From Stone and Thread to Shared Intelligence

Fixed W0-006 release

Part II — The Starting Materials: What People Already Know and Have

A Credit-Card-Sized Starting Point for Local Making and Global Participation

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W0-006 · P3-B English Master · 11 November 2026

Human Authority · Local Capability · Global Participation
No One Left Behind in the GenAI Physical Era

Part II at a glance

Part I argued that the distance between an AI-generated answer and a physical outcome is not a temporary inconvenience. It is the place where materials, tools, people, authority, time and evidence must be brought together.

Part II begins with a practical question: **what if participation starts not from a new factory, but from what people already know and already have?**

A small workshop may have stone offcuts, packaging stock, a sewing machine, an embroidery machine, a printer, a laser marker, copper foil, hand tools, a phone, a camera, a jig, a box of old tags, or simply a reliable way of making one thing repeatedly. None of those assets, by itself, is “GenAI manufacturing.” Yet each can become part of an AI-enabled production network when its function, conditions, interfaces and evidence are made explicit.

This Part develops three propositions.

First, a material should not be valued only by its original market category. A discarded mineral panel, a piece of construction material or an offcut can acquire a second life if its source, condition, processing limits and new function are understood. The same principle applies to paper-like mineral composites, recycled plastics, metals and other material streams. Reuse claims must be tied to actual material identity and measured performance rather than to attractive labels.

Second, familiar craft processes can become functional engineering processes without ceasing to be craft. Thread can carry current. Embroidery can position conductive paths. Printing can place conductive, dielectric or visual layers. Copper foil can become a quick prototype conductor. A sewing or printing process does not become an electronics factory merely because conductive material is added; the electronic function still depends on geometry, resistance, matching, bonding, insulation, curing, durability and test.

Third, the real transition is from **craft to reproducible capability**. A useful contribution is not simply “I can sew,” “I have a printer,” or “I can cut this material.” It is a versioned function that another person or system can request, understand, inspect and reproduce under declared conditions.

That transition is the foundation for local making and global participation.

Chapter 4 — A Second Life for Stone

4.1 From a material source to a defined use

“Stone” in this white paper is deliberately broad. It can mean natural stone, mineral-filled sheet, construction offcut, concrete fragment, ceramic piece, tile, mineral composite, or another material whose dominant character is inorganic and whose original use may have ended.

The point is not to collapse these materials into one category. The point is to show how a local material becomes useful when its identity and next function are described well enough for another person to act.

Construction and demolition waste illustrates the scale of the opportunity. The European Commission notes that this waste stream includes concrete, bricks, wood, glass, metals and plastics, and accounts for more than a third of waste generated in the EU. It also emphasizes that some fractions have high resource value while others can be reprocessed into new products, provided hazardous substances and poor sorting do not undermine reuse and recycling.

This is an important distinction for HSIMC: **a discarded material is not automatically a resource. It becomes a resource only when its condition, risk and possible use are understood.**

A useful material record therefore starts with facts such as:

- source and previous use;
- approximate composition or product identity, when known;
- dimensions, thickness and mass;
- visible damage, contamination, moisture or surface treatment;
- whether the material has been cut, painted, laminated or chemically treated;
- who owns it and who may authorize reuse;
- where it is stored and when it is available;
- what tests have been performed;
- what uses are explicitly not yet validated.

A photograph can help, but a photograph is not a material specification. A product name can help, but a product name is not a current condition report. A previous building use can help, but it does not prove suitability for a new load, electrical, hygienic or fire-related function.

The value of a Resource record is therefore not that it turns uncertainty into certainty. It makes uncertainty visible.

A local example: from discarded surface to functional sample

Consider a small mineral offcut recovered from a renovation site. The most useful first question may not be, “Can this become a new commercial product?” It may be, “Can this become a stable sample base, jig plate, mounting surface, sign, spacer or fixture for a defined test?”

A modest second use can be economically and environmentally meaningful if it displaces a new purchase and if the preparation effort is low enough. The same piece may be unsuitable for a structural use but perfectly adequate as a non-structural test fixture.

The capability is then not “recycling stone.” It is something more precise, for example:

> **Prepare a flat mineral sample base, 85.60 × 53.98 mm nominal footprint, within an agreed thickness and edge condition, suitable for a specified non-structural test.**

That statement creates a pathway to evidence:

1. identify the source material;
2. inspect for contamination and defects;
3. cut or machine the sample;
4. measure final dimensions;
5. record mass, thickness and surface condition;
6. perform the intended test;
7. retain a versioned result.

A maker with simple cutting and finishing tools can contribute to this workflow. A remote engineer can define geometry and acceptance criteria. A local camera or measurement tool can generate evidence. A second workshop can reproduce the same sample using a different material and compare results.

The intelligence is not inside the stone. The intelligence is in the **shared definition of what the material is being asked to do, and the evidence that it did it.**

4.2 Stone paper, composites and construction waste: distinct pathways

The phrase “stone paper” is attractive because it appears to connect mineral content with a familiar paper-like product. It is also a source of confusion.

Commercial mineral-filled paper-like sheets are typically engineered composites with a defined formulation and manufacturing process. Construction mineral waste is a heterogeneous waste stream. Natural stone is another category again. These pathways should not be silently merged.

For HSIMC, the correct approach is to treat each as a separate Resource and process profile.

Path A: existing commercial mineral-filled sheet

If a commercially produced mineral-filled sheet is available, the useful questions include:

- declared composition and manufacturer data;
- thickness and dimensional stability;
- surface energy and printability;
- heat sensitivity;
- laser, blade or punch compatibility;
- adhesion of inks, laminates, NFC inlays or labels;
- fold, tear and abrasion behavior;
- recycling or disposal route in the actual market.

A design can then test whether the material is useful for a card, label, sleeve, gift insert, jig, packaging component or another defined function.

Path B: locally formulated mineral composite

If the objective is to formulate a new sheet or molded part from mineral powder and binder, that is a materials-development project. It requires a declared recipe, particle characteristics, binder system, mixing and forming process, curing conditions, mechanical testing and repeatability data.

The attractive phrase “from stone to card” is not enough. A formulation that works once in a hand sample is not yet a manufacturing capability.

The minimum useful evidence is closer to:

- input material identity and batch;
- mass fractions or formulation range;
- processing method and equipment;
- temperature, pressure, time and other relevant process variables;
- sample thickness and density;
- dimensional change after processing;
- strength, flexibility, abrasion or other property relevant to the intended function;
- failure modes;
- number of samples and variation observed.

Path C: direct reuse of construction material

A third pathway avoids making a new composite at all. A recovered tile, panel, stone offcut or other piece can be cut and reused directly.

This may be the fastest local route because it minimizes transformation. It also places greater importance on inspection, sorting and adaptation to the irregularity of the source material.

The environmental logic is different in each pathway. Reusing an existing offcut may avoid new material production but require transport and cutting. Producing a new composite may consume binders, energy and finishing steps. A commercial mineral-filled sheet may have different upstream impacts and end-of-life options.

Therefore this white paper does not claim that one route is universally “greener.” It proposes that the comparison should be measured for the specific function.

A practical comparison record

For a card-sized sample, a simple comparison could record:

Field	Reused mineral offcut	Commercial mineral-filled sheet	New local composite
Source	recovered local material	purchased product	locally prepared ingredients
Preparation	cut / grind / clean	cut / print / laminate	mix / form / cure / finish
New material added	low to moderate	product already manufactured	binder + additives + energy
Dimensional consistency	source-dependent	usually high	process-dependent
Surface for printing	may require treatment	product-dependent	formulation-dependent
Evidence needed	condition + geometry + use test	datasheet + process test	recipe + process + property test
Current status	must be verified	must be verified	R&D until repeatable

This table is intentionally incomplete. It is a decision framework, not a material certification.

4.3 Measure yield, durability, cost and environmental effects

A material experiment becomes economically useful when it begins to answer four questions:

1. **Yield** — how much usable output is obtained from the available input?
2. **Durability** — does the result remain fit for the intended function for the required time?
3. **Cost** — what does one accepted output actually cost, including failed attempts and labor?
4. **Environmental effect** — what new material, energy, transport and waste are introduced or avoided?

Yield

Yield should be defined against an acceptance rule. If ten recovered pieces are collected and only four can produce a flat, clean sample of the required size, the yield is not ten. The rejected pieces are part of the process evidence.

For local making, yield can be more informative than material price. A “free” waste stream with high sorting, cleaning and failure cost may be more expensive than a purchased sheet. Conversely, a local offcut that requires almost no processing may be an excellent resource even if it is available only in small quantities.

Durability

Durability must be tied to the intended use. A sample used for one laboratory alignment test has a different requirement from a card intended to survive years in a wallet, a gift item handled by customers, or a fixture exposed to heat and vibration.

Useful tests can be modest but explicit:

- repeated insertion or removal;
- bend or flex cycles;
- surface abrasion;
- moisture exposure;
- adhesion of printed or bonded layers;
- dimensional change;
- edge damage after cutting;
- read performance of an attached QR, NFC or RFID element.

The test method and number of cycles matter. “Looks durable” is not an engineering result.

Full cost per accepted result

A useful formula is:

> **Full cost per accepted result = total material + labor + machine + energy + tooling + inspection + failed-output cost, divided by accepted quantity.**

This is especially important in small-batch local manufacturing. The unit price of material may be almost irrelevant compared with setup, alignment and rework.

The same logic helps explain why speed can become more important than low unit cost. A local workshop may be more expensive per sheet but capable of producing a revised sample today, allowing a global engineering team to continue work immediately. The economic value lies in iteration time, not only in material price.

Environmental effects without automatic claims

Environmental claims should be made against a defined baseline.

If a recovered material replaces a newly purchased board, useful questions include:

- what new material was actually avoided;
- how far the recovered material was transported;
- what cleaning, cutting or coating was required;
- what waste was generated by preparation;
- whether the new use extends life or merely delays disposal;
- whether the new combination makes later separation harder;
- whether any hazardous or unknown constituent is introduced into a new context.

This is consistent with a broader circular-economy principle: recovery has value, but quality, sorting and safe handling matter.

From environmental story to reproducible evidence

The strongest sustainability story is often not a dramatic one. It may simply be:

> **This batch used 12 locally recovered offcuts. Eight met the sample criteria. Four were rejected. The accepted samples replaced eight newly purchased boards for this test series. Cutting consumed a recorded amount of machine time and produced a measured mass of waste.**

That statement can improve over time. It can be compared with other materials. It can be audited. It can inform the next decision.

It is more useful than an unsupported claim that a product is “zero waste” or “green.”

Chapter 5 — From Thread to Interface

5.1 Conductive thread and textile antennas

A sewing machine is one of the most familiar production tools in the world. It is also an instructive example of how an existing craft capability can acquire a new engineering role.

Ordinary thread is used to join, reinforce and decorate. Conductive thread can also carry electrical current or form part of an antenna, electrode or sensor. Embroidery can place that thread into a repeatable geometry.

Research on embroidered NFC antennas shows the potential and the constraints clearly. A University of Manchester study fabricated NFC antenna prototypes on cotton using conductive yarns coated with metals including silver and stainless steel. The work compared embroidery approaches and measured substantial differences in DC resistance. It also matched an embroidered coil to a specific NFC microchip. The result was not “any metal thread becomes NFC.” The result was that a defined thread, stitch geometry, antenna shape and chip can be engineered together and measured.

That distinction is central to this white paper.

The sewing machine contributes placement capability

The sewing or embroidery machine does not need to understand NFC protocol. Its contribution can be narrower:

> **Place a specified conductive thread along a versioned path on a specified textile substrate, with declared stitch parameters and inspection evidence.**

Another contributor may provide the antenna design. Another may select the chip. Another may model the RF behavior. Another may test read range. Another may design the mechanical attachment to a cable, gift, garment or card sleeve.

This is how an everyday machine becomes part of a global engineering workflow without pretending to perform the entire system function.

The important variables

For a conductive textile function, useful variables include:

- thread material, coating and diameter;
- measured resistance per unit length;
- substrate type, thickness and stretch;
- stitch type, pitch, tension and number of passes;
- geometry and spacing between conductive paths;
- connection method to a component or connector;
- insulation and strain relief;
- bending, washing, abrasion or moisture requirements;
- antenna or sensor tuning, when relevant;
- inspection and acceptance method.

A remote engineer can specify these variables. A local maker can report what the machine can actually achieve. The design can then converge through evidence rather than assumption.

Decorative function and electronic function can coexist

Embroidery also demonstrates that electronic function does not require industrial visual language. Research has shown conductive textile antennas integrated into decorative embroidered logos, with conductive thread positioned on the reverse while colored yarn creates the visible design.

For HSIMC, this suggests a valuable design principle:

> **A functional interface can remain culturally, aesthetically and commercially local.**

A hotel gift, team uniform, event badge or cable accessory does not have to look like a laboratory prototype merely because it contains a digital entry point or functional conductor.

That matters for participation. Local producers can contribute not only manufacturing capacity but also material knowledge, aesthetics, cultural meaning and customer familiarity.

5.2 Printed marks, electrodes and functional surfaces

Printing is another mature process that can become part of electronics and sensing when the deposited material has a functional property.

Printed electronics literature describes conductive, semiconducting and dielectric inks deposited on substrates through methods such as screen printing and inkjet printing, often followed by curing or sintering. The performance depends not only on the ink but also on substrate roughness, porosity, wetting, drying and post-processing.

This provides a useful bridge between traditional printing districts and electronic prototyping.

Start with the simplest functional layer

The first functional contribution does not need to be a transistor or a complete circuit. It may be:

- a high-contrast visual alignment mark;
- a conductive pad;
- a capacitive touch electrode;
- an antenna trace;
- a resistive element;
- a connector footprint;
- a dielectric separator;
- a printed calibration target;
- a QR code linked to a Resource identity;
- a registration layer that allows a later process to align accurately.

Each function has a different acceptance test.

A QR code can be validated by optical decoding. A conductive trace can be checked for resistance and continuity. A capacitive electrode can be tested with a known controller. An antenna requires tuning and read-performance testing. A registration mark requires geometric measurement.

The local printer does not have to become responsible for the entire final product. It must be responsible for the agreed printed result.

The substrate is part of the process

A design that prints well on coated PET may fail on rough paper, textile or mineral sheet. A conductive ink may penetrate a porous substrate or crack when flexed. A curing temperature suitable for one material may deform another.

Therefore a printed functional layer should always be linked to a substrate profile.

At minimum:

- material identity and thickness;
- surface treatment, coating or laminate;
- print process and equipment;
- ink or paste identity and batch;
- mesh, nozzle, resolution or other process parameter as applicable;
- cure or drying condition;
- finished geometry;
- electrical or optical test;
- environmental and handling limits.

This is where local printing knowledge becomes valuable. Operators often know, through practice, which substrate feeds reliably, which coating causes adhesion problems, how humidity changes drying, and how registration drifts on a particular machine. GenAI can help structure and compare those observations, but the local process still produces the evidence.

Copper foil, film and fast iteration

Copper foil provides another accessible prototyping route. A conductive pattern can be cut, etched, laminated or otherwise formed without committing to a conventional multilayer PCB process.

The value is speed and accessibility. A local team may be able to produce a one-off antenna, electrode, jumper or low-complexity circuit pattern immediately.

The limitation is equally important. A foil prototype is not automatically equivalent to a production PCB. Adhesion, minimum feature size, insulation, oxidation, current carrying capacity, bending, connector reliability, RF behavior and manufacturing tolerance may all differ.

The correct workflow is therefore:

prototype quickly → measure → learn → decide whether to keep the local method or move to a more controlled manufacturing process.

The result of an experiment is not a commitment to a manufacturing technology. It is evidence that narrows the next decision.

5.3 Joining craft, electronic modules and computing

The most powerful pattern in this chapter is separation of roles.

A functional object can be built from layers contributed by different people:

1. **material layer** — textile, paper, mineral sheet, plastic, metal or another substrate;
2. **functional surface** — printed conductor, embroidered thread, foil trace, marker or electrode;
3. **electronic module** — NFC chip, sensor, reader, controller, radio or interface board;
4. **compute node** — phone, T736 node, local computer or another runtime;
5. **cloud and model layer** — design, analysis, planning, versioning and collaboration;
6. **human authority** — the person or organization allowed to use, modify, share or operate the result;
7. **evidence layer** — the measurements and records that prove what was actually built and tested.

The advantage of this architecture is that innovation does not require every contributor to master every layer.

A textile workshop can contribute repeatable placement. A printer can contribute functional marks. An electronics company can provide a module. A software team can provide a tool. A local integrator can connect it to an existing machine. A global AI team can help compare designs and generate test plans.

The shared interface is what allows these contributions to meet.

A credit-card-sized example

Imagine a card-sized object whose visible surface is locally printed, whose reverse side contains an embroidered or foil antenna, whose electronic function is provided by a small NFC module, and whose deeper capability is reached through a QR/NFC URI connected to an HSIMC Resource.

The card itself may have no processor.

In another version, the card may connect to a small interface module.

In a later version, a T736-based compute node may provide local processing and physical interfaces.

All three can belong to the same capability family without pretending to be the same hardware.

That is the value of a layered architecture: **the visible object can stay simple while capability evolves behind it.**

A gift can become an entry into capability

This also changes the role of everyday products.

A cable, tag, card sleeve, textile patch, package or gift can carry:

- a durable identifier;
- a QR/NFC entry;
- material and batch information;
- a service or configuration link;
- a warranty or maintenance action;
- a local capability description;
- a route to a human or AI support function.

The physical product remains useful on its own. The digital layer does not have to dominate the object. It can simply create a continuing relationship between the object, the maker, the user and the next service.

This is especially relevant to small producers. They do not need to build a global platform. They can produce one well-defined physical layer and connect it to a broader system under agreed authority.

Chapter 6 — From Craft to Reproducible Capability

6.1 A function, an interface and a repeatable result

The most important transformation in Part II is not from “old material” to “smart material.” It is from an informal skill to a capability another party can safely use.

A craft capability often lives in a person’s memory:

- “I know how to make this cut cleanly.”
- “This machine can handle that fabric if I change the tension.”
- “This ink works on this coating.”
- “The laser marks well if the focus is slightly changed.”
- “This supplier can make the part quickly.”

These statements are valuable. They are also difficult to scale because the conditions are implicit.

A reproducible capability makes the useful parts explicit.

A minimal capability description can include:

Field	Question
Function	What result can be produced?
Input	What material, file, object or state is required?
Output	What physical or digital result is returned?
Conditions	What machine, tool, environment or preparation is required?
Interface	How is the request submitted and how is the result identified?
Authority	Who may request, approve, modify or release the work?
Evidence	What measurement or inspection proves completion?
Version	Which method, design and software were used?
Cost and time	What resources were actually consumed?

Field	Question
Limits	What remains unsupported or unverified?

This description can exist as a human-readable sheet, a machine-readable profile, or both.

The goal is not bureaucracy. The goal is to reduce the amount of hidden knowledge that must be rediscovered every time a new collaborator arrives.

Reproducible does not mean identical everywhere

A second workshop may use a different machine. A different city may have different material. A local operator may choose another fixture.

Reproducibility therefore does not require that every implementation be identical. It requires that the differences are visible and that the result can be checked against the same functional expectation.

For example, two workshops may produce an NFC textile antenna using different embroidery machines. If both record thread, geometry, stitch settings, resistance and read-performance tests, their results can be compared.

The common object is the **function contract**, not the brand of machine.

6.2 Skills, samples, process conditions and acceptance

A practical contribution can be organized into four linked objects:

1. Skill

The human or organizational capability: cutting, printing, sewing, machining, assembling, testing, coding, calibrating, repairing or coordinating.

The skill record should not claim universal competence. It can be narrow and useful.

Example:

> **“Can embroider conductive thread on cotton and polyester substrates using a specified vector path; can provide resistance measurement and sample photographs; RF tuning is performed by another party.”**

That is more trustworthy than “smart textile expert” if the actual contribution is embroidery and measurement.

2. Sample

A sample is evidence that a process has produced a result under known conditions.

A useful sample record includes:

- sample ID;
- design version;
- input batch;
- machine and tool;
- operator or responsible party;
- date and location;
- process settings;
- inspection result;
- photographs or measurement files;
- deviations and failures.

A sample can then become part of a growing evidence library.

3. Process condition

Process conditions make the sample interpretable.

Without them, a successful sample may be impossible to reproduce.

For local manufacturing, even a simple record can be powerful:

- machine model;
- tool or needle type;
- feed rate or speed;
- temperature or cure time;
- fixture version;
- environmental condition if relevant;

- operator note about a manual adjustment.

GenAI can help turn free-form notes into structured profiles, compare versions and identify missing variables. It should not invent a value that was never measured.

4. Acceptance

Acceptance is what turns “something was made” into “the requested result was delivered.”

Acceptance can be:

- dimensional measurement;
- continuity test;
- resistance range;
- QR decode;
- NFC read;
- image alignment score;
- visual inspection against a reference;
- successful mechanical fit;
- customer sign-off;
- a combination of tests.

Different applications need different acceptance rules.

The important point is that acceptance is agreed before scale-up whenever possible.

6.3 Participation across making and use

When capability is described this way, participation becomes broader without becoming vague.

A family workshop can participate by producing a tested textile pattern. A print shop can participate by making a registered conductive or visual layer. A student can participate by writing an inspection tool. A retiree with deep process knowledge can contribute a fixture method or troubleshooting guide. A large supplier can contribute a certified component. A cloud engineer can contribute a simulation. A logistics provider can contribute an accepted transport window.

They do not need to become one company.

They need a way to make their contribution understandable, authorized and verifiable.

Participation is not free labor

A global participation model must distinguish between learning, volunteering, research contribution, paid work, commercial supply and intellectual property licensing.

The same physical action can have very different economic and ethical meaning depending on the agreement.

A contributor should be able to know:

- what is being requested;
- whether the work is paid, donated, experimental or speculative;
- how the result may be reused;
- whether the contributor will be named;
- who owns the new design or data;
- who carries the cost of failure or rework;
- when payment is due;
- how the contributor can stop participating.

This is where Human Authority becomes a practical economic principle.

Participation should create capability, not dependence

A useful project should leave participants with something they can use again:

- a tested process;
- a better fixture;
- a reusable template;
- a machine profile;
- a documented skill;
- a new customer relationship;
- a measurement method;
- a software tool;
- a reference sample;
- a clearer understanding of cost and limits.

The objective is not to make every person a hardware engineer. It is to let people contribute at the level where they already have competence, while providing pathways to learn more.

From local proof to global participation

A local capability becomes globally useful through a sequence:

1. **discover** — someone identifies an existing material, skill, tool or process;
2. **describe** — the function and limits are recorded;
3. **sample** — a small result is produced;
4. **measure** — the result is inspected;
5. **version** — the method and evidence are frozen;
6. **offer** — the capability becomes available under stated conditions;
7. **accept** — a responsible party agrees to perform a specific Work;
8. **execute** — the work is performed locally;
9. **verify** — evidence is returned;
10. **learn** — the result improves the next design, process or model.

This loop connects local making to global engineering without requiring the local maker to operate a global software platform.

The first economic question: what changed?

The value of a capability should be measured by the change it creates.

Did the sample arrive faster?

Did the new method reduce failed iterations?

Did the local material avoid a new purchase?

Did a maker gain a new paid task?

Did another team reproduce the result without a long explanation call?

Did a customer receive a better product or service?

Did the process reduce or increase material and energy use?

Did the contributor retain authority over the use of their work?

These questions connect Part II directly to ROI, ESG and the SDGs without turning those frameworks into decoration.

A compact participation package

The white paper proposes a simple first package for a new contributor:

> **Bring one existing capability. Deliver one reproducible function.**

A contribution package can be small:

- one function description;
- one sample or reference output;
- one process note;
- one acceptance method;
- one statement of authority and reuse terms;
- one record of actual time and cost.

That is enough to begin.

It can later connect to a card, NFC/QR entry, HSIMC Resource, machine-readable profile, T736 node, simulator or global collaboration workflow.

The small package is intentional. Participation should not require a small workshop to build a complete digital twin before anyone can work with it.

The bridge to Part III

Part II has focused on materials, familiar tools and the transformation of craft into reproducible capability.

Part III will address the collaboration model that makes those capabilities usable across teams: people who hold authority, tools that perform actions, resources that provide context, contracts that define functions, and evidence that preserves accountability across stateless requests.

The material is local.

The skill is local.

The responsible person is local.

The collaboration can be global.

Source notes for Part II

The following external sources support specific background statements in this Part. They do not certify HSIMC prototypes or future products.

1. European Commission, **Construction and demolition waste** — construction and demolition waste composition, resource recovery potential, sorting and hazardous-material considerations.
   https://environment.ec.europa.eu/topics/waste-and-recycling/construction-and-demolition-waste_en

2. University of Manchester research PDF, **e-Textile Embroidered Wearable Near Field Communication RFID Antennas** — embroidered NFC antenna prototypes, conductive yarns, stitch-method comparison, measured resistance and chip matching.
   https://research.manchester.ac.uk/files/76660584/e_Textile_Embroidered_Wearable_Near_Field_Communication_RFID_Antennas.pdf

3. Gil et al., **Colorful Textile Antennas Integrated into Embroidered Logos**, Journal of Sensor and Actuator Networks — conductive e-thread integrated into embroidered decorative forms.
   https://www.mdpi.com/2224-2708/4/4/371

4. A. Kamyshny et al. and related review literature summarized in **A Review on Printed Electronics: Fabrication Methods, Inks, Substrates, Applications and Environmental Impacts** — functional inks, substrates, printing methods, curing and the importance of ink-substrate interaction and repeatability.
   https://www.mdpi.com/2504-4494/5/3/89

5. Rubio & Bolduc, **Screen Printing for Energy Storage and Functional Electronics: A Review** — screen printing of conductive and functional materials on flexible substrates, with process variables influencing device performance.
   https://www.mdpi.com/2673-3978/6/2/7

6. OpenAI, **Accelerating engineering for the physical world**, 3 November 2026 — background context for AI-supported mechanical, electrical, simulation and manufacturing workflows.
   https://openai.com/index/accelerating-engineering-for-the-physical-world/

Evidence boundary

Part II is an architectural and participation framework. It does **not** claim that:

- recovered construction material has been qualified for a structural, food-contact, electrical-safety or fire-rated use;

- locally formulated “stone paper” has been developed or validated by HSIMC;
- ordinary sewing thread or any arbitrary conductive thread is suitable for NFC;
- a sewing or embroidery machine alone can manufacture a complete electronic product;
- a printed conductor is equivalent to a production PCB;
- any particular conductive ink, foil, textile, substrate, NFC chip or attachment process has been qualified for a commercial release;
- a credit-card-sized T736 product has been completed;
- environmental benefit has been demonstrated without a defined baseline and measurement.

The purpose of this Part is to define how such claims could become testable, attributable and reproducible through Resource, Authority and Evidence.