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BUILD TRUST.
VALUE ORIGINAL.

GUIDELINES FOR USING AUTHENTICATION TECHNOLOGIES

Strategic partnership to train fashion SMEs in the fight against counterfeits using modern technologies

PROJECT NUMBER
2024-1-RO01-KA220-VET-000243739

Co-funded by the European Union

Introduction & Positioning

This guide reviews AI-based authentication technologies, cryptographic systems, blockchain solutions, NFC/RFID and secure QR technologies to support textile supply chain traceability and Digital Product Passport (DPP) implementation.

This guide does not promote specific vendors or commercial solutions. It focuses on functional capabilities, limitations and SME-relevant use cases.

Authentication systems support human verification and informed decision-making. They do not replace professional judgement and must follow the EU human-centered AI approach.

SMEs must ensure data integrity, appropriate access control and compliance with data protection requirements.

Learning Outcomes

The *No Fake Fashion* project aligns its educational resources with recognized European frameworks and standards. The learning outcomes presented in this guide are structured in accordance with the European Digital Competence Framework (DigComp2.0), supporting the development of practical digital competences related to authentication technologies, secure data management, and Digital Product Passport (DPP) implementation within textile SMEs.

After completing this guide, SMEs will acquire the following learning outcome:

LEARNING OUTCOMES

These learning outcomes are aligned with the European **DigComp framework** to build the digital competencies needed for secure and transparent textile traceability.

PRACTICAL & RELEVANT
Focused on real-world challenges in textile traceability.

SKILLS FOR IMPACT
Supporting informed decisions, secure data, and trustworthy digital solutions.

ALIGNED & RECOGNISED
Based on the European DigComp framework for digital competence.

#	COMPETENCY AREA	LEARNING OUTCOME	DIGCOMP REFERENCE
01	AUTHENTICATION TECHNOLOGY AWARENESS	Describe the main authentication technologies used in textile traceability.	DigComp 1.1 Browsing, searching and filtering data, information and digital content
02	AI & ANOMALY DETECTION	Explain how AI tools detect anomalies and counterfeit products.	DigComp 1.2 Evaluating data, information and digital content
03	SECURE VERIFICATION CONCEPTS	Interpret cryptographic signatures and understand blockchain roles.	DigComp 1.2 Evaluating data, information and digital content
04	TECHNOLOGY EVALUATION & COMPARISON	Compare NFC, RFID and secure QR authentication solutions.	DigComp 5.2 Identifying digital needs and technological responses
05	PROBLEM SOLVING & DECISION-MAKING	Assess the suitability and limitations of authentication technologies in SME contexts.	DigComp 5.2 Identifying digital needs and technological responses
06	DPP DATA INTEGRATION	Support the integration of authentication data into Digital Product Passports (DPPs).	DigComp 1.3 Managing data, information and digital content

AI AUTHENTICATION
Detect anomalies and identify counterfeits

BLOCKCHAIN
Immutable records and shared traceability

RFID / NFC
Contactless identification and data capture

SECURE QR
Product verification for everyone

CRYPTOGRAPHIC SECURITY
Data integrity and secure verification

DPP INTEGRATION
Authentication data linked to the Digital Product Passport

Integrated authentication ecosystem for textile traceability.

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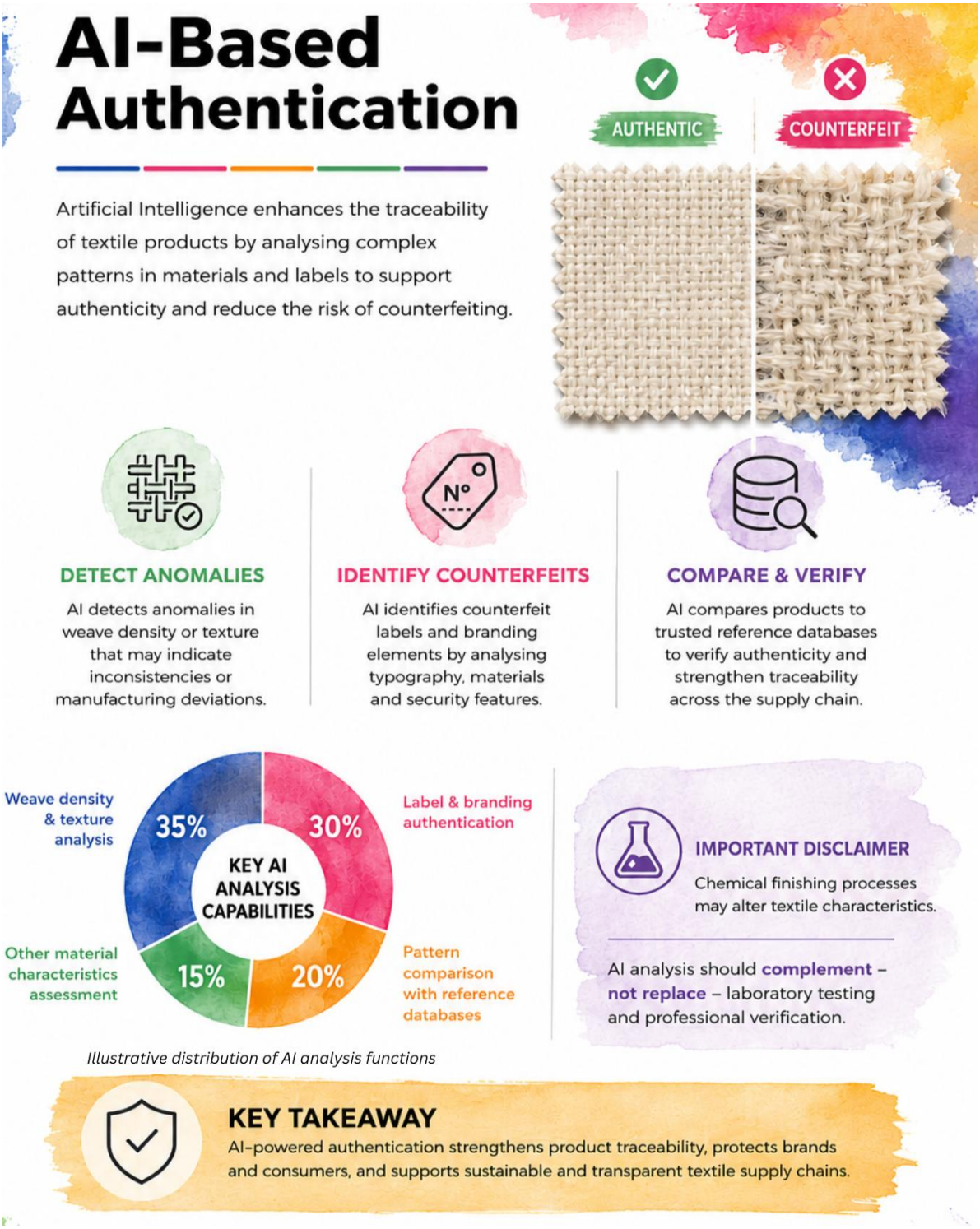
Basic Technologies Overview

Fashion design today combines creativity, technology, sustainability, and cultural awareness. The following infographic highlights the key stages and ideas that shape innovative fashion practices, from concept development and digital tools to ethical production and identity-driven design. Use it as a visual guide to better understand how these elements connect within the modern fashion industry.



As fashion supply chains become increasingly complex, traceability and Digital Product Passports (DPPs) are emerging as essential tools for transparency, authenticity, and sustainability. Within the No Fake Fashion project, SMEs are encouraged to adopt practical and accessible traceability solutions that do not require advanced IT expertise. These systems can support product verification, improve consumer trust, and strengthen protection against counterfeit goods. AI-based analysis further enhances this process by identifying anomalies in textile structures, labels, and material composition.

IMPLEMENTING TRACEABILITY AND DPP FOR SMEs

Cryptographic Signatures

Cryptographic signatures secure product data and ensure authenticity of digital records.

1. DATA INTEGRITY

Ensures that product data remains accurate, complete and unchanged from the moment it is created.

2. TAMPER DETECTION

Any change to the signed data can be detected immediately, protecting against fraud.

3. SECURE EXCHANGE

Enables safe sharing and verification of authentication data across the supply chain.

EXAMPLE: MANUFACTURER SIGNS PRODUCT DATA → RETAILER VERIFIES SIGNATURE

1. MANUFACTURER

Creates product data and generates a cryptographic signature.

2. SIGNED DATA

Product data is digitally signed. The signature is attached to the record.

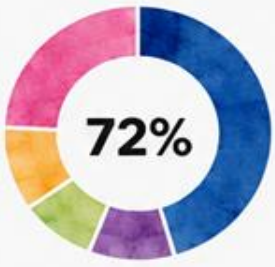
3. DATA SHARED

Signed data is shared securely with the next actor in the supply chain.

4. RETAILER

Verifies the signature to confirm authenticity and integrity.

WHY IT MATTERS FOR SMES



72%

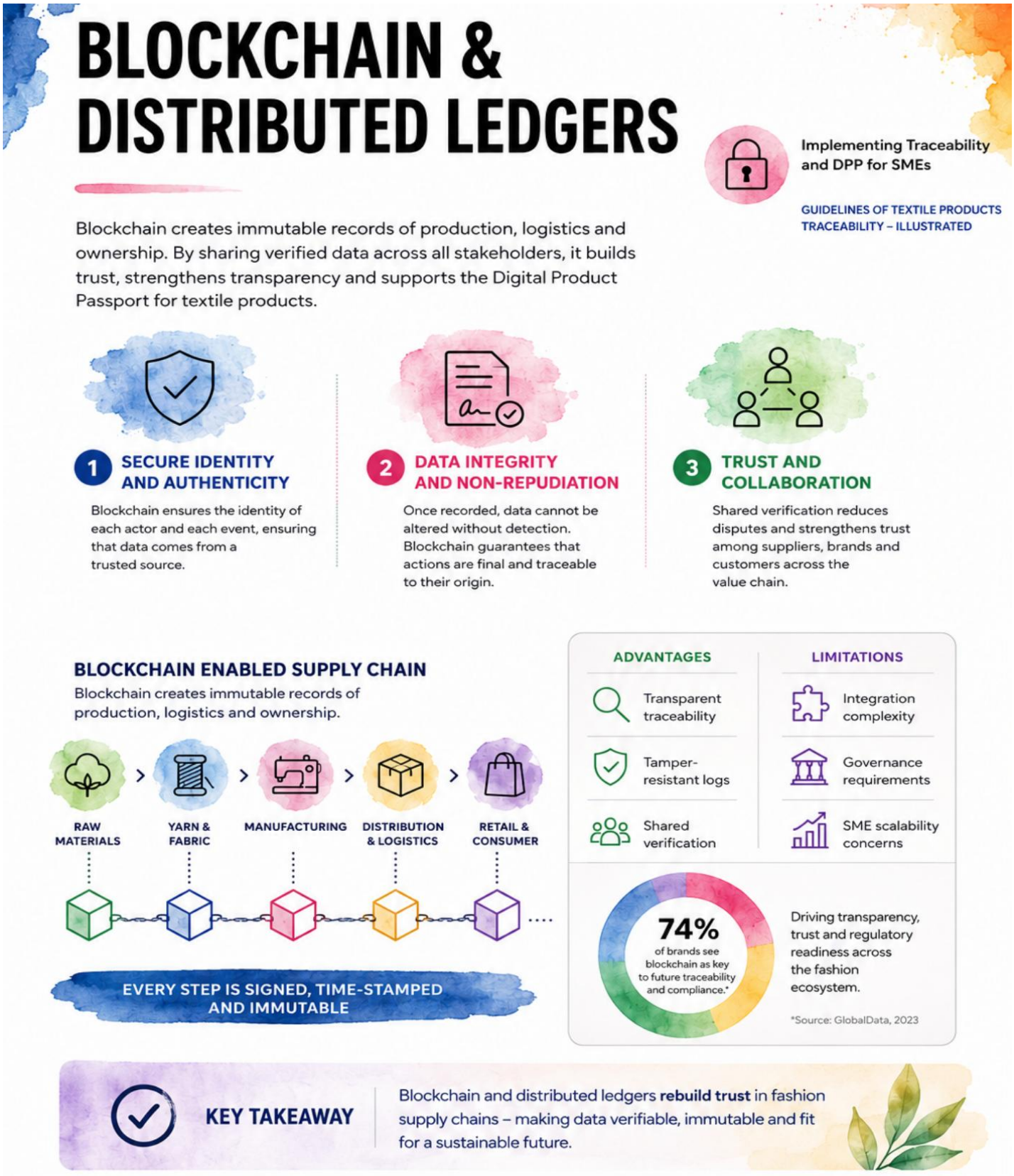
of organisations say data integrity and authenticity are critical to building trust in the supply chain.*

- Data integrity & authenticity
- Regulatory compliance
- Consumer trust
- Operational efficiency
- Other

*Source: Deloitte, Global Blockchain Survey 2023

KEY TAKEAWAY

Cryptographic signatures build a trusted digital foundation for traceability and DPP by guaranteeing that the right data comes from the right source – every time.



Fashion companies are adopting advanced digital solutions to improve transparency, traceability, and product verification. Blockchain and distributed ledgers create secure and shared digital records that cannot easily be modified or deleted. In the context of fashion authentication, they allow brands to store and verify information about a product's origin, production process, logistics, and ownership history in a transparent and reliable way.

NFC, RFID & Secure QR Codes

Contactless technologies enable secure and instant verification of textile products across the supply chain.

They support transparency, efficiency and trust for businesses and consumers.

NFC

Near Field Communication enables data exchange with a simple tap.
Ideal for consumer engagement and product authentication.

RFID

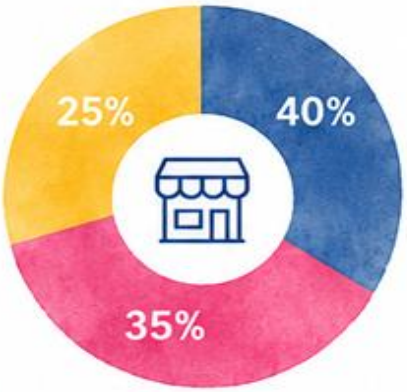
Radio Frequency Identification allows bulk reading and real-time tracking.
Perfect for logistics, inventory and warehouse management.

Secure QR Codes

Encrypted QR Codes provide accessible verification via any smartphone.
Simple, versatile and cost-effective.

WHERE VERIFICATION HAPPENS

Contactless technologies are used across the value chain.



40% Warehouses

35% Retail

25% Consumers

APPLICATIONS

Inventory control
Real-time visibility and stock accuracy.

Consumer authenticity scanning
Empowers customers to verify products instantly.

Audit verification
Supports compliance and simplifies audit processes.

KEY TAKEAWAY

NFC, RFID and Secure QR Codes make traceability simple, reliable and accessible for businesses and consumers alike.
They build trust, improve efficiency and strengthen the value of every product.

AUTHENTICATION TECHNOLOGIES ACROSS THE TEXTILE SUPPLY CHAIN

Authentication technologies strengthen textile traceability, transparency, and counterfeit prevention when connected to the Digital Product Passport (DPP), ensuring trusted information from fibre origin to the final consumer.

1 FIBRE LEVEL AUTHENTICATION

- Molecular tracers and invisible markers
- Blockchain-linked fibre registration
- Verification of fibre origin and authenticity
- Prevention of material substitution
- Trusted sourcing records for DPP integration

2 PROCESS LEVEL AUTHENTICATION

- RFID and NFC production checkpoints
- Cryptographic production records
- Blockchain registration of manufacturing events
- AI-supported anomaly detection
- Improved audit and regulatory transparency

3 FINISHED PRODUCT AUTHENTICATION

- Secure QR code verification
- NFC-enabled product tags
- Digital authenticity certificates
- AI-supported product verification
- Consumer trust and anti-counterfeit protection

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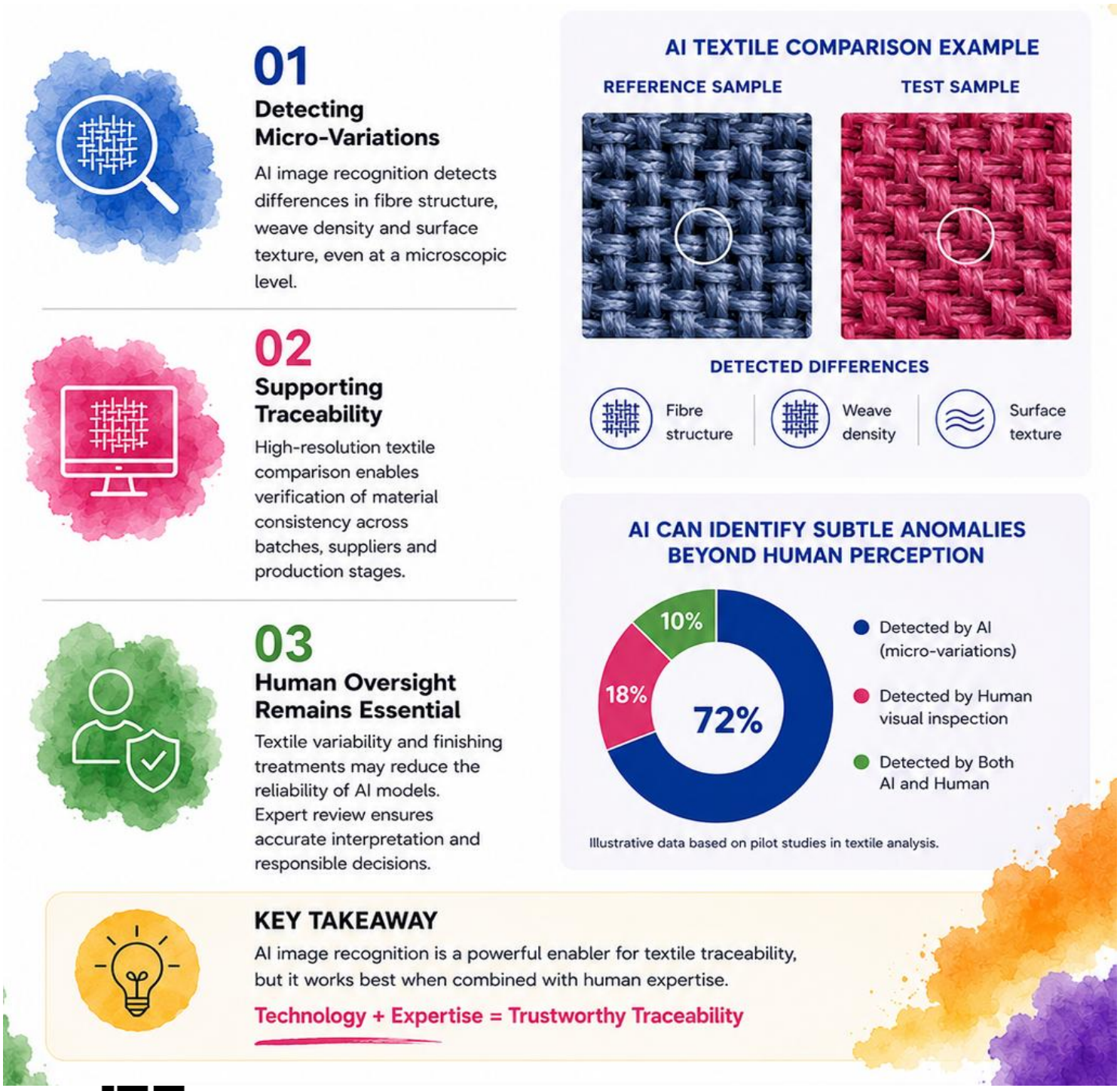
Image Recognition & Anomaly Detection

Artificial Intelligence is transforming textile traceability by enabling faster and more accurate material verification across the fashion supply chain. Through advanced image recognition systems, AI can analyze fiber structure, weave density, and surface texture to identify subtle differences that are often invisible to the human eye. High-resolution textile analysis can help detect inconsistencies, monitor production quality, and reduce the risks linked to counterfeit or misidentified materials. By improving accuracy in production and verification processes, these technologies can also help prevent textile surplus, minimize unnecessary waste, and support more sustainable manufacturing practice



AUTHENTICATION MODELS

1 PHYSICAL AUTHENTICATION

Uses physical or chemical features and scientific testing methods that are embedded or applied to the product or its packaging. These features are difficult to copy and can be verified with the naked eye or specialized tools.

Material markers | Chemical analysis | Spectroscopy (NIR, FTIR, Raman) | DNA or bio-testing

These methods provide concrete, verifiable evidence that a product is genuine and made with the claimed materials and processes.

- Harder to replicate or remove
- Provides strong evidence of authenticity
- Requires lab equipment or specialized tools
- Best for high-value or high-risk products

2 DIGITAL AUTHENTICATION

Connects the physical product to a unique digital identity using digital tools and data systems. Consumers can verify authenticity and access product information through a secure and transparent digital platform.

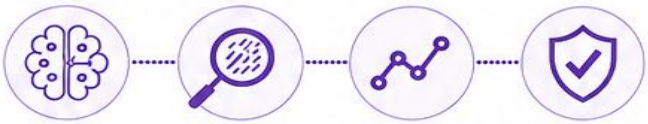
QR codes & NFC | Blockchain & ledgers | Digital certificates | IoT & data logging

These technologies create a verifiable digital trail that allows brands and consumers to confirm origin, track movement, and access trusted product information in real time.

- Easy to update and share information
- Enables end-to-end traceability and real-time verification
- Improves transparency and data integrity
- Best for scalable and connected supply chains

3 AI / INTELLIGENT AUTHENTICATION

Applies artificial intelligence, machine learning and advanced data analytics to automatically detect counterfeits, identify anomalies, and assess risks with greater speed, accuracy and scale.



AI image recognition | Pattern & behaviour analysis | Anomaly detection | Risk scoring & alerts

These systems continuously learn from data to improve detection of counterfeits, inconsistencies, and suspicious activities across products and supply chains.

- Detects fakes and irregularities faster than manual methods
- Learns from data and improves accuracy over time
- Handles complex patterns humans may miss
- Best for large volumes and evolving counterfeit threats

4 HYBRID MULTI-LAYER MODELS

Combines two or more authentication approaches into an integrated system. By layering multiple verification methods, it creates strong, complementary protection that is much harder to replicate or bypass.

Physical markers + Digital verification + AI / intelligent analysis + Security & encryption = Stronger authenticity assurance

By integrating technologies across physical, digital and intelligent layers, hybrid models deliver the highest level of confidence, security and resilience.

- Reduces the risk of counterfeiting and data tampering
- Provides multiple layers of proof and security
- Adapts to different products, markets and threats
- Best for maximum trust and brand protection

Textile-Specific Constraints

01 Material & Process Variation

- **Natural fibre variability:** structure, colour, density and surface traits vary by origin, cultivation, processing, dyeing and finishing; AI may read normal variation as anomalies.
- **Dyeing, washing and finishing:** treatments can alter texture, colour intensity, fibre surface and label readability; define authentication checkpoints before and after key processes.

02 Operational & Economic Feasibility

- **High-volume, low-margin production:** advanced tools may be useful but too costly across all products; start with high-risk, premium, limited or export lines.
- **Tag durability:** QR, NFC or RFID identifiers must survive washing, ironing, friction, humidity, folding, transport and long-term use; test placement, compatibility and durability.
- **Cost versus accuracy:** easy low-cost tools are more exposed to copying unless supported by secure databases or digital signatures; choose what fits risk, value and capacity.

03 Data Quality & Human Oversight

- **Supplier data dependency:** incomplete, inconsistent or unverifiable supplier data weakens authentication; set minimum data requirements and basic verification procedures.
- **Need for human oversight:** tools should support decision-making, not replace professional judgement; textile experts, quality controllers and production managers remain essential.

Constraint Distribution

2	3	2
Material & Process	Operations & Economics	Data & Oversight

Key Takeaway

Start proportionally: pilot on selected products, validate data quality, test identifiers under real textile conditions, and keep experts in the loop before scaling traceability or DPP integration.

AUTHENTICATION TECHNOLOGIES IN TEXTILE SUPPLY CHAINS:

IDEAL VS REAL-WORLD IMPLEMENTATION

Authentication technologies strengthen traceability and transparency in textile supply chains and support the Digital Product Passport (DPP). However, SMEs face multiple real-world constraints that affect implementation, scalability, and long-term effectiveness.

	IDEAL SYSTEM (THEORETICAL MODEL)	VS	REAL-WORLD IMPLEMENTATION (SMES REALITY)
1 COST & SCALABILITY	Low-cost scalable deployment, standardized infrastructure.		High costs of blockchain, AI, IoT technologies; limited SME budgets.
2 ERP INTEGRATION	Seamless integration with ERP systems and full interoperability.		Complex integration with legacy or fragmented ERP systems.
3 REAL-TIME MONITORING	Full real-time visibility across the supply chain.		Delays in data capture and synchronization.
4 SUPPLIER DATA QUALITY	Fully accurate, standardized, and verified supplier data.		Inconsistent, incomplete, or unreliable supplier inputs.
5 HUMAN OVERSIGHT	Fully automated authentication and validation.		Human expertise still required for validation and compliance.

GAP BETWEEN IDEAL AND REAL-WORLD IMPLEMENTATION IN SMES

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SERVICES & FUNCTIONAL CATEGORIES

FUNCTIONAL CATEGORIES

AI FIBRE ANALYSIS SOFTWARE

Analyses textile fibres and materials to identify composition and detect inconsistencies.

- Fiber identification & blends
- Material comparison
- Anomaly detection
- Quality control support

BLOCKCHAIN LOGGING PLATFORMS

Creates immutable, tamper-evident records for transparency and traceability.

- Manufacturing & sourcing data
- Ownership & certification
- Logistics & shipment tracking
- Repair & resale history

NFC / RFID SERVICES

Uses embedded tags or labels for digital identification and interaction.

- Product identification
- Inventory & stock tracking
- Consumer engagement
- Digital product passports

MULTI-MODALITY AUTHENTICATION SOLUTIONS

Combines multiple technologies to verify authenticity and reduce replication risk.

1 HARDWARE LAYER – PHYSICAL IDENTIFICATION

Physical security features and identification carriers embedded in or attached to the product.

- Material markers
- NFC tags
- RFID labels
- QR codes & data codes
- Holograms & security labels
- Seals & fasteners

2 SOFTWARE LAYER – VERIFICATION & ANALYSIS

Digital tools and algorithms process and verify product information.

- AI fibre analysis & material identification
- Image recognition & pattern matching
- Authentication logic & rule engine
- Tag reading & device management
- Data validation & cross-checking systems

3 CLOUD LAYER – DATA & TRACEABILITY INFRASTRUCTURE

Centralised or distributed systems store, secure and share authentication data.

- Secure cloud storage
- Blockchain databases
- Digital records & certificates
- Traceability analytics
- APIs & data sharing

4 USER LAYER – ACCESS & INTERACTION

Stakeholders access and interact with authentication information.

- Brands & manufacturers
- Retailers & distributors
- Customs & inspectors
- Consumers (scan & verify)
- Resale & circular economy platforms

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Case-Based Functional Examples

These case-based examples demonstrate how SMEs in the textile sector can implement Digital Product Passport (DPP) technologies in a gradual and realistic way, addressing operational challenges related to traceability, authentication, and sustainability compliance.

Case 1 - Secure QR codes for basic product traceability

A small textile SME producing denim garments faced increasing difficulties in managing product traceability across suppliers and distribution channels. The company also identified growing concerns related to counterfeit products and the lack of accessible product information for consumers and retailers.

To address these challenges, the company implemented a secure QR code system linked to a cloud-based Digital Product Passport platform. Each garment received a unique encrypted QR identifier containing basic product information, including material composition, batch number, production country and supplier references.

Operationally, the solution improved transparency across the supply chain and simplified access to product information for both internal teams and external stakeholders. The company also reduced manual documentation processes and created a scalable digital foundation for future DPP requirements.

One of the main lessons learned was that SMEs can begin DPP implementation with relatively low cost technologies before moving towards more advanced systems. The company also recognised the importance of standardising supplier data collection from the beginning to improve future interoperability.

Case 2 - NFC Integration for Internal Logistics and Authentication

A mid-sized knitwear manufacturer operating with multiple production facilities experienced inefficiencies in inventory management and difficulties verifying product authenticity during warehouse operations and retail distribution.

The company introduced NFC tags integrated into garment labels together with QR Digital product passports. NFC technology was primarily used for internal logistics, enabling faster warehouse scanning, inventory verification and shipment tracking, while QR codes provided consumer facing transparency and product information access.

The operational impact included improved inventory accuracy, faster product verification processes and better coordination between production and logistics departments. The integration also strengthened anti-conterfeiting measures by allowing unique product authentication during distribution and retail stages.

The SME learned that combining consumer facing and operational technologies creates greater value than relying on a single traceability tool. The company also identified employee training and supplier alignments as essential factors for successful technology adoption.

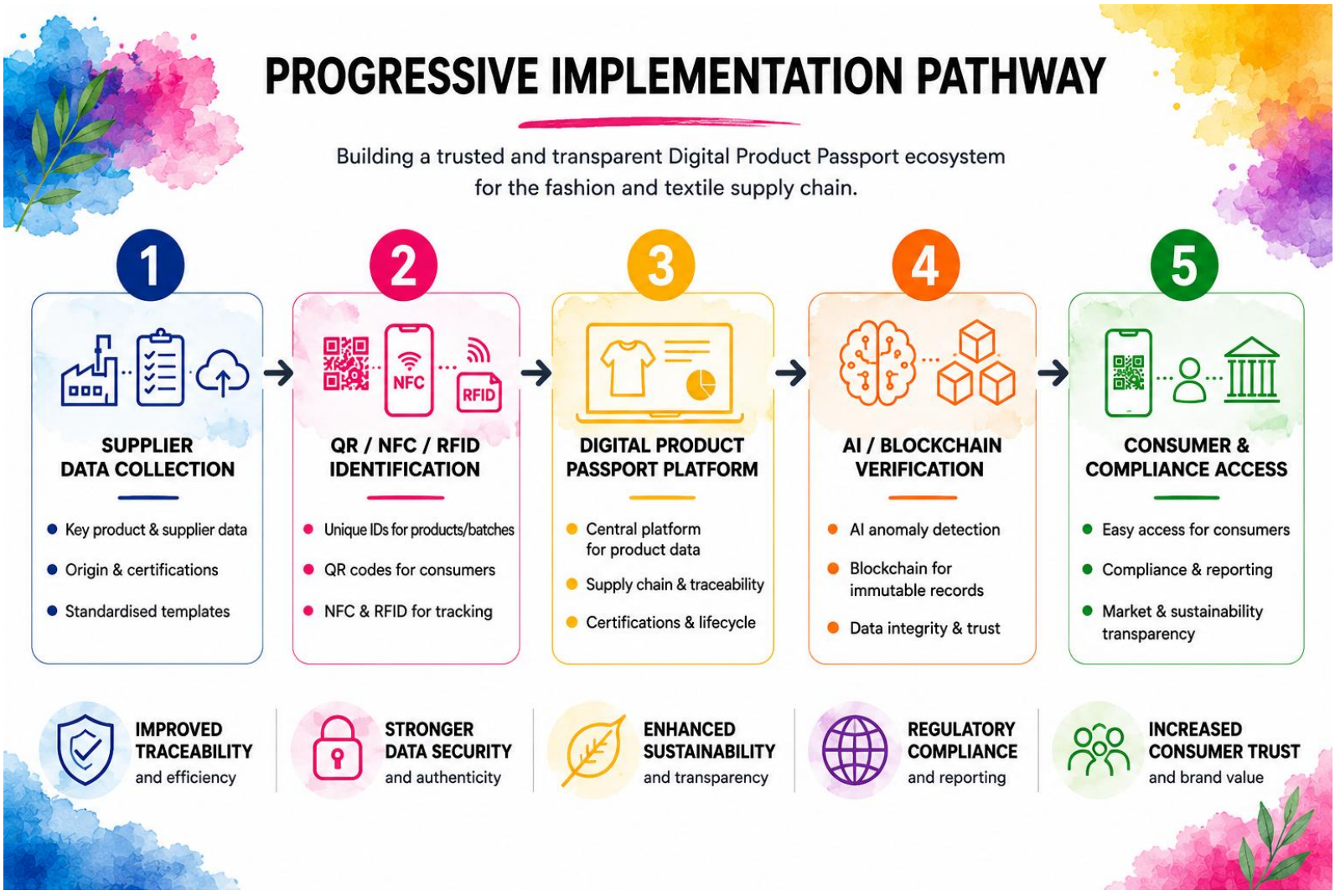
Case 3 - Blockchain, traceability for sustainable footwear

A sustainable footwear SME exporting products to different European markets needed to improve the reliability and transparency of sustainability to product claims. The company also sought to strengthen compliance with emerging Digital Product Passport and traceability requirements.

To support these objectives, the SME implemented a blockchain traceability system combined with RFID technology. RFID tags enabled automated tracking throughout manufacturing and logistics processes, while blockchain technology stored immutable records related to material sourcing, certifications, transport history and production events.

The implementation improved supply chain transparency, reduced risks associated with data manipulation and facilitated access to verified sustainability information for business partners and consumers. It also supported audit preparation and regulatory reporting activities.

The main lesson learned was that advanced technologies such as blockchain are most effective when built upon already structured and digitised supply chain data. The SME also recognised that gradual implementation and collaboration with suppliers are critical to ensuring long term scalability and operational efficiency.



HOW AUTHENTICATION TECHNOLOGIES STRENGTHEN THE DIGITAL PRODUCT PASSPORT (DPP)

1 FIBRE ORIGIN STAGE

- Material source
- Certification status
- Supplier verification

2 PROCESS VERIFICATION STAGE

- Production records
- Quality checks
- Compliance validation

3 FINAL PRODUCT VERIFICATION STAGE

- QR / NFC tags
- Digital certificates
- Consumer access

DIGITAL PRODUCT PASSPORT (DPP)

Verified · Secure · Transparent · Trusted

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TYPES OF DATA IN AUTHENTICATION SYSTEMS

1. SENSOR READINGS (TEMPERATURE, HUMIDITY)

Sensor data can include temperature, humidity, location tracking, or production monitoring information collected during manufacturing and logistics processes.

Includes:

- Temperature
- Humidity
- Location (GPS)
- Light exposure
- Shock / vibration

Purpose

Ensures the product has been handled under the right conditions and detects any anomalies.

2. DIGITAL SIGNATURES

Cryptographic signatures help verify data authenticity, prevent unauthorised modifications, and ensure secure validation of supply chain records.

Includes:

- Entity digital signatures (manufacturers, suppliers, certifiers)
- Time-stamped approvals
- Key management information

Purpose

Confirms the origin and integrity of data and provides non-repudiation.

AUTHENTICATION DATA REPOSITORY

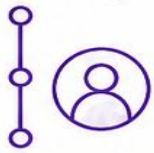
Secure • Structured
Tamper-evident

3. AUDIT LOGS

Audit logs create transparent records of production activities, verification events, and supply chain interactions for traceability and compliance purposes.

Includes:

- Data creation and updates
- Access events (who, when, what)
- Data sharing and transfers
- System actions and changes



Purpose

Provides a complete history of actions, supports accountability and enables traceability of changes.

4. VERIFICATION RESULTS

Verification systems confirm product authenticity, certification validity, and consistency between physical products and digital records.

Includes:

- Authentic / not authentic
- Match / mismatch details
- Test or inspection results
- Confidence scores

Purpose

Provides evidence of verification and builds confidence for consumers and other stakeholders.

HOW THESE DATA TYPES WORK TOGETHER

1. Data is captured from physical events and devices
2. Data is signed and validated to ensure authenticity
3. All activities are logged for full transparency
4. Verification results confirm authenticity and quality
5. All data is stored securely and linked to the product

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DIGITAL PRODUCT PASSPORT (DPP) ACCESS LEVELS IN TEXTILE SUPPLY CHAINS

Digital Product Passport (DPP) systems use layered access structures to ensure secure, transparent, and appropriate information sharing across stakeholders in the textile value chain. This model balances transparency and traceability with commercial confidentiality and data protection.

3 ADMINISTRATIVE — Full Manufacturer & Regulator Access

- Raw material records
- Production process history
- Full authentication records
- System configurations
- Audit histories and compliance monitoring

Ensures governance, legal compliance, and full supply chain oversight.

2 RESTRICTED — B2B Auditing & Compliance

- Production events
- Compliance documentation
- Authentication logs
- Supply chain traceability
- Quality assurance processes

Supports secure business-to-business traceability and regulatory compliance.

1 PUBLIC — Consumer QR/NFC Verification

Product identity | Country or fibre origin | Material composition | Sustainability information | Product authenticity verification

Enables consumers to verify product legitimacy and make informed purchasing decisions.

SECURE LAYERED INFORMATION ACCESS IN DPP SYSTEMS

CONSUMER	SUPPLIER	MANUFACTURER	REGULATOR
Accesses public product information by scanning QR/NFC code.	Accesses restricted information for B2B operations and compliance.	Accesses comprehensive data for production management and traceability.	Accesses full data for audit, oversight, and regulatory enforcement.

Increasing data visibility and access responsibility

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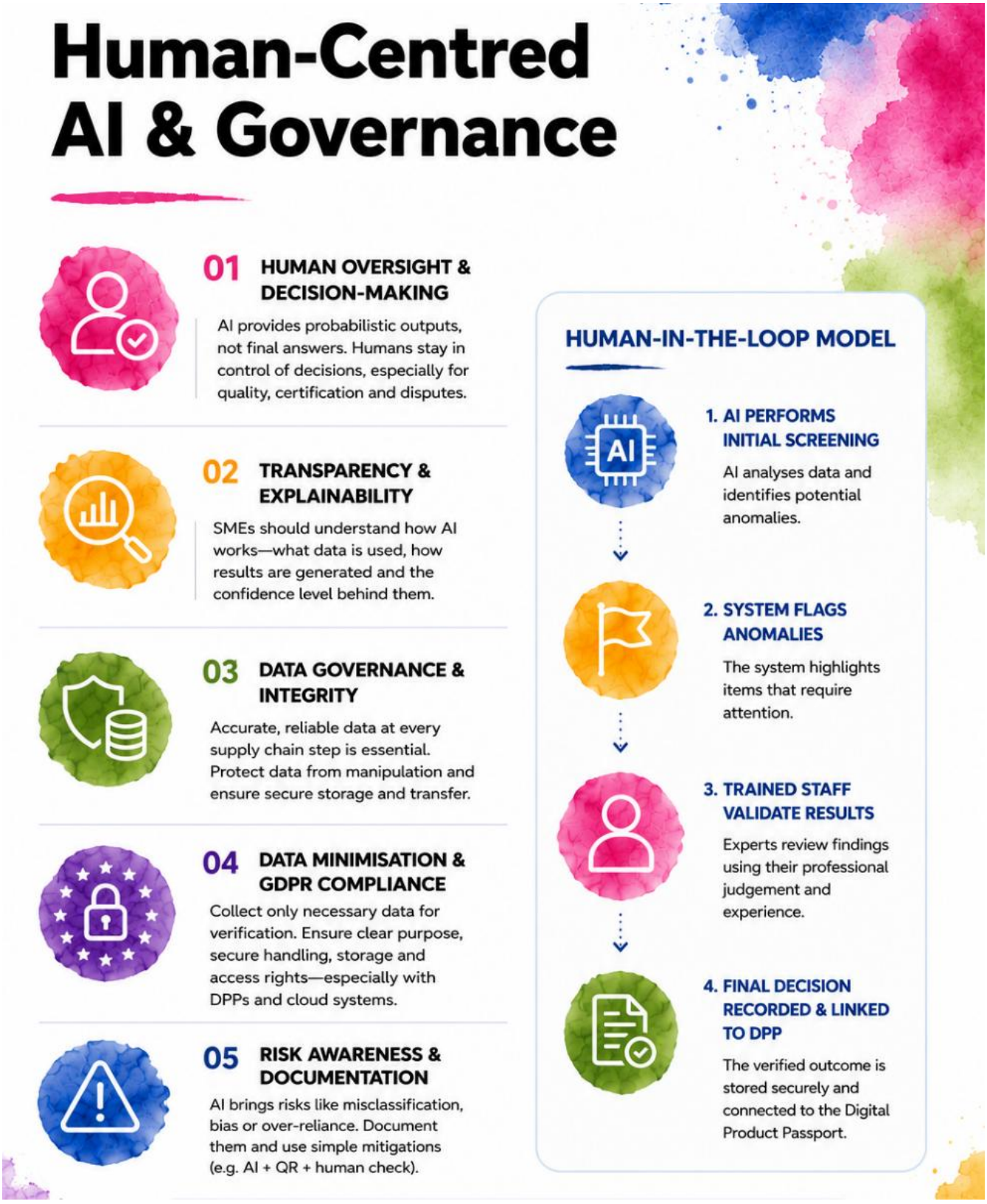
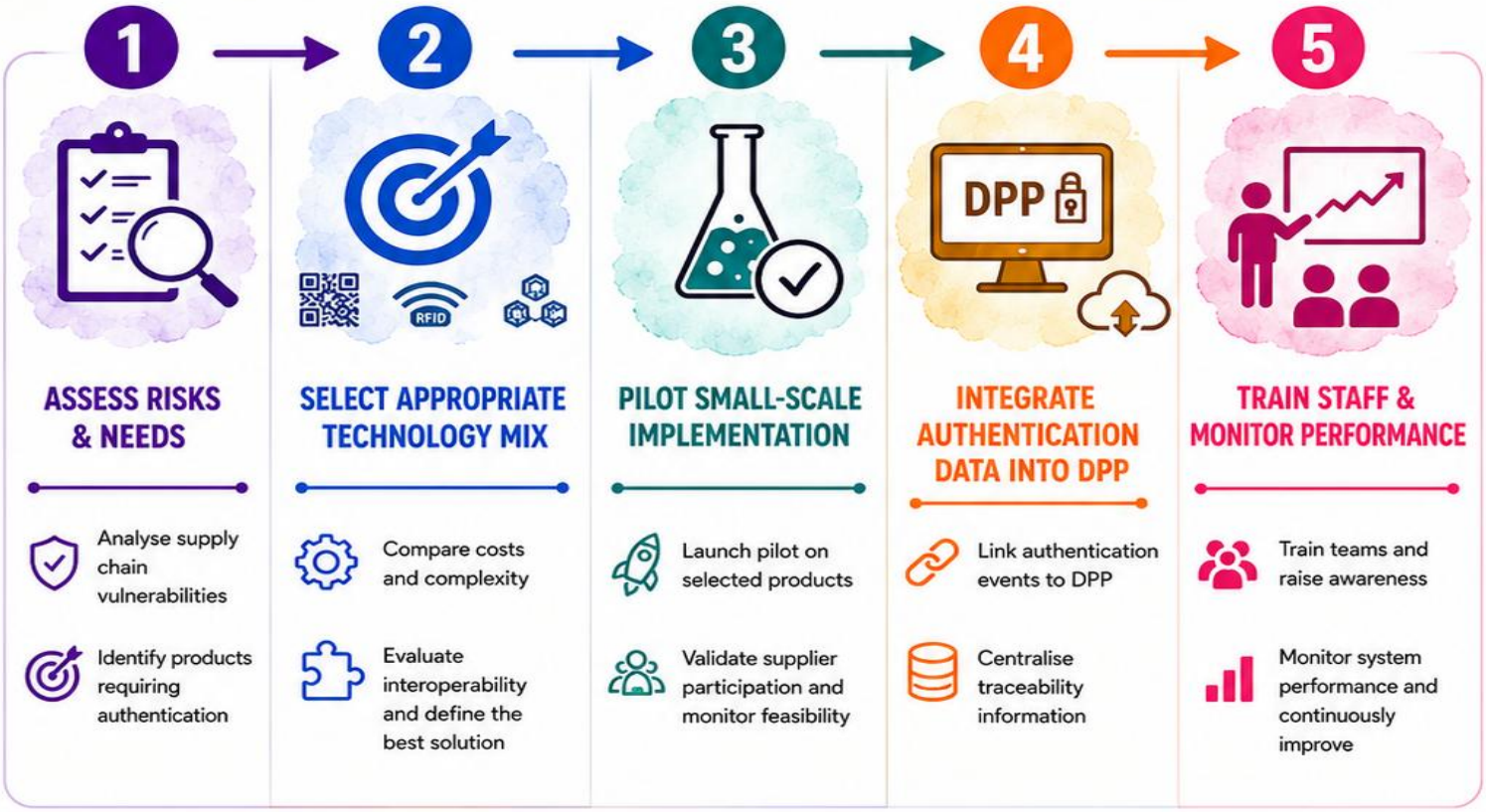


Artificial Intelligence (AI) is increasingly used in the textile and fashion sector to support authentication, detect counterfeits, and improve supply chain transparency. A human-centered approach ensures that AI technologies remain ethical, transparent, secure, and supportive of human decision-making, while governance helps SMEs use these tools responsibly and in line with European values and regulations.

IMPLEMENTATION ROADMAP & NEXT STEPS

A phased approach to help textile SMEs strengthen traceability, improve transparency and reduce counterfeit risks.



1 ASSESS RISKS & NEEDS

- Analyse supply chain vulnerabilities
- Identify products requiring authentication

2 SELECT APPROPRIATE TECHNOLOGY MIX

- Compare costs and complexity
- Evaluate interoperability and define the best solution

3 PILOT SMALL-SCALE IMPLEMENTATION

- Launch pilot on selected products
- Validate supplier participation and monitor feasibility

4 INTEGRATE AUTHENTICATION DATA INTO DPP

- Link authentication events to DPP
- Centralise traceability information

5 TRAIN STAFF & MONITOR PERFORMANCE

- Train teams and raise awareness
- Monitor system performance and continuously improve

MINIMUM VIABLE SYSTEMS

Simple • Affordable • Gradual

Secure QR codes | Cloud-based records | Spreadsheet documentation | Manual verification processes | Limited supplier integration

Lower cost • Faster deployment • Easier adoption
Good starting point for DPP readiness

VS

ADVANCED SYSTEMS

Automated • Scalable • Integrated

RFID infrastructure | Blockchain verification | AI-assisted anomaly detection | Automated supplier integration | Real-time product authentication

Higher automation • Stronger verification • Improved scalability
Greater supply-chain visibility

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No Fake Fashion (NFF) is a strategic partnership dedicated to empowering fashion SMEs with the skills, tools and modern technologies needed to fight counterfeits and protect creativity, authenticity and consumer trust.

Reginnova

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GRINCO
GREEN INNOVATIVE COMPANY

LOTTOZERO

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PROJECT NUMBER:
2024-1-RO01-KA220-VET-000243739

Co-funded by the European Union