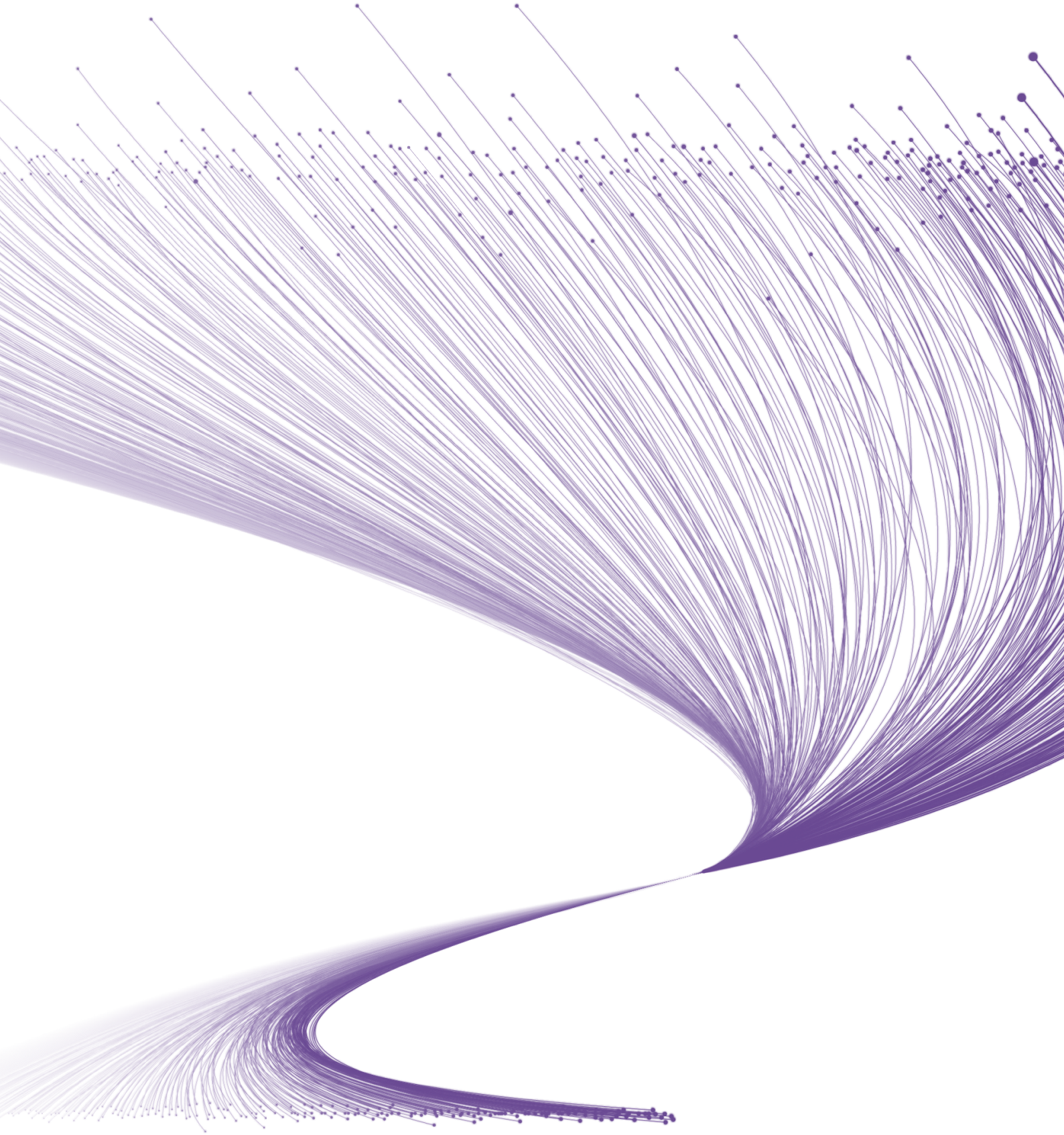
# Building the Supply Chain Data Highway



SMARTEX.AI

**The Modern Textile Factory (MTF) initiative is now two years old.**

Smartex started this group to bring a diverse group of knowledgeable stakeholders together each year to delve into essential topics for the future of the textile industry.

Each MTF Report is a recognition of the critical role the textile supply chain - and its constituent factories - has in advancing this industry, both commercially and sustainably. The supply chain is the crucial, hidden actor.

As a pioneer in the textile tech space, Smartex understands firsthand how hard it is to create change. However, by making the time to deep-dive into the industry's challenges, explore the possibilities and share insights in an organized manner, we aim to equip textile factories, the textile ecosystem and ourselves with an actionable roadmap of where we need to go.

Our hope is that by disseminating this knowledge, the textile sector can collectively navigate the ongoing period of rapid evolution to unlock a more sustainable, efficient, and responsive future.

## Gilberto Loureiro

CEO & Co-Founder — Smartex.ai

## Max Easton

Group Facilitator & Lead Author

## Taylor Bradley

Supporting Author

## Will Barrett

Lead Designer

# Members

## Tércio Pinto
Board Member, Grupo Impetus

*Portugal*

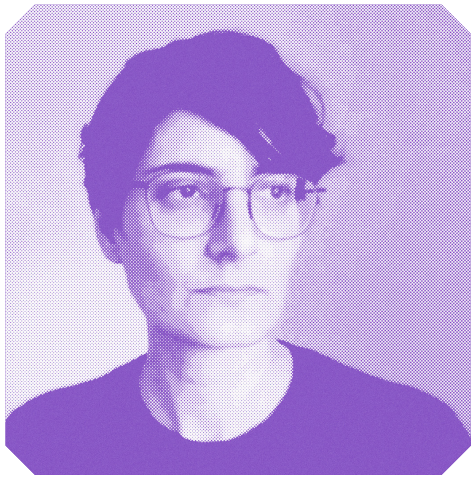
## Louise Claughton
Former Vice President, PVH Corp

*United States*

## Manoj Dimri
CEO — GoodEarth Apparels

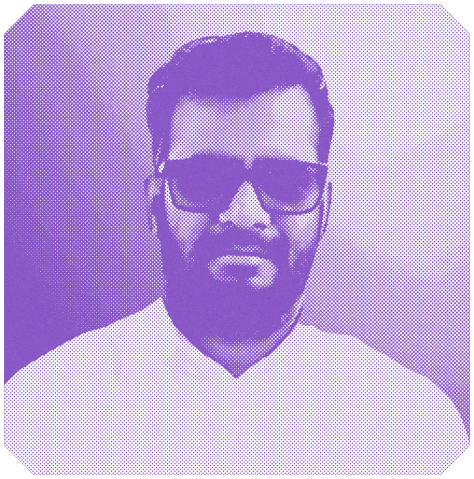
*Bangladesh*

## Patricia Ahufinger
CEO – Nodes Studio



*Portugal*

## Arfan Zaman
Assistant General Manager – Mascom Composite Limited



*Bangladesh*

## Lutz Walter
Managing Director – Textile ETP

*Belgium*

## Mikael Weinholtz
Executive Director Business Strategy – Seduno Group

*Sweden*

## Deniz Ata
Director of Business Development – Pameks Giyim

*Türkiye*

## James Crowley
Manager, Transparency & Traceability – Cascale

*Netherlands*

# Introduction

Last year, after much discussion, the first Modern Textile Factory (MTF 1.0) Committee[1] identified four critical trends that are driving change across textile supply chains: **price, speed, quality** and **compliance**. Manufacturers must navigate these brand-driven trends in order to stay competitive in today's rapidly evolving, global market.

Brands are requiring their supply chains to:

- **Reduce prices** to boost brand margins and allow them to maintain their competitive edge in a price-sensitive landscape.
- **Increase speed** to bring products to market faster and allow brands to capture shorter, social-media led trends before consumers move on and deadstock accumulates.
- **Standardize quality** to make production timelines more reliable and satisfy the demands of vocal, discerning customers.
- **Prepare for stricter compliance** from a wave of legislation across Europe and the US that requires much deeper supply chain knowledge, data and due diligence efforts.

All of these trends - especially because they are being requested simultaneously - will increasingly require the textile supply chain to modernize quickly to survive. Laggards will be left behind.

Modernization is multifaceted, but MTF 1.0 identified five pivotal pillars for textile factories to focus on, with data as their cornerstone:

**01. Resource efficiency**

**02. Real-time data collection**

**03. Stakeholder integration**

**04. Data-driven decision-making**

**05. Fostering high-quality jobs in safe work environments**

This year, the MTF 2.0 Committee held in-depth quarterly sessions to discuss and better understand the Textile Data Highway, with a focus on existing data structures in the supply chain, and how these can be both radically and pragmatically improved.

Our conclusions:

## Data quality must be improved first – otherwise any following forms of communication and utilization will be useless.

The expression "trash in, trash out" for communication technologies like blockchain speaks to this.

## Not all supply chain data holds equal value. Commercial factors like price and speed dictate which data is prioritized and improved first.

However, textile players can utilize these commercial data structures to improve the flow of other crucial data, such as primary environmental and social data.

## The goal of the data highway is not to tick boxes. It is to reveal new insights that empower quicker, better, data-led decisions.

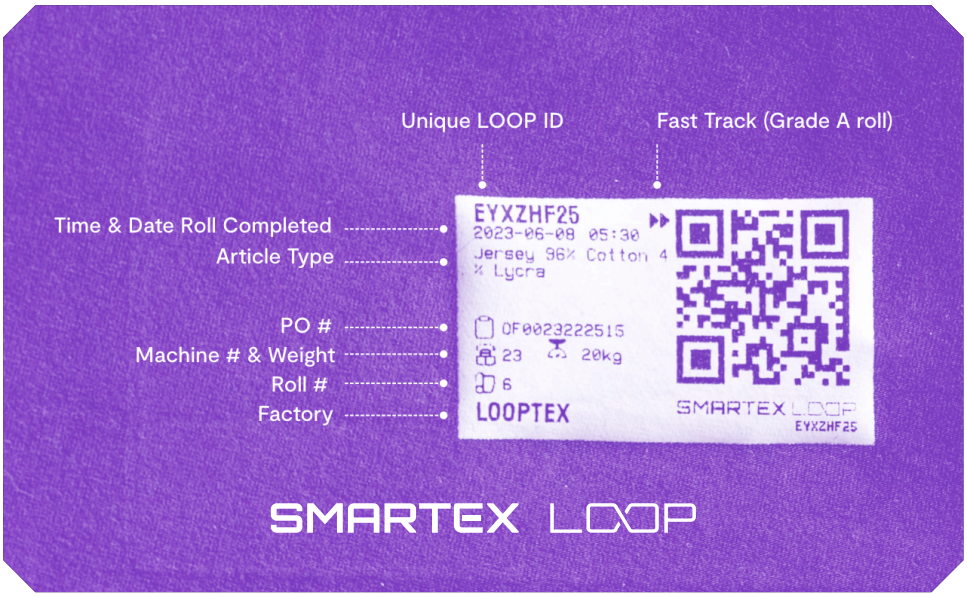
After a blood test, if you are told by the doctor to cut back on gluten or sugar, this is a data-led decision. Now, attention can go to adjusting your diet and communicating to loved ones who can support you with your goals.

This is exactly the same for the textile industry. Data makes decisions clearer and provides feedback when actions are taken. Less time is required for finding the truth and more time is allotted for reducing prices, increasing speed, standardizing quality and meeting stricter compliance standards.

1. Smartex Report: Smartex. The Modern Textile Factory Report 2023. Smartex, 2023. Web.

In this report, we will first deconstruct existing data that is shared between supply chain steps. Next, we'll explore three key components for judging the standard of any data highway: data quality, communication methods, and utilization of data in decision-making. We'll examine real-world tools and technologies that improve these components, including a deeper dive into product quality data - an area close to Smartex's heart - to showcase a real-life example of an evolving data highway.

Finally, we'll make predictions on the future of the textile data highway and how this transformation will unfold. Fortunately, there are a lot of opportunities to be seized.




*Indestructible quality records with Smartex LOOP.*

# Data Flow in the Textile Supply Chain

## What Do We Mean by the "Textile Data Highway"?

The Textile Data Highway is the **flow of information** throughout the textile industry's ecosystem, **back and forth** from raw material origins (i.e. the field, forest or oil field) **across each stage to final product delivery.**

Although a new data highway is developing between brands and recyclers (i.e. the life of a garment) to enable circularity, the supply chain data highway has been around for much longer. In this report, **we have decided to focus on the supply chain data highway, specifically between yarn suppliers and brands.**

**Data is shared on the way down when orders are placed ("Order Flow" ⓘ ) and on the way up when product heads towards the brand ("Product Flow" ⓘ ).** For simplicity, we have assumed information travels in a linear manner from one supply chain step to the next. However, it should be noted that there are common cases in which data travels between non-adjacent steps (e.g. if a brand buys yarn and assigns it to a fabric mill).

**Data can be organized into three main categories:**

**For full term definitions, see Glossary (pg. 22 & 23)*

## Product Data

Defining the Product to be Delivered

**Features**
- Description / Style # / SKU
- Color
- Finishes
- Components
- Material / Yarn / Fiber Specs
- Labeling Information

**Quantity**
- Volume
- Sizes
- Over-Under Ratio
- Percentage to Ship Ratio
- Weight / Width

**Quality**
- AQL (Acceptable Quality Level)
- Minimum Quality Grade

## Production Data

Price, Speed & Logistical Agreements

**Price**
- Price per Garment / KG / Meter / Yard
- Total Value
- Payment Terms

**Speed**
- Order Date
- Delivery Date

**Logisitics**
- Brand Name
- Types of Transport
- Import Codes
- Shipping Details
- Packaging

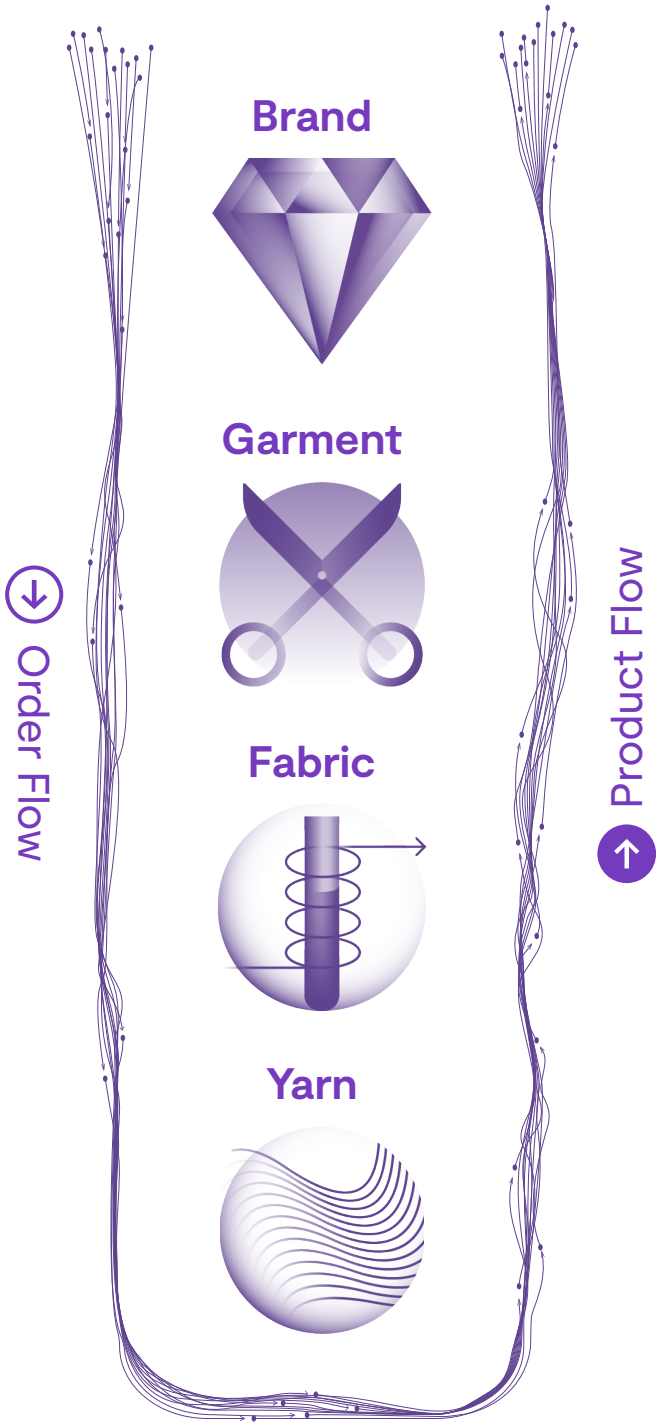
## Compliance & Impact Data

How & Where Products are Produced

**Facility**
- Factory ID & Location
- Certification # & Expiration Date

**Transaction**
- Transaction Certification
- Delivery Information

**Product**
- Evidence for Marketing Claims




Numerous data points exist within each of these three categories, and like any supply chain, their measurements can vary at different stages. For instance, volume units may shift from individual garments when reporting to brands to kilograms when reporting to fabric mills.

The following tables illustrate how product data, one of the three categories of data, flows through the supply chain, detailing the information shared at each stage from brands to yarn suppliers. While this overview is comprehensive, it's important to note that customers rarely share all of this data at once.

Typically, brands send order data in parts, often withholding color decisions until the last minute to assess what will sell best based on sales data. The level of detail provided also varies significantly from one brand or supplier to another.

# Product

## An In-Depth Look: Defining the Product to be Delivered

### Brand to Garment

#### Features

**Description / Style # / SKU**
154285 / TSHIRT-WHT-S / 100% Cotton, Short Sleeve, Crew Neck

**Color Code / Finishes / Components**
#FF5733 Navy Blue (to match approved sample) / Plain with no additional prints or logos

**Material / Yarn / Fiber Specs**
Pique 40/1 100%CO BCI | 170g

**Labeling Information**
“Made in USA”/ “100% Cotton”

#### Quantity

**Volume**
10,000 units

**Sizes**
Small: 2,000 units ; Medium: 4,000 units ; Large: 3,000 units ; Extra Large: 1,000 units

**Over-Under Ratio**
Brand will allow -3%/+3% over-under ratio on order, any more or less will not be accepted

#### Quality

**AQL (Acceptable Quality Level)**
1.5 for critical defects, 2.5 for major defects, & 4.0 for minor defects

### Garment to Fabric

#### Features

**Code #**
MCM/JEBZ51Z44F84120

**Color / Finishes**
Navy Blue (to match approved sample)

**Material Fiber Specs**
(Include weight per unit area)
Pique 40/1 100% CO BCI | 170g

#### Quantity

**Weight**
1,900kg

**Width**
1,75M

#### Quality

**Minimum Quality Grade**
Acceptable = 31 points/100m²

## Fabric to Yarn

### Features

**Description / Style # / SKU**

**Fiber Content**
100%CO BCI

**Yarn Count**
Ne 30/1

**Ply**
Single

**Twist**
Z-Twist

**Color**
White

**Finish**
Mercerized

### Quantity

**Weight**
2,500kg

### Quality

**Minimum Quality Grade**
Acceptable = 31 points/100m²

**Quality Standards**
Must meet ISO 9001 standards

The status quo is far from a slick and seamless highway. Most data is manually inputted and shared in non-standardized formats that require additional data input in order to transfer from PDF or Excel to the customer's Enterprise Resource Planning (ERP) system.

As a result, data becomes increasingly inaccurate, slow to communicate, and impossible to utilize effectively. This creates disconnected supply chain steps rampant with inefficiencies.

In order to keep up with the growing list of brand-led demands, textile factories need to upgrade their data highways into streamlined flows of high quality information.

*The lack of digitalization across the industry often results in non-standardized, handwritten information sharing.*

## Evaluating Any Data Highway:

# Quality, Communication and Utilization

How can we judge the effectiveness of any data highway? MTF 2.0 member, Lutz Walter, shared some wisdom on this subject:

> *"Let's start by clarifying what I mean when I talk about supply chain traceability and transparency. It doesn't mean that everything that happens in a supply chain from the extraction or sourcing of the raw material to the end product in the hands of the final user can be available for the whole world to see. Rather it means that all data that can serve a legitimately interested and duly authorized stakeholder linked to that value chain gets methodologically collected, securely stored, efficiently processed and reliably transmitted upon authorized request – through an unbroken chain of custody."*[2]

Building on this during our MTF 2.0 sessions, we agreed on three highly interconnected components - and their respective "Good" and "Bad" characteristics - to evaluate any data highway:

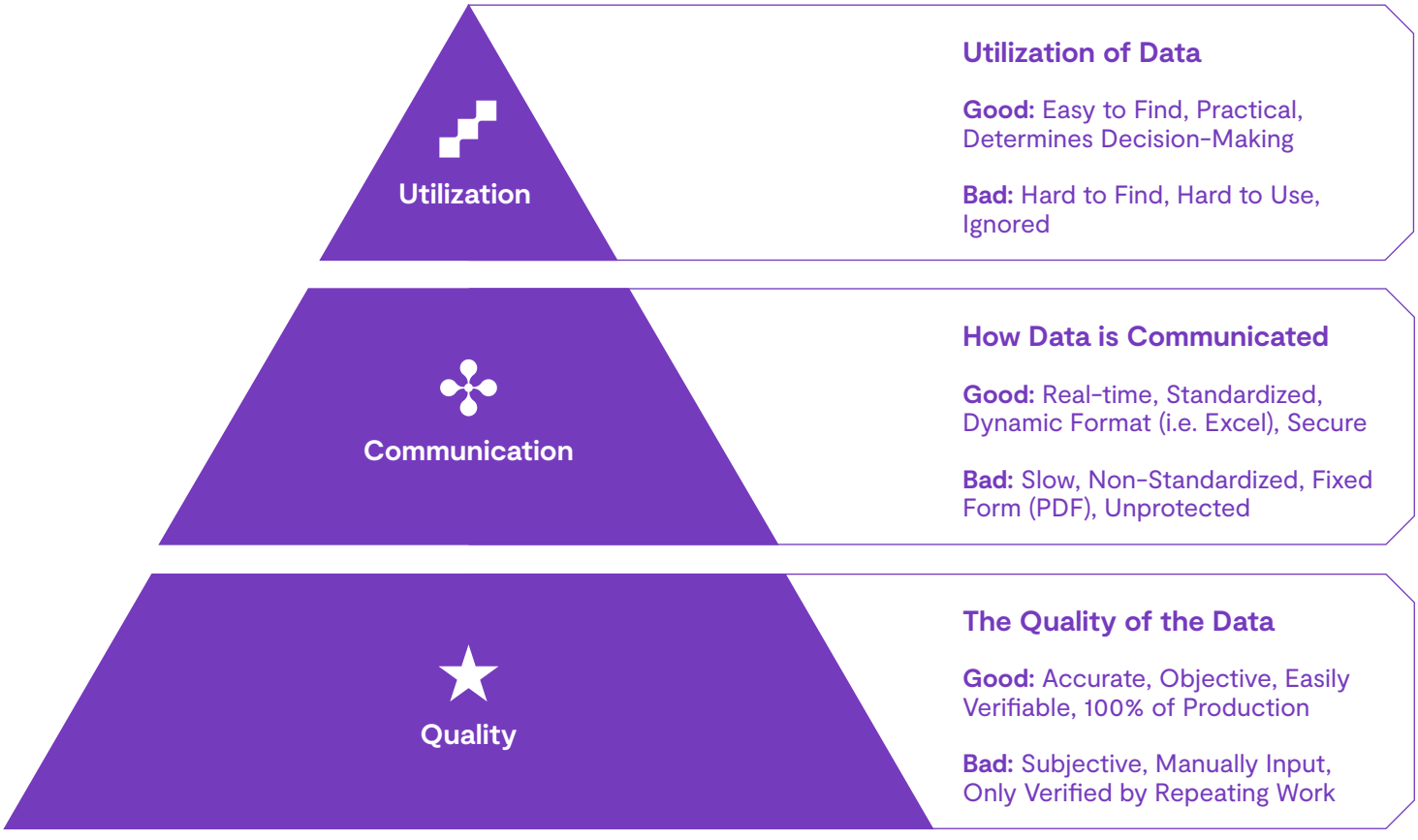
### Quality is the Foundation

Consider the example of a garment facility trying to use fabric quality data provided by their fabric partner - including roll grade, width, and color matching - to understand whether they have enough usable fabric to fulfill their production order. If the data is inaccurate and the actual quality is worse than communicated, the facility could end up with a significant short shipment and a disappointed customer who deems them unreliable. **Communicating and utilizing low-quality data hurts processes and timelines more than it helps.**

Yet, even with high quality data, the way it is communicated affects its utilization.

If accurate data is shared in the form of a PDF, the garment facility may struggle to integrate it into their systems efficiently to approve the batch for production or discern whether if they should order more fabric to avoid a short-shipment. Someone has to manually review the PDF data and perform the analysis themselves. Mistakes happen and actions are delayed or misguided.

An effective data highway requires all three key data elements - quality, communication and utilization - to be in place. Picture these principles as a pyramid with data quality as its foundation. Like Maslow's Hierarchy of Needs, stronger data highways can focus on higher levels.




2. **LinkedIn Article:** Walter, Lutz. "Textile Supply Chain Traceability: Imminent Reality or Distant Dream?" *LinkedIn Pulse*, 22 Sept. 2023. Web.

# Current Tools and Technologies to Enhance the Textile Data Highway

## The Quality of the Data →

Data quality forms the bedrock of any data highway.

To date, the industry has primarily relied on **third-party auditors** like SGS or Intertek to verify that factories have the right processes in place. These auditors provide a snapshot but cannot guarantee the quality of day-to-day data shared between supply chain steps.

**Certification bodies** such as Better Cotton, BlueSign, and GOTS help validate the credibility of high-value materials within supply chains through Transaction Certificates and Mass Balance Systems. Their primary goal is to ensure accurate accounting of all high-value materials sold throughout the supply chain. Given that these materials (such as organic cotton or recycled polyester) tend to be more expensive than conventional options, buyers have a strong financial incentive to require proof that they're getting what they're paying for. Some certification bodies are taking additional measures to validate data by requiring factories to provide bank transfer records to confirm the buying and selling of certified products.

Unfortunately, certification bodies often encounter challenges when large orders of certified products are divided into smaller ones - for example, splitting 10 tons of yarn into two separate orders of 5 tons of fabric. As a result, products often move through the supply chain without (or with seriously delayed) official certification documentation, increasing the risk of inaccuracies and fraud.

**Physical tracers** enhance the verification processes by integrating readable substances into fibers, enabling manufacturers to confirm the integrity and source of materials throughout their journey from yarn production to final garment. Fashion for Good and Textile Exchange created the Textile Tracer Assessment[3] guide to evaluate available options.

Oritain uses **forensic science** to verify the origin of natural, raw materials like cotton, wool, and cashmere. This capability became particularly vital following implementation of the Uyghur Forced Labor Prevention Act in the United States, which requires brands to provide evidence that their cotton products are not sourced from Xinjiang, China in order to avoid port detention.

Finally, **smart machinery** captures data from factory operations, machines that create yarn cones, knit and dyed fabric - to name a few. This technology typically delivers accurate and objective data, which can be shared directly with factories and integrated with their ERPs. By eliminating manual reporting, smart machinery significantly reduces data entry errors and reporting inaccuracies.

Although these technologies offer benefits, significant opportunities for enhancing data quality, and the way it is communicated, persist throughout the textile supply chain.

## How Data is Communicated →

The Higg Index Facility Tools, developed by Cascale, are completed quarterly or annually by facilities to assess their environmental and social performance. Together with The Higg Materials Sustainability Index (Higg MSI)[5] Cascale's **standardized assessment tools** have become the most widely adopted framework in the apparel sector, used by over 22,000 facilities worldwide. By providing a common language and framework for industries to measure and manage their supply chain's impact, the Higg Index allows brands and suppliers to benchmark progress, identify areas for improvement, and leverage data for decision-making, such as facility selection and supply chain strategies.

**Integrated data systems** act like express lanes along a data highway, letting information flow seamlessly between machines and manufacturers without unnecessary human intervention.

Smartex - like other smart machinery - integrates with factory ERPs to automate data collection (e.g. production orders), reduce manual entry (e.g. fabric or article type), and centralize production information. However, the industry's tendency towards custom, in-house ERP development complicates the process and limits widespread adoption by necessitating multiple unique platform integrations. Like with clothing, there is no "one size fits all" model.

3. **Fashion for Good Report:** Fashion for Good. *Textile Tracer: Fashion for Good Report.* Fashion for Good, 2023. Web.

4. **Higg Index Facility Tools:** Sustainable Apparel Coalition. *Higg Index Tools: Facility Tools.* Sustainable Apparel Coalition, 2024. Web.

5. **Higg Index Product Tools:** Sustainable Apparel Coalition. *Higg Index Tools: Product Tools.* Sustainable Apparel Coalition, 2024. Web.

This trend of **consolidating data onto a single platform** is gaining traction among major textile conglomerates, such as Seduno Group, with many developing bespoke platforms that require supply chain partners to directly input their data. Though data quality can be an issue, and developing these custom systems requires substantial investment and effort, a key advantage is that data communication is streamlined.

For smaller manufacturers, cost barriers are a real concern. Potential solutions such as modular ERP systems or partnerships with technology providers that enable gradual scaling of digital capabilities need to be explored and made accessible.

**Blockchain technology** offers another avenue for tamper-proofing data, though its effectiveness is highly reliant on the quality of the data it protects and the way it is transmitted.

Pratibha Syntex, a vertically integrated facility in India, uses blockchain technology to trace its organic cotton supply chain.[7] Meanwhile, Stella McCartney uses the UNECE blockchain platform[8] to track material lifecycles and improve supply chain transparency. However, these are still early days for blockchain - and we'll wait to see if it can deliver beyond the hype.

Along with quality, we must not overlook the **importance of timeliness** in communicating data well and keeping it actionable. For example, a transaction certificate holds little value to a brand if it's submitted seven months after the garments are already on store shelves.

If data quality is high, it must be communicated effectively in order to be utilized.

## Utilization of Data →

Supply chain data remains difficult to act upon due to its poor quality, non-dynamic formats, and slow delivery. However, when good data arrives in usable form and reasonable timing, factories need to put it to work.

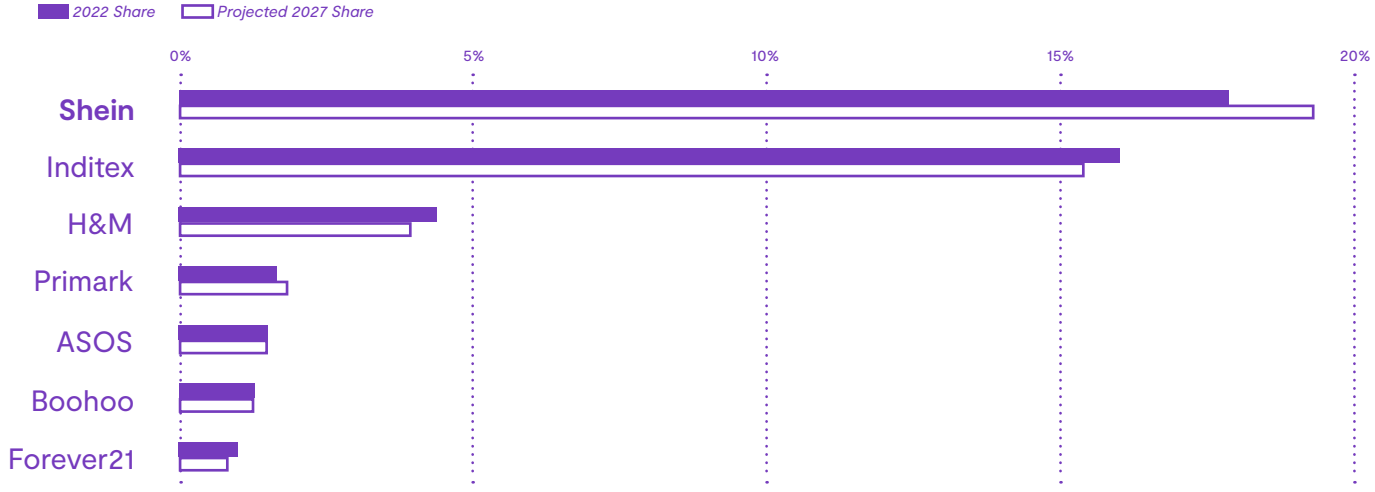
Shein's willingness to share consumer data with their supply chain helps **shorten lead times** by allowing suppliers to bid to produce top selling items, removing typical middleman delays. This has a significant knock-on effect on inventory turnover, as discussed in last year's MTF Report.[9]

Inditex, the parent company of Zara, pioneered a real-time inventory management system[10] which allows them to **restock popular items quickly and adjust production based on sales data**. This agility has been a key factor in their market success.

Well known global fashion retailer, H&M focuses on collecting granular energy data[11] - allowing them to analyze the specific energy profiles of their key suppliers. They use this data to make strategic sourcing decisions based on environmental impact considerations, particularly focusing on the carbon density of different energy sources (for example, coal produces significantly higher emissions compared to fossil gas or solar power). This data-driven process has achieved tangible results - the number of H&M suppliers operating on-site coal boilers decreased from 117 in 2022 to 67 in 2023.[12]

## Shein's Competitive Advantage: Data Sharing

Global fast-fashion market share by leading companies from 2022 - 2027




**Coresight Research.** *Global Fast-Fashion Market Share by Leading Companies for 2022 and 2027.* Reuters Graphics, 12 Dec. 2023. Web.

6. **Nike Supply Chain Strategy Blog:** DFreight. "An Insight into Nike's Supply Chain Strategy." *DFreight Blog*, 10 July 2023. Web.
7. **Pratibha Syntex Article:** "Pratibha Syntex Playing a Leadership Role in Sustainable Textiles and Products." *Indian Textile Magazine*, The Textile Magazine, 2023. Web.
8. **Stella McCartney Website:** *Sustainability: Traceability and Block-Chain Technology.* Stella McCartney, 2023. Web.
9. **Smartex.ai.** The Modern Textile Factory Report. Smartex.ai, 2023. Web.
10. **Inditex Group Website:** *Our Approach.* Inditex, 2024. Web.
11. **H&M Group Sustainability Page:** *Climate: Circularity and Climate.* H&M Group, 2024. Web.
12. **H&M Group.** *H&M Group Annual and Sustainability Report 2023.* H&M Group, 2023.

Another key advantage of effective data use is the ability to **push production lines to their fullest potential.** By closely tracking production speed and quality, manufacturers can anticipate issues and make immediate adjustments. While these decisions currently rely on manual analysis, AI integration with quality data has capacity to transform supply chain planning.

One of the world's largest garment manufacturers, TAL Apparel, has implemented several innovative tools to optimize their processes.[13] Their 3D body scanning technology upgrades their garment development by creating highly accurate avatars for virtual fitting and capturing minute fabric details for photorealistic 3D garments. This **allows clients to visualize and modify designs** in a lifelike 3D environment, streamlining communication through a collaborative platform. Furthermore, TAL employs FibreTrace® technology to aid traceability throughout their supply chain.

TAL also integrates with the Open Supply Hub and the Higg Index[14] to collect and share information about its facilities and subcontractor sites. By claiming public profiles for each site, detailing facility type, workforce size, and certifications, TAL promotes industry-leading transparency, **differentiating itself in the market.**

Artistic Milliners, a leading denim manufacturer in Pakistan, uses Datatex ERP[15] solutions to optimize production planning, cost management, and multi-site operations.

Artistic Milliners strategic partnerships allow them to create digital twins of materials, enabling realistic garment simulations, **reducing sampling time by 40%, cutting costs, and minimizing environmental impact. These tools streamline decision-making and allow rapid testing** of fabric variations without the need for physical prototypes.

Ekoten Tekstil, a pioneering Turkish manufacturer within the Sun Tekstil Group, leverages advanced analytics from quality data to drive **performance improvements** across its operations. By integrating Smartex's real-time quality monitoring technology, Ekoten captures critical data on factors like fabric defects, production speeds, and machine performance. This enabled Ekoten to **reduce defective fabric production by 80%[16], eliminating over 4.5 tonnes of raw fabric waste annually.** Beyond waste reduction, in only their first year of implementing Smartex technology in the knitting stage, the company prevented 224.41 tonnes of $CO_2$ emissions and saved 804,336 GJ of energy. Ekoten's integration of quality monitoring technology demonstrates that data-driven decision-making can simultaneously reduce operational costs, minimize environmental impact, and drive continuous improvement.

No matter how underdeveloped the status quo may seem, we hope to have shown that there are numerous players actively strengthening the textile data highway. Factories can act today.

13. **TAL Apparel Technologies Page:** *Innovations: Technologies.* TAL Apparel, 2024. Web.

14. **TAL Apparel Case Study (Open Supply Hub):** *TAL Apparel Limited Case Study.* Open Supply Hub, 2023. Web.

15. **Artistic Milliners Agreement (Datatex):** *New Customer Agreement with Artistic Milliners.* Datatex, 2024. Web.

16. **AI-Enabled Quality Control (CSP Apparel Impact):** *AI-Enabled Real-Time Quality Control.* Clean by Design Apparel Impact Institute, 2024. Web.

## Product Quality Reporting:

# A Deep-Dive into the Developing Data Highway

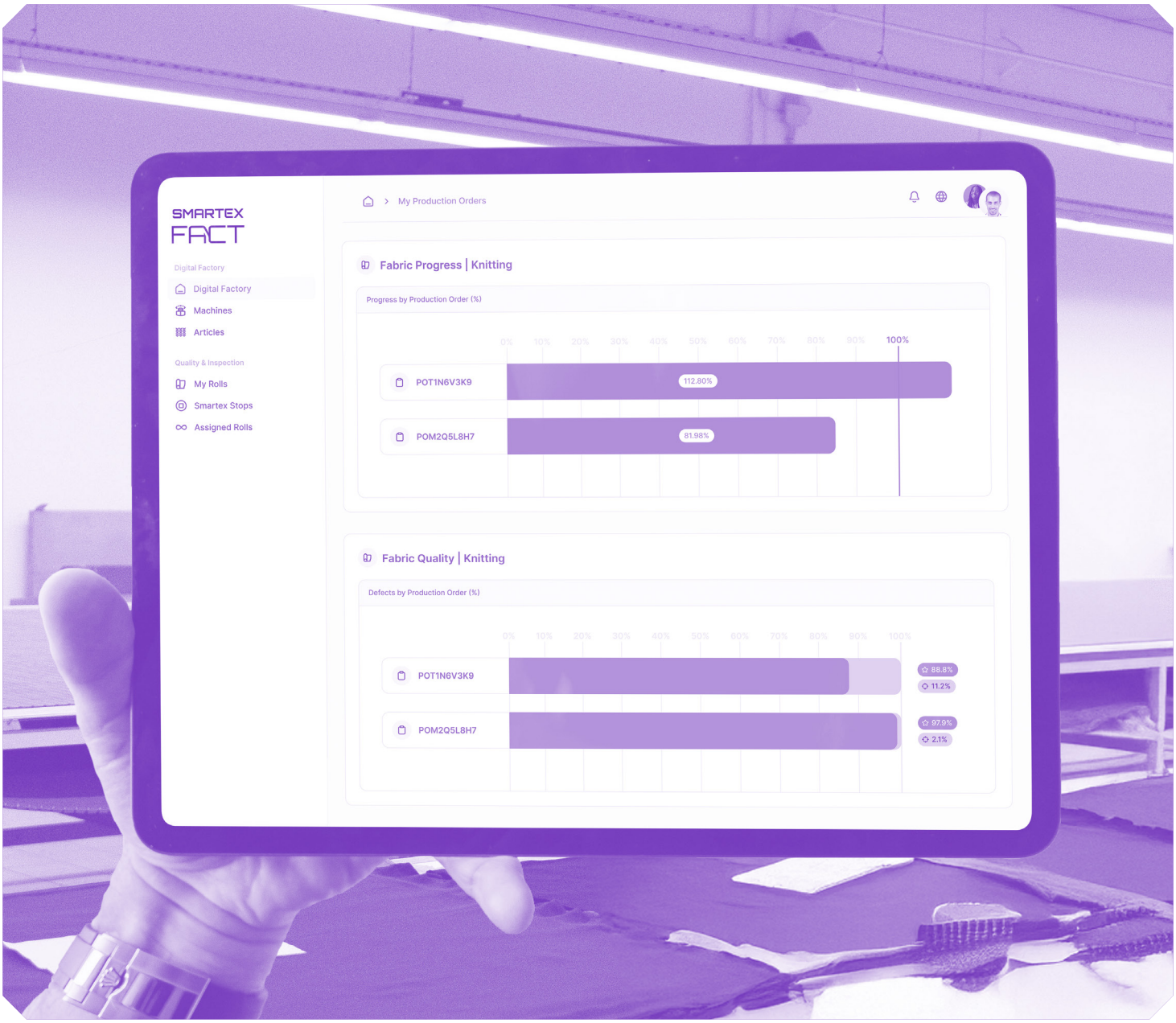
Let's dive into a specific data point in the textile data highway to explore its current quality, communication and utilization - and how this can be improved.

To help provide granular analysis, we've chosen one that Smartex knows well - product quality reporting (i.e. the quality of a yarn, fabric, garment etc).

When brands place an order, they care about price, speed and quality - typically in that order. Though prioritized differently, these factors are more interwoven than they may seem.

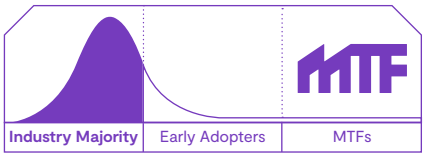
The quality of the end product is crucial, but it's not the only important factor. Quality also plays a significant role in determining production speed. In fact, issues with fabric quality account for approximately 50% of shipment delays, which can lead to missed sales opportunities, increased air freight costs, and strained business relationships.

So how is product quality treated today - both in the majority of cases and in the early adopters - and where is this data highway headed?




*Smartex FACT's Live Dashboard showcases real-time, actionable production data.*

# Industry Majority




### Grading System

**0/10 → 4/10**
Non-Existent. Hits none of the definitions.

**5/10 → 8/10**
On the way. Hits 1 or 2 of the definitions.

**9/10 → 10/10**
Top-level. Hits most or all definitions.

## Quality

**Good**
Accurate, Objective, Easily Verifiable, 100% of Production

**Bad**
Subjective, Manually Inputted, Verification Requires Re-Doing Work

## Communication

**Good**
Real-time, Standardized, Dynamic Format (at least Excel), Secure

**Bad**
Slow, Non-Standardized, Fixed Form (PDF), Unprotected

## Utilization

**Good**
Easy to Find, Practical, Determines Decision-Making

**Bad**
Hard to Find, Hard to Use, Ignored

## Product Quality Reporting

### Brand to Garment

Brand defines AQL (Acceptable Quality Level).

E.g. 2.5 AQL means that approximately 4% of garments shipped to brands can contain defects.

### Garment to Brand

At least one thorough inspection stage (panel or garment). Quality communicated by PDF. No utilization beyond claims of poor quality.

| | |
|---|---|
| 3/10 | Quality |
| 1/10 | Communication |
| 1/10 | Utilization |

### Garment to Fabric

No quality stipulated. Trust in informal, handshake agreements.

### Fabric to Garment

Manual inspection for sample set of rolls. Quality communicated by PDF. No utilization beyond claims of poor quality.

| | |
|---|---|
| 2/10 | Quality |
| 1/10 | Communication |
| 1/10 | Utilization |

### Fabric to Yarn

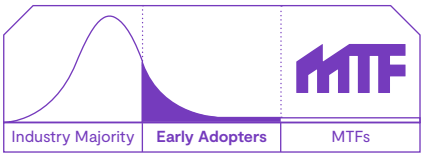
No quality stipulated. Trust in informal, handshake agreements.

### Yarn to Fabric

No quality data provided unless requested (accurate lab samples for example). If asked for, quality is shared by PDF. No utilization beyond claims of poor quality.

| | |
|---|---|
| 4/10 | Quality |
| 1/10 | Communication |
| 1/10 | Utilization |

# Early Adopters

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**Bad**
Hard to Find, Hard to Use, Ignored

## Product Quality Reporting

### Brand to Garment

Brand defines AQL (Acceptable Quality Level).

E.g. 2.5 AQL means that approximately 4% of garments shipped to brands can contain defects.

### Garment to Brand

Rolls inspected by workers using Inspectario or Pivot88 apps. Results shared on Excel or platform. Mill utilizes to review production. No utilization unless complaints.

| | |
|---|---|
| 4/10 | Quality |
| 4/10 | Communication |
| 2/10 | Utilization |

### Garment to Fabric

No quality stipulated. Trust in informal, handshake agreements.

### Fabric to Garment

Objective, accurate, standardized data for all rolls via Smartex's AI technology. Results shared on Excel or Smartex platform. Mill utilizes to review production. No utilization unless complaints.

| | |
|---|---|
| 8/10 | Quality |
| 5/10 | Communication |
| 3/10 | Utilization |

### Fabric to Yarn

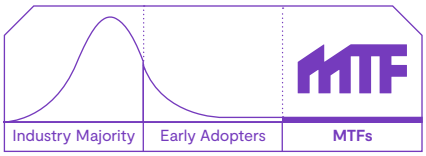
No quality stipulated. Trust in informal, handshake agreements.

### Yarn to Fabric

Objective, accurate, standardized data available via Uster (Usterized Yarn). Tests are on samples only and must be shipped to a lab. No utilization unless complaints.

| | |
|---|---|
| 6/10 | Quality |
| 3/10 | Communication |
| 2/10 | Utilization |

# Modern Textile Factory




### Grading System

**0/10 → 4/10**
Non-Existent. Hits none of the definitions.

**5/10 → 8/10**
On the way. Hits 1 or 2 of the definitions.

**9/10 → 10/10**
Top-level. Hits most or all definitions.

## Quality

**Good**
Accurate, Objective, Easily Verifiable, 100% of Production

**Bad**
Subjective, Manually Inputted, Verification Requires Re-Doing Work

## Communication

**Good**
Real-time, Standardized, Dynamic Format (at least Excel), Secure

**Bad**
Slow, Non-Standardized, Fixed Form (PDF), Unprotected

## Utilization

**Good**
Easy to Find, Practical, Determines Decision-Making

**Bad**
Hard to Find, Hard to Use, Ignored

## Product Quality Reporting

### Brand to Garment

Brand defines lower AQL due to advancements in quality technology. Garment facilities can share fabric reports if brand requests.

E.g. 0.5-1.5 AQL means 2% defective garments.

### Garment to Brand

Mills can utilize AI-inspection on incoming fabric & on cutting tables. This helps identify problematic pieces to catch any defective garments. Brands use information to understand issues ahead of time.

| | |
|---|---|
| 8/10 | Quality |
| 8/10 | Communication |
| 7/10 | Utilization |

### Garment to Fabric

Garment Facility requests a minimum fabric standard (e.g. no more than 5% defective fabric) given improvements in data quality & communication.

### Fabric to Garment

Smartex inspects 100% of fabric with AI enabling seamless switching between materials & structures. Results & analysis are easily accessible. Garment facilities use data to judge fabric quality risk & adjust orders ahead of time.

| | |
|---|---|
| 10/10 | Quality |
| 9/10 | Communication |
| 9/10 | Utilization |

### Fabric to Yarn

Fabric Mill can decide sample size expected quality standards.

### Yarn to Fabric

Uster - or similar technology - is used widely. Larger sample sizes are enabled by tech advancements. Mills use information to identify particular yarn cones or batches and select for certain customers.

| | |
|---|---|
| 8/10 | Quality |
| 7/10 | Communication |
| 6/10 | Utilization |

# Where are we going?

## Envisioning the *Future* of the Textile Data Highway

**Software is eating the world - one industry at a time.**

Industries can shift *fast*.

A prime example is automobiles - and its ongoing software revolution. In 2023, the CEO of Ford, Jim Farley, gave a very honest interview where he explained that Ford had 150 different pieces of software in their cars - none of which included code Ford wrote or could edit. Ford relied on many different contracted partners, outsourcing this work to drive down price. Meanwhile, Tesla introduced a new dimension in which car software upgrades became increasingly normalized and a growing differentiating factor. Although electric cars are still finding their feet in a combustion engine landscape, the future of cars - or software on wheels - is in full flow and slower adopters like Ford are struggling to keep pace. This explains why VW recently invested 5 billion in US truck start-up Rivian - because of their software capabilities. Software is taking over and stragglers are paying the price (literally).

The textile industry should take notes. Shein has already demonstrated the potential of better connectivity and a more established data highway. Once something is proven to work, the speed limit ceases to exist. Laggards will be left in the dust.

The future of textile manufacturing isn't just about producing more efficiently - it's about transforming the very foundation of how the industry operates; utilizing data and technology to create agile, sustainable, and on-demand supply chains. High-quality, actionable data will soon form the backbone of a new era driven by AI-driven, real-time decisions.

In the next section, we'll explore how the 2024 MTF Committee envisions and predicts the future of our industry's data highway.

**Imagine: it's 2030... pioneering textile factories around the world have adopted some radical, innovative practices.**

*Let's take a tour.*

# Data Quality

## Order Flow

Brands no longer simply place orders - they share data directly with their production partners via **integrated software systems.** Once an order arrives, the manufacturer's **AI-enabled planning system** instantly translates each submission into detailed production schedules, material orders, and accessory ordering management. No errors or delays - just immediately verified data and action.

## Product Flow

With stringent environmental regulations shaping the landscape, factories are equipped with **sophisticated, granular data collection systems**. Diverse frameworks capture key environmental metrics and ensure compliance with emerging legislation, using Digital Product Passports to create transparent, verifiable supply chains.

Smart machinery - from automated meters to AI-powered cameras - gathers **objective data in real time**, ensuring 100% of production is traceable.

AI goes beyond efficiency - the latest factory tools continuously analyze products in the supply chain for anomalies to ensure quality standards are maintained. **Physical trackers**, such as QR codes on yarn and fabric and radio frequency identification (RFID) tags on garments, offer **real-time tracking** across the supply chain, promoting transparency from fiber to finished product. This opens the door to **fiber-forward traceability** as data moves along with each item through its lifecycle.

# Communication

## Order Flow

**Real-time brand sales data is integrated with factory systems,** enabling immediate production and faster speed to market. Similar to Shein's model - in which small and medium-sized factories must implement its order management software to receive orders - factories across the industry now leverage cutting-edge capacity and order management systems. This ensures rapid, responsive production that adapts instantly to consumer demand and cuts down on brand deadstock.

Data standardization has advanced significantly, with widely adopted frameworks for data collection and communication across the supply chain. Factories and brands benefit from **uniform reporting standards,** streamlining production and enhancing collaboration across the industry.

## Product Flow

The future involves total integration. **All smart machinery within factories is connected to central systems,** allowing data to be shared effortlessly between platforms. For example, ERP systems can automatically provide production orders and article details to machines, while machinery responds with real-time data on usage, resource consumption, and product quality. This interconnectivity ensures factories operate at maximum efficiency, with systems like ERP and MES acting as central command centers in increasingly automated environments.

The rise of Direct-to-Consumer (D2C) and Consumer-to-Manufacturer (C2M) models further transforms the product flow, eliminating intermediaries and allowing **manufacturers to connect directly to consumers.** Data-driven production responds to consumer trends within days, producing hyper-personalized products (almost) on-demand.

# Utilization

## Order Flow

Factories are no longer chosen solely for cost but for their ability to meet real-time performance standards. Brands select production locations based on transparent metrics for price, speed, quality, and compliance. **AI-powered factory systems dynamically adjust production schedules in response to real-time demand forecasts and material availability.** These advanced systems predict potential bottlenecks, streamline resource allocation, and prevent idle inventory and resources. Greater operational control and flexibility allow factories to implement **dynamic pricing** models that strengthen profitability and the ability to deliver products at speed.

## Product Flow

Modern production processes are increasingly driven by real-time tracking systems that provide **precise production and shipment updates, lowering minimum order quantities and shortening production times.** Factories have adopted energy-smart practices, shifting high-energy tasks to periods of lower energy demand or when renewable sources are more abundant. This not only reduces environmental footprint but also increases profitability by optimizing energy use.

There is opportunity for players of all sizes along the modern data highway. Affordable technology solutions enable gradual adoption of automation tools for SMEs. Cloud-based ERP platforms offer scalable, step-by-step automation by integrating inventory management, production scheduling, and data analysis without the heavy upfront costs traditionally associated with large systems.

**Localized ecosystems** foster collaboration by allowing select factories and partners to openly share data between each other and improve mutual decision-making. This data-driven ecosystem empowers manufacturers to deliver **superior, data-backed products,** giving them a competitive edge.

The lesson?

**Data's true power lies not in its collection but in its ability to drive action.**

Factories must leverage these advanced tools to optimize production, reduce environmental impact, and empower decision makers across the supply chain. The future of the textile industry is bright for those ready to meet the challenges of tomorrow with confidence and innovation, harnessing the power of high-quality, well-communicated, actionable data.

Smartex stands ready to catalyze this future vision – partnering with forward-thinking leaders to usher in a new era of efficiency, sustainability, and innovation in textiles. Together, we will redefine what's possible in our industry, creating a more responsible and responsive textile ecosystem for generations to come.

**Don't let your business fall behind in the rapidly evolving textile landscape. Act now. Contact Smartex to schedule a personalized demonstration of our cutting-edge solutions.**

**The future of textiles is here.**

SMARTEX.AI

Smartex advances textile manufacturing with cutting-edge AI solutions that eliminate waste and optimize production. Our integrated system combines real-time automated fabric inspection with a comprehensive digital platform for operational management and traceability. By leveraging these technologies, we empower manufacturers to enhance quality, boost productivity, and achieve greater sustainability across their operations.


www.smartex.ai

## Features

**Description / Style # / SKU**
*Definition:* Description of finished item. Stock keeping unit. Smallest unit of unique item.
*Brand Example:* 100% Cotton, Short Sleeve, Crew Neck ; SKU: "TSHIRT-WHT-S", MCM/JEBZ51Z44F84120

**Colour / Finishes / Components**
*Definition:* BOM (Bill of Material) information at the highest level.
*Brand & Garment Example:* #FF5733 Navy Blue (to match approved sample). Plain with no additional prints or logos. Mercerized cotton.

**Material Specs**
*Definition:* A set of parameters defining a fabric's characteristics, including fabric structure (weave, knit, or bonding type), yarn size (thickness or fineness of the yarn), construction type (yarn arrangement, like threads per inch or knit gauge), and fabric weight (mass per unit area, e.g., GSM). These specifications determine the fabric's texture, durability, and suitability for various applications.
*Brand & Garment Example:* Pique 40/1 100%CO BCI | 170g

**Yarn Specs**
*Definition:* A set of parameters describing the properties of yarn, including yarn size (thickness or fineness, measured in tex, denier, or Ne), fiber composition (type of fibers, such as cotton, polyester, wool), twist (the number of turns per unit length, affecting strength and texture), and ply (the number of strands twisted together to form the yarn). These specifications determine the yarn's strength, elasticity, feel, and suitability for various fabric constructions.
*Garment & Fabric Example:* Ne 30/1, Single Ply, Z-Twist

**Fiber Specs**
*Definition:* A set of parameters defining the characteristics of a fiber, including fiber type (natural like cotton or wool, or synthetic like polyester or nylon), fiber length (staple for short fibers or filament for continuous fibers), fineness (thickness, often measured in microns or denier), and strength (resistance to breaking under tension). These specifications influence the fiber's texture, durability, and suitability for different yarn and fabric applications.
*Fabric Example:* 100%CO BCI / A100 Tencel / Supima Cotton + length (staple or filament), fineness (microns or denier), and strength (g/den)

**Labeling Information**
*Definition:* Key information to ensure compliance and inform consumers, including fiber content, care instructions, country of origin, manufacturer, size, and any necessary safety warnings.
*Brand Example:* "Made in USA", "100% Cotton", "Recycled Cardboard Box"

## Quantity

**Volume / Weight**
*Definition:* Key purchasing contract terms in apparel manufacturing, where volume denotes the quantity of items ordered, impacting bulk pricing, and weight refers to the total mass, influencing shipping costs and logistics arrangements.
*Brand Example:* 10,000 units
*Garment Example:* 1,900 KG

**Sizes**
*Definition:* Standardized measurements that define the dimensions and fit of apparel, typically labeled as sizes (e.g., S, M, L) or numeric values (e.g., 4, 8, 12). Sizing is based on specific body measurements, such as chest, waist, and hip circumference, and varies by market, brand, and region to ensure proper fit for target consumers.

- *Size Ratio: The planned distribution of each size within a purchase order (PO) or shipment, used to match inventory with demand. For example, a size ratio of 1:2:2:1 for sizes S, M, L, XL in an order of 100 units would allocate 10 small, 20 medium, 20 large, and 10 extra-large garments.*

This ensures balanced inventory for various size demands in the target market.
*Brand Example:* Small: 2,000 units ; Medium: 4,000 units ; Large: 3,000 units ; Extra Large: 1,000 units

**Over-Under Ratio**
*Definition:* An allowable range of variance in the quantity or specifications of produced goods, typically expressed as a percentage - this flexibility accounts for minor fluctuations in production, helping manage inventory and fulfill contracts effectively.
*Brand Example:* +3% / -3%. If the order was 100 t-shirts, the garment facility could deliver 103 or 97 t-shirts.

**Percentage to Ship Ratio**
*Definition:* Proportion of garments shipped vs total garments ordered. An allowable range of difference in the quantity or specifications of goods shipped versus ordered, typically expressed as a percentage. This variance accommodates minor discrepancies in packing or production, helping manage fulfillment and logistics expectations.
*Garment Example:* If you shipped 7,500 out of the 8,000 ordered T-shirts, percentage to Ship Ratio = 93.75%

**Fabric Width**
*Definition:* The total measurement across the fabric (actual width) versus the usable portion for cutting (cuttable width), excluding any unusable edges. Essential for maximizing fabric yield in garment production.
*Garment Example:* 1,75 M

**AQL (acceptable quality level)**
*Definition:* A quality control standard in garment production that sets the maximum acceptable defect rate in a sample, ensuring products meet specified quality limits before shipment.
*Brand Example:* AQL for this order is 1.5 for critical defects, 2.5 for major defects, and 4.0 for minor defects

**Minimum Quality Grade**
*Definition:* The lowest acceptable quality standard for a product in garment manufacturing, specifying criteria for aspects like fabric defects, stitching, and finishing. Products must meet or exceed this grade to pass inspection and be approved for shipment. Also used by garment facilities and fabric mills to define fabric acceptance criteria.
*Garment Example:* Acceptable = No more than 3 small defects (e.g., loose threads, minor fabric flaws) are allowed per 10 garments.
*Fabric Example:* Acceptable = 31 points/100m2

# Glossary | **Production: Price, Speed & Logistics Agreements**

## Price

**Price per Unit (Garment / KG / Meter / Yard)**
*Definition:* Average unit cost
*Brand Example:* $5.00 per unit
*Garment Example:* $10 per KG
*Fabric Example:* $4 per KG

**Total Value**
*Definition:* Total value of an order
*Example (All Stages):* $50,000

**Payment Terms**
*Definition:* The agreed conditions between buyer and supplier in apparel production regarding the timing, method, and amounts for payment. Payment terms help manage cash flow, set clear expectations, and reduce financial risks for both parties
*Example (All Stages):* 30% advance, 70% upon delivery; Letter of Credit (L/C), Net 30 days

## Speed

**Order Date / Delivery Date**
*Definition:* The Order Date is when the order is confirmed and starting production, while the Delivery Date is the agreed date for the finished products to be shipped or arrive, crucial for planning inventory and logistics.
*Example (All Stages):* 09.05.2024 / 14.06.2024

## Logistics

**Purchase Order Number (PO)**
*Definition:* A unique identifier assigned to an apparel order, used to track and reference specific order details, quantities, prices, and delivery requirements throughout the production and shipping process.
*Example (All Stages):* P24000789

**Type of Transport**
*Definition:* The chosen method for moving apparel across the supply chain, such as **Air** (fast but expensive), **Ocean** (cost-effective for bulk), **Rail** (moderate speed and cost), and **Road** (short distances or final delivery). The choice depends on cost, speed, and logistical requirements.
*Example:* For a fast launch, **air freight** might be used to ensure timely arrival despite higher costs. For bulk restocking, **ocean freight** is more economical, though slower. **Rail** offers a cost-speed balance for continental shipping, while **road** transport covers final delivery from port to distribution centers.

**Import Codes**
*Definition:* Classification codes used in international trade to identify products and determine applicable duties, taxes, and regulations. **HTS (Harmonized Tariff Schedule)** codes are specific to the U.S. and classify imported goods based on material, function, and origin, helping customs authorities assess tariffs and compliance requirements accurately.
*Example (All Stages):* Exporting men's cotton T-shirts from Bangladesh to USA, the import code is 6109.10.00

**Incoterms**
*Definition:* Shipping conditions in apparel logistics that define cost and responsibility sharing between buyer and supplier. Examples include **FOB** (buyer takes responsibility at loading), **CIF** (supplier covers cost, insurance, and freight to destination port), and **DDP** (supplier covers all costs to buyer's location). These terms manage costs, risks, and logistics roles in global transport.
*Brand Example*: FOB Point: FOB Chittagong Port ; Destination: Port of New York, USA
*Garment Example:* FOB Point: ABC Dyehouse Ltd

**Packaging**
*Definition:* Guidelines that define how goods are prepared for safe and efficient transport, specifying carton sizes, stacking methods, labeling, and handling instructions.
*Brand Example:* Each T-shirt to be packed in individual poly bags, 50 units per carton. Carton Dimensions: 60 cm x 40 cm x 30 cm. Each carton to be labeled with SKU, quantity, and destination details.
*Garment Example:* Packed in 25kg rolls, wrapped in waterproof plastic

# Glossary | **Compliance & Impact - How, Where and the Contents of the Production Process**

## Facility

**Factory ID & Location**
*Definition:* A unique identifier and geographic information for a manufacturing facility, including address and GPS coordinates. This data enables precise tracking, compliance verification, and supply chain transparency.
*Example (All Stages):* PT2019087ZY8NC5 ; ABC Garments Ltd., 123 Industrial Road, Dhaka, Bangladesh

**Certification # & Expiration Date**
Definition: A unique identifier for a certification, with a defined validity period and expiry date, ensuring compliance is current and traceable.
*Examples:*
*Chemical Safety:* Certifications like **OEKO-TEX®** and **ZDHC** verify that materials are free from harmful chemicals, safeguarding consumers and the environment.
*Social Responsibility:* Standards such as **Fairtrade** and **Higg's Social & Labor Module (FSLM)** validate fair labor practices and worker welfare.
*Ecological Management:* Programs like **ISO 14001** and **Higg Facility Environmental Module (FEM)** monitor suppliers' environmental practices, focusing on resource use and waste reduction.
*Quality Assurance:* Certifications under the **Textile Exchange**, including the **Global Recycled Standard**, ensure responsible sourcing and material quality.
*Circularity:* Initiatives like the **Responsible Wool Standard** and **GOTS** support closed-loop systems by validating organic and recycled materials.

## Transaction

**Transaction Certifications**
*Definition:* Documents that verify the authenticity and compliance of individual apparel shipments, ensuring they meet specific standards (e.g., organic, fair trade, or safety requirements). These certifications trace each transaction within the supply chain, providing transparency and confirming that materials and products adhere to designated quality, ethical, or environmental standards.
*Example:* Materials (GOTS, OCS)

**Delivery Information**
*Definition:* Specific conditions outlined for the delivery of materials or apparel, detailing timelines, packaging standards, quantity accuracy, quality checks, and documentation (e.g., packing list, invoice, certifications).
*Example:* GRM - Goods Received Notice, Packing list

## Product

**Evidence for Marketing Claims**
*Definition:* Verified documentation required to back marketing claims, including certifications (e.g. organic, fair trade), lab tests, sourcing records, and compliance with industry standards. This ensures claims are accurate, credible, and meet regulatory standards.
*Example:* Lowest impact cotton etc.

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