Trace — Validation & Research Notes

Project Overview

Trace is a mobile-first sustainability tracking platform designed for Indian SME manufacturers. The platform helps factories track operational resource usage batch-by-batch and generate auditable sustainability report cards. The application was built as part of the Wooble Sustainability & Systems Thinking Hackathon with a focus on operational simplicity, transparency, and mobile accessibility.

The primary goal of the project was to help manufacturing units quickly answer buyer sustainability questions such as water consumption per production unit, electricity usage per batch, fuel dependency, and waste generation. Existing sustainability tools are often too expensive, overly complex, or designed for large enterprises. Trace was designed specifically for small and medium manufacturing units that rely heavily on manual processes and low-tech operational workflows.

Problem Statement

Many Indian SME manufacturers store operational sustainability-related information across disconnected systems such as electricity bills, handwritten registers, WhatsApp invoices, spreadsheets, and manual logs. When procurement teams or international buyers request sustainability data for specific production batches, factories struggle to provide fast, accurate, and defensible answers.

This problem becomes even more difficult because manufacturing is batch-based rather than continuous. Different production batches may involve different materials, processes, and resource usage patterns. Most existing systems do not support simple batch-level sustainability tracking for small manufacturers.

Another major challenge is usability. The people entering operational data are often not sustainability specialists. In many factories, data may be logged by storekeepers, accounts staff, or operations assistants with limited technical experience. Therefore, the system needed to prioritize simplicity, speed, and mobile usability over complex analytics or enterprise workflows.

Research & Understanding

The project was approached from an operational manufacturing perspective instead of a traditional startup dashboard approach. The focus was on understanding how sustainability

information is actually collected in smaller factories and how quickly that information could be transformed into usable reporting.

The system architecture and user flows were designed around four operational realities:

1. Sustainability data exists across multiple disconnected sources.
2. Data entry users may have low digital literacy.
3. Manufacturing operations are batch-based.
4. The application must work on low-end Android devices with unstable internet conditions.

Based on these constraints, the product focused on minimizing complexity and reducing the number of interactions required to complete important workflows.

Design & UX Decisions

Several design decisions were made specifically to support usability and operational simplicity:

- Mobile-first responsive layout
- Large touch-friendly form inputs
- Minimal navigation complexity
- Fast-loading lightweight interface
- Structured batch-based workflows
- Clear operational terminology
- Black-and-white printable reporting
- Simple deterministic sustainability scoring

The interface was intentionally designed to feel closer to industrial operational software rather than a marketing-oriented analytics dashboard. Unnecessary animations, gamification systems, and decorative UI patterns were avoided to maintain clarity and trustworthiness.

The dashboard prioritizes readability and fast interpretation of operational information. Sustainability report cards were optimized specifically for A4 printing because physical reporting remains important in many manufacturing environments.

Features Implemented

The final application includes the following major features:

- Batch setup system
- Resource logging for water, electricity, fuel, and waste
- Sustainability scoring engine
- Per-unit resource calculations

- Batch comparison system
- Trend dashboard
- Printable A4 PDF report cards
- Demo Factory with realistic mock manufacturing data
- Mobile-first responsive design

The Demo Factory environment includes realistic manufacturing scenarios across industries such as garments, ceramics, food processing, and paper manufacturing. The mock data was intentionally designed to include efficient, inefficient, and mixed-performance production batches to create believable sustainability trends.

Sustainability Score Logic

The sustainability score follows the exact formula provided in the hackathon specification. The score begins at 100 and deducts points based on operational resource usage patterns including:

- Water usage per unit
- Electricity usage per unit
- Fuel usage
- Waste disposal methods
- Tanker water usage

The scoring logic was intentionally implemented as a transparent rule-based system instead of an AI-generated evaluation system. This ensures that factories can clearly understand how their scores are calculated and defend those numbers during procurement or compliance discussions.

Each report card displays both the final score and the deduction breakdown to improve auditability and operational transparency.

Validation & Testing

The application flow was tested by simulating real manufacturing workflows such as:

- Creating production batches
- Logging operational resource usage
- Generating sustainability report cards
- Comparing production batches
- Exporting printable PDF reports

Testing focused heavily on:

- mobile usability

- readability
- operational clarity
- form simplicity
- dashboard performance
- print compatibility

The lightweight interface and simplified forms helped reduce interaction complexity and made the workflow easier to understand for non-technical users.

Technical Stack

The project was built using:

- Next.js
- TypeScript
- Tailwind CSS
- shadcn/ui
- Recharts

The architecture was intentionally kept lightweight and hackathon-focused while maintaining reusable utilities, modular components, and clean TypeScript structures.

Performance & Accessibility

The application was optimized for:

- low-end Android devices
- 2GB RAM mobile phones
- Chrome mobile browser
- fast 4G loading
- responsive layouts

Performance optimization included:

- lightweight rendering
- responsive component structures
- minimized UI complexity
- optimized chart rendering
- mobile-first spacing and typography

Accessibility considerations included:

- readable font sizes
- touch-friendly interactions

- clear labels
- simple navigation structures
- high readability for printed reports

Future Improvements

If the project were continued further, the next improvements would include:

- Offline-first functionality
- Bulk data entry workflows
- Industry-specific customizations
- Multi-language support
- Better large-scale factory workflows
- Improved operational integrations
- Advanced report export options

Additional usability testing with real manufacturing staff would also help further refine terminology, interaction flows, and operational reporting structures for different industries.