

C O C O O N L O O P

A circular knitting system for transforming tussah silk into adaptable tubular structures



COCOON LOOP

explores how tussah silk can be processed through a small-scale circular knitting machine to generate adaptable tubular textile structures through human-machine collaboration.

A. Purpose-driven Proposition



localized production

non-standard material

human judgement

tubular textile platform

Contemporary production often favours standardised materials and predictable processes. However, tussah silk is naturally variable: it has visible slubs, uneven thickness, and unstable feeding behaviour. Instead of forcing it into a fully standardised industrial process, this project explores how a small-scale circular knitting machine can work with these variations through human judgement and machine adjustment.

Industry 5.0 Position



Traditional making is not copied as a finished craft object, but translated into a production logic.

“COCOON LOOP does not attempt to reproduce the skill of a master craftsperson. Instead, it translates material judgement into machine settings, sample parameters, and repeatable production workflows. Needle count, tightness, length, feeding tension, and sample records become a shared language between designer and maker.”

1/

Traditional making ethics

working with material variation

2/

Machine repeatability

generating consistent tubular structures

3/

Design translation

turning tacit craft judgement into parameters, samples, and workflows



Material Rationale

“Tussah silk is chosen because its natural variation makes the production process visible.”



- Visible slubs create interruptions in feeding.
- Uneven thickness affects tension and density.
- Unstable yarn behaviour requires manual adjustment.

Its slubs, uneven thickness, and unstable tension challenge the circular knitting machine, requiring human observation, adjustment, and response throughout the making process.

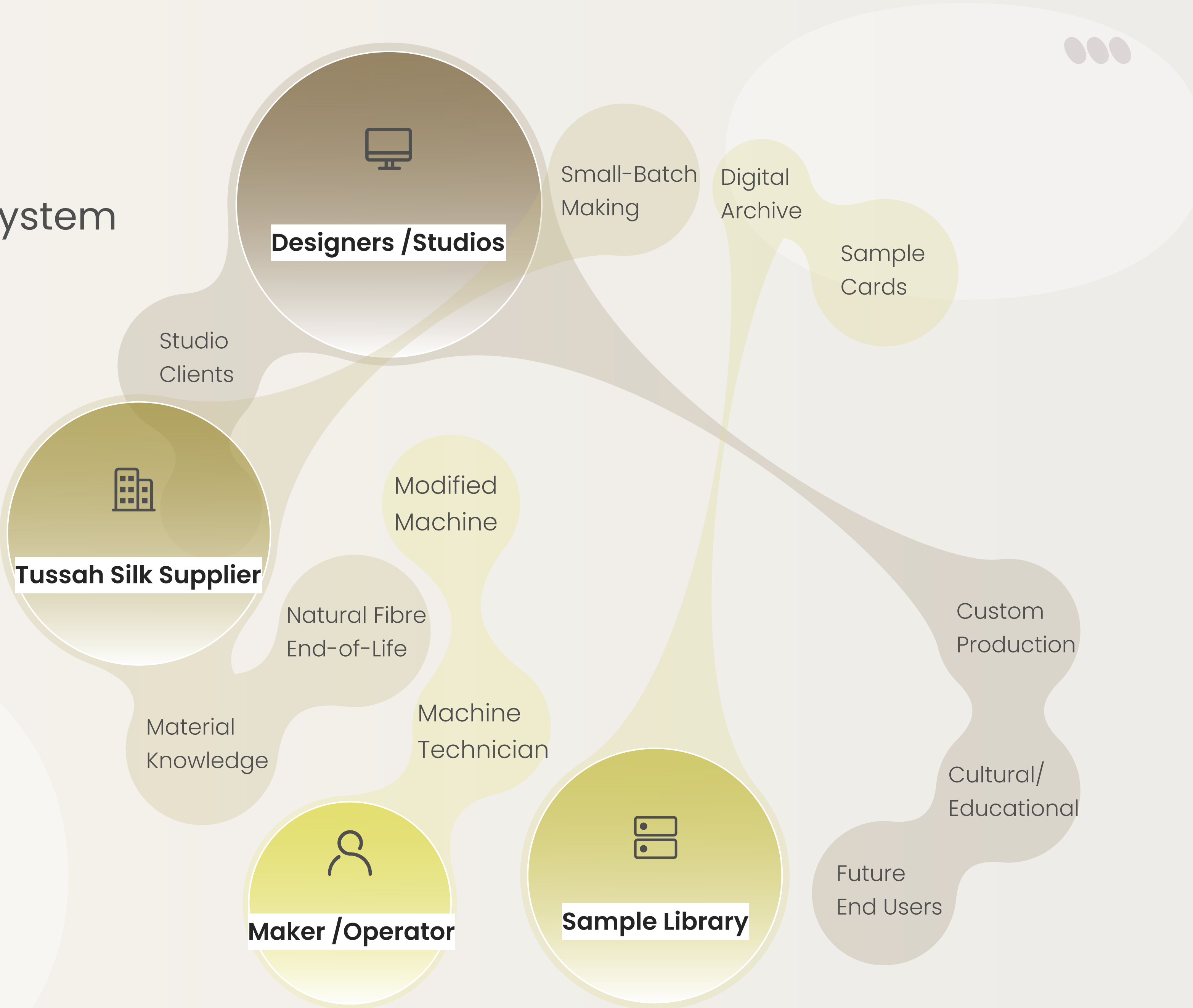
Stakeholder Map

Localized silk knitting production system

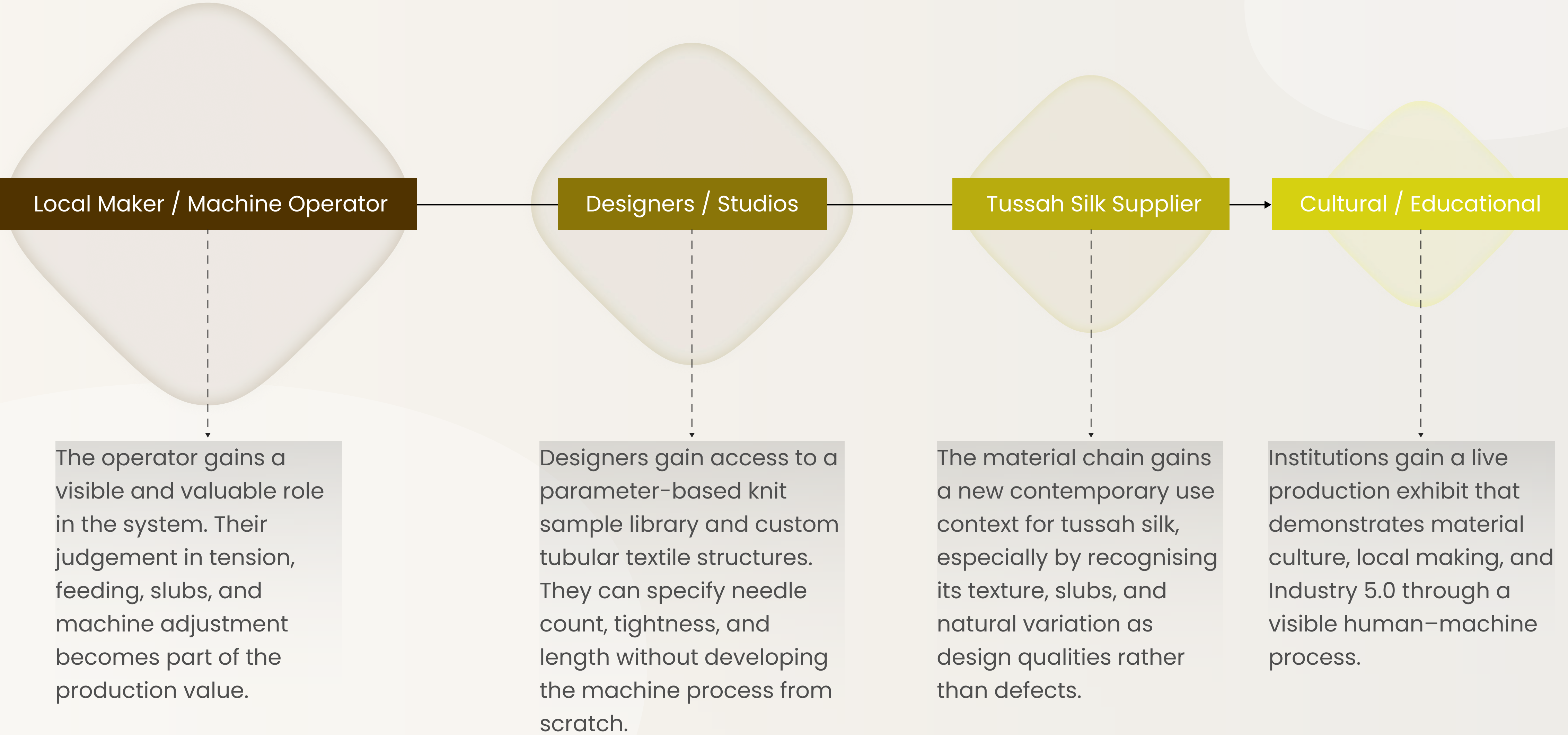
stakeholders

- Maker /Operator
- Designers /Studios
- Sample Library
- Tussah Silk Supplier

The primary relationship is between material, maker, designer, and sample library.



Beneficiaries



Value Proposition

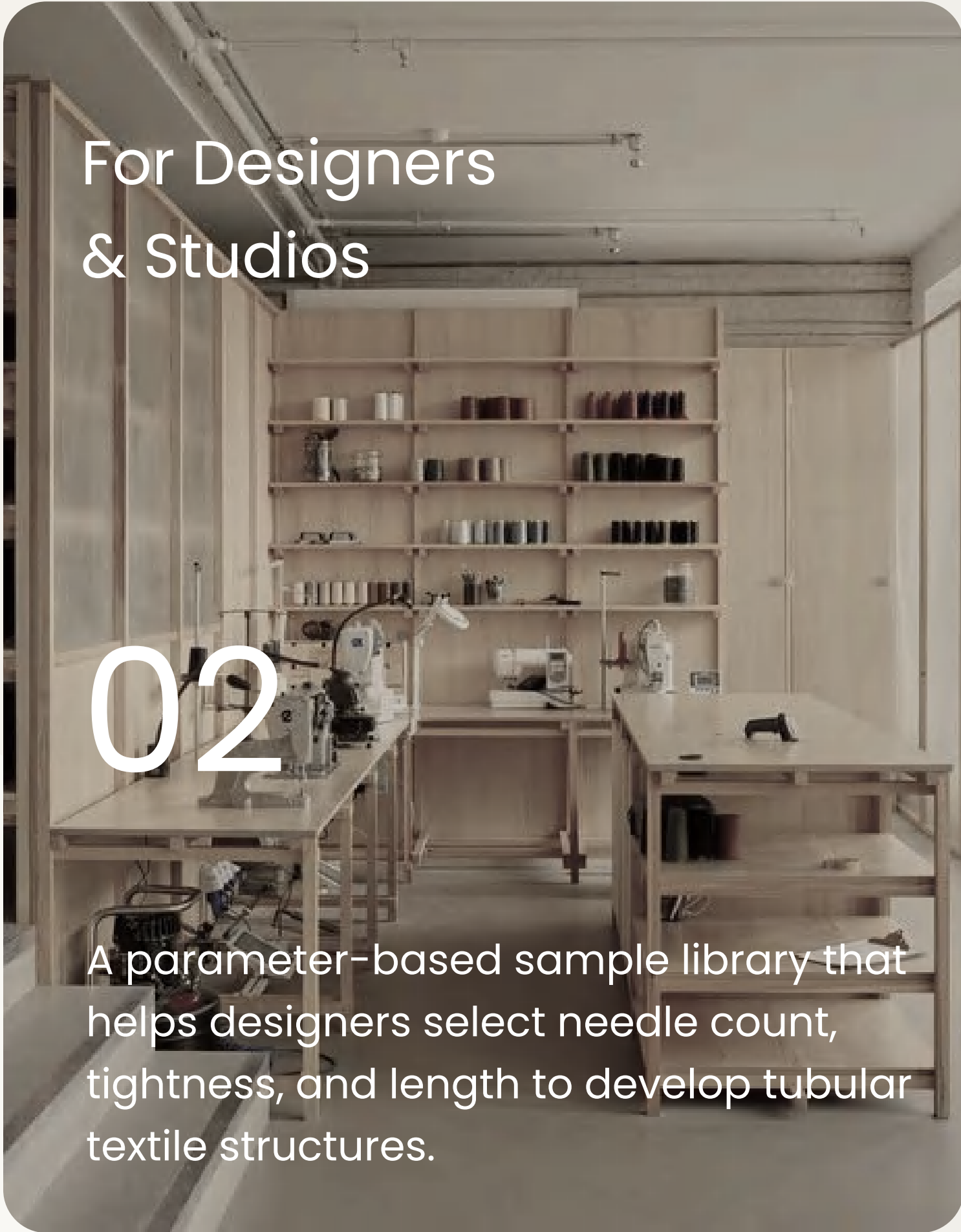


For Makers

01

(01)

A small-scale machine system that makes material judgement visible and creates a potential production service.



For Designers
& Studios

02

A parameter-based sample library that helps designers select needle count, tightness, and length to develop tubular textile structures.



For Material Culture
& Industry 5.0

03

(03)

A human-machine production model that works with the natural variation of tussah silk instead of erasing it.

Business Case



COCOON LOOP makes irregular tussah silk yarn processable through a human-adjusted circular knitting system.

Custom Sample Production



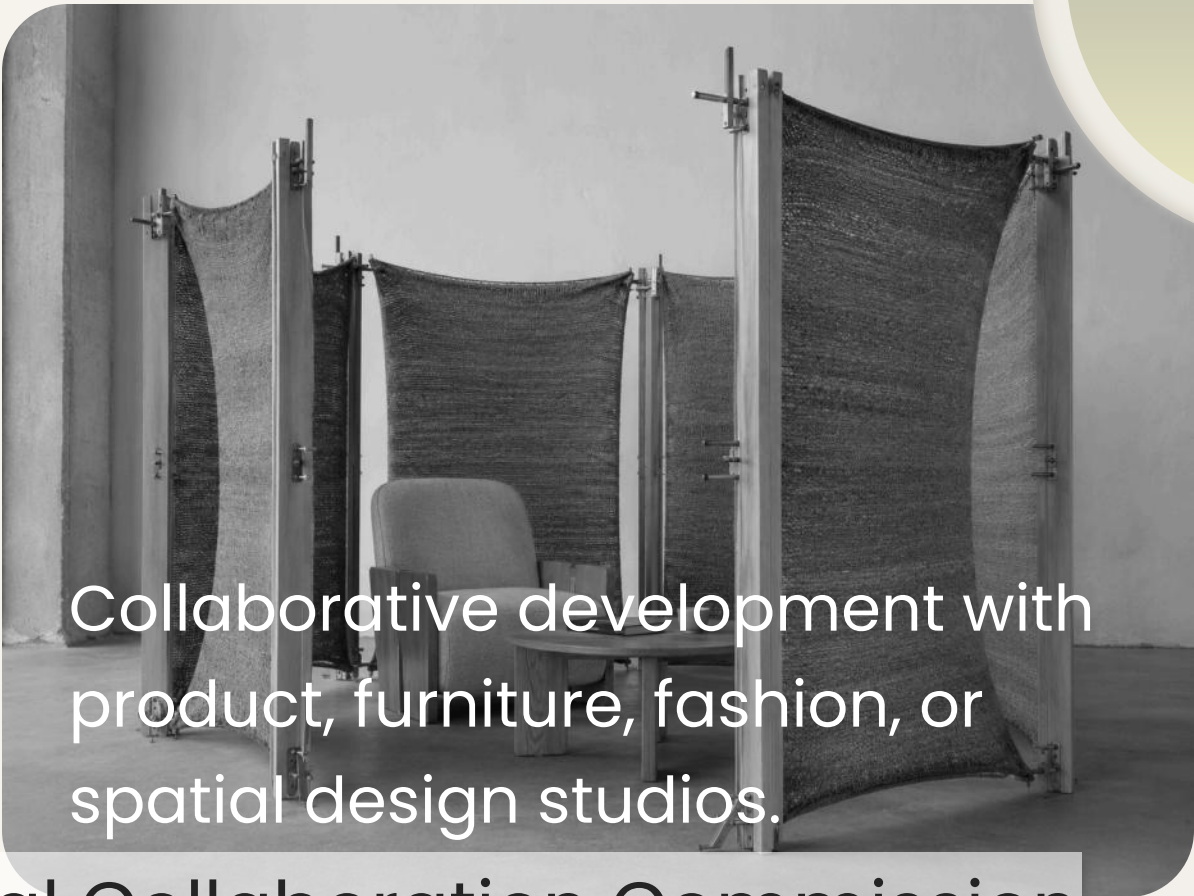
Paid development of tussah silk knit samples based on selected parameters: needle count, tightness, and length.



Bespoke Tubular Textile Production

Small-batch production of tubular silk structures for specific design briefs or application contexts.

case



Collaborative development with product, furniture, fashion, or spatial design studios.

Material Collaboration Commission



Exhibition | Workshop | Education

The machine operates as a live production exhibit and educational tool for material culture, local making, and Industry 5.0.

It turns experimental material making into a repeatable sample service for designers, studios, and small-batch production.



Mini Business Canvas

“A localized production service for tussah silk tubular knit structures”

Key Partners Tussah silk yarn suppliers Machine supplier / technician Local makers / operators Design studios Cultural institutions	Key Activities Machine operation Yarn feeding and tension testing Tubular sample production Parameter mapping Failure documentation Application prototyping	Key Resources Modified circular knitting machine Flexible feeding mechanism Tussah silk yarn Needle cylinders Sample library Production records	Value Propositions Localized silk knitting production Customizable tubular textile structures Human-machine collaboration Physical sample library for designers Production capability, not a fixed product	
Customer Relationships Bespoke collaboration Sample consultation Studio-to-studio production service Workshop / exhibition engagement Iterative prototyping	Customer Segments Product designers Furniture / interior studios Textile researchers Small design brands Cultural institutions Exhibition curators	Channels Degree show Technical package Project film CSM online showcase Design fairs Studio partnerships Workshops / exhibitions	Cost Structure Machine purchase and maintenance Yarn cost Failed samples and material waste Production time Feeding mechanism prototyping Documentation and display Transport and installation	Revenue Streams Custom sample production Bespoke tubular textile production Material collaboration commissions Workshop / exhibition fees Educational demonstrations Future toolkit / licensing

SWOT Analysis

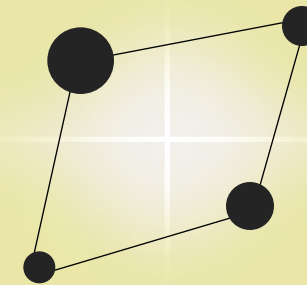


Strengths

- Visually and technically engaging machine
- Seamless tubular textile structures
- Distinctive texture and material identity of tussah silk
- Human judgement visible in feeding and adjustment
- Parameter-based sample library as a development foundation

Opportunities

- Growing interest in localized and distributed making
- Collaboration with product, furniture, textile, and spatial studios
- Live production exhibit for cultural institutions and design fairs
- Future digital parameter database
- New contemporary context for tussah silk



- Slow and small-scale production
- Sample library currently limited to needle count, tightness, and length
- Jams and inconsistency caused by variable yarn behaviour
- Final product applications still open
- Performance data not yet tested

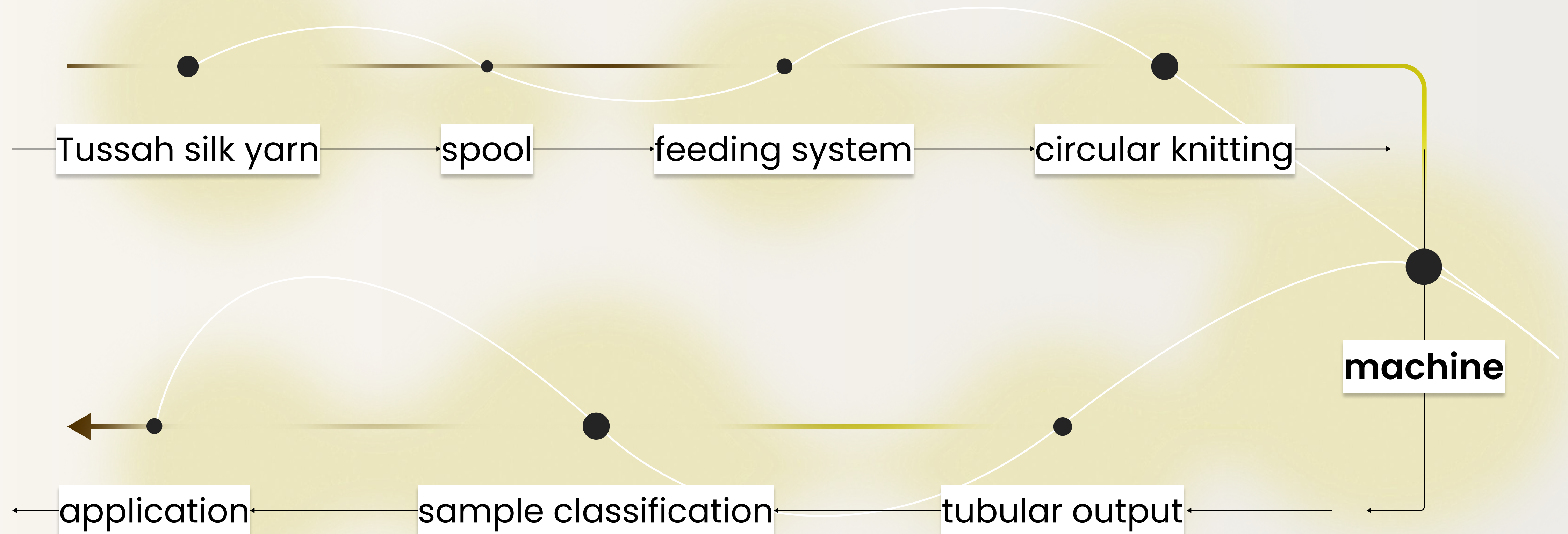
- Cheaper and more standardised yarn alternatives
- Other textile processes may produce similar outcomes more efficiently
- Market value depends on designer adoption
- Machine reliability during exhibition
- Risk of appearing too open-ended without application testing

Weaknesses

Threats

B. Manufacturing and CMF Proposition

Manufacturing Ecosystem



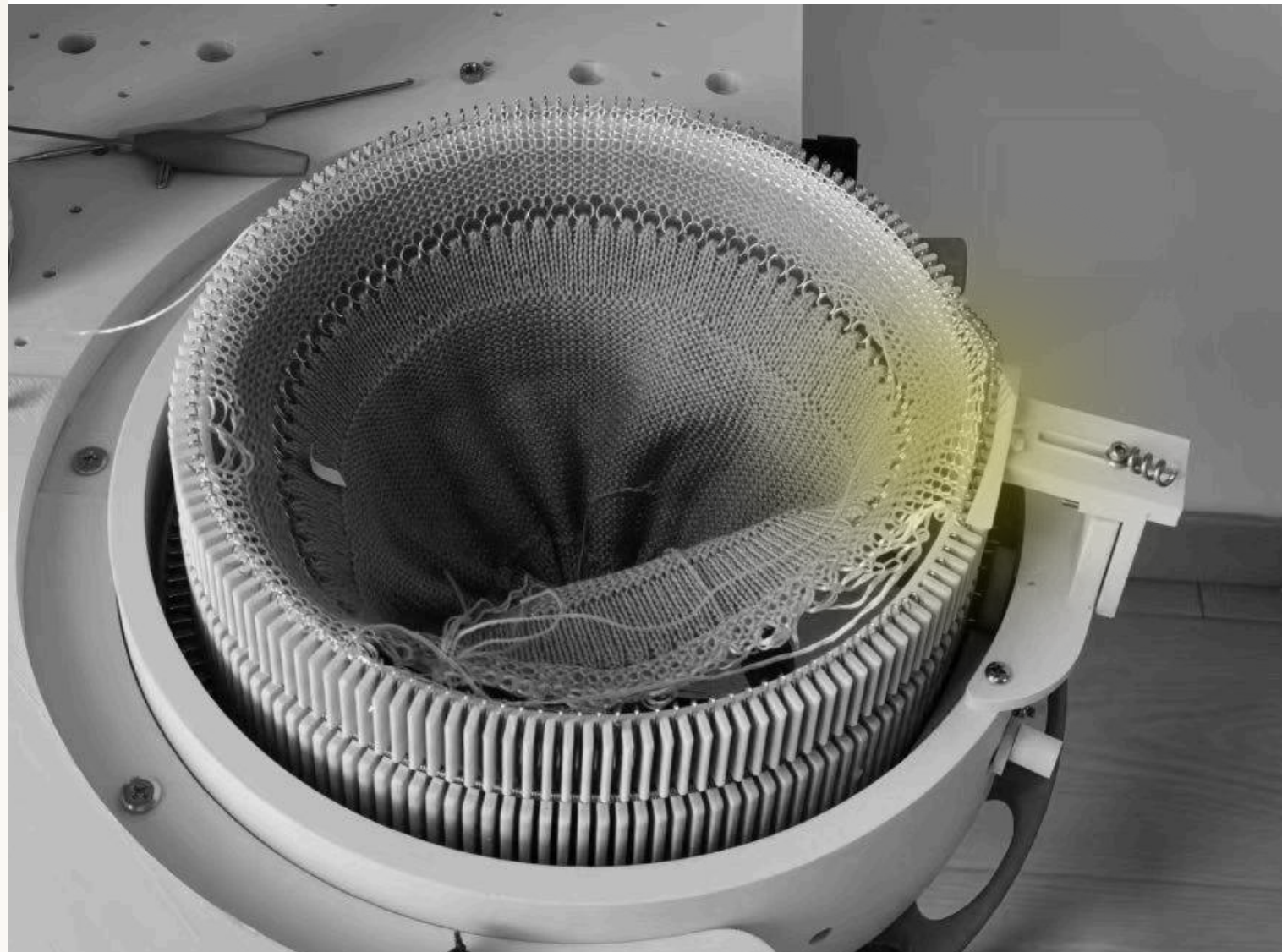
Show overall machine diagram



Yarn Feeding Problem

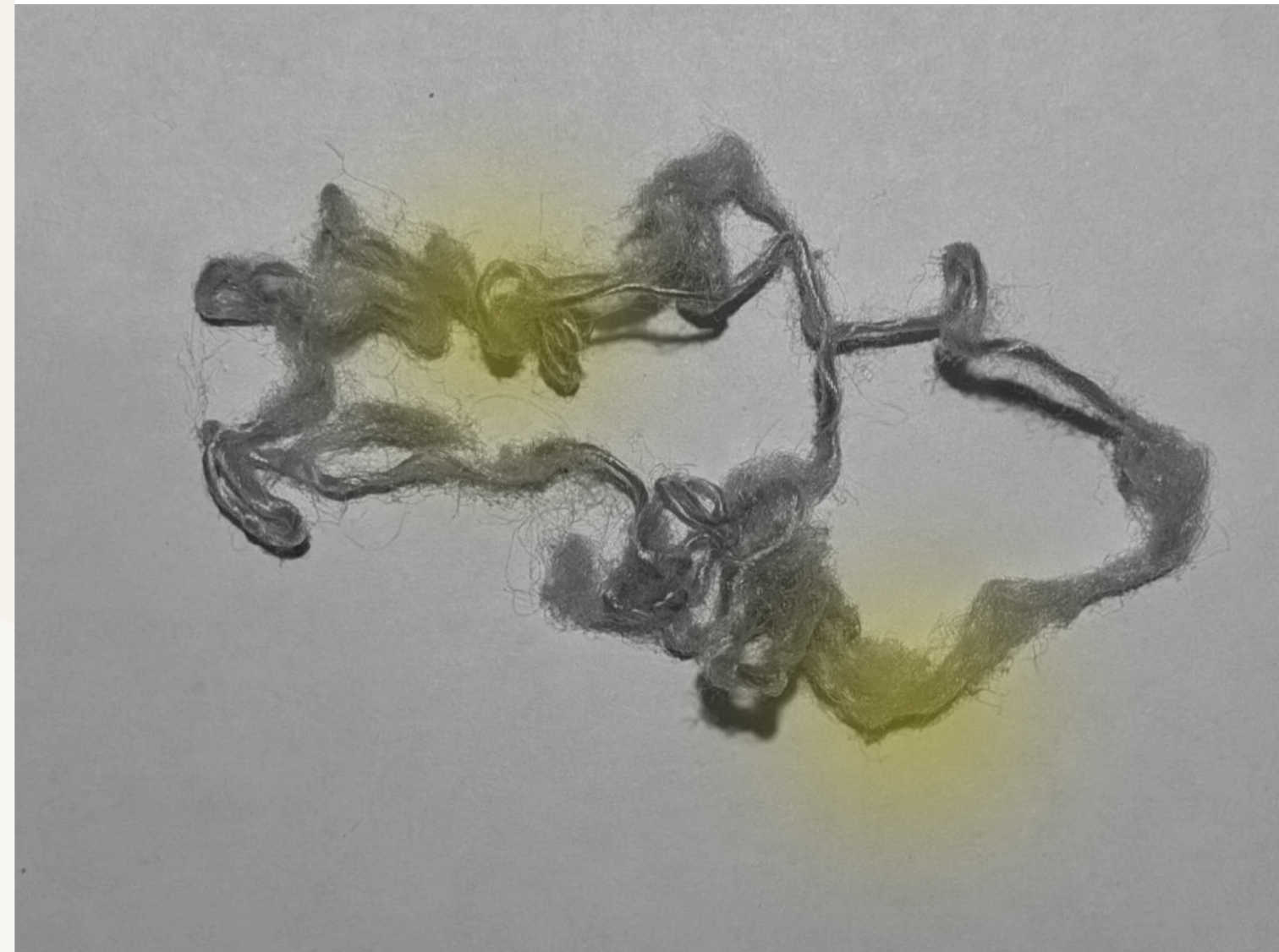
Q.

1/Too Tight



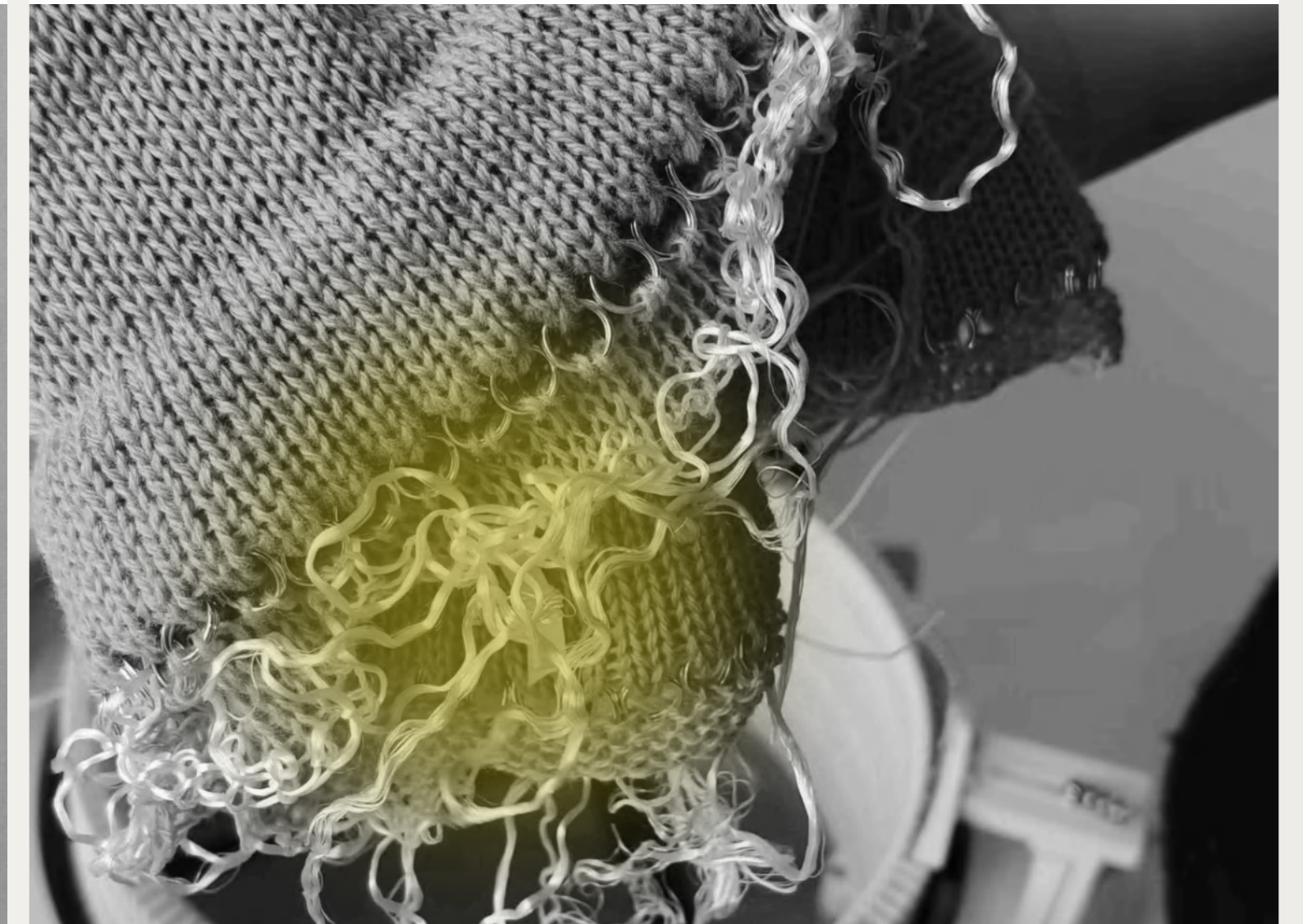
- Machine jams
- Over-tension
- High resistance

2/Material Variation



- Slubs
- Thickness variation
- Friction changes

3/Too Loose



- Yarn tangles
- Slack
- Unstable feeding



spool → guide → flexible pulley/tension arm → machine

Model illustration

Flexible Feeding Mechanism

The flexible feeding mechanism absorbs sudden pulling forces and compensates for slack, allowing tussah silk to pass through the machine more smoothly.

Spool with Light Damping

Prevents the yarn from releasing too much material at once.

Fixed Yarn Guide

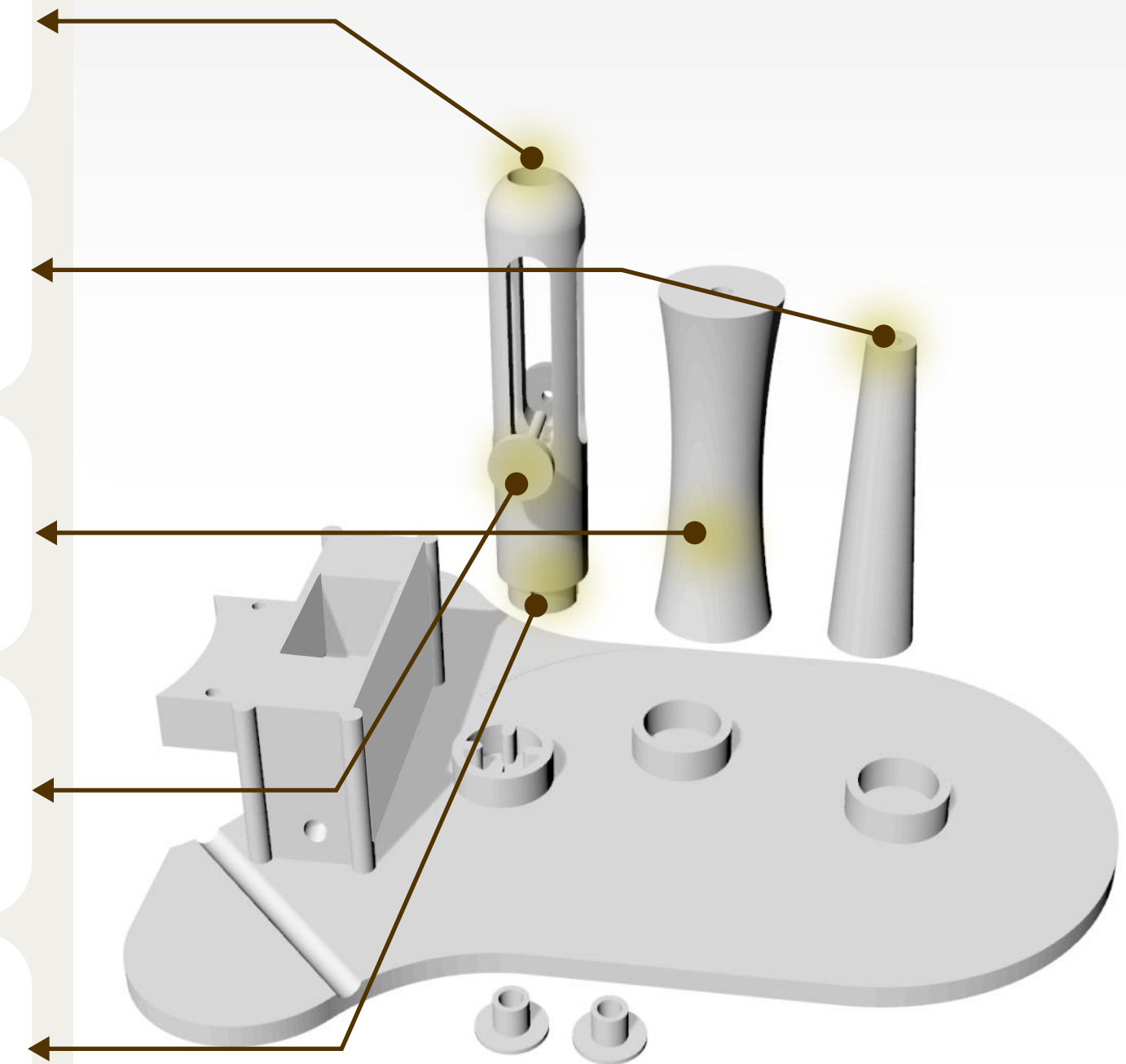
Defines the feeding direction and stabilises the yarn path.

Flexible Pulley Arm

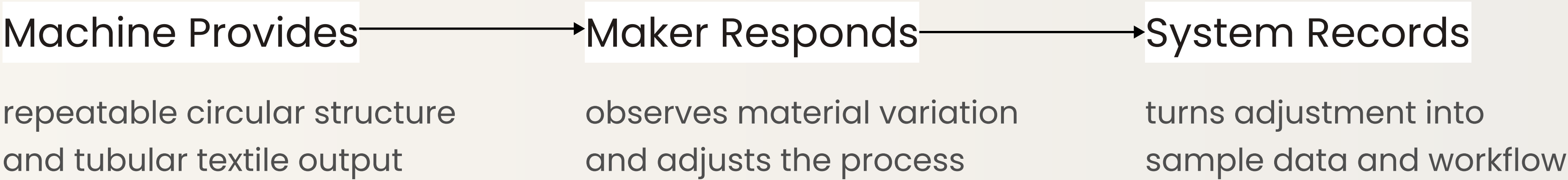
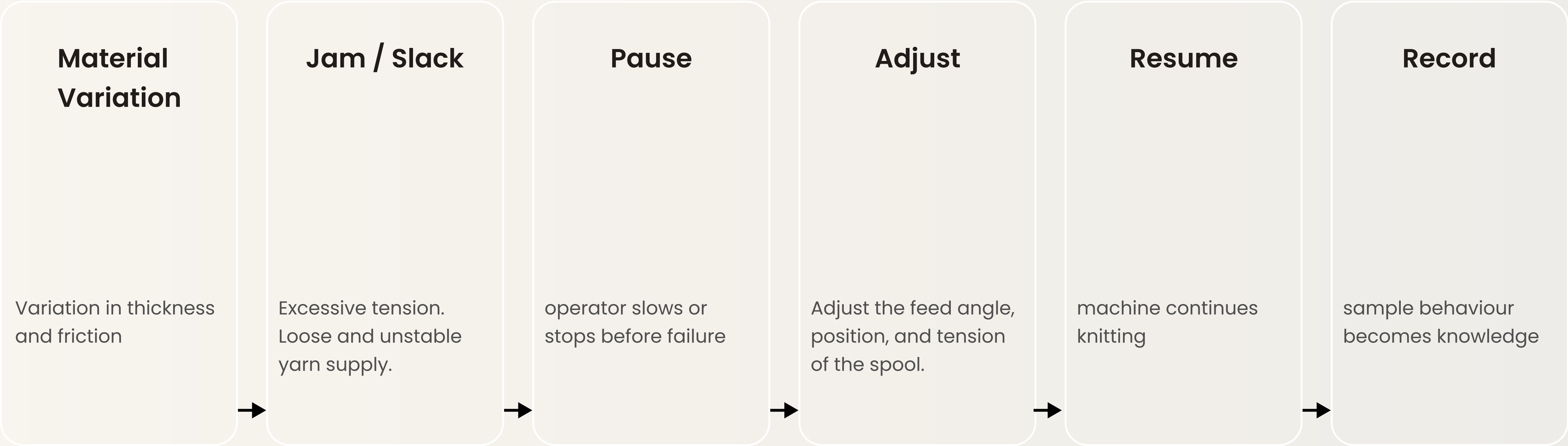
Acts as a passive tension buffer. It moves with the yarn tension, releasing extra yarn when tension spikes and restoring tension when slack appears.

Machine Entry Guide

Stabilises the yarn before it enters the needle cylinder.



Human Adjustment Workflow



Based Sample Library

“Simple representative sample cards for the knit sample library”

Sample ID : **N30-T1-L30**



Needle Count **30** needles
Tightness **High**
Length **30** cm

Observations :
Compact, cushioned form with dense texture and rolled edges. Suitable for herbal compress or resting pouch.
Making Notes :
Short tube works well with filling. Ends need controlled closing and cleaner edge finishing.

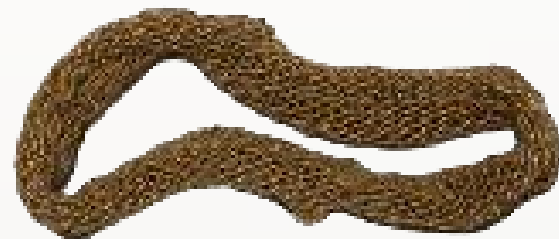
Sample ID : **N60-T2-L30**



Needle Count **60** needles
Tightness **Loose**
Length **30** cm

Observations :
Longer tubular textile with visible slubs, uneven density, and soft deformation.
Making Notes :
Longer production increases tension instability. Feeding control needs improvement for consistency.

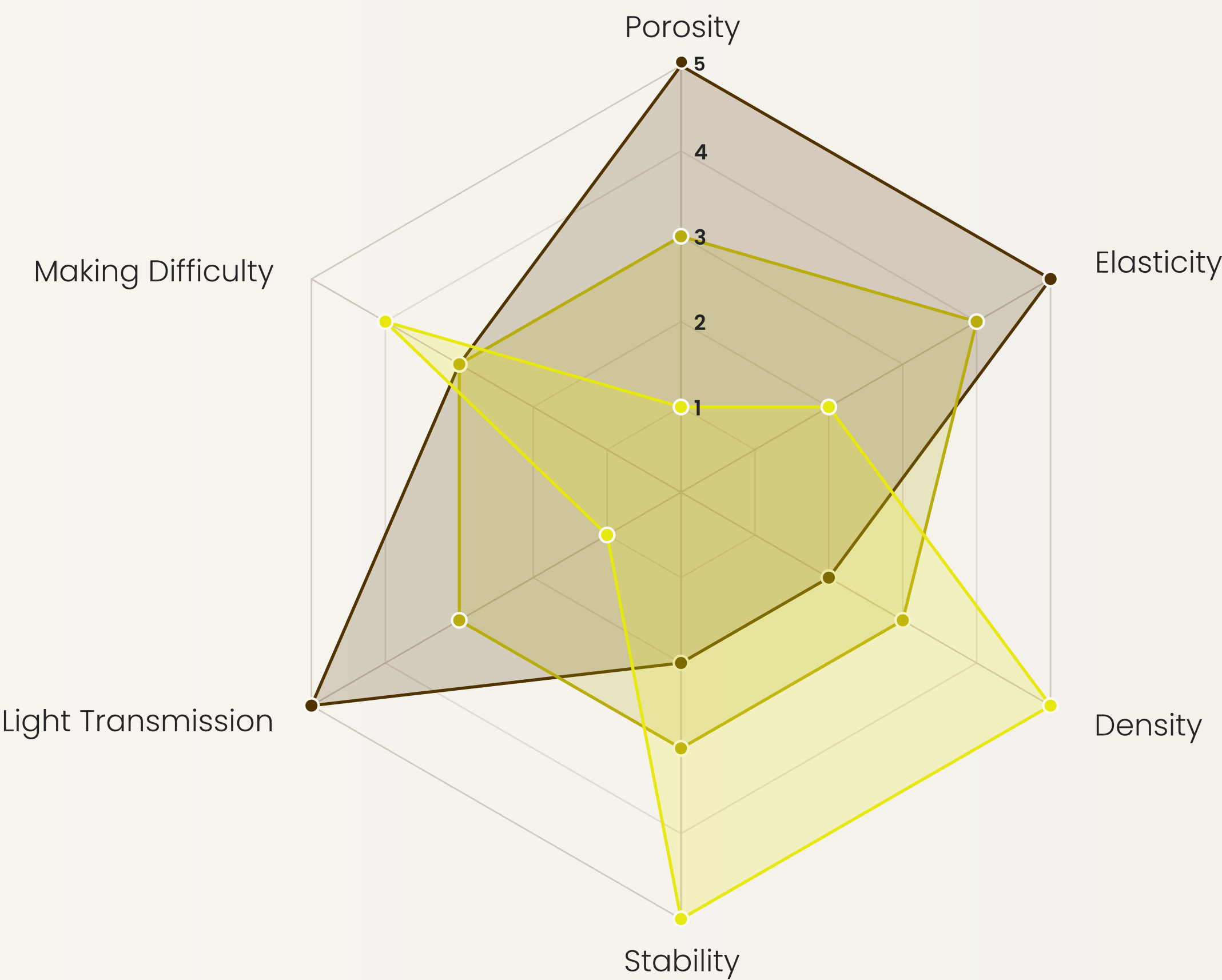
Sample ID : **N60-T3-L20**



Needle Count **60** needles
Tightness **Loose**
Length **20** cm

Observations :
Open, elastic, porous loop with strong flexibility and lightweight behaviour.
Making Notes :
Loose tension improves stretch but reduces stability. Needs edge control for product application.

Qualitative radar chart



	N30-T3-L20	N60-T2-L30	N30-T1-L30
Porosity	5	3	1
Elasticity	5	4	2
Density	2	3	5
Stability	2	3	5
Light Transmission	5	3	1
Making Difficulty	3	3	4
	Open elastic porous	Balanced flexible stable	Dense compact structured

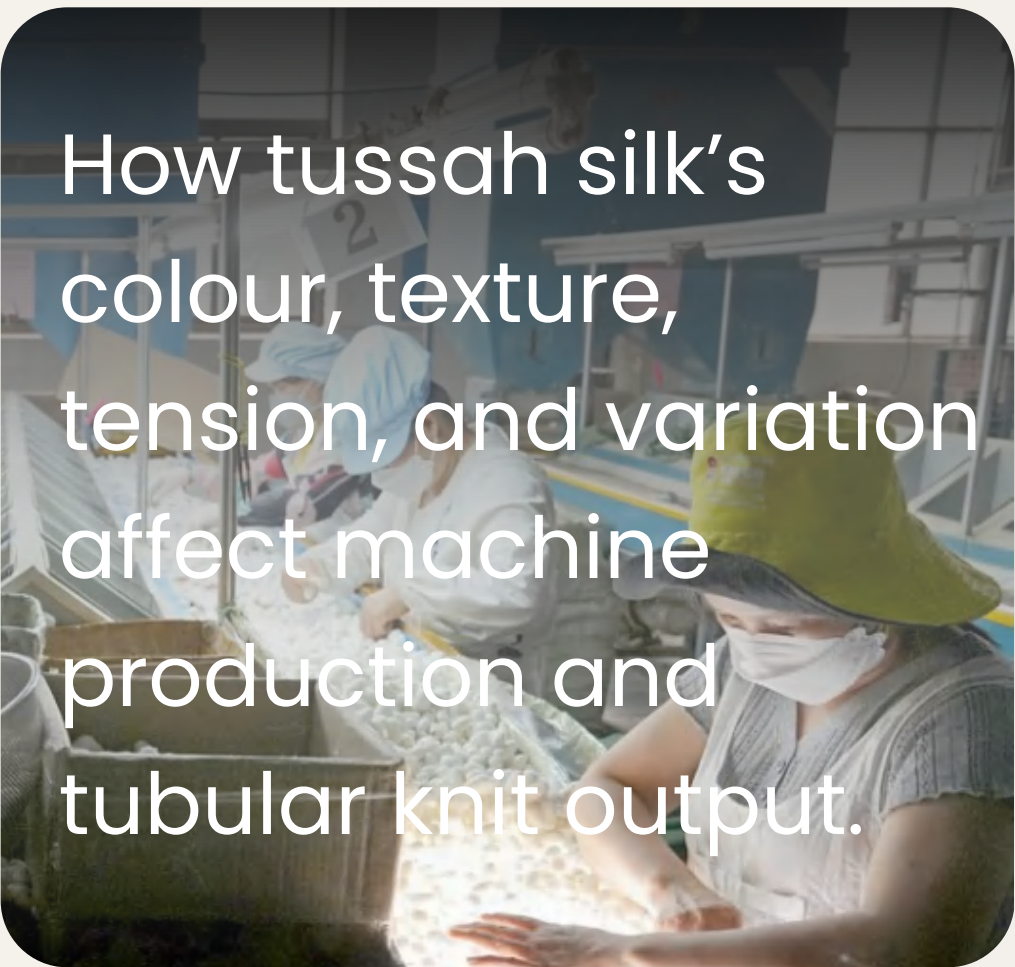
Material Character & Behaviour

CMF Development



Colour

natural beige
warm brown
low saturation



How tussah silk's colour, texture, tension, and variation affect machine production and tubular knit output.

Natural Colour

Undyed beige and warm brown tones keep the material close to its natural state.

Surface Texture

Visible slubs and thickness variation create a non-uniform surface, making each knitted tube slightly different.

Finish

untreated
light tension-set
edge fixing test



Material

tussah silk
slubs
uneven thickness
matte texture

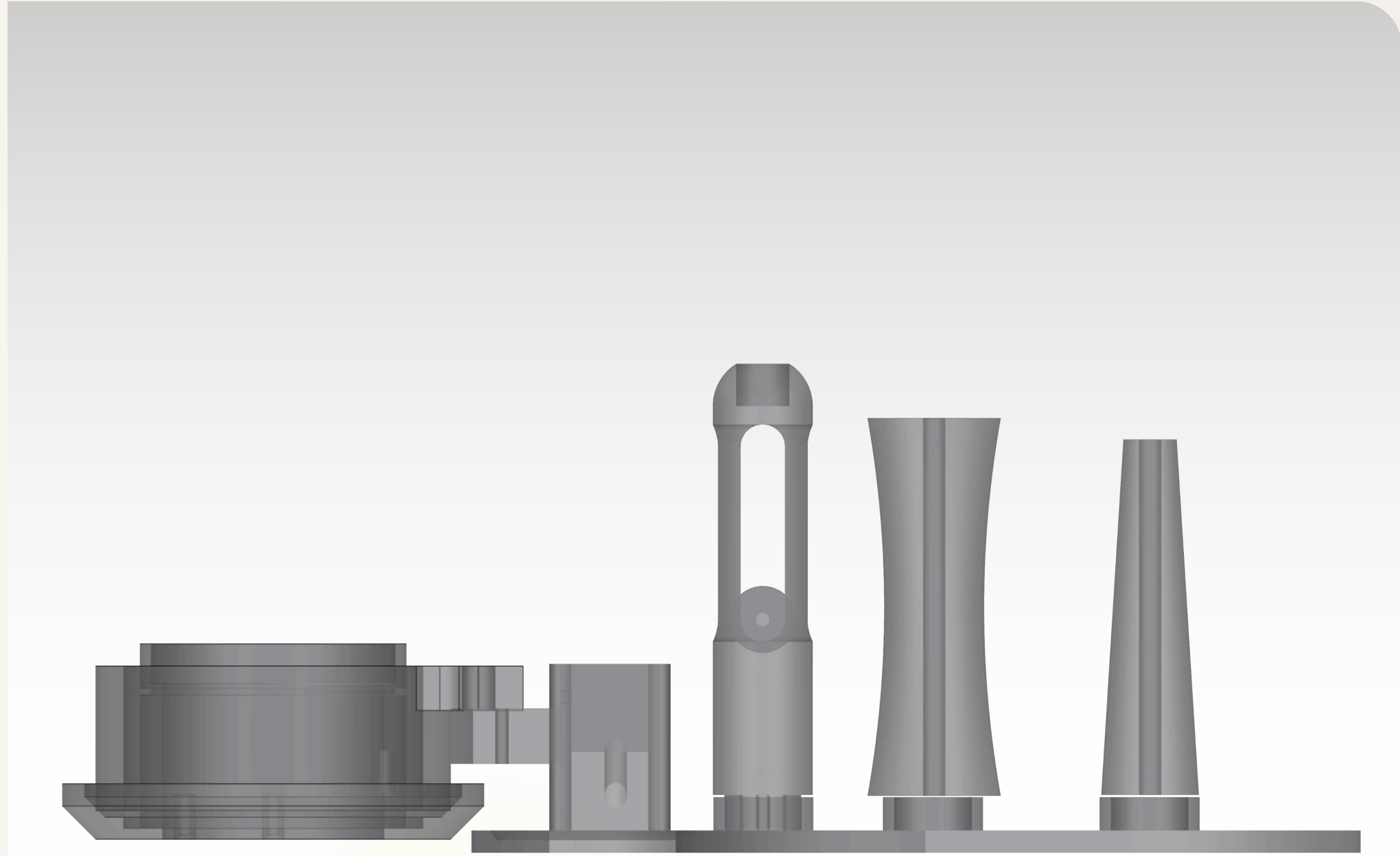


Tension Behaviour

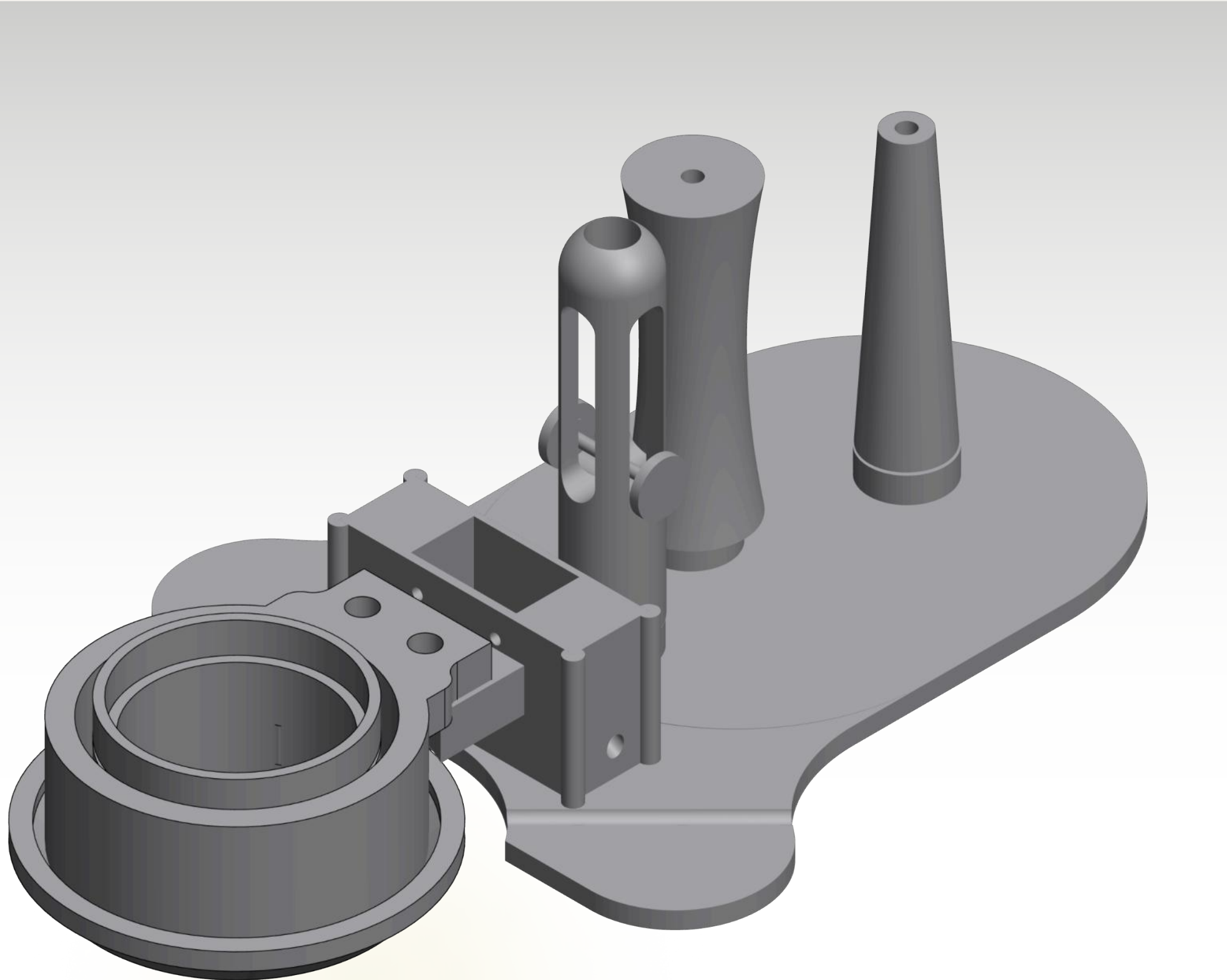
The yarn's variation affects feeding stability, tightness, density, and machine adjustment.

Structural Output

Needle count, tightness, and length influence porosity, elasticity, density, and scale.



2D



3D

“Users are designers and makers, not only final consumers”

Designer / Studio

Needs to understand material behaviour before production.
Compares density, porosity, elasticity and stability.
Selects needle count, tightness and length.
Uses samples to develop future applications.

Sample Library

Works as the shared interface.
Records sample ID, machine settings and making notes.
Turns tacit making knowledge into a visible language.
Connects selection, production and evaluation.

Maker / Operator

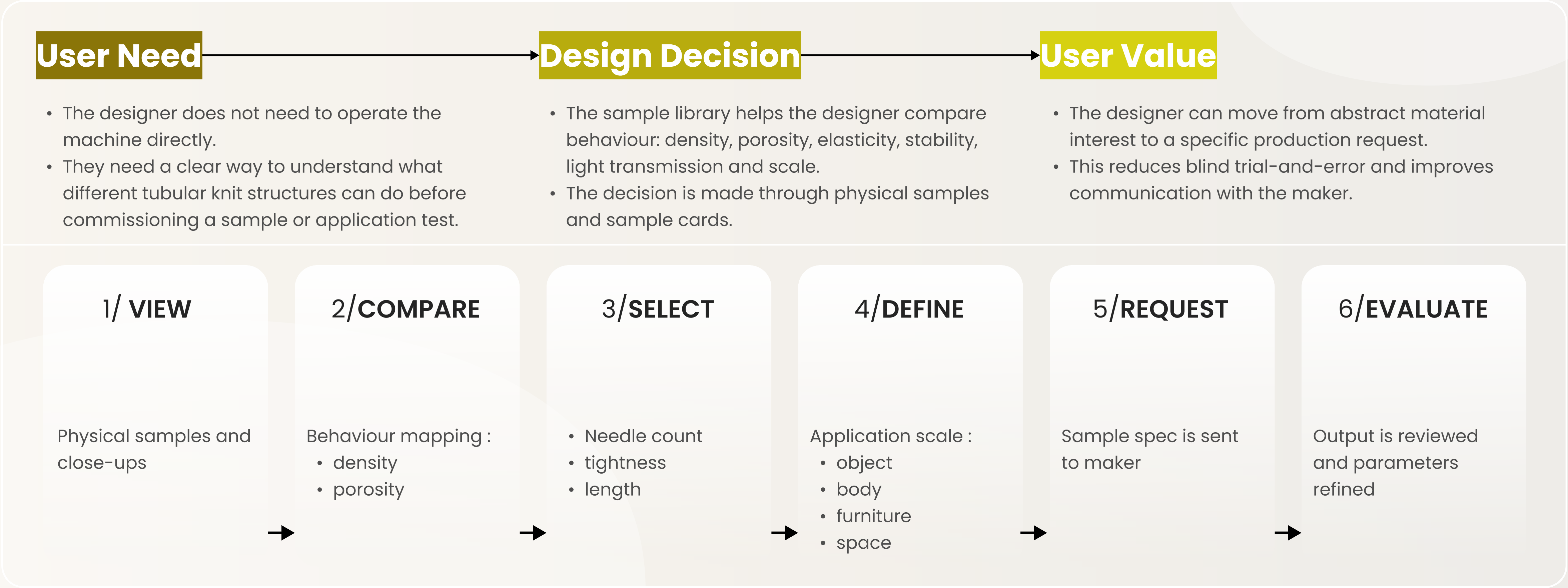
Operates the circular knitting machine.
Responds to slubs, slack, tension changes and jams.
Adjusts feeding path and tension during making.
Records successful and failed samples.

- In COCOON LOOP, user-centred design focuses on the people who use and operate the production system.
- The core users are designers who specify tubular knit structures, and makers who produce them through machine operation and material judgement.
- The sample library becomes the shared interface between design intention, material behaviour and machine production.

UCD value Making the production system understandable, selectable and repeatable for both designers and makers.

a.Designer-Centred Journey

“How a designer uses the sample library to specify tubular structures”

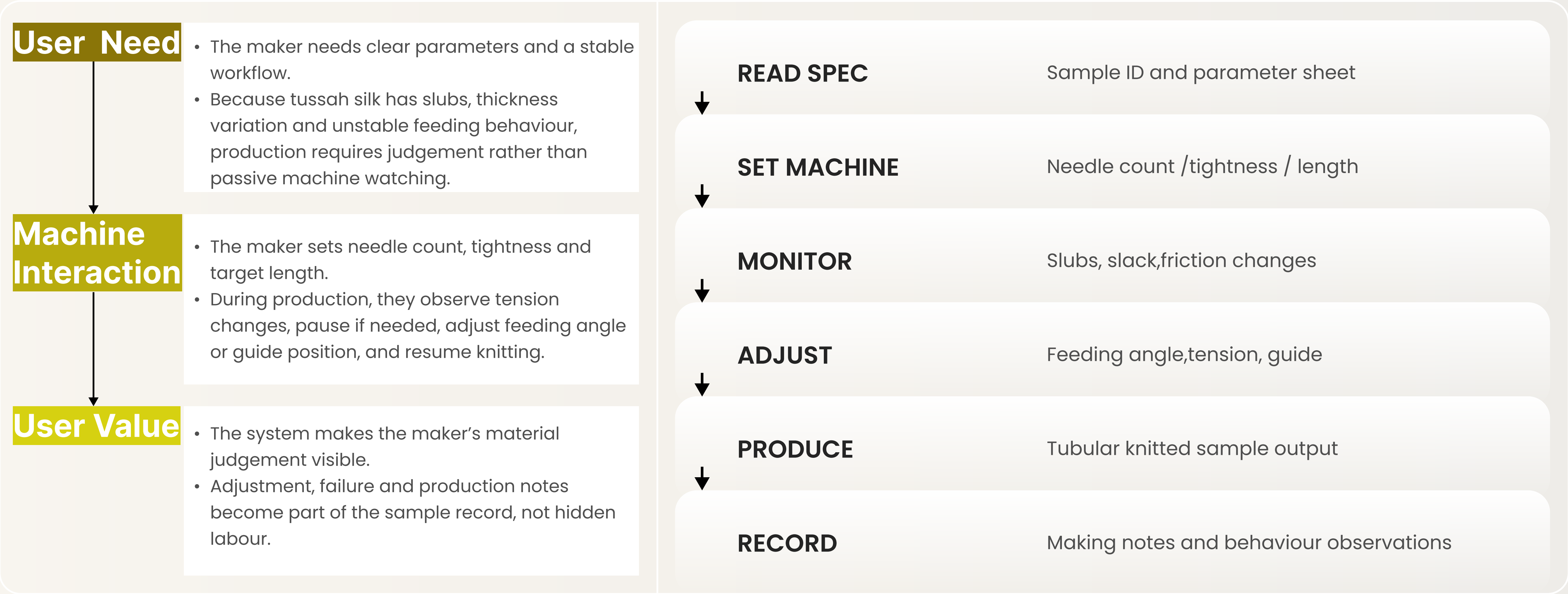


Designer insight The sample library turns material behaviour into selectable design criteria.

b.Maker-Centred Journey



“How the operator translates selected parameters into production”



Maker insight Human adjustment is part of the production logic, not a failure of automation.

c.Shared Interface and Service Blueprint

“How sample cards connect designer intention with machine production”

- The sample card is the key UCD object. It allows designers and makers to speak through the same production language.
- It connects what the designer wants, what the machine can produce, and what the maker observes during production.

Sample Card Records		Designer Reads	Maker Reads	System Learns
Sample ID	Needle count	What does it look like?	Which needle setup?	Successful settings
Tightness	Length	How open or dense is it?	What tightness setting?	Failure records
Observation notes	Making notes	How elastic or stable is it?	What target length?	Adjustment patterns
Behaviour mapping		What application scale fits?	Where might feeding fail?	Behaviour comparison
		Which sample should be requested next?	What needs to be recorded after production?	Future digital database

Service blueprint

Designer action : view library → compare behaviour → select parameters → request sample → evaluate output.

Maker action : read specification → set machine → adjust feeding → produce tube → record behaviour.

System output : sample card → behaviour mapping → production knowledge → future digital selection interface.

C. Technology, Systems and UX | UI

System Diagram Localized textile production service for designers, studios, researchers, and small brands.



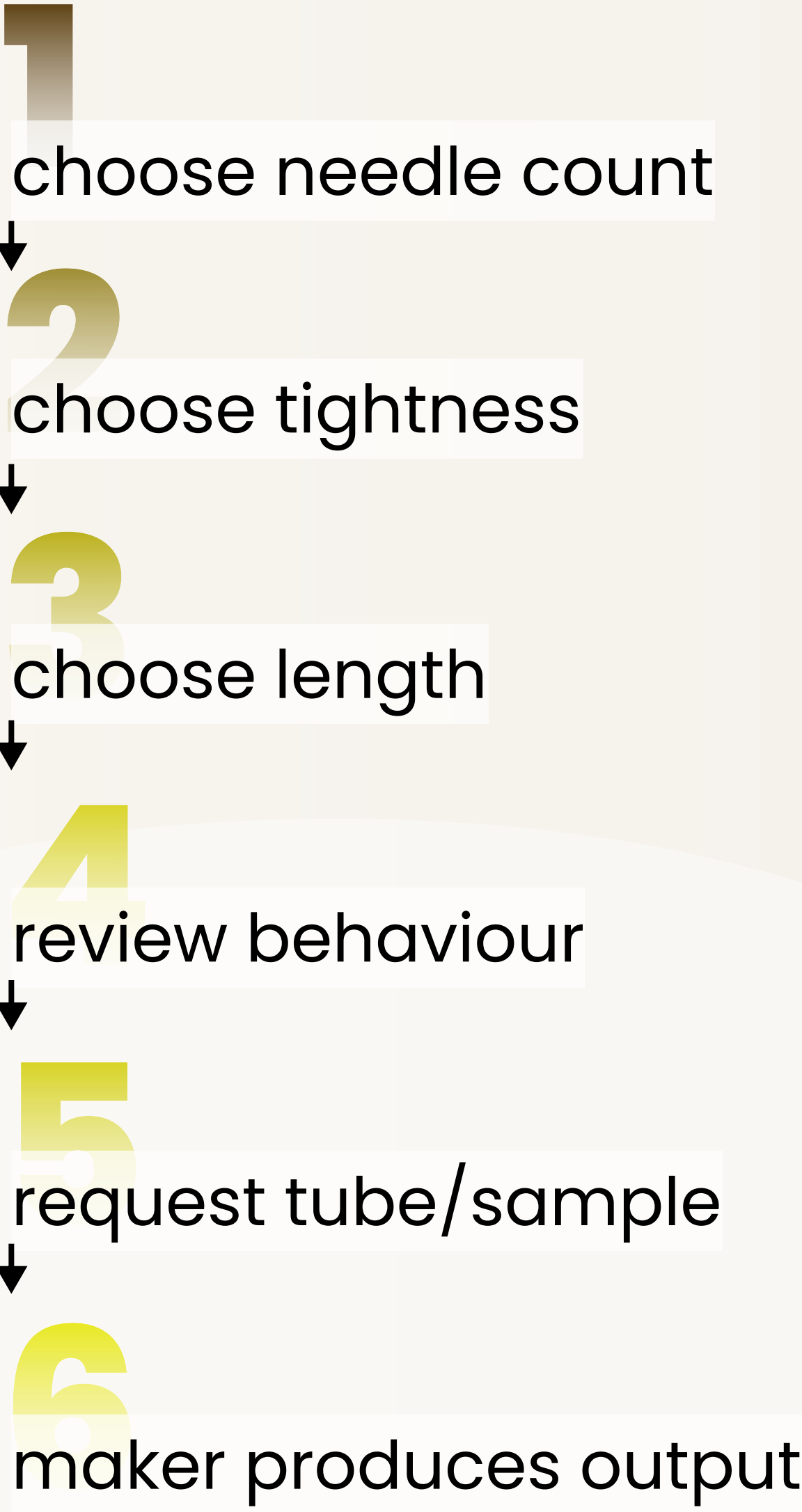
- Tussah silk yarn
- Slubs and uneven thickness
- Natural protein fibre
- Material variation as input

- Circular knitting machine
- Flexible feeding buffer
- Human adjustment workflow
- Tubular textile output

- Needle count
- Tightness
- Length
- Behaviour mapping
- Density / porosity / elasticity

- Custom sample production
- Bespoke textile development
- Material collaboration
- Workshops
- Future digital selection interface

Sample Selection UX



SELECT PRODUCTION PARAMETERS

Needle Count60

60 needles — wider, more open structure

TightnessMedium

Length45 cm

Application Scale

Object scale — protective sleeve / vessel cover

Design Brief

A flexible tubular textile sample for material exploration.

Generate Sample Spec

Reset

GENERATED SAMPLE

N60-T2-L45

medium 60-needle tubular knit, 45 cm length.

60 needles

medium tightness

45 cm

Object scale

BEHAVIOUR MAPPING

DensityMedium

PorosityMedium

ElasticityMedium

StabilityMedium

material: tussah silk

machine: circular knitting

output: seamless tube

01View

Designer reviews physical samples and behaviour notes.

02Select

Needle count, tightness, length and intended scale are chosen.

03Specify

The selected parameters become a sample specification.

04Produce

Maker sets the machine and adjusts feeding tension.

05Evaluate

Tube behaviour is tested through stretch, porosity and stability.

06Iterate

Designer and maker refine the next sample together.

Sample Specification

Sample ID

N60-T2-L45

Needle count

60

Tightness

Medium

Length

45 cm

Application scale

Object

Maker Instruction

Set needle cylinder

60 needles

Set tightness

T2 / medium

Target output length

45 cm

Check during making

feeding tension / slubs / jams

Record after production

density / porosity / elasticity

POSSIBLE APPLICATION DIRECTIONS

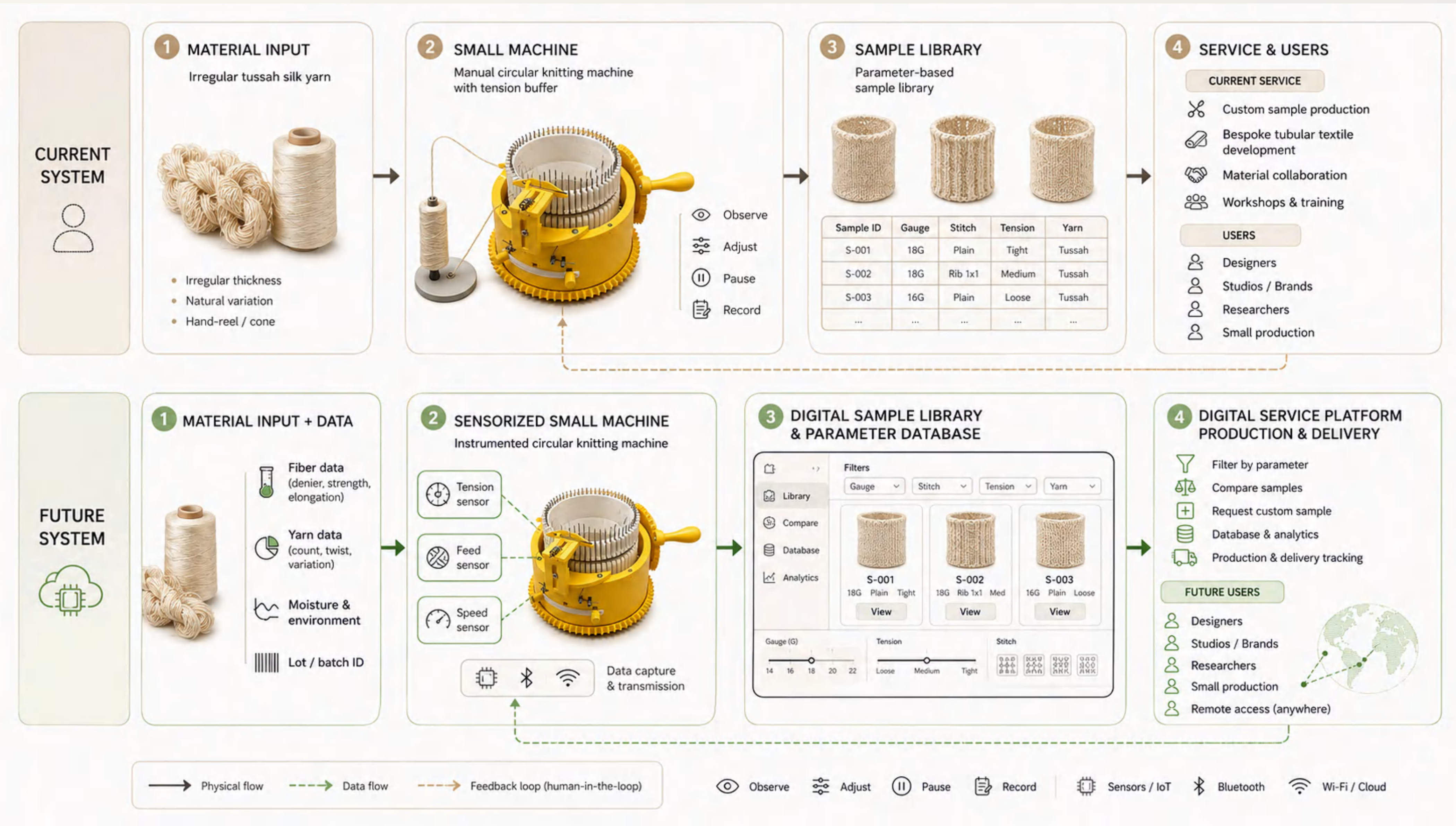
Object

Body

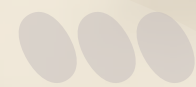
Furniture

Space

Computational Systems: Current and Future



Circular Economy and Planetary Considerations



Natural Protein Fibre

- Tussah silk is a natural protein fibre with a tactile, biodegradable material potential that can be further tested through future soil-return experiments.
- Needle count, tightness, and length are selected before production, helping designers reduce blind trial-and-error and unnecessary material use.

Small-Batch Production

- The system supports localized, small-batch production, allowing tubular textile structures to be made according to specific parameters and needs.
- Future work will compare untreated and treated tussah silk samples through soil-return or biodegradation documentation, including the impact of edge fixing and finishing methods.

Parameter-Based Making

Future End-of-Life Testing

Product Application Possibilities

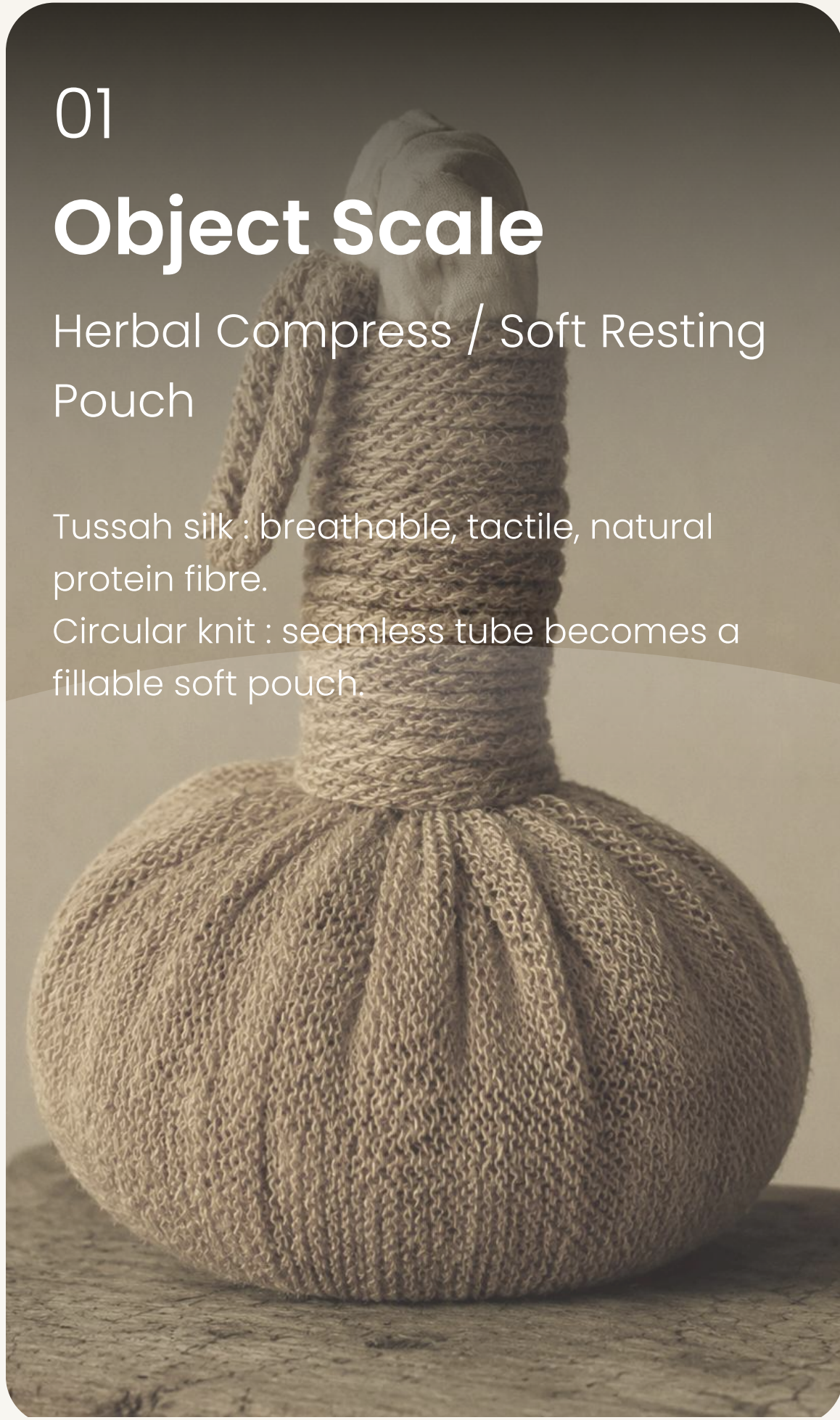
“Four scales developed from material character and tubular knitting logic.”

01

Object Scale

Herbal Compress / Soft Resting Pouch

Tussah silk : breathable, tactile, natural protein fibre.
Circular knit : seamless tube becomes a fillable soft pouch.



02

Body Scale

Wearable Sleeve / Soft Holding Structure

Tussah silk : skin-adjacent, lightweight, breathable, textured.
Circular knit : seamless elasticity fits limbs and supports movement.



03

Furniture Scale

Furniture Skin / Arm Wrap

Tussah silk : adds warmth, softness, and visible material character.
Circular knit : removable tube wraps around arms, rails, and cushions.

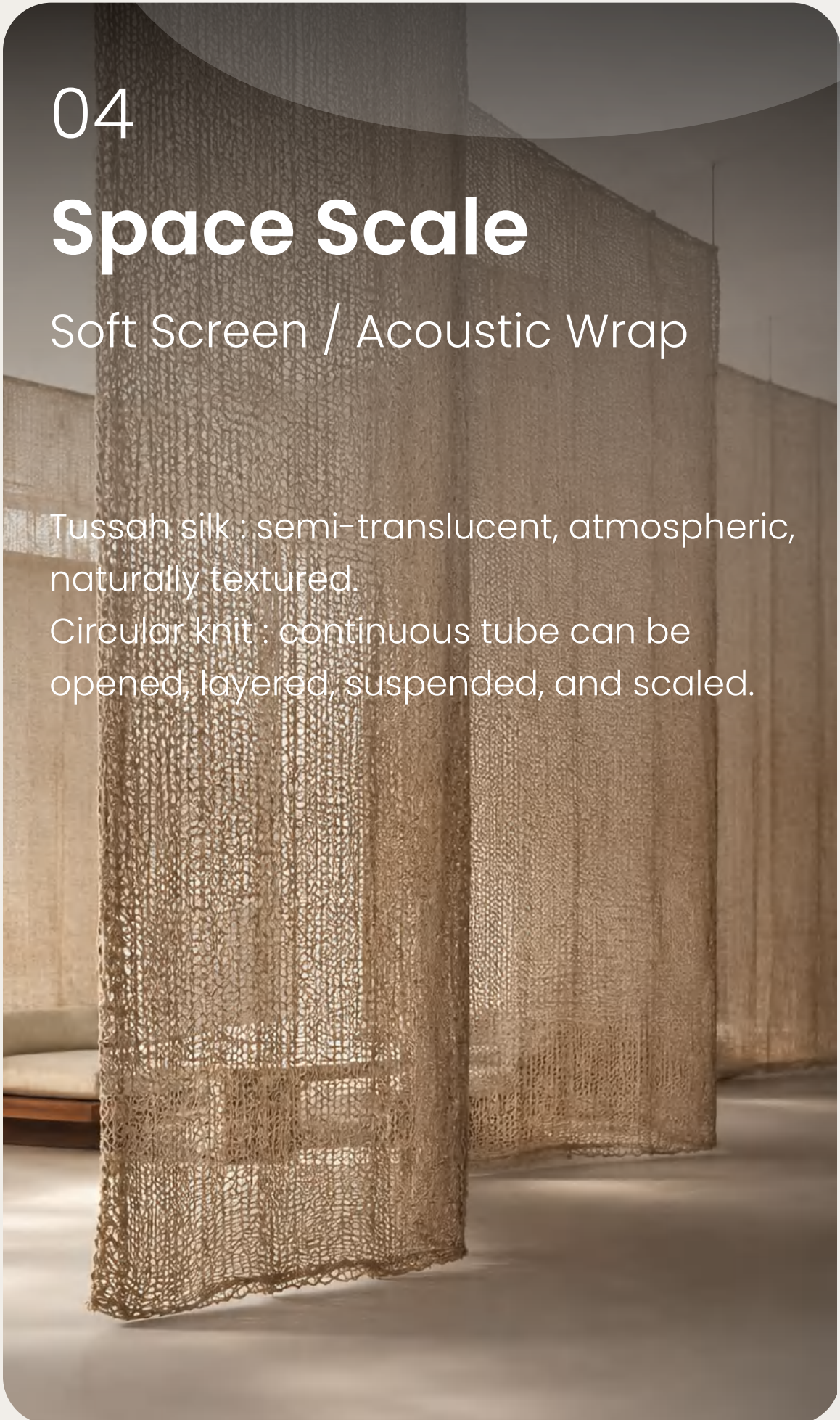


04

Space Scale

Soft Screen / Acoustic Wrap

Tussah silk : semi-translucent, atmospheric, naturally textured.
Circular knit : continuous tube can be opened, layered, suspended, and scaled.



Critical Reflection and Next Steps

Verified :

- machine works
- tussah silk can be processed
- sample library established
- tension issue identified and improved

Unverified :

- product-market fit
- performance data
- scalability
- long-term application

Next step :

1. stitch patterns
2. performance testing
3. digital parameter tool
4. product-specific pilots