points before systems and international definitions have matured.[14]

3. System Architecture: Actors and Data Flow in the Smartphone Lifecycle

3.1 Creation of the Smartphone DPP Data Map: Mapping Lifecycle Actors and Data Locations

The feasibility of aggregating datapoints within the DPP is shaped by how information is distributed and collated across actors throughout the smartphone lifecycle. As such, the DPP Data Map developed in this project emerged as a methodological necessity.

The combination of interview findings and literature review revealed a level of complexity and interdependence between actors that could not be adequately captured through linear analysis alone. A visual mapping approach was therefore developed to represent information flows, actor interactions, and structural discontinuities across the lifecycle. The DPP Data Map functions as a visualisation tool, supporting a more precise understanding of where DPP-relevant information exists, how it circulates, and where feasibility limits emerge.

The DPP Data Map reflects the structure of the smartphone value chain, wherein each category of actor controls a distinct segment of information. Upstream actors, including raw material extractors, refiners, and component suppliers, hold information related to material composition, sourcing, and processing, often at aggregated or batch level. Manufacturers (OEMs) consolidate the most structured product-level datasets, including bills of materials, design specifications, software support information, and

---

[11] Van Der Feen, L. (2026, April). Interview on DPP policy, Global South inclusion and UNEP [Interview]. Sciences Po Capstone Research Team.

[12] European Parliament and Council. (2023). Regulation (EU) 2023/1542 concerning batteries and waste batteries.

[13] Battery Pass Consortium. (2023). Battery Passport Content Guidance: Achieving compliance with the EU Battery Regulation and increasing sustainability and circularity (Version 1.1).

[14] Tobon, D. (2026, May 6). Interview regarding DPP, with Sciences Po [Interview]. Sciences Po Capstone Research Team.

performance metrics. Downstream actors, such as repairers, refurbishers, recyclers, and waste operators, generate operational information related to repair, maintenance, component replacement, reuse, and end-of-life treatment.

Within such a complex environment, the DPP Data Map is intended as a tool to support discussion and debate across a wide range of actors and stakeholders. By providing a systemic visualisation of lifecycle interactions, information flows, and potential DPP touchpoints, it aims to help stakeholders develop a broader understanding of what a DPP encompasses and what it could represent under a best-case implementation scenario.

3.2 Three Structural Patterns in Data Flow

The DPP Data Map highlights three structural patterns.

First, that there is a stronger consolidation of information at the manufacturing stage. OEMs act as the principal aggregating actor where component-level and design information are consolidated into product-level systems. Larger manufacturers therefore possess the highest degree of lifecycle visibility, even if this visibility remains incomplete, as the Representative of Wuppertal Institute shares; *"Larger companies have the information and the data available. When it comes to SMEs, or actors at the end of the supply chain such as recyclers, they don't really have as much data. Recyclers just don't receive as much data as they would need to perform their practices adequately, there should be more opportunities for them to receive data from manufacturers in order to have an adequate database."*[15]

Second, information is available upstream but for commercial or political reasons remains fragmented and uncaptured. Representative from the Wuppertal Institute shares that the DPIS framework should prevent data flows from cutting off beyond Tier 1, while also acknowledging that companies often lack incentives to share upstream information, as she states: *"the data doesn't just cut off at some point, like beyond tier 1 suppliers, for example."*[16] The representative from Huawei confirmed that supply chain visibility stops at Tier 1 suppliers, reflecting broader confidentiality norms within manufacturing ecosystems, as stated *"we are the OEM and then we rely on the tier one. We will not jump over the tier one to talk to the tier two."*[17] Tobon describes this as a normal feature of manufacturing ecosystems because tier-one suppliers protect commercial relationships and confidentiality. This represents the current industry norm as the OEM's right to access can be constrained by contractual, cultural and competitive boundaries that a DPP cannot automatically override.

This perspective is confirmed by Lawson, the Representative from Fairphone, as stated *"Some of our sub-suppliers won't share or don't want to share detailed information because the way information is collected, it includes pricing information, and they don't want that shared."*[18]

Beyond sub-supplier constraints, collecting information remains a challenge upstream, as shared by Investigative Journalist Niarchos; *"Visibility breaks down at three specific choke points: at the pit itself, at the trader depot level inside Congo where artisanal and industrial ore is reportedly commingled, and at the refining stage."*[19]

[15] Paust, N. (2026, April).
[16] Ibid.
[17] Tobon, D. (2026, May 6).
[18] Lawson, B. (2026, April). Interview on DPP feasibility, supply-chain transparency and circular design [Interview]. Sciences Po Capstone Research Team.
[19] Niarchos, N. (2026, April). Interview on critical minerals, DRC cobalt supply chains and DPP traceability [Interview]. Sciences Po Capstone Research Team.

Third, substantial information loss occurs downstream due to dispersion. Although repair, refurbishment, and recycling activities generate valuable operational insights, this information is rarely captured in standardized formats or reintegrated into manufacturer systems. Larissa Van Der Feen, the Representative from UNEP, highlights that downstream lifecycle stages remain significantly less structured than OEM ecosystems, particularly across fragmented waste and repair infrastructures.[20]

3.3 Implications for Lifecycle Continuity

As a result, the smartphone lifecycle functions as a series of partially disconnected stages, wherein information is generated at each point, design, production, distribution, use, repair, reuse, and end-of-life, but is rarely retained, standardised, or transferred in a way that would enable a continuous lifecycle dataset. This fragmentation has direct implications for DPP feasibility. It limits the ability to connect lifecycle stages, weakens feedback loops between actors, and constrains the level of granularity at which product information can be reliably represented.

An operational DPP must therefore function within a system where information is partial, unevenly distributed, and structurally discontinuous, rather than assuming the existence of a fully integrated lifecycle dataset.

4. What Is Technically Feasible: Evidence from Fairphone

4.1 Product-Level Data and Transparency Readiness

Designed with a sustainability emphasis, Fairphone provides an illustrative example of a manufacturer that has invested significantly in product-level sustainability and supply-chain data collection.

Lawson, the Representative from Fairphone, confirms that product-level data exists at a rare granularity in the industry: *"the data exists on the individual device level and can be aggregated up."*[21] This is intentional. Fairphone positions itself as a sustainability pioneer for the wider industry, as stated; *"the whole idea is that Fairphone is the proof, we're out there trying to figure out what can be done and show that it can be done."*[22]

4.2 Environmental, Repairability and Circularity Indicators

Regarding carbon, Fairphone operates a comprehensive Scope 1, 2 and 3 accounting methodology covering all company-wide costs, allocated to a per-device carbon intensity figure updated in real time.[23] E-waste neutrality credits through Argo 360 cover 97% of products sold by weight, and Fairmined credits[24] for cobalt and copper are secured through the Fair Cobalt Alliance.[25] The Representative from Fairphone notes the significance by comparison to other OEM’s who are: *"not partaking in fair mined credits. I find that extraordinary given that the mechanism exists and is operational."*[26] Fairphone's 2026 Nature Report focusing on nature impact and dependencies, is the first to be published by a smartphone manufacturer, and assesses 23 focus minerals across 74 regions in 33 countries, identifying 11 global

[20] Van Der Feen, L. (2026, April).
[21] Lawson, B. (2026, April).
[22] Ibid.
[23] Fairphone. (2026a). Fairphone Impact Report 2025.
[24] Fairmined credits are a volume-based sourcing mechanism allowing companies to financially support certified artisanal and small-scale mining operations without requiring full physical traceability of the minerals throughout the supply chain. https://www.fairphone.com/fr/stories/what-are-fairmined-credits
[25] Fairphone. (2026a). Fairphone Impact Report 2025.
[26] Lawson, B. (2026, April).

mining hotspots with the highest biodiversity risk.[27] Given that approximately 75% of a smartphone's total environmental impact occurs during manufacturing.[28] This component-level granularity is where DPP data collection has its greatest leverage.

Regarding repairability, the Fairphone Gen 6 model achieved a perfect repairability score according to iFixit's independently verified criteria.[29] The Representative from Fairphone emphasises the necessity of a standardised repairability score, notably the iFixit metric[30], to be included within the DPP: *"the iFixit score is a really solid one versus just general claims about what can technically be possible to be repaired, because if the standard general consumer can't actually easily repair it, that's what matters."*[31] In 2025, 2,594 devices were recovered through Fairphone's Reuse and Recycling Programme, with 65% of harvested spare parts reused within the same year and only 30% of devices sent to recycling as a genuine last resort.[32] Without a standardised, verified methodology however, the DPP risks inclusions of self-declared claims which dilute its value and credibility longterm, as warned by the Representative from Fairphone: *"a company could put together a digital product passport that sounds equally good but really isn't. It's like grade inflation: it can just dilute the value of what we're saying."*[33]

4.3 Traceability Ceilings and Practical Alternatives

Despite comprehensive due diligence, Fairphone evidences that maximalist traceability challenges persist. The Representative from Fairphone confirms that full mine-site traceability is *"virtually impossible to actually go down to a specific mine site and say, this is where we source from, because when a smelter or refiner is working with the minerals, they have to in some instances bundle the minerals together to be able to actually process them."*[34] and that overemphasising perfect provenance can create *"a burdensome reporting requirement that is almost impossible to meet."*[35] The policy risk is that maximalist traceability requirements could produce unverifiable reporting rather than real improvement. A credible smartphone DPP should therefore make the limits of traceability visible, rather than implying a level of certainty that the upstream mineral system cannot support.

The Representative of Fairphone highlights that a more credible approach to traceability within the DPP would be to disclose the type of claim being made, whether direct traceability, smelter due diligence, certified sourcing, recycled content, or credit-based support, and to make unknown or unverifiable shares explicit.

By contrast, Tesla shows that deeper traceability is possible when a large OEM has sufficient purchasing power and direct sourcing relationships. Tesla's 2024 Impact Report exemplifies a different feasibility frontier. Regarding nickel, Tesla sourced 49% of the nickel used in its batteries directly from miners and refiners, required traceability and upstream performance improvements for the remainder, and states that *"all nickel used in Tesla batteries in 2024 was traced to its origin of extraction."*[36] Tesla equally reports 17 audits across nickel mines and smelters, 10 product Life Cycle Assessments (LCA) for nickel suppliers or facilities, and site-specific environmental and social impact assessments for mine sites and processing

[27] Fairphone. (2026b). The impact of consumer electronics on nature and biodiversity.
[28] Ibid.
[29] Fairphone. (2026a). Fairphone Impact Report 2025.
[30] iFixit. (n.d.). *Repairability*. Retrieved May 10, 2026, from iFixit Repairability Page
[31] Lawson, B. (2026, April).
[32] Fairphone. (2026a). Fairphone Impact Report 2025.
[33] Lawson, B. (2026, April).
[34] Ibid.
[35] Ibid.
[36] Tesla. (2024). *Tesla impact report 2024*. Tesla, Inc.

facilities entering its supply chain.[37] For lithium, Tesla sourced more than 73% of the lithium used in its batteries directly from mines and refiners, received LCA datapoints for 100% of directly contracted lithium suppliers, and reviewed decarbonisation plans for both directly contracted suppliers and lithium extraction sources supplying those suppliers.[38]

The Tesla example qualifies that full traceability becomes technically feasible for selected high-priority minerals where an OEM redesigns procurement around direct sourcing, supplier contracts, audit rights, LCA data, and upstream leverage. The implication for smartphone DPP design is that full traceability should not be treated as universally impossible or universally available; it is conditional on supply-chain architecture, purchasing power and the degree of direct control an OEM has over upstream actors.

5. The DPP as a Regulatory Requirement: Compliance, Competitiveness, and Data Sovereignty in Global Manufacturing Ecosystems

Huawei illustrates the case of a major non-European manufacturer for whom the European market represents only one segment of a broader global commercial strategy, but one that still requires adaptation to EU regulatory conditions. In this context, the DPP is not approached primarily as a voluntary sustainability instrument, but as a potential market-access requirement. This creates a structural bifurcation between globally integrated supply chains optimised for scale and region-specific regulatory expectations requiring additional data collection, interoperability and transparency mechanisms.

Huawei's perspective is therefore particularly relevant because it reflects the conditions under which DPP systems would need to function for large-scale global manufacturers entering, or re-entering[39], the European market. According to Tobon, Huawei's DPP-related efforts are currently compliance-driven *"we are not doing anything for phones because there is no regulation requiring it yet."* [40] This confirms a broader finding across interviews: DPP adoption among mainstream manufacturers is unlikely to be driven by voluntary transparency alone. Instead, it becomes operationally relevant when regulation, market demand or consumer expectations create a clear business case.

This is especially important for a foreign OEM operating across multiple regulatory environments. Huawei approaches DPPs from the standpoint of a multinational competing across global markets. In this context, DPPs are not viewed solely as environmental tools, but equally as instruments capable of reshaping industrial competition, data governance and market access.[41] The Huawei Representative's use of the term *"technical tariff"* is significant, raising the concern that collecting DPP data is technically possible, but that the way disclosed data is measured, benchmarked and enforced could create a technical market-access condition if standards are set unilaterally by European authorities without sufficient dialogue with major producing countries, as he explains: *"If Europe makes its own data standards without a formal dialogue with India, with China, with Japan, this can be seen as a unilateral regulation and a technical tariff."*[42] From this vantage point, additional European-led regulatory infrastructures, particularly around lifecycle data, traceability, thresholds and compliance verification, may be perceived

[37] Tesla. (2024). *Tesla impact report 2024*. Tesla, Inc.
[38] Ibid.
[39] Huawei's smartphone market share in Europe sharply declined after U.S. export restrictions and the 2019 Android/Google services ban prevented the company from providing Google Mobile Services on new devices, significantly reducing their attractiveness for European consumers. See Elsas-Nicolle, A. (2025). *Threats, bans, and competition: Ripple effects in the global smartphone market* (hal-05358064). HAL Open Science.
[40] Tobon, D. (2026, May 6).
[41] Ibid.
[42] Ibid.

as both environmental measures as well as technical regulation capable of affecting competitiveness.[43] The DPP therefore sits at the intersection of sustainability policy, industrial strategy and geopolitical trust.

This concern appears explicitly in the 2025 report published by the China Academy of Information and Communications Technology and the China National Institute of Standardization, which frames European DPP initiatives as having implications for *"industrial security"* and *"data sovereignty"*, while also emphasising the need to avoid *"green trade barriers"* and reduce compliance costs for Chinese exporters.[44] The report repeatedly promotes a strategy of *"mutual recognition instead of access"*, reflecting concern about excessive dependence on foreign-controlled systems and standards.[45] For Huawei, DPP feasibility encroaches upon data sovereignty concerns notably that data is internationally interoperable, commercially fair and politically acceptable.

At the operational level, Huawei's experience highlights the structural complexity of achieving lifecycle data continuity across global supply chains. While manufacturers often possess detailed internal engineering and production data, visibility declines significantly beyond Tier 1 suppliers. The Representative explains that Huawei generally relies on Tier 1 suppliers and does not bypass them to access Tier 2 or Tier 3 actors, because supplier identities and relationships are treated as commercially confidential, as stated; "*We will not jump over the tier one to talk to the tier two."*[46] The challenge is therefore not simply generating more information, but ensuring that information can circulate in ways that remain technically interoperable, commercially acceptable, legally compliant and geopolitically manageable.[47]

This reinforces a central finding of this research, notably that collating information for the DPP may be dependent on legal, economic, commercial and geopolitical conditions surrounding data exchange.[48] A DPP system may be technically feasible as an IT architecture, but still fail operationally if it requires exposing commercially sensitive data, duplicates incompatible regional standards or creates asymmetric compliance burdens.

The Huawei case elucidates that realistic DPP implementation at industrial scale requires a phased approach rather than fully comprehensive architectures all at once. The Huawei Representative proposed an incremental approach: begin with a smaller number of internationally agreed parameters and expand gradually as supplier systems, verification methods and cross-border data governance mature.[49] Regarding availability of data; high-confidence datasets already generated within manufacturer systems, such as product identity, software support periods, battery information, selected repairability information and model-level environmental data, appear significantly more feasible currently than highly granular upstream traceability requirements or continuous full-lifecycle monitoring systems.[50]

---

[43] Counterpoint Research. (2021, March 1). European smartphone market down 14% YoY in 2020; Xiaomi gains while Huawei and Samsung lose.
[44] China Academy of Information and Communications Technology & China National Institute of Standardization. (2025). Report on Digital Product Passport (DPP) Technology Development (2025).
[45] Ibid.
[46] Tobon, D. (2026, May 6).
[47] Ibid.
[48] Ibid.
[49] Ibid.
[50] Ibid.

The Huawei Representative highlights the Catena-X[51] and data-space models as relevant case studies in order to achieve interoperability whilst preserving data sovereignty. Catena-X is a decentralised data-space architecture designed to enable trusted supply-chain data exchange between firms while preserving data sovereignty. The Catena-X offers a model for interoperability which does not force all actors into a single centralised repository. The Huawei Representative's reference to Catena-X reflects a preference for industry-to-industry technical dialogue, pilots, memoranda of understanding and interoperability testing, rather than top-down regulatory imposition alone.[52]

The Huawei case demonstrates why DPP implementation cannot be understood only through the lens of technical data availability. For a manufacturer entering the EU regulatory space, the DPP raises questions of competitiveness, data sovereignty, regulatory trust and standard-setting power. The Huawei case study demonstrates the significance of building the smartphone DPPs within a system perceived as proportionate, phased and internationally co-produced. If designed in this way, the DPP becomes a credible mechanism for lifecycle transparency. If designed as an exhaustive set of unilateral requirements before systems and definitions have matured, it risks being interpreted as a *technical tariff* rather than a shared sustainability infrastructure.

6.3 Batteries as a Regulatory Preview for Smartphones

The Huawei Representative indicates that DPP-relevant data practices within Huawei are currently more developed for large batteries than for smartphones. This is fitting given the EU regulation 2023/1542 requiring an electronic battery passport from 18 February 2027 for light means of transport batteries, industrial batteries above 2 kWh and electric vehicle batteries placed on the EU market, and the Battery Pass guidance translates this into a practical implementation pathway with approximately 90 data attributes.[53] In this way, batteries have given Huawei a first practical view of what DPP implementation looks like: compliance-driven data collection, lifecycle reporting, third-party verification, digital identification and eventual disclosure through a structured passport system. However, such data accumulation is limited at smartphone-level for Huawei. As of yet, post-market smartphone data is not systematically captured, repair data is not digitally retained or product-linked, and feedback into design remains focused primarily on conventional product performance rather than circularity or repairability.[54]

The Representative from Huawei explains Huawei's market-innovation logic is driven by consumer demand: *"if we do not see that the consumer is asking for this, we will not do it"*, "*Huawei will always look to stimulate growth everywhere by innovation. DPP could be innovative and generate new streams of revenue, we support that*", because Huawei *"mostly care[s] about the innovation on the phone"* and consumers are *"not asking for this yet."*[55] In this light, DPP-relevant smartphone data is not currently treated as consumer-led innovation, but as a future compliance requirement that would only become operationally relevant once regulation, market demand or both make it necessary. This highlights that voluntary DPP frameworks alone are unlikely to move the mainstream smartphone industry at scale.[56]

---

[51] Catena-X (https://catena-x.net/) is an industry-led data ecosystem "*Enabling globally trusted, interoperable, and regulatory-compliant product data exchange across the automotive value chain. As the EU and other regions mandate Digital Product Passports by 2027, Catena-X provides the open, standardized, and vendor-agnostic foundation to make it happen, connecting manufacturers, suppliers, and service providers in a secure and sovereign dataspace.*"
[52] Tobon, D. (2026, May 6).
[53] European Parliament and Council. (2023). Regulation (EU) 2023/1542; Battery Pass Consortium. (2023). Battery Passport Content Guidance.
[54] Tobon, D. (2026, May 6).
[55] Ibid.
[56] Lawson, B. (2026, April); Tobon, D. (2026, May 6).

7. Where Information Along the Supply Chain Breaks: Physical, Systemic, Strategic Limits

In this research, 'upstream actors' refer to all actors involved before the OEM stage (raw material extraction, refining, component manufacturing), while 'downstream actors' refer to all actors involved after product placement on the market, including repair, refurbishment, collection, and recycling.

7.1 Physical Limits and Material Fungibility Upstream

One of the most fundamental constraints on DPP data feasibility is not technical but physical. At the smelter and refiner stage, minerals from multiple sources are blended together as a necessary part of the processing operation. This commingling makes it structurally impossible to trace a specific material back to the mine from which it was extracted, regardless of how sophisticated the data architecture above it may be. The Fairphone Representative is direct on this point: *"it is virtually impossible to actually go down to a specific mine site and say this is where we source from, because when a smelter or refiner is working with the minerals, they have to in some instances bundle the minerals together."*[57] This is not a data gap that investment in traceability systems can close. It is a physical property of how industrial refining works.

Field evidence from the DRC confirms that the problem compounds at multiple points upstream. The New Yorker Investigative Reporter, drawing on direct fieldwork across artisanal mine sites, trader depots, and refining operations, identifies three structural break points: the pit itself, where documentation is often absent; the trader depot, where artisanal and industrial ore is commingled before leaving the extraction zone; and the refining stage, where the concentration of global cobalt processing[58] creates a bottleneck at which chain-of-custody verification consistently breaks down, and *auditors rarely penetrate.*[59] The Field Geologist & Conflict Minerals Expert, who oversaw certification programmes across more than 90 mine sites in Eastern DRC, independently corroborates this analysis: fungibility at the input stage is the fundamental reason that existing traceability schemes such as ITSCI[60] consistently fail to deliver on their stated purpose.[61]

The constraint is not uniform across all materials. The Field Geologist & Conflict Minerals Expert draws an important distinction between mineral types; *"the 3Ts are very well controlled, but copper and cobalt are less controlled"*. For 3T minerals, tin, tantalum and tungsten, smelter-level certification is comparatively well established, with recognised audit mechanisms and certification bodies that have developed over more than a decade of conflict minerals governance. For copper and cobalt, the situation is fundamentally different. At the refining stage for these minerals, industrial and artisanal production streams are blended together into battery precursors before being supplied to battery manufacturers across Asia and ultimately back into consumer markets globally. It is at this point, where commingling and limited third-party verification coincide, that traceability is lost, a phenomenon coined as *"the big black box."*[62] As the former Field Geologist & Conflict Minerals Expert describes it, this creates a structural opacity: once industrial and artisanal cobalt are processed together, there is no mechanism to disaggregate

[57] Lawson, B. (2026, April).
[58] According to the European Commission Raw Materials Informations dashboard, 78% of the world's cobalt is refined in China https://rmis.jrc.ec.europa.eu/rmp/Cobalt
[59] Niarchos, N. (2026, April).
[60] ITSCI is an industry traceability and due diligence program designed to monitor and certify the responsible sourcing of tin, tantalum, and tungsten (3TG) minerals from conflict-affected and high-risk areas. https://www.itsci.org/about-itsci/
[61] Naeher, U. (2026, April). Interview on critical raw materials, ASM conditions and traceability [Interview]. Sciences Po Capstone Research Team.
[62] Ibid.

them or attribute the resulting material to a specific source.[63] A smartphone DPP therefore needs to distinguish between different levels of verifiability that exist by mineral type, and avoid creating equivalences between well-audited 3T supply chains and cobalt and copper chains where that audit infrastructure does not yet exist.

The practical implication for DPP design is clear; credibility over maximalism. A passport should credibly disclose the type of claim being made, recycled content, Fairmined credits, book-and-claim support, mass balance certification, but it should not imply that every material in a finished device can be traced to a specific mine site (unless this is the case).

Despite Fairphone's commitment to a sustainable and ethical supply chain sourcing, structural limits persist. Fairphone's Gen 6 material disclosure provides a prevalent illustration of this ceiling: 51.31% of materials by weight are classified as fair or recycled, while 48.69% remains unknown. Nonetheless, this the most rigorous public disclosure of this kind in the smartphone industry.[64] A DPP standard should clarify and spotlight this ceiling as a structural reality or risk producing false claims, which would not serve the goal of credible sustainability governance.

7.2 Systemic Fragmentation and Downstream Data Loss

System-level fragmentation compounds these physical limits. Fairphone has mapped 20 tier-3 suppliers, which it describes as *"still a fraction"* of the total[65], illustrating that DPP feasibility declines sharply as data moves from OEM-controlled systems to indirect supplier networks. The representative from UNEP identifies this precisely: upstream manufacturers are growing more aware of DPP data demands, but their readiness to respond remains *"very limited."*[66] Downstream actors face the same gap from the other direction. As the representative from the Wuppertal Institute (2026) observes, *"recyclers just don't receive as much data as they would need to perform their practices adequately"*[67], reinforcing discontinuities at precisely the points where circular economy value is highest.

The structural response to this fragmentation is to design the DPP in a way that progressively reduces the gap. The representative from UNEP frames this precisely[68]: rather than treating incomplete data as non-compliance, the framework should distinguish between what is verified, what is estimated, and what remains unavailable, making the limits of transparency visible rather than concealing them behind a uniform disclosure template. The representative from the Wuppertal Institute reinforces this with a design logic that moves away from exhaustive data capture toward interoperability and usability: *"Our goal isn't to add more compliance tasks for manufacturers, it is to move from information requirements to empowerment, allowing actors to use data to unlock new circular business models and support sustainable supply chains."*[69]

The Representative from Huawei, approaching the same problem from an industrial-scale perspective, advocates for a phased approach: *"Start with 20 parameters and gradually industry can add more parameters. It should be driven by industry in close cooperation with regulators."*[70]

[63] Naeher, U. (2026, April).
[64] Fairphone. (2026a). Fairphone Impact Report 2025.
[65] Ibid.
[66] Van Der Feen, L. (2026, April).
[67] Paust, N. (2026, April).
[68] Van Der Feen, L. (2026, April).
[69] Paust, N. (2026, April).
[70] Tobon, D. (2026, May 6).

Enhanced credibility would be achieved by building a modular DPP architecture: a first tier anchored in manufacturer-controlled data that already exists and can be reliably structured; a second tier that progressively integrates supplier, repair, and reuse data as digital infrastructure matures across the chain; and a third tier reserved for advanced fields, mine-level provenance, real-time lifecycle tracking, downstream material recovery data, that should be clearly labelled as conditional or in development rather than presented as current requirements. In this way, the DPP design should clarify what is feasible today, what is not yet feasible, and make explicit this distinction.

7.3 Strategic Opacity and Commercial Confidentiality

Commercial and strategic confidentiality introduces a further layer of constraint: data that exists within the supply chain but is deliberately not shared.

The Representative from Fairphone illustrates this point: *"A large electronics company could always offer a better deal than Fairphone because of the volumes they purchase in, so there are non-disclosure agreements in contracts that create these limitations."*[71] Supplier data sharing is constrained by the competitive dynamics of multi-tier supply chains, where disclosure at one tier can inadvertently expose sourcing relationships that confer market advantage, as stated: *"Some of our sub-suppliers will not share detailed information because the way information is collected, it includes pricing information and they do not want that shared. It can be a market advantage or a distinguisher."*[72]

Nicholson, Commodity Trading Expert who holds professional expertise from De Beers and Trafigura, adds a structural dimension, highlighting that large buyers routinely structure purchasing through intermediaries specifically to avoid due diligence requirements: *"In the trading sector, I saw a consistent and deliberate pattern: certain market participants, financiers, suppliers and buyers included, structured transactions through chains of third parties specifically to manufacture opacity and distance themselves from upstream realities. This was not risk management; it was risk displacement or 'layering'."*[73] Such competing economic interests demonstrate that voluntary frameworks alone cannot ensure enhanced transparency.

The New Yorker Investigative Reporter lends an ethical dimension to this strategic constraint. Niarchos' claim that *"each transfer launders accountability"* shows why DPP systems must not only collect data but equally prevent the conversion of fragmented reporting which allows for moral distancing.[74] This supports a design requirement for independent verification, community input and clearly labelled uncertainty rather than a single manufacturer-controlled disclosure claim.

8. System-Level Implications: From Aspirational to Implementable

8.1 Sequencing Implementation

The central policy risk is that DPP requirements become aspirational rather than implementable. The existence of a data model does not mean every field is available, verifiable, or safely disclosable at the same level of granularity. The representative from UNEP captures this succinctly: *"there is definitely tension where it may look like some of the policies or frameworks being developed are more aspirational. It may then arise that there is some tension between what is feasible and what is really necessary for these*

[71] Lawson, B. (2026, April).
[72] Ibid.
[73] Nicholson, J. (2026, April). Interview on commodity trading, supply-chain power and ESG backlash [Interview]. Sciences Po Capstone Research Team.
[74] Niarchos, N. (2026, April).

transitions to happen."[75] The appropriate response is sequencing: begin with high-confidence fields already measured and structured by advanced manufacturers, repairability scores, software support periods, product carbon footprint, material categories, smelter and refiner due diligence status, and e-waste claims, then extend toward greater granularity as supplier systems mature. Fairphone demonstrates what this first tier looks like in practice: a reduction in product carbon footprint from 42 kg CO2e for the Fairphone 5 to 29 kg CO2e for the Gen 6, a 10 out of 10 iFixit repairability score, eight years of software support, and over 50% fair-sourced materials by weight.[76]

Huawei's evidence supports a sequential logic so as to avoid hampering industry innovation. The Huawei Representative highlights this as follows: "*You fund the industry so the industry can do innovation. When something works well, maybe you regulate. I call it sustainable sustainability: try to be green, but carefully, staged approach, to really keep business healthy and factories open in the EU."*[77] From an industry perspective attempting immediate compliance with a large number of fields risks turning sustainability into a cost and compliance exercise rather than an innovation process.

The first and central challenge is to avoid a DPP design that does not reflect the reality of supply chain fragmentation and competing economic interests. Expert perspectives compiled in this research converge in their preference for credibility over maximalism, wherein a starter kit logic emerges, which includes staged implementation, modularity, and clarity on data limits.[78]

8.2 Avoiding Fragmentation and Supply Diversion

Fragmentation across competing DPP formats amplifies the implementation risk.

Tesla's participation in two consecutive Global Battery Alliance battery passport pilots, published in 2023 and 2024, illustrates precisely what coordinated standardisation can achieve: a single, harmonised framework in which cell manufacturers representing over 80% of global electric vehicle battery market share mobilised their supply chains from mining to recycling under shared rulebooks and comparable data structures.[79]

Without a level playing field built on shared standards, the transparency signal that the DPP is designed to create cannot function, as Ferdinand Maubrey, Head of Responsible Sourcing, Battery Supply Chain & Battery Minerals, at Tesla illustrates with the case of the Battery Passport: *"Tesla piloted the Battery Passport and collected the relevant environmental and social data points on our cobalt supply chain. While a lot more work needs to be done to cover all relevant areas across battery mineral supply chains, standard reporting across a level playing field certainly has a role to play in the transition towards sustainable energy."*[80] The lesson for smartphone DPPs is clear: where multiple non-interoperable frameworks proliferate, the collective leverage that makes traceability meaningful is diluted, and manufacturers will gravitate toward whichever standard asks the least of them. As the UNEP Representative summarises: *"China is developing a DPP-like system, Russia has a DPP-like system, and then the European Commission. And these are not necessarily interoperable with each other."*[81]

Multiple and non-coordinated passport frameworks would have the effect of diluting collective impact. The Representative from Alternative Solutions Consulting reinforces this warning with a structural

[75] Van Der Feen, L. (2026, April).
[76] Fairphone. (2026a). Fairphone Impact Report 2025.
[77] Tobon, D. (2026, May 6).
[78] Paust, N. (2026, April); Van Der Feen, L. (2026, April); Tobon, D. (2026, May 6).
[79] Global Battery Alliance. (2024). *Battery passport MVP pilots*.
[80] BEST Magazine. (2023, January 20). *Global Battery Alliance launches battery passport concept*.
[81] Van Der Feen, L. (2026, April).

reflection from his legislative experience with the European Union Deforestation Regulation (EUDR)[82]: regulations that demand impossible precision incentivise elaborate but unverifiable documentation rather than genuine improvement, and circumvention risks must be anticipated from the design stage rather than discovered during implementation, as stated; "*You don't want to see a replication with critical raw minerals of what happens with soy, where the greenest or most responsible share of production is sent to the EU and the rest is shared to other markets, with almost a clear certainty from those actors that they will keep benefiting from access to other markets with far less stringent requirements. China sends the green part of their steel production to the EU, pays no CBAM price, but keeps producing as much coal-based steel because they know they have other markets."*[83]

The Representative from Alternative Solutions Consulting's supply diversion warning is particularly relevant to DPPs. If only EU-destined smartphones require the highest data and sustainability standards, manufacturers may route their cleanest or best-documented products to Europe while maintaining lower standards elsewhere, repeating what occurred with soy, green steel and EU Carbon Border Adjustment Mechanism-related contexts.[84] As confirmed by the Representative from Alternative Solutions Consulting: *"I think that's the lesson we got from the EUDR, you can anticipate the scale of the circumvention risks early enough, or discover them along the legislative and implementing process. Some of the obligations of the EUDR actually didn't really make sense. So I would be very careful, and design things in a way that from the start anticipate the potential circumvention risks."*[85] This means DPPs must be designed with considerations towards global standards and trade repercussions and not only as a European market-access filter.

8.3 Inclusivity As A Design Requirement

Global inclusivity is the second major implication. Designing frameworks that assume high levels of digital literacy and infrastructure risks entrenching existing inequalities under the banner of sustainability. The Representative from UNEP notes the risk of the DPP functioning as a de facto trade barrier for manufacturers in lower-income countries, as stated: *"That is a risk that we often hear from member states, particularly in the Global South, that they are unable to comply and that this might pose a new trade barrier. So that's definitely a concern that we take very seriously, and one that also needs to be addressed."*[86]

With this concern in mind, the Representative from the Wuppertal Institute confirms that the DPIS framework is designed with flexible implementation to mitigate discrimination: *"Our approach was to suggest common definitions and interoperability principles, but to provide flexibility when it comes to implementation. A common alignment ensures that a product passport is recognised globally, flexibility ensures that a small manufacturer in a developing economy can actually implement it without being excluded from the market."*[87] Inclusivity is fundamental to the design of the DPP if it is to function as a global standard rather than a regional compliance instrument.

9. Implications: Feasible and High-Impact Design

[82] See https://green-forum.ec.europa.eu/nature-and-biodiversity/deforestation-regulation-implementation_en
[83] Leturcq, P. (2026, April). Interview on EU trade policy, EUDR, CBAM and DPP design [Interview]. Sciences Po Capstone Research Team.
[84] Ibid.
[85] Ibid.
[86] Van Der Feen, L. (2026, April).
[87] Paust, N. (2026, April).

9.1 Design Principle: Credibility Before Maximal Coverage

The findings of this report point toward a practical design principle for future DPP work: prioritise credibility, usability, inclusivity and interoperability over maximal data coverage. A DPP framework that asks for too much, too early, risks producing reporting burdens, unverifiable claims, and uneven implementation across manufacturers and regions.

9.2 Priority Recommendations

Firstly, prioritise a core set of high-confidence credible data fields. Early implementation should focus on information that manufacturers are already more likely to structure internally, such as product identity, model information, software support period, repairability information, battery characteristics, spare-part availability, and selected environmental indicators. These categories offer a stronger starting point than highly granular upstream claims that cannot yet be reliably verified across global supply chains.

Secondly, DPP's have the opportunity to make uncertainty visible. DPP frameworks should clearly distinguish between verified, estimated, and unavailable data in order to avoid creating false precision. DPPs should not imply certainty where the underlying supply chain cannot support it. Mine-level traceability, precise environmental attribution, or continuous lifecycle monitoring may represent important long-term ambitions, but where evidence remains incomplete or structurally constrained, these limitations should be made explicit to the user. In this sense, the value of the DPP is not to claim total transparency, but to provide a credible representation of what is known, what is verified, what is estimated, and where data gaps persist. This would make the DPP a trustworthy and operationally credible instrument for sustainability governance and supply chain transparency.

Thirdly, promote modular implementation. Rather than designing DPPs as fully populated lifecycle passports from the outset, the framework should allow staged expansion. A first module could cover manufacturer-controlled data; later modules could progressively integrate supplier, repair, reuse, and recycling data as interoperability and verification capacities improve.

Fourth, treat interoperability as a governance priority, not only a technical requirement. The Huawei case shows that DPPs will not scale globally if they are perceived as regionally imposed systems or *"technical tariffs'* as stated by the Huawei Representative; "*There is no global standard for calculation methods agreed by all players as of today. Semantic interoperability of the DPP will be a huge challenge.'*[88] Alignment with non-European actors, including Chinese, Japanese, Korean, and Global South manufacturers, should therefore be built into the standard-setting process from the beginning.

9.3 Interoperability, Catena-X and Multilateral Standard-Setting

This is where Catena-X and other data-space models may become relevant. Tobon endorses the Catena-X model, which is decentralised and relies on industry-led technical dialogues, to be used as a template for making DPP data exchange credible across jurisdictions.[89] Translating that logic into globally neutral principles includes interoperability without forced centralisation, data sovereignty without exclusion, and phased standards without permanent fragmentation.

Furthermore, supporting incentive-based participation may have positive repercussions. Compliance should not be the only driver of meaningful data sharing. DPP frameworks have the opportunity to be designed to create value for actors across the supply chain: manufacturers through market recognition,

---

[88] Tobon, D. (2026, May 6).

[89] Ibid.

repairers through better access to technical information, recyclers through improved material identification, and consumers through clearer product information.

Finally, the DPP framework should treat social and occupational harms as part of the feasibility and transparency discussion, rather than an external ethical context. An example regarding mine safety is highlighted by the Field Geologist & Conflict Minerals Expert, as follows: *"Mine safety is, in my opinion, a much bigger problem than child labour, because people get hurt all the time. There's landslides, there's collapses of mine tunnels [...] I counted over 100 incidents from 2011 to 2020, with over 842 people killed and 335 injured, just in DRC. There's no mine rescue team, no mine safety equipment, or very rudimentary equipment. There's no first aid stations. The child labour aspect is totally small compared to the safety aspect. That is the most important overlooked aspect."*[90] A DPP focused only on provenance or conflict status may miss significant and non-mentioned harms most relevant to environmental or human wellbeing.

Taken together, these recommendations encourage a positioning of the DPP as an evolving infrastructure for progressively improving data quality, interoperability, and inclusivity across the smartphone value chain.

10. Conclusion

10.1 Core Feasibility, Conditional or Constrained

This section distinguishes feasible, conditional and constrained data, giving concrete examples for each category, linking feasibility to system and incentive constraints, and highlighting the risks of overreach.

Across expert interviews, impact reports as well as the results from the manufacturer's survey, three levels of feasibility emerge. At the highest level of data availability for manufacturers, standardised data sets exist for repairability, component composition, software support, and lifecycle metrics and can be reliably included. These are areas where data is both available and structurally compatible with disclosure.

At an intermediate level of data availability, data sets exist for supplier information, regional environmental impacts, and circularity flows but remain difficult to standardise or share. In these cases, the challenge is interoperability, as shared by Nathalie, Researcher at the Wuppertal Institute, "*Our approach was to suggest common definitions and interoperability principles, but to provide flexibility when it comes to implementation. A common alignment ensures that a product passport is recognised globally, flexibility ensures that a small manufacturer in a developing economy can actually implement it without being excluded from the market."*[91]

At the lowest level, certain data categories remain structurally constrained. Full material traceability, real-time lifecycle tracking, and precise environmental attribution remains opaque or complex due to physical processes, fragmented systems, and strategic non disclosure. Even with advanced sustainability objectives the value of transparency sometimes outweighs its costs, as the Representative from Fairphone reflects: *"if we're investing time in producing a digital product passport, what are we not doing instead?"*[92]

Designing effective DPPs therefore requires aligning technical capability with economic reality, prioritising what is feasible today, while building the conditions for greater transparency over time.

[90] Naeher, U. (2026, April).
[91] Paust, N. (2026, April).
[92] Lawson, B. (2026, April).

The central finding of this research is that smartphone DPP feasibility is tiered, conditional and actor-dependent. Some data is technically feasible today because it already exists within manufacturer systems: product identity, model specifications, software support periods, repairability information, spare-part availability, selected material composition and selected environmental indicators. Other data is feasible only with system changes: repair histories, battery health, refurbishment outcomes, component replacement histories and downstream end-of-life data. A final category remains structurally constrained under current conditions: full mine-level provenance, real-time lifecycle tracking, precise environmental attribution and product-instance social impact data across global supply chains. These limits define the conditions under which a DPP can be credible.

10.2 Strategic Choices for Implementation

The Fairphone and Huawei cases together sharpen this conclusion. Fairphone demonstrates the upper boundary of what can be achieved when sustainability is built into the business strategy, design choices and supplier engagement. Huawei demonstrates the industrial reality of a non-EU adhering to EU regulations, as stated by the Huawei Representative as follows: "*If we do not see that the consumer is asking for this, we will not do it. We do it because the European Union is saying Battery vendors need to do it for the large batteries above 2.0KWH, but our priority is about the innovation on the phone. The consumer, at least to my knowledge, is not asking for this yet. So there is no process in place for the phones to capture data digitally during the repair process. If DPP is deployed successfully and ROI is found, then this concept can extend to other products.*"[93]

10.3 Final Recommendation

Our recommendation is that the smartphone DPP should not be a maximalist attempt at disclosure. It should prioritise inclusivity, credibility and global interoperability that distinguishes verified data from estimated data, product-level data from model-level data, and feasible data from unavailable data. It should make transparency limits visible, not hide them behind comprehensive templates. Over time, as supplier systems mature, repair data is digitised, battery health standards develop, and cross-border data governance becomes clearer, the DPP can expand toward a more innovative vision.

This staged approach equally reduces the risk that the DPP becomes a *"technical tariff"*[94] or a regional compliance barrier. If the passport is designed through multilateral dialogue, with battery-producing countries, major OEM jurisdictions, Global South manufacturers, repairers, recyclers and civil society, it can become a coordination infrastructure for circularity. If it is designed as an exhaustive European checklist imposed before data systems exist, it risks generating compliance theatre, supplier secrecy, trade diversion and consumer confusion. The policy should nonetheless be ambitious, whilst retaining feasibility. An ambitious agenda that is sequenced, verified and globally interoperable is preferable to an ambition that is formally comprehensive but operationally fragile.

The value of the DPP lies not in requiring perfect data immediately, but in specifying the credibility and status of the data: verified, estimated, commercially restricted or unavailable. A passport that discloses uncertainty may be more useful than one that presents incomplete evidence as full traceability. The opportunity is to ensure that DPP development is technically grounded, globally inclusive, and draws upon expertise and knowledge throughout the supply chain to clarify data limits. We recommend that the DPP be designed with these principles in mind and be positioned as an evolving, ambitious digital architecture.

[93] Tobon, D. (2026, May 6).

[94] Ibid.

References

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. (1989). United Nations Environment Programme. https://www.basel.int/

Battery Pass Consortium. (2023). Battery Passport content guidance: Achieving compliance with the EU Battery Regulation and increasing sustainability and circularity (Version 1.1). https://thebatterypass.eu/

BEST Magazine. (2023, January 20). *Global Battery Alliance launches battery passport concept*. https://www.bestmag.co.uk/global-battery-alliance-launches-battery-passport-concept/

Catena-X. (n.d.). *The automotive network*. https://catena-x.net/

China Academy of Information and Communications Technology & China National Institute of Standardization. (2025). Report on Digital Product Passport (DPP) technology development (2025). CAICT & CNIS. https://www.caict.ac.cn/english/research/whitepapers/202507/t20250731_687661.html (chinese version available online, english version provided to the research team by David Tobon)

Counterpoint Research. (2021, March 1). European smartphone market down 14% YoY in 2020; Xiaomi gains while Huawei and Samsung lose. https://www.counterpointresearch.com/insights/european-smartphone-market-2020/

Elsas-Nicolle, A. (2025). *Threats, bans, and competition: Ripple effects in the global smartphone market* (hal-05358064). HAL Open Science. https://hal.science/hal-05358064v1/file/Trade_War_2_0%20%281%29.pdf

European Commission, Joint Research Centre. (2017). Critical raw materials and the circular economy : background report. Publications Office. .https://publications.jrc.ec.europa.eu/repository/handle/JRC108710

European Parliament and Council. (2023). Regulation (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC. Official Journal of the European Union, L 191, 1-117. https://eur-lex.europa.eu/eli/reg/2023/1542/oj/eng

European Parliament and Council. (2024). Regulation (EU) 2024/1781 of 13 June 2024 establishing a framework for ecodesign requirements for sustainable products. Official Journal of the European Union. https://eur-lex.europa.eu/eli/reg/2024/1781/oj/eng

Fairphone. (2026a). Fairphone impact report 2025. Fairphone B.V. https://www.fairphone.com/en/impact/impact-report/

Fairphone. (2026b). The impact of consumer electronics on nature and biodiversity. Fairphone B.V. https://www.fairphone.com/wp-content/uploads/2026/03/The-impact-of-consumer-electronics-on-nature-and-biodiversity.pdf

Global Battery Alliance. (2024). *Battery passport MVP pilots*. https://www.globalbattery.org/battery-passport-mvp-pilots/

iFixit. (n.d.). *Repairability*. Retrieved May 10, 2026, from iFixit Repairability Page

International Data Corporation. (2025, January 13). Worldwide smartphone shipments grew 6.4% in 2024, despite macro challenges, according to IDC. Business Wire. https://www.businesswire.com/news/home/20250113500219/en/Worldwide-Smartphone-Shipments-Grew-6.4-in-2024-Despite-Macro-Challenges-according-to-IDC

International Telecommunication Union. (2023). Recommendation ITU-T L.1070: Global digital sustainable product passport opportunities to achieve a circular economy. ITU. https://www.itu.int/rec/T-REC-L.1070

International Telecommunication Union. (2024). Recommendation ITU-T L.1071: A model for digital product passport information on sustainability and circularity. ITU. https://www.itu.int/rec/T-REC-L.1071

International Telecommunication Union & United Nations Institute for Training and Research. (2024). The Global E-waste Monitor 2024. ITU. https://www.itu.int/pub/D-GEN-E_WASTE.01-2024

Lawson, B. (2026, April). Interview on DPP feasibility, supply-chain transparency and circular design [Interview]. Sciences Po Capstone Research Team.

Leturcq, P. (2026, April). Interview on EU trade policy, EUDR, CBAM and DPP design [Interview]. Sciences Po Capstone Research Team.

Maubrey, F. (2026, April). Interview on direct sourcing, GBA battery passport and collective action [Interview]. Sciences Po Capstone Research Team.

Naeher, U. (2026, April). Interview on critical raw materials, ASM conditions and traceability [Interview]. Sciences Po Capstone Research Team.

Naeher, U. (2020). A Compilation of accidents in DRC mining sites from 2011 to 2020. Version 1, 27.09.2020. BGR Kinshasa 2020.

Niarchos, N. (2026, April). Interview on critical minerals, DRC cobalt supply chains and DPP traceability [Interview]. Sciences Po Capstone Research Team.

Nicholson, J. (2026, April). Interview on commodity trading, supply-chain power and ESG backlash [Interview]. Sciences Po Capstone Research Team.

Paust, N. (2026, April). Interview on DPIS framework design and global interoperability [Interview]. Sciences Po Capstone Research Team.

Sciences Po Capstone Research Team. (2026a). Questionnaire on Digital Product Passport data: Responses from Fairphone [Unpublished primary research data]. Sciences Po / International Telecommunication Union Capstone Project.

Sciences Po Capstone Research Team. (2026b). Questionnaire on Digital Product Passport data: Responses from Huawei Technologies [Unpublished primary research data]. Sciences Po / International Telecommunication Union Capstone Project.

Tesla. (2024). *Tesla impact report 2024*. Tesla, Inc. https://www.tesla.com/ns_videos/2024-extended-version-tesla-impact-report.pdf

Tobon, D. (2026, May 6). Huawei interview regarding DPP, with Sciences Po [Interview]. Sciences Po Capstone Research Team.

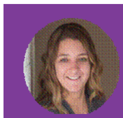
UNEP. (2025). *Blueprint for a Global Digital Product Information System (DPIS) Framework.* United Nations Environment Programme. UNEP Blueprint Report PDF

Van Der Feen, L. (2026, April). Interview on DPP policy, Global South inclusion and UNEP [Interview]. Sciences Po Capstone Research Team.

Appendix A. Interview Speaker Profiles and Contributions

Sciencespo x ITU Capstone Project. Greening Value Chains: Digital Product Passport for Smartphones

Interview Speaker Profiles	Background and Role	Key Quote and Research Contribution
 **Larissa Van Der Feen** *Product Sustainability Data Specialist* UNEP — One Planet Network *DPP Policy | Global South | Data Standards | UNEP*	BACKGROUND Larissa leads the Digitalisation for Circular Economy (D4CE) initiative at UNEP, developing the Guidelines for DPS Designers and advancing Global South inclusion in DPP governance frameworks.	KEY QUOTE ***"There is definitely tension where it may look like some of the policy or frameworks being developed are more aspirational. It may then arise that there is some tension between what is feasible and what is really necessary for these transitions to happen."*** VALUE TO THE PROJECT Provides authoritative UNEP institutional perspective on DPP governance, including the in-progress Guidelines for DPS Designers not yet in the academic literature, and a tiered granularity model directly applicable to ICT supply chains.
 **Nathalie Paust** *Researcher* Wuppertal Institute — DPIS Framework Project *DPIS Framework | Interoperability | Circular Economy | Governance*	BACKGROUND Nathalie works with the UNEP One Planet Network on the DPIS framework, contributing to landscape and gap analyses underpinning the system's seven data categories and engaging JTC standardisation bodies on global interoperability principles.	KEY QUOTE ***"We prioritise inclusivity over perfection in the process. We would rather have a functional, inclusive starter kit that governments can use and that leaves no one behind, than a perfect system that excludes countries of lower income. The DPP should not become exclusive to developed countries, in the worst case, it can lead to countries being excluded from the market, and that is definitely not the mindset we want to push forward."*** VALUE TO THE PROJECT Provides conceptual clarity on the DPP versus DPIS distinction, shifting the unit of analysis from passport content to the governance infrastructure that makes passports interoperable at scale.



Brooke Stearns Lawson

Head of Impact Innovation

Fairphone

Manufacturer | Right to Repair | Fairmined Credits | iFixit Score

BACKGROUND

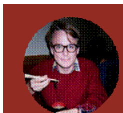
Brooke leads impact innovation at Fairphone, overseeing impact strategy across the full product lifecycle including tier 2 and 3 supplier due diligence, scope 1-2-3 carbon accounting, Fairmined credits via the Fair Cobalt Alliance, and e-waste neutrality through Argo 360.

KEY QUOTE

"The DPP will help actually be concrete and to be able to mitigate some of the greenwashing that can happen, or just claims that are unsubstantiated. Fairphone really does walk the walk. Impact is at the heart of some of these strategic trade-offs and discussions, it's not just the sales or the price."

VALUE TO THE PROJECT

Provides primary practitioner evidence from the only smartphone manufacturer that has systematically implemented what DPP policy demands, including the critical finding that full mine-site traceability is physically impossible due to mineral commingling at the smelter stage.



Nicolas Niarchos

Investigative Journalist and Author

The New Yorker

Field Research | DRC Cobalt | Conflict Minerals | Political Economy

BACKGROUND

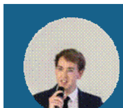
Nicolas is a staff writer at The New Yorker specialising in critical minerals and the political economy of extractive industries in Central Africa, with extensive fieldwork across artisanal mine sites, trader depots, and civil society networks in Kolwezi and Lualaba.

KEY QUOTE

"Moral distance is manufactured through layers. Subcontractors are used to obscure these distances. Traders and depots commingle the ore. Each transfer launders accountability. Reporting structures can also do that — they can produce this idea of the non-existence of harm through the way that things are reported."

VALUE TO THE PROJECT

The only interviewee with primary on-the-ground investigative research at DRC mine sites. His concept of manufactured moral distance is the most analytically distinctive contribution of the series, with no equivalent in academic or policy literature.



Pierre Leturcq

Founder and EU Policy Consultant

Alternative Solutions Consulting and IEEP

EUDR | CBAM | CSDDD | Trade Policy

BACKGROUND

Pierre is an independent Brussels-based policy consultant with eight years of experience at the trade policy and environmental sustainability nexus, with direct legislative experience on the EUDR, CBAM, CSDDD, and free trade agreement sustainability provisions.

KEY QUOTE

"You do not want to see a replication with critical raw minerals of what happens with soy, where the greenest share of production is sent to the EU and the rest goes to other markets, with near certainty that those actors will keep benefiting from access to markets with far less stringent requirements."

VALUE TO THE PROJECT

Direct legislative experience on EUDR, CBAM and CSDDD gives his DPP design warnings particular credibility. His supply diversion argument and regulatory sequencing framework are the clearest available positioning of the DPP within the EU's longer regulatory arc.

Uwe Naeher

Field Geologist and Conflict Minerals Expert

Former BGR Project Manager, DRC

ASM Certification | Mine Safety | DRC Fieldwork | BGR / CTC Standards

BACKGROUND

Uwe is a geologist with eighteen years of mineral exploration experience before serving as BGR project manager for DRC conflict minerals certification, developing the Certified Trading Chain (CTC) standards and overseeing certification across over 90 mine sites in Eastern DRC.

KEY QUOTE

"The biggest misconception policymakers have is that traceability is the silver bullet that solves all problems. Traceability is one element under a whole bunch of other measures that need to be improved. You need to work on the root and not just on the symptoms."

VALUE TO THE PROJECT

The only interviewee who managed mine certification programmes on the ground in DRC. His empirically corrected child labour statistics, personal mine safety incident database, and account of the BGR mineral isotope fingerprint technology are all primary research unavailable elsewhere.

James Nicholson

Former Global Head of Social Responsibility

Trafigura — formerly De Beers Group

Commodity Trading | Due Diligence | Matoshi Pilot | ESG Backlash

BACKGROUND

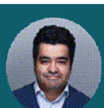
James is an independent consultant with 25 years in the natural resources sector, including nine years at De Beers and a final role as Global Head of Social Responsibility at Trafigura, one of the world's largest commodity trading companies, where he built the responsible sourcing framework and was directly involved in the Matoshi artisanal cobalt formalisation pilot.

KEY QUOTE

"Nothing is more powerful than regulation. However, one of the reasons I am sitting here as an independent, not employed, is that as the regulatory environment has been significantly undermined, people like me have been made redundant all over the world. In the social sphere, we have taken a pounding."

VALUE TO THE PROJECT

The only interviewee who operated at the most senior level of social responsibility inside a major commodity trading house. His insider account of de-risking as a deliberate corporate evasion strategy and his description of pre-payment finance as a leverage mechanism are findings unavailable from any other source.



David Tobon

Industry Development Manager and Lead Robotics Expert

Huawei Technologies

DPP Strategy | Manufacturing Automation | Battery Regulation | Geopolitical Risk

BACKGROUND

David Tobon is Industry Development Manager and Lead Robotics Expert at Huawei Technologies, based in Munich, with 20 years of experience in manufacturing, robotics, and firmware development. His department works on projects five years ahead of the market. He leads Huawei's internal DPP research and compliance preparation, focusing on the EU Battery Regulation and ESPR, and has been central to Huawei's engagement with the Battery Pass project, Catena X, and Data Spaces initiatives.

KEY QUOTE

"We classify the DPP as a risk because we think maybe we will be applied some kind of unfair thresholds because it was not discussed with us, and with China, and with the battery makers in China. It was not discussed. It is just coming from European authorities without a serious project of research and discussion."

VALUE TO THE PROJECT

The only interviewee from inside a major Chinese OEM's DPP strategy function. David provides the compliance-first proof point: Huawei does nothing on DPP for phones because no regulation requires it, demonstrating that voluntary frameworks cannot move the industry. His identification of the unresolved GDPR conflict with post-market DPP data collection, his threshold asymmetry risk framing, and his advocacy for a staged incremental

		approach driven by multilateral industry dialogue are findings unavailable from any other source in this series.