

# Perspectives on traceability framework

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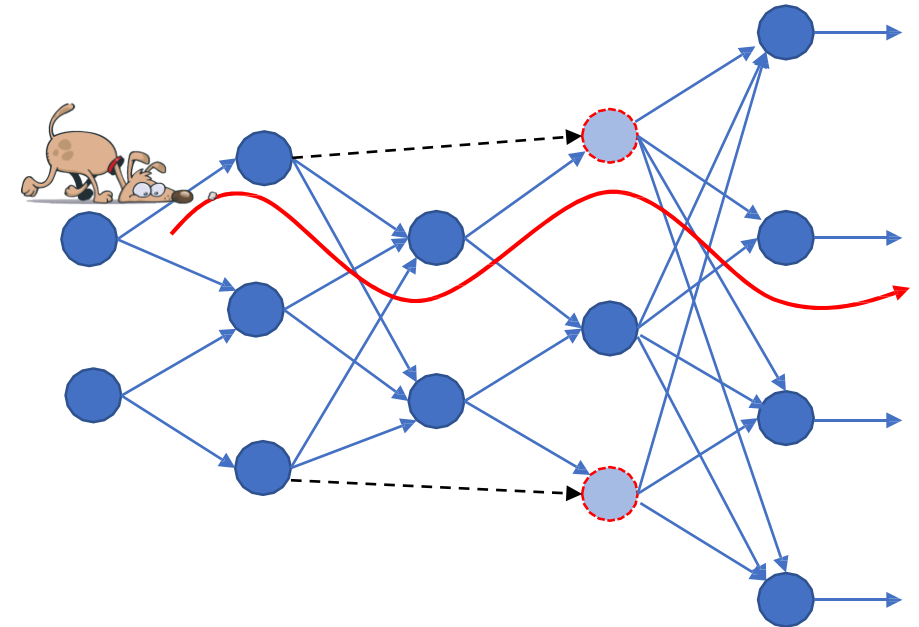
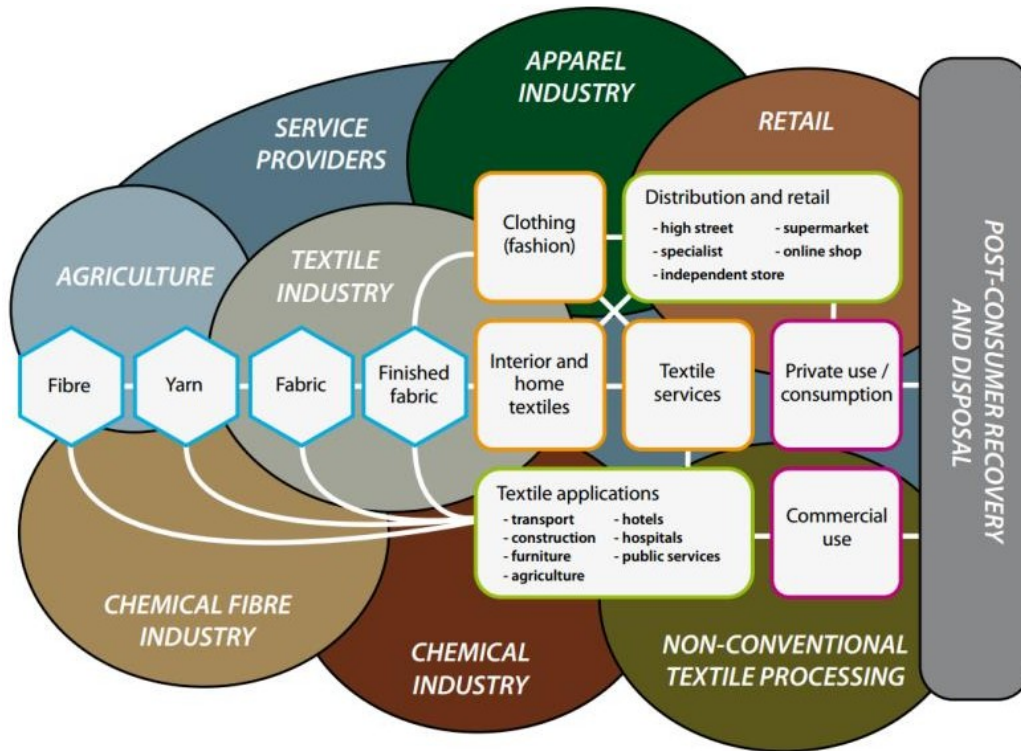


THE SWEDISH SCHOOL  
OF TEXTILES  
UNIVERSITY OF BORÅS

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- ❖ Traceability Data Management architecture
- ❖ Key Underlying Components of Traceability
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- ❖ Understanding traceability models

# Textile supply chain

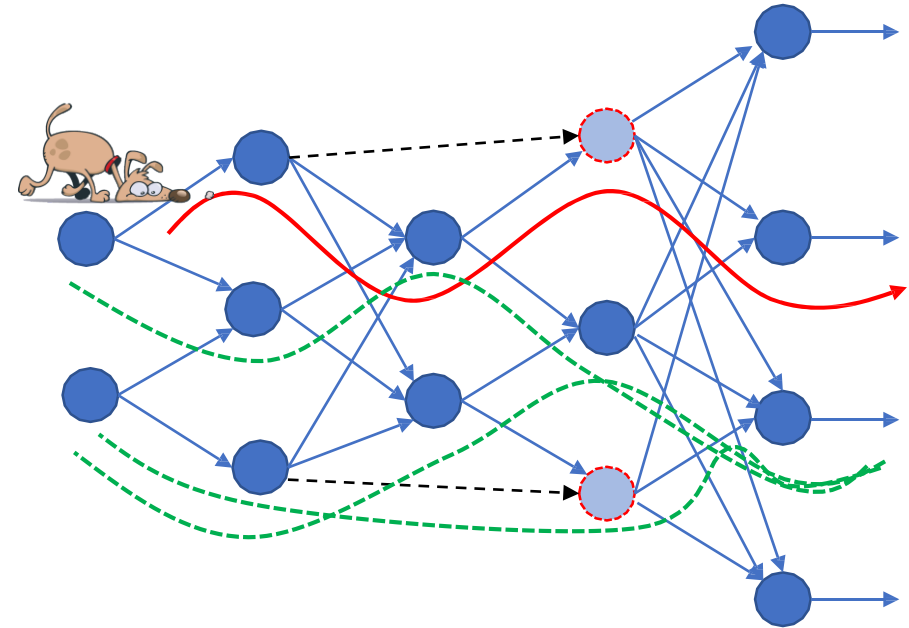


Overview of textile supply chain\*

\*Allwood, J. M., Laursen, S. E., Rodríguez, C. M. de, & Bocken, N. M. P. (2006). Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom. (Technical Report). Cambridge, UK: University of Cambridge - Institute for Manufacturing. [http://www.ifm.eng.cam.ac.uk/uploads/Resources/Other\\_Reports/UK\\_textiles.pdf](http://www.ifm.eng.cam.ac.uk/uploads/Resources/Other_Reports/UK_textiles.pdf). Accessed 4 May 2017

# Traceability and its purpose/drivers

“[...]the ability to trace the history, application or location of an entity by means of **recorded identifications.**” (ISO 8402:1994)



*Traceability is the ability to track a product batch and its history through the **whole, or part, of a production chain** from harvest through **transport, storage, processing, distribution and sales** (hereafter called **chain traceability**) or internally in one of the steps in the chain for example the **production step** (hereafter called **internal traceability**) \**

# Traceability and its purpose/drivers

- Counterfeit detection
- Inventory management
- Supply chain management
- Transparency
- Sustainability (accountability)
- Product security
- Product recall
- Servicing (eg. repairing)
- Disposal/recycling

etc.

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# Traceability and its purpose/drivers

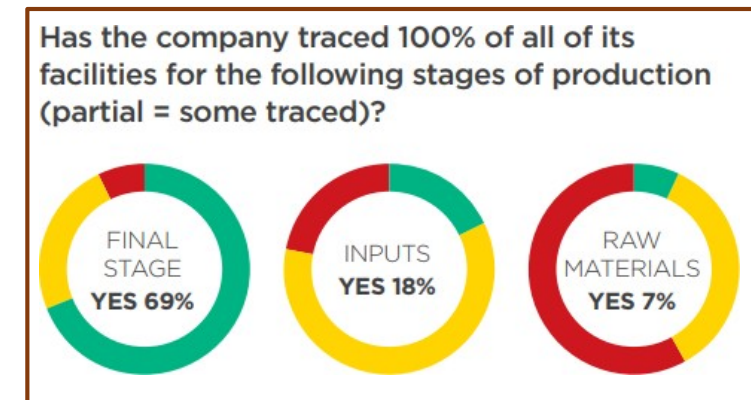
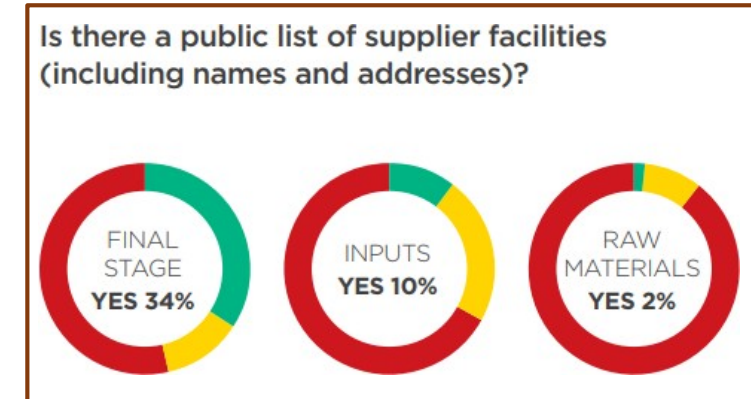
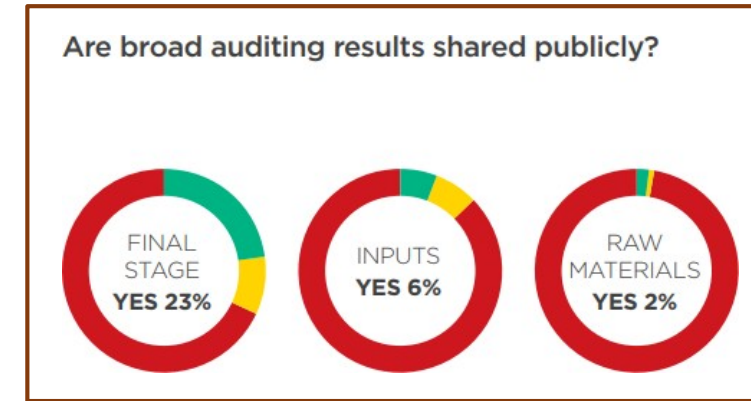
- Counterfeit detection
  - Inventory management
  - Supply chain management
  - Transparency
  - Sustainability (accountability)
  - Product security
  - **Product recall**
  - Servicing (eg. repairing)
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# Traceability and its purpose/drivers

- Counterfeit detection
  - Inventory management
  - Supply chain management
  - **Transparency**
  - Sustainability (accountability)
  - Product security
  - Product recall
  - Servicing (eg. repairing)
  - Disposal/recycling
- etc.

Data related to 106 companies  
fashion companies representing  
**330 brands\***





**Key message:**

- Thus traceability claims should be customized according to the defined purpose

What's On Shopping

# Warning over thousands of fake counterfeit goods and clothes - and how to spot them

seized millions of fake electronics, dodgy designer clothes and counterfeit football shirts last year and the be dangerous

By [Simon Meechan](#)  
00:01, 12 DEC 2018

4 SHARES COMMENTS

WHAT'S ON

RECOMMENDED

Watch gem thieves' dramatic £300,000

**The Telegraph**

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## Euro 2012: football supporters warned over 'toxic' shirt

European Consumers' Organisation (BEUC) have warned football fans not to buy jerseys of some of the nations competing at the tournament after research discovered that some of the shirts contain dangerous levels of chemicals.

## The Rana Plaza Accident and its aftermath

The Rana Plaza disaster, Savar, Bangladesh

On 24 April 2013, the collapse of the Rana Plaza building in Dhaka, Bangladesh, which housed five garment factories, killed more than 2,500 people and injured another 2,000.

## Why Is a Major Clothing Retailer Selling Fake Organic Cotton?

### STORY AT-A-GLANCE

- > Swedish fashion giant H&M is the world's largest user of organic cotton, but in 2010 it was revealed that some of their 'organic' cotton contained genetically modified material
- > H&M now requires products containing organic cotton have a transaction certificate issued by a third-party certifier to verify the content of the organic fiber
- > Cotton is considered the world's dirtiest crop due to the cotton industry's heavy use of hazardous herbicides and insecticides



POSTED ON JULY 8, 2016 BY ADMIN

## ARE YOUR CLOTHES HELPING TO FUND ISLAMIC STATE?

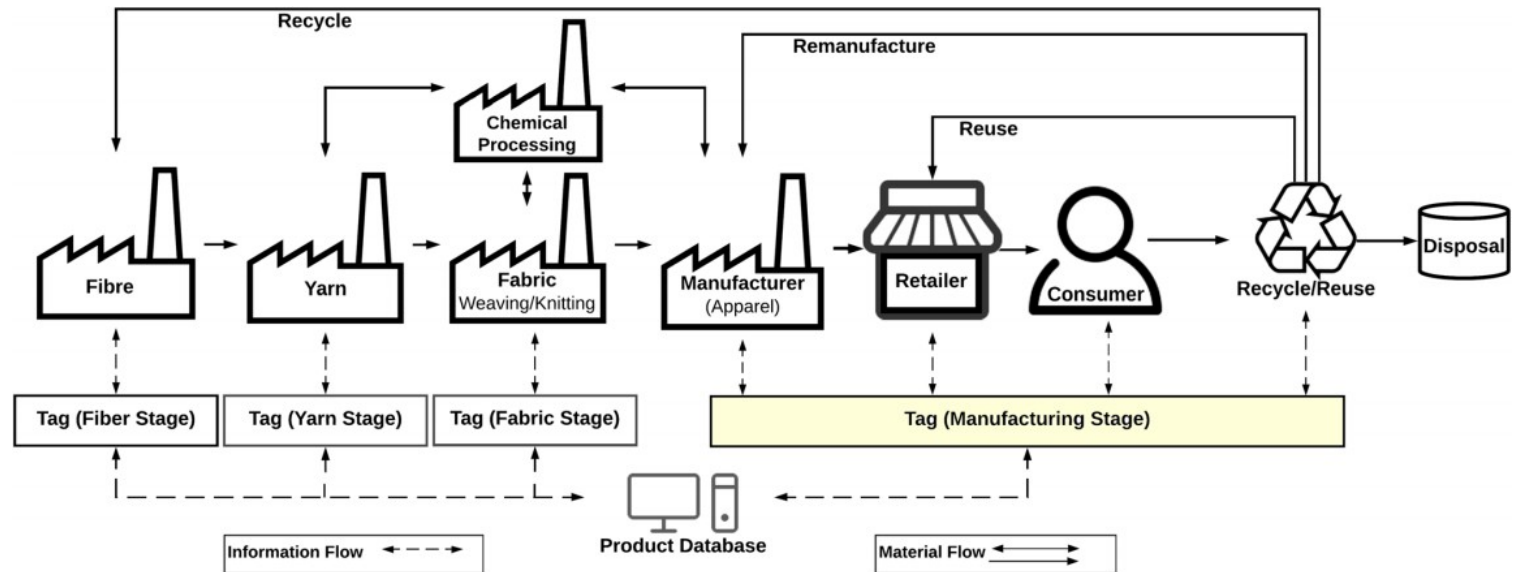
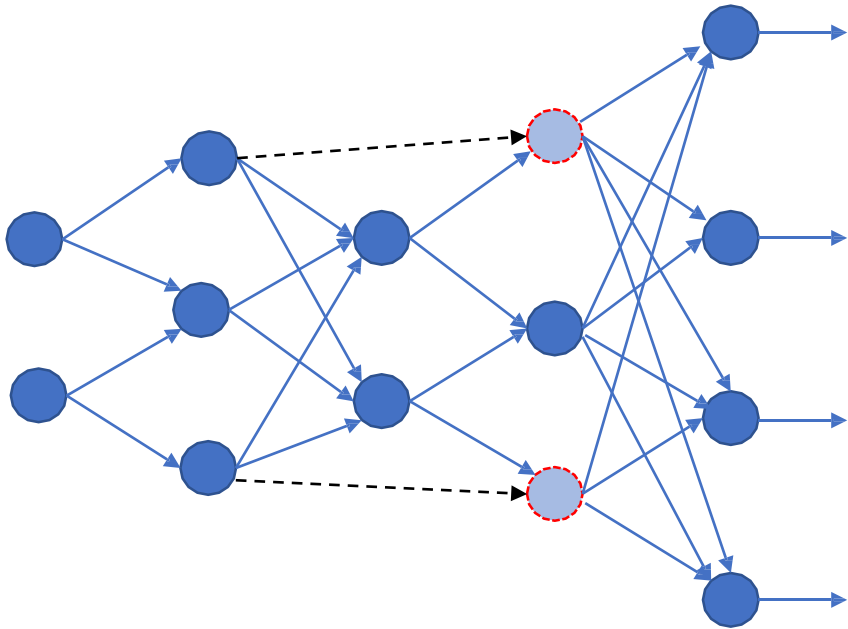
ETHICAL

Since September last year, Islamic State militants have gained control over the Syrian cotton production, which could mean that the clothes you buy can indirectly benefit ISIS.



# Traceability Data Management

## Ideal data management system



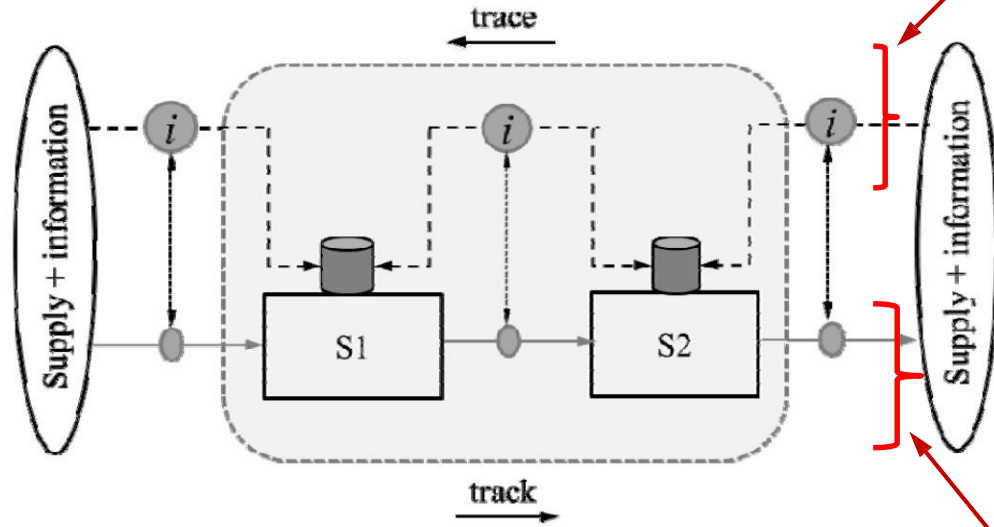
**An ideal traceability system\***

\*Agrawal, T. K., Koehl, L., & Campagne, C. (2018). A secured tag for implementation of traceability in textile and clothing supply chain. *The International Journal of Advanced Manufacturing Technology*, 99(9-12), 2563-2577.

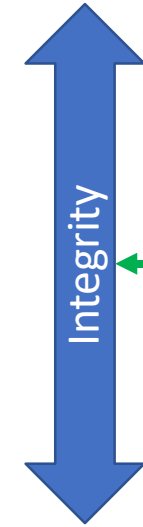
# Traceability Data Management

Zooming at dyadic level

```
<?xml version="1.0" encoding="UTF-8"?>
<dataroot generated="2016-09-22T13:45:48"
xsi:noNamespaceSchemaLocation="LotIDs_v4.xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:od="urn:schemas-microsoft-com:officedata">
  <LotIDs>
    <Lot_ID>12345</Lot_ID>
    <Product_type>CO_120GSM</Product_type>
    <Start_Date>2016-06-14T00:00:00</Start_Date>
    <End_Date>2016-08-31T00:00:00</End_Date>
    <OutboundProfInfo>
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      <ID>1</ID>
    </OutboundProfInfo>
    <BuyerInfo>
      <ID>1</ID>
      <Ref_ID>1</Ref_ID>
      <Buyer_name>xx1 Germents Ltd.</Buyer_name>
      <Buyer_ID>ZU-G</Buyer_ID>
      <Contact_no>xx-xxxxxxx</Contact_no>
      <Product_Name>Graige fabric</Product_Name>
      <Shipment_ID>34F45G3</Shipment_ID>
      <Shipping_info>xx2 Logistic Company</Shipping_info>
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    </BuyerInfo>
  </LotIDs>
</dataroot>
```

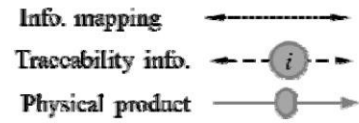


Information Channel



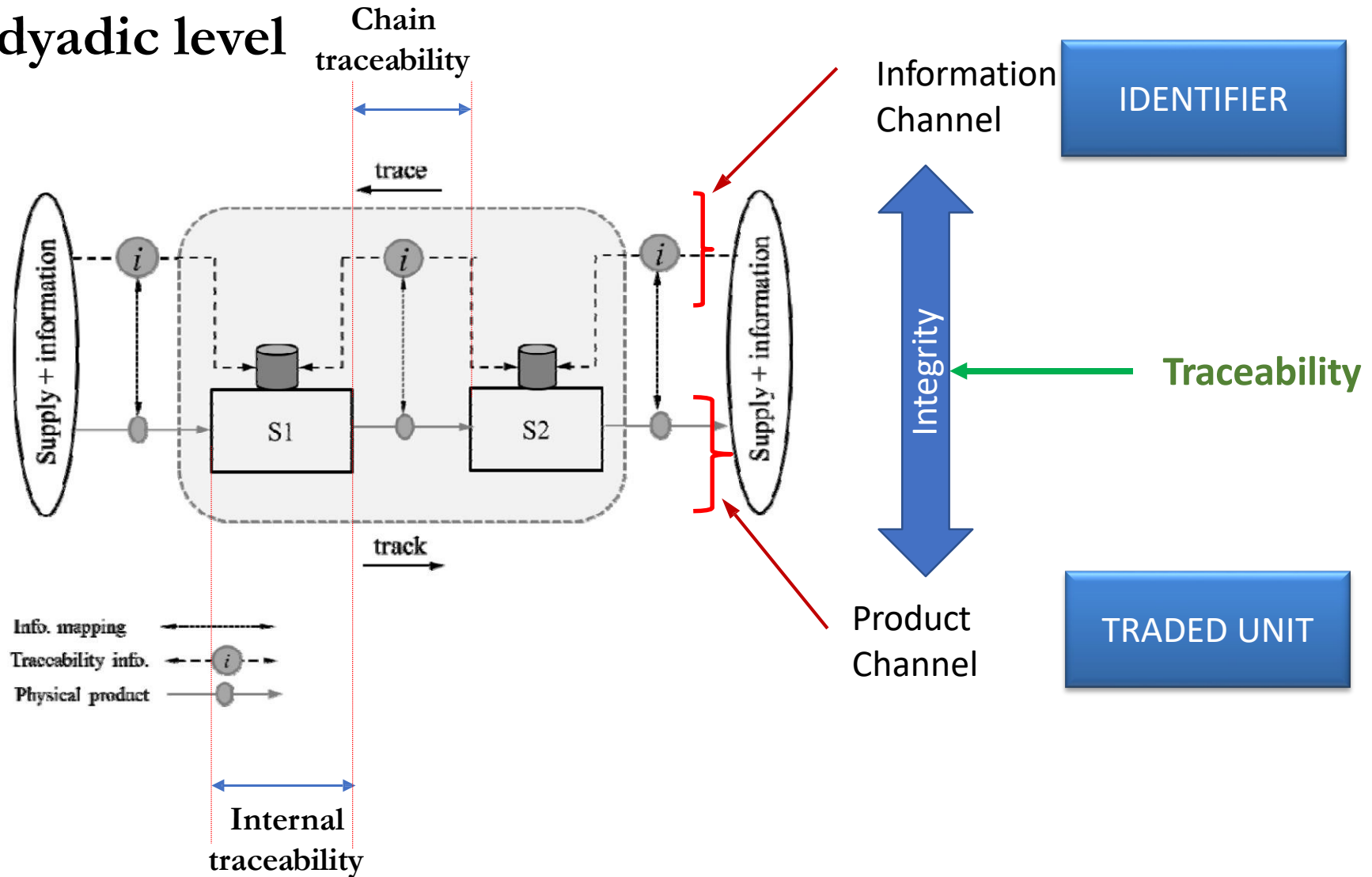
Traceability

Product Channel



# Traceability Data Management

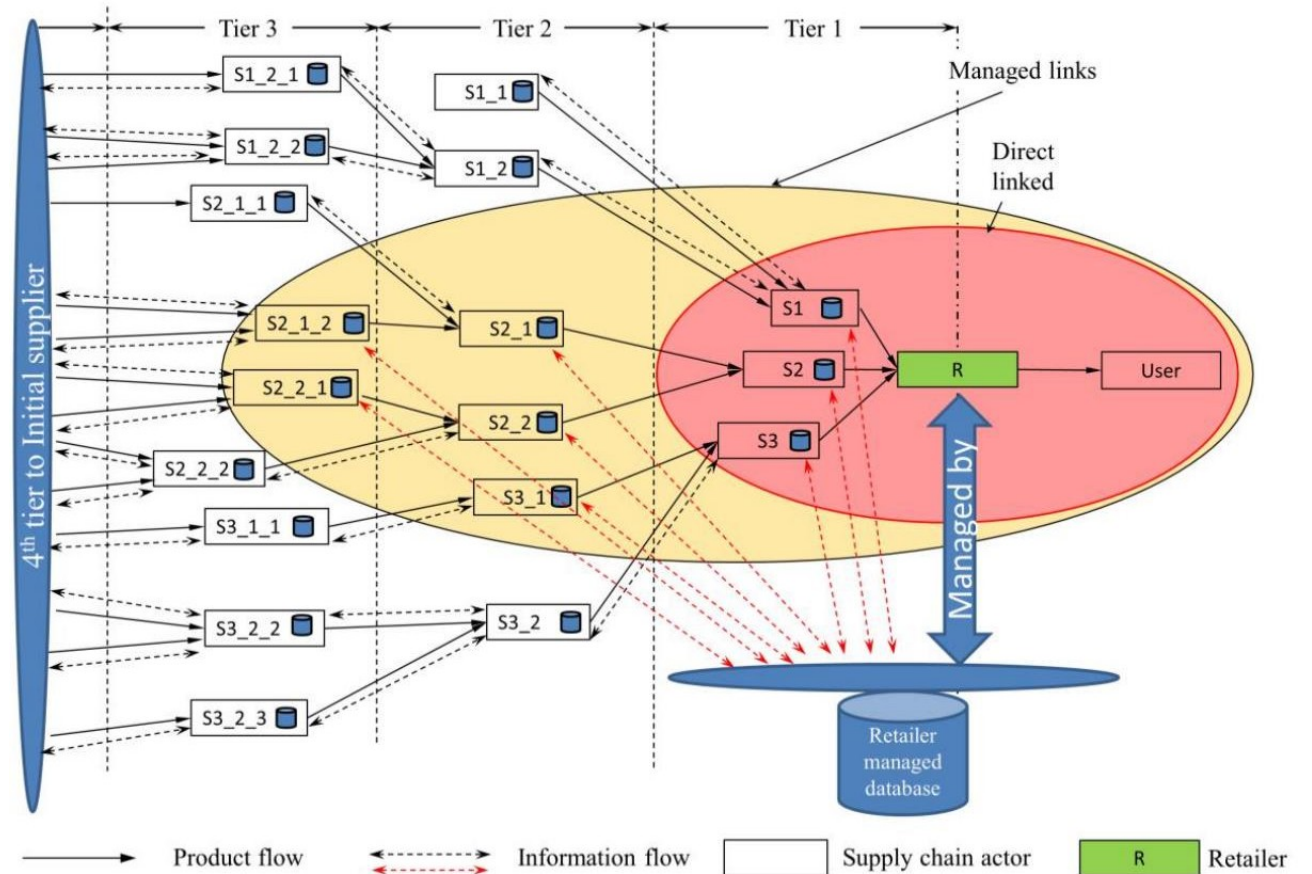
Zooming at dyadic level





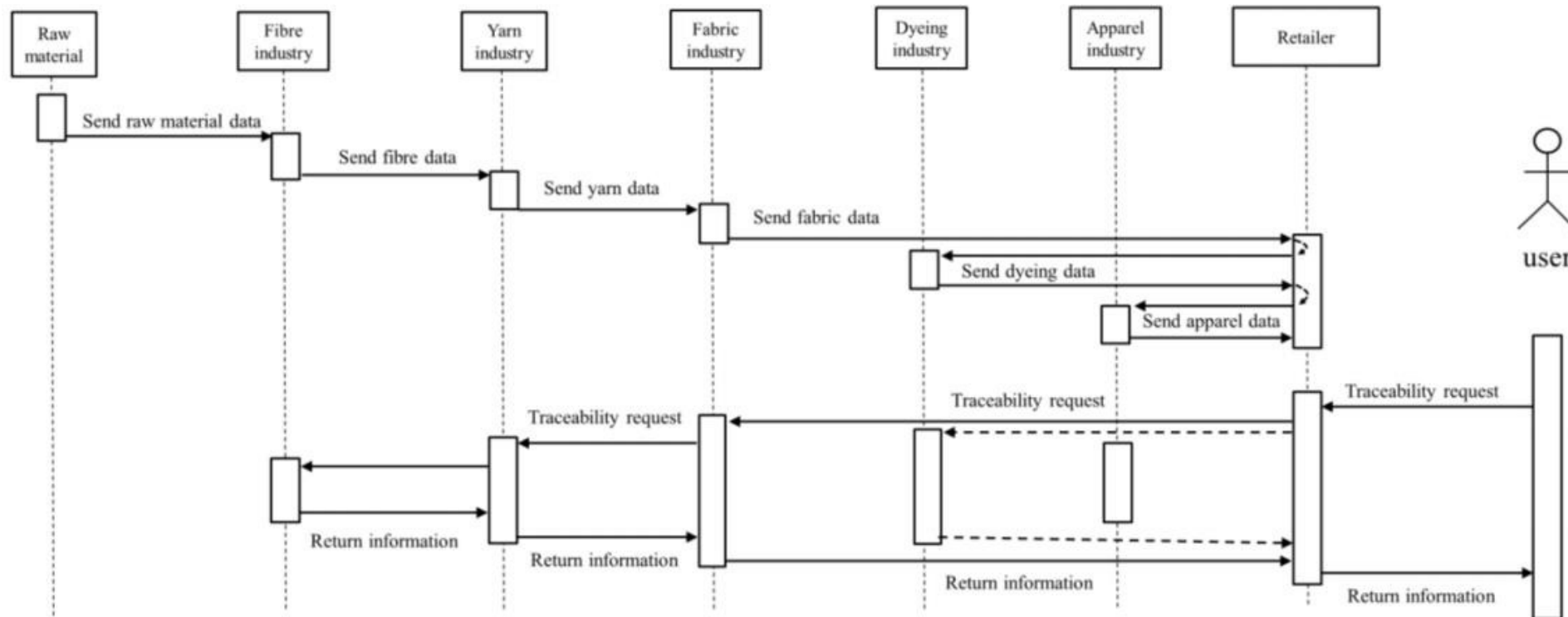
# Traceability Data Management

Distributed data management system for network traceability



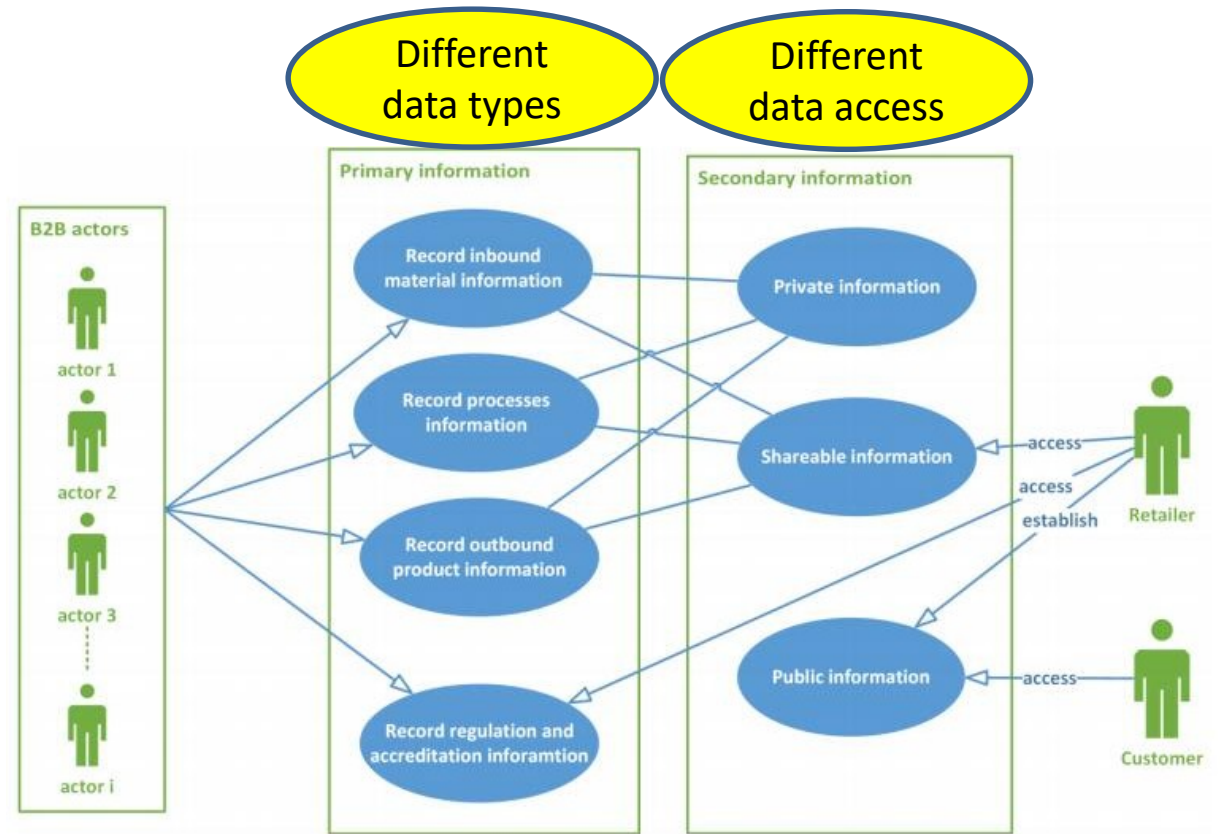
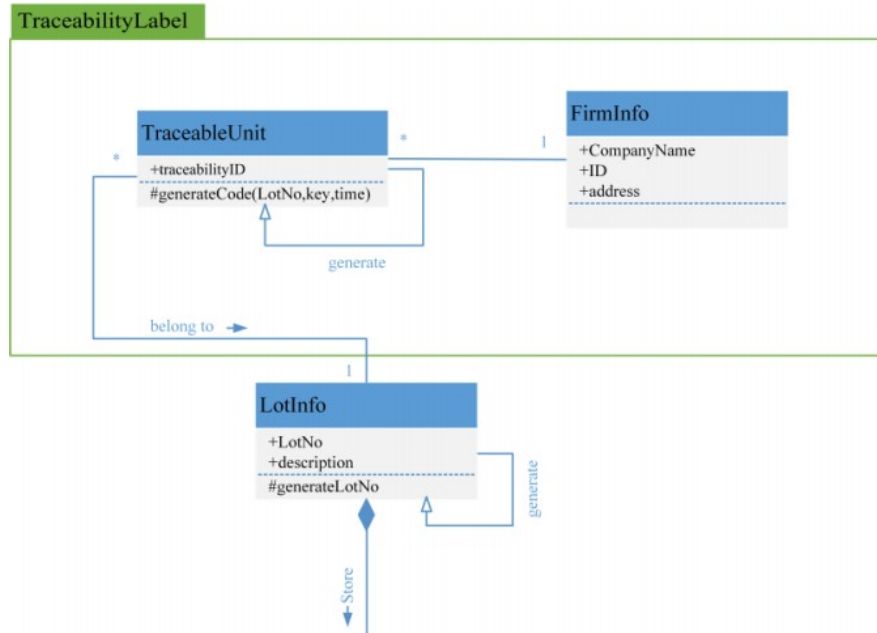
# Traceability Data Management

Distributed data management system, an example



# Traceability Data Management

## Distributed data management system

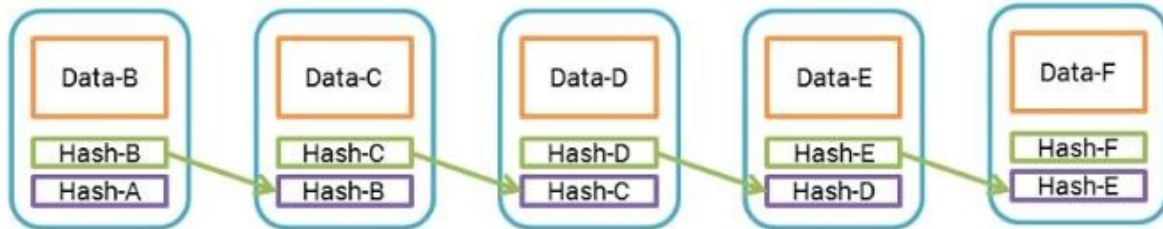


The use-case diagram for the traceability information\*

\*Kumar, V., Hallqvist, C., & Ekwall, D. (2017). Developing a framework for traceability implementation in the textile supply chain. *Systems*, 5(2), 33.

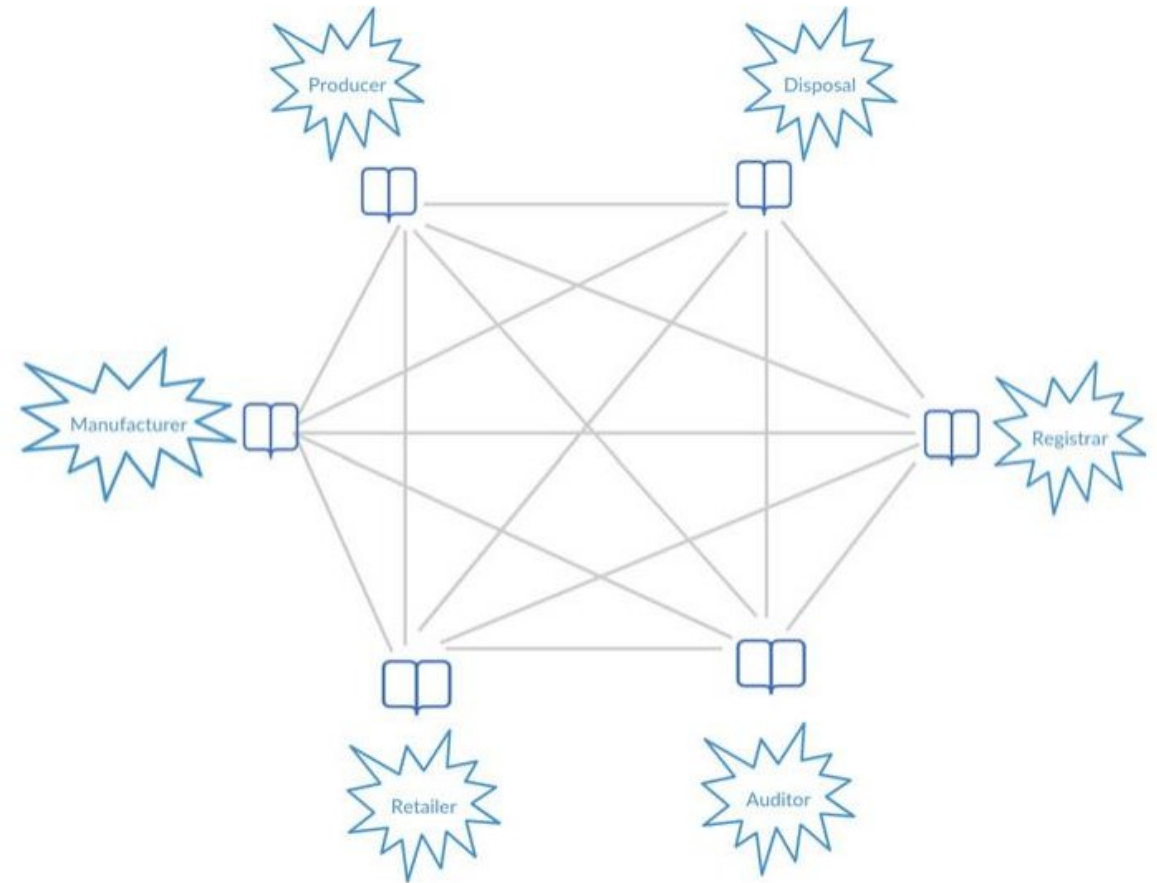
# Traceability Data Management

## Blockchain based data management



Hash ?

Boras -> **41sd52f6df3e6f5e** + Sweden -> **asfsbdfnsfn454df1vad**



**Blockchain modules\***

\*Agrawal, T. K., Sharma, A., & Kumar, V. (2018). Blockchain-Based Secured Traceability System for Textile and Clothing Supply Chain. In *Artificial Intelligence for Fashion Industry in the Big Data Era* (pp. 197-208). Springer, Singapore.



# Key underlying Components of Traceability

- **Identify** all data that would be required for future from traceability context
- **Record** the identified traceability data
- **Communicate** the necessary traceability data with supply chain partners (stakeholders) with flow of products or services
- **Manage** long term **links** for exchange of request of traceability data (preferred in an automated way)



Underlying components of traceability\*

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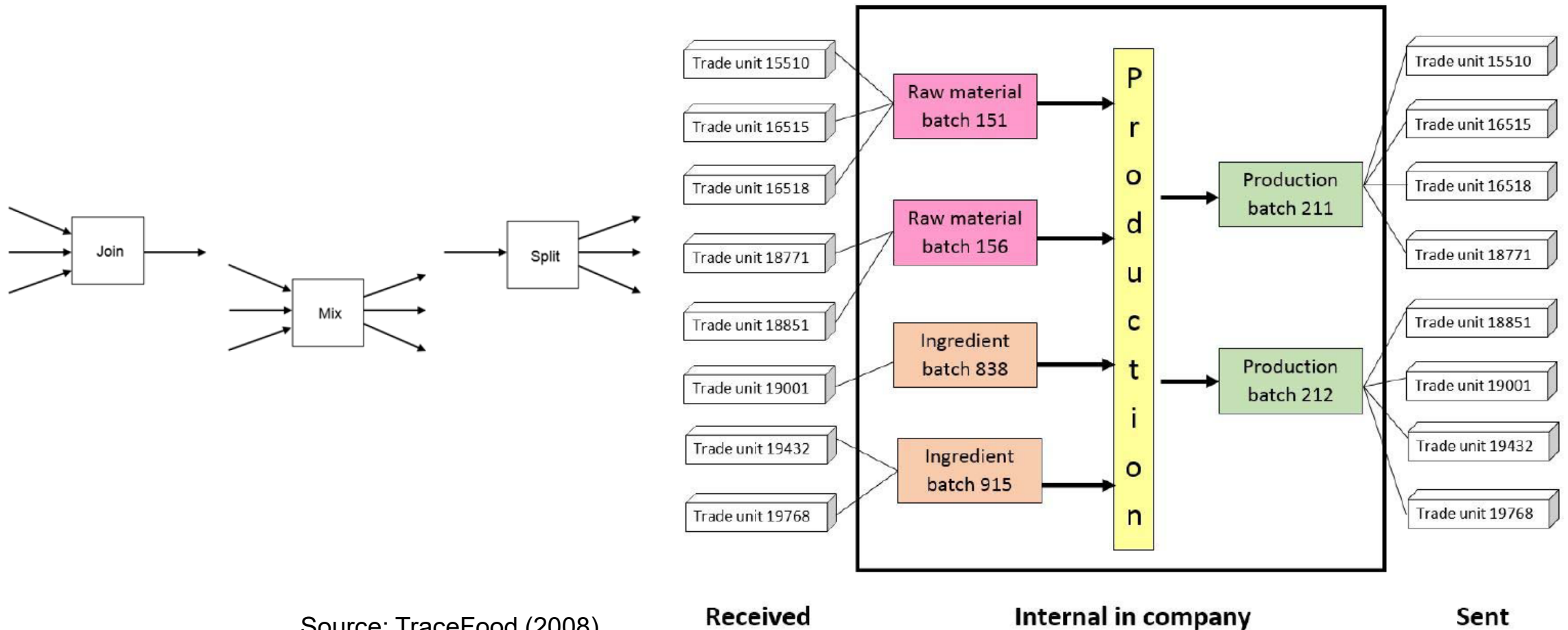


# Components of Traceability System

- **Policy Claim** which provides the purpose of the traceability project
- **Traceable Asset**
- **Entry/Exit Points** and their conditions, describing the condition/requirements on the traceable asset
- **Transformation rules**, in conformance with the policy statement
- **Audit Agency**, monitoring all rules and conditions for meeting traceability

# Key underlying Components of Traceability

## Traceable Resource Unit (TRU): deciding granularity



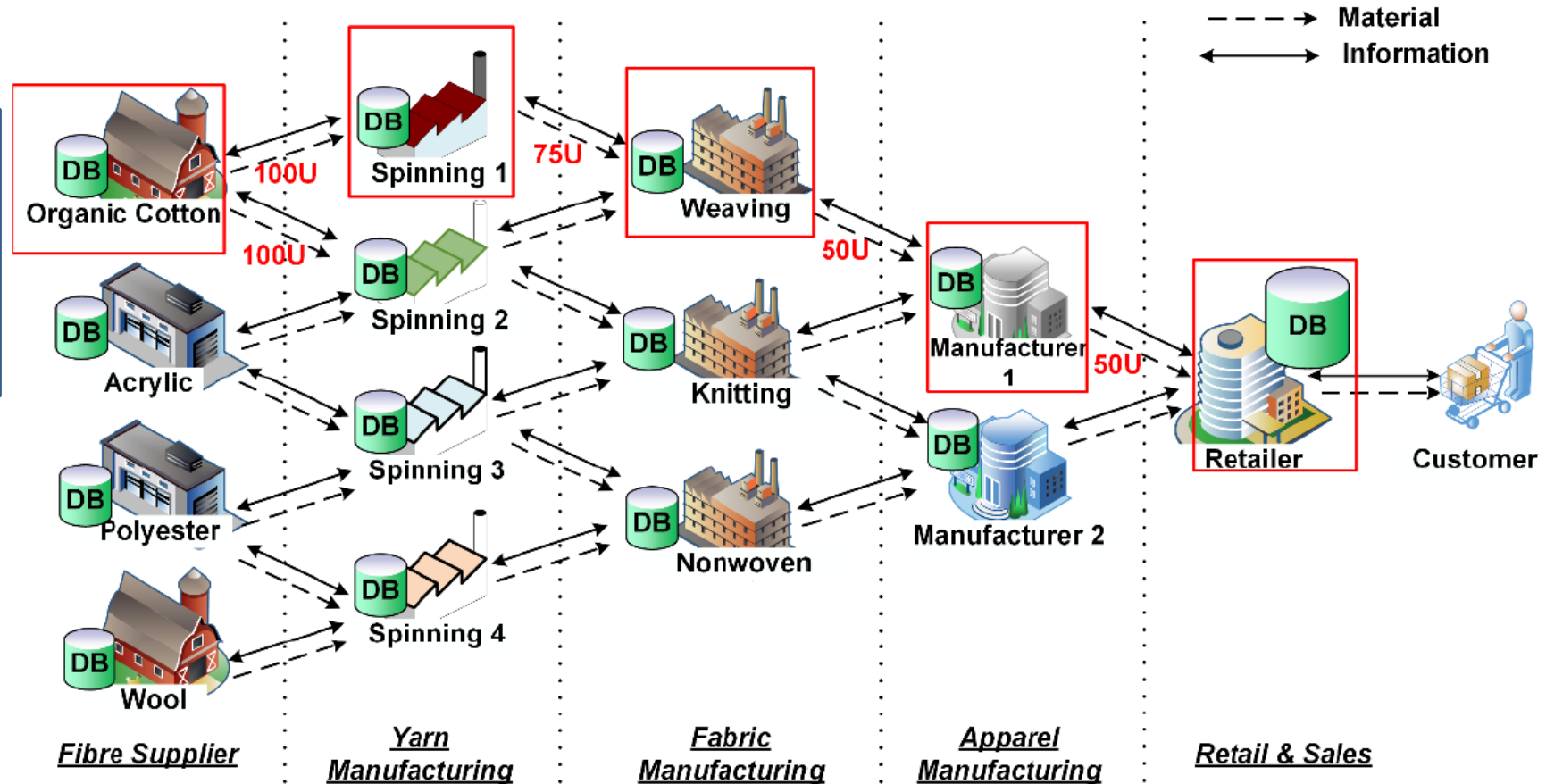
Source: TraceFood (2008).

# Key underlying Components of Traceability

Traceable Resource Unit (TRU): deciding granularity

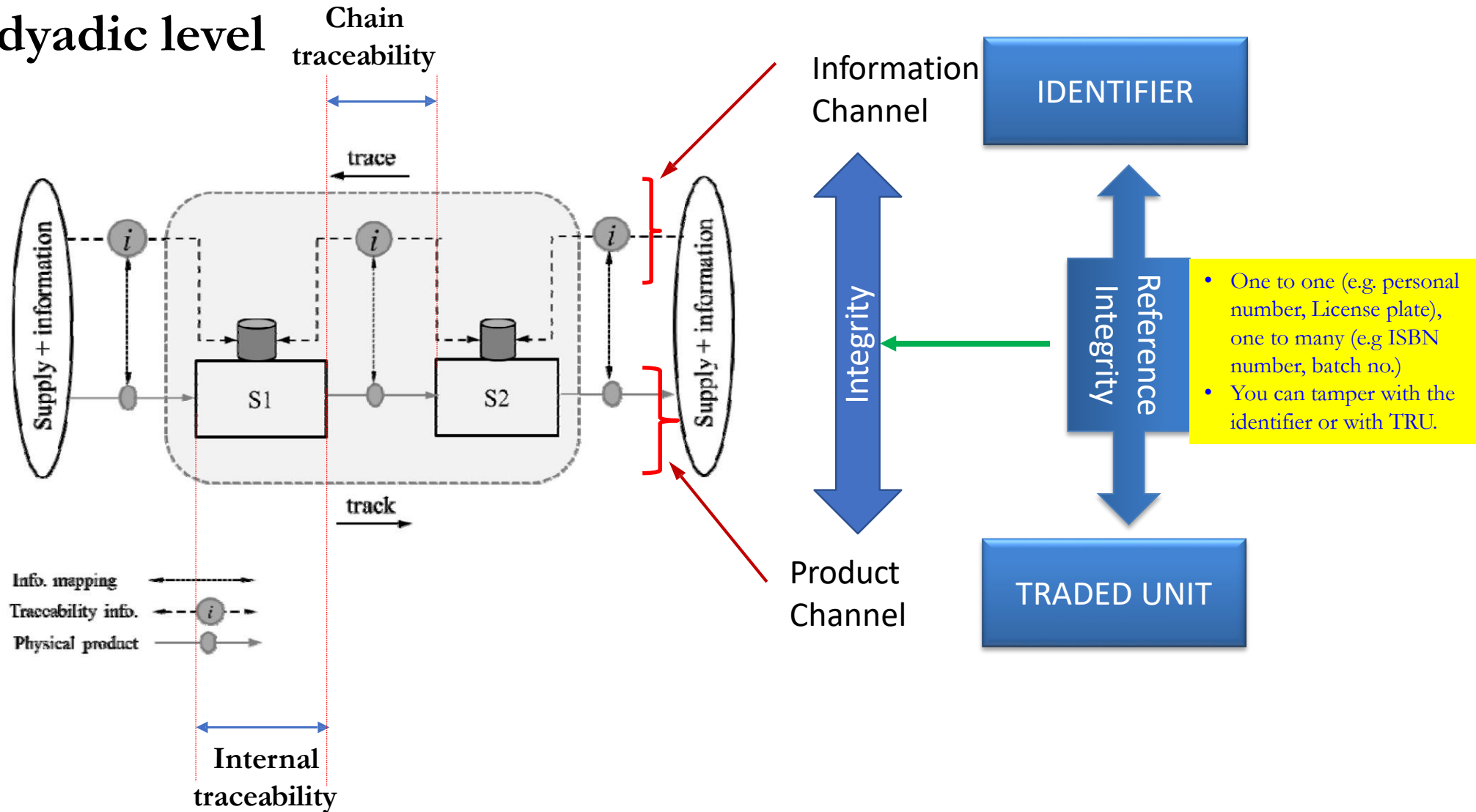
## Key message:

- Trade-off: Precision vs. Cost
- Traceability cost vs. Product pricing
- Problem-based TRU "definition"

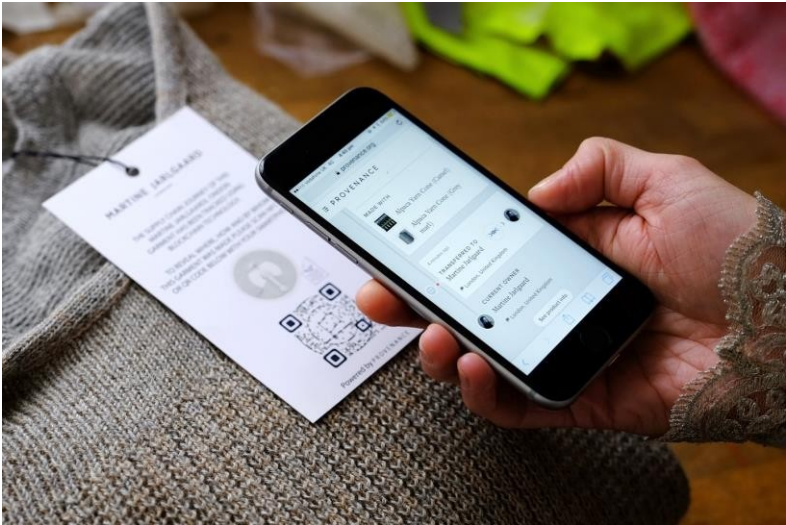
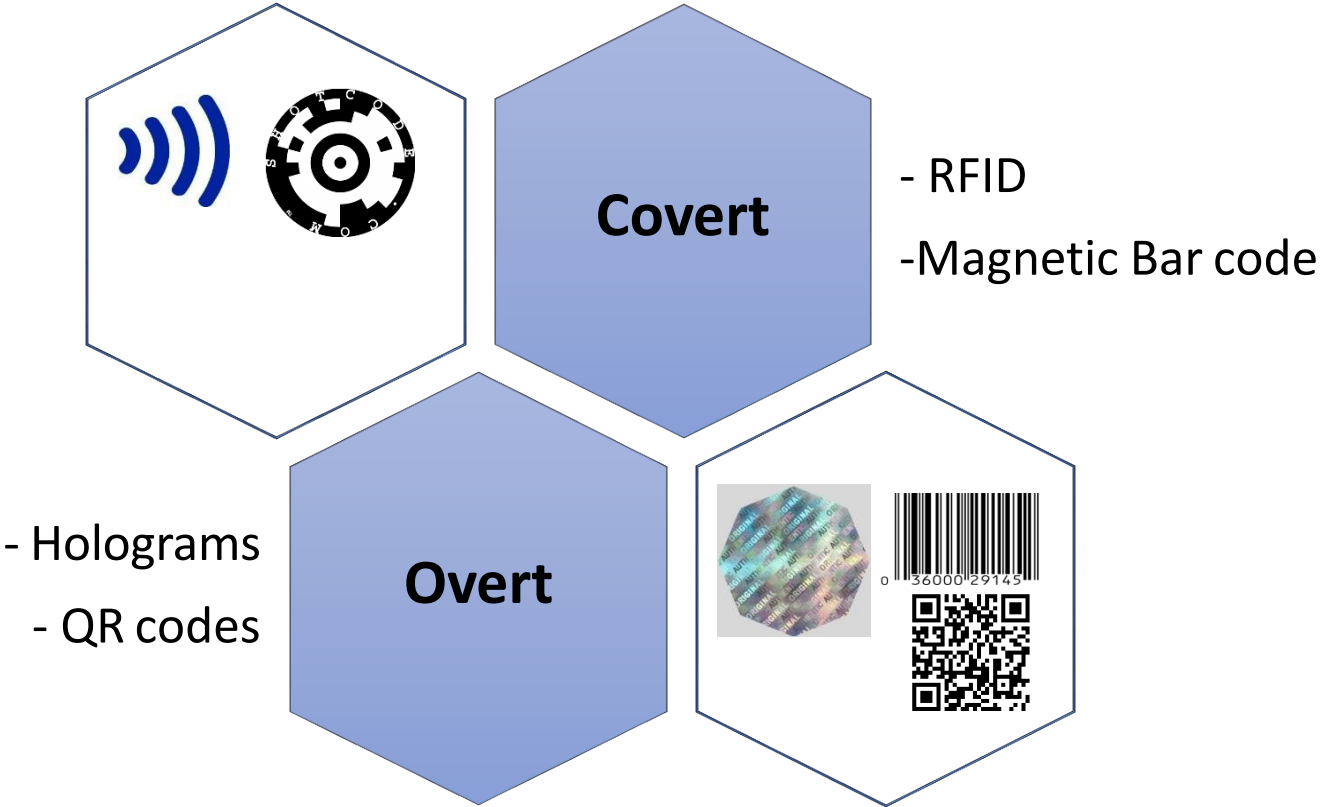


# Traceability Data Management

Zooming at dyadic level

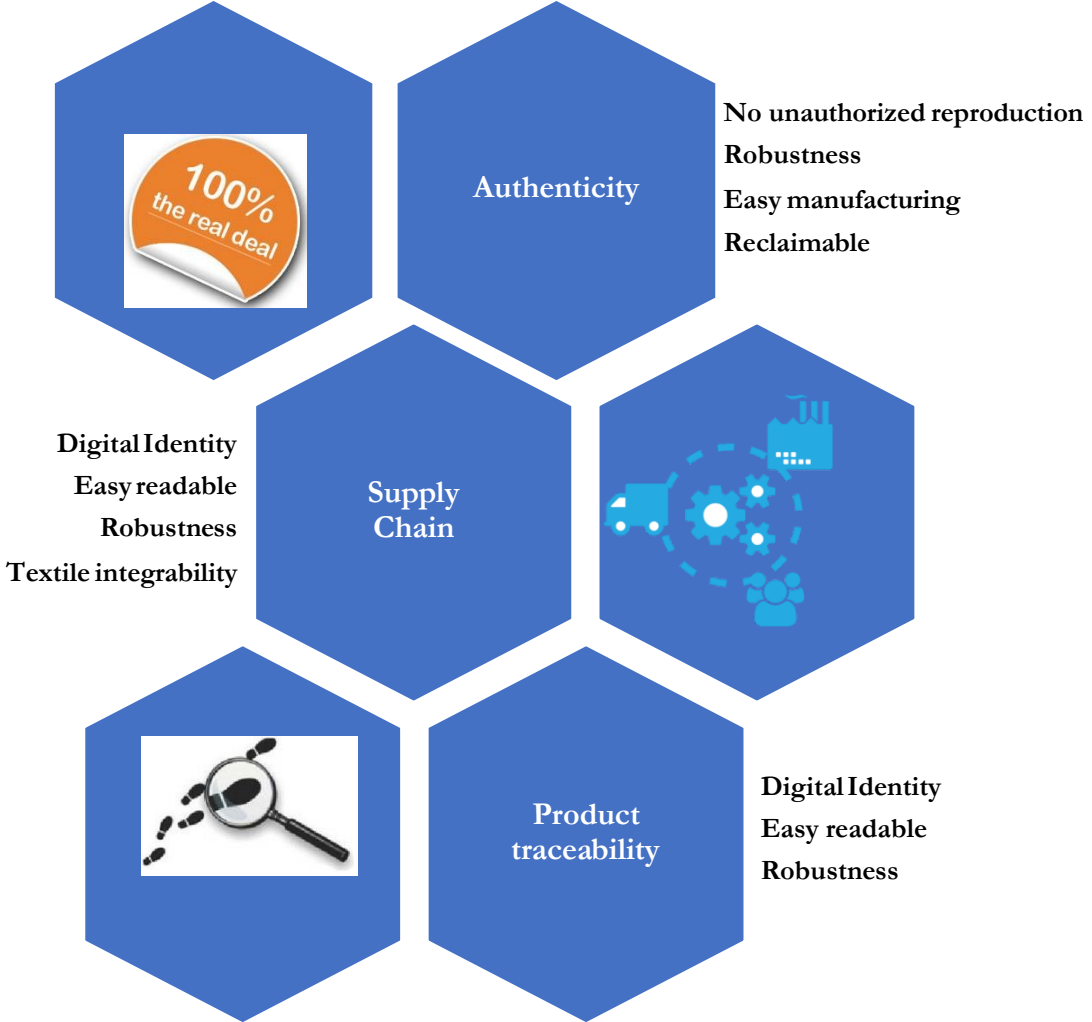


# Traceability Data Mapping with product



# Traceability Data Mapping with product

## Characteristics of ideal traceability tag





# Traceability Data Mapping with product

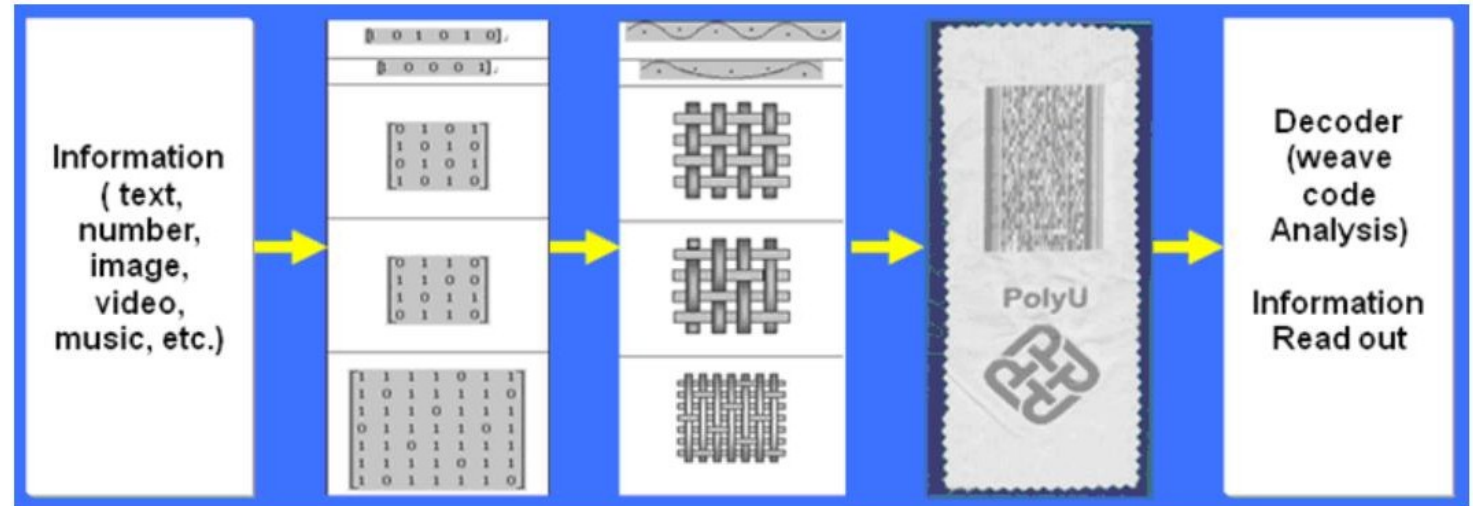
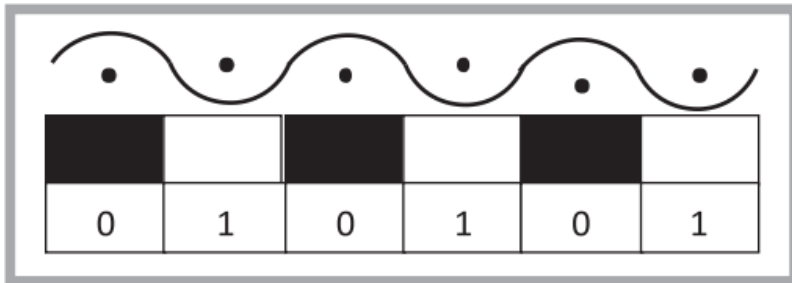
Fiber-based  
traceability tag  
through  
forensics





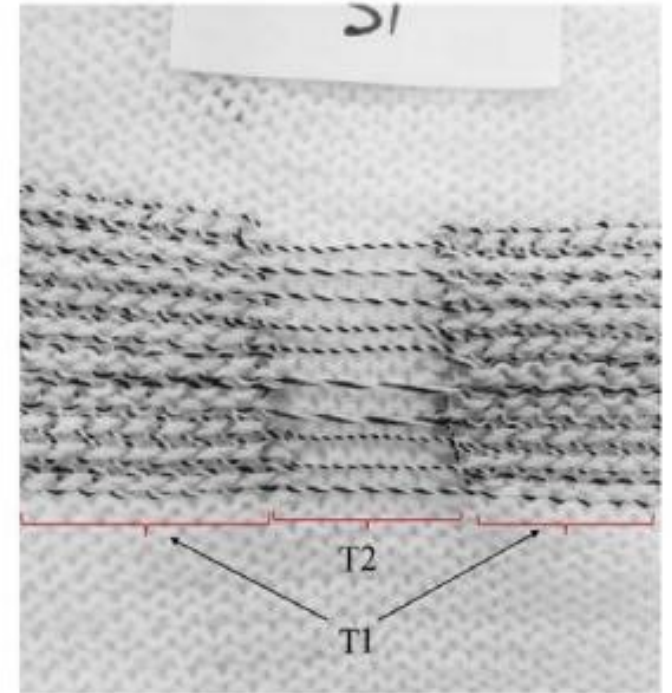
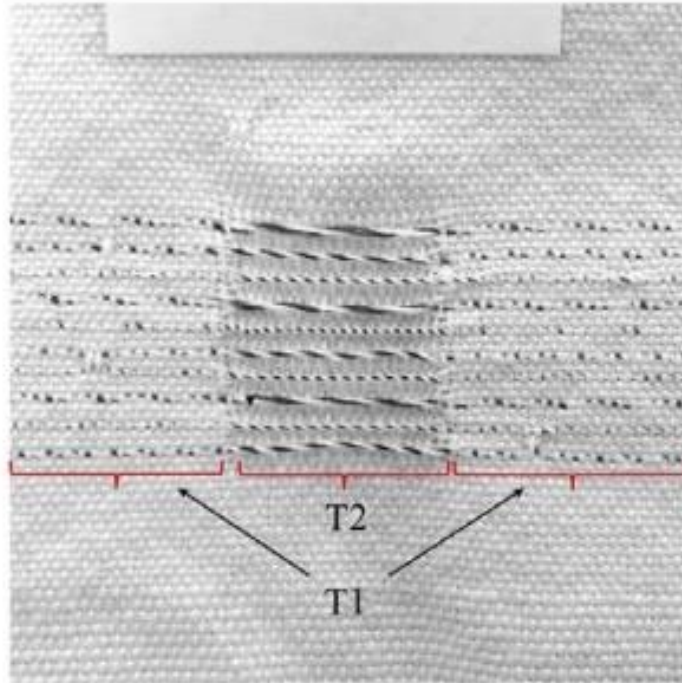
# Traceability Data Mapping with product

## Yarn-based traceability tag



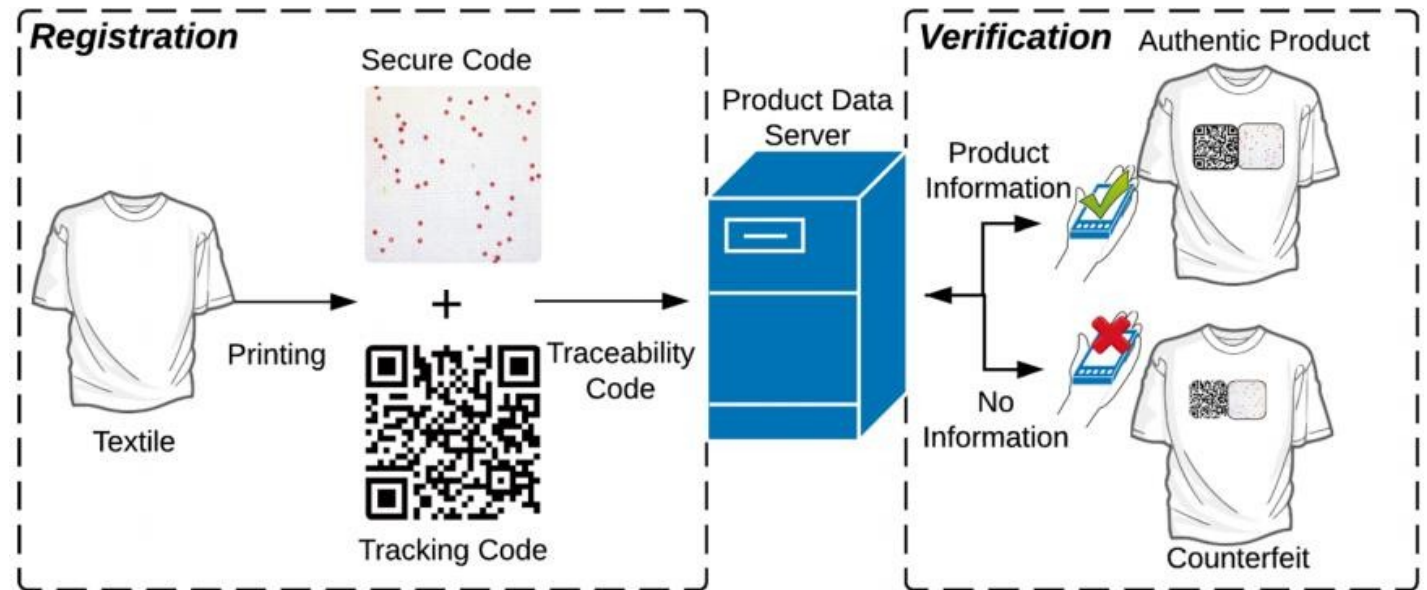
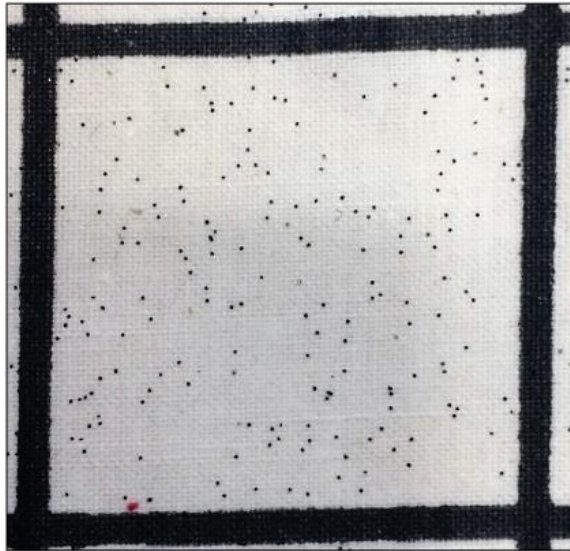
# Traceability Data Mapping with product

## Yarn-based traceability tag



# Traceability Data Mapping with product

## Pattern encoded QR code



# Product integrity and certification

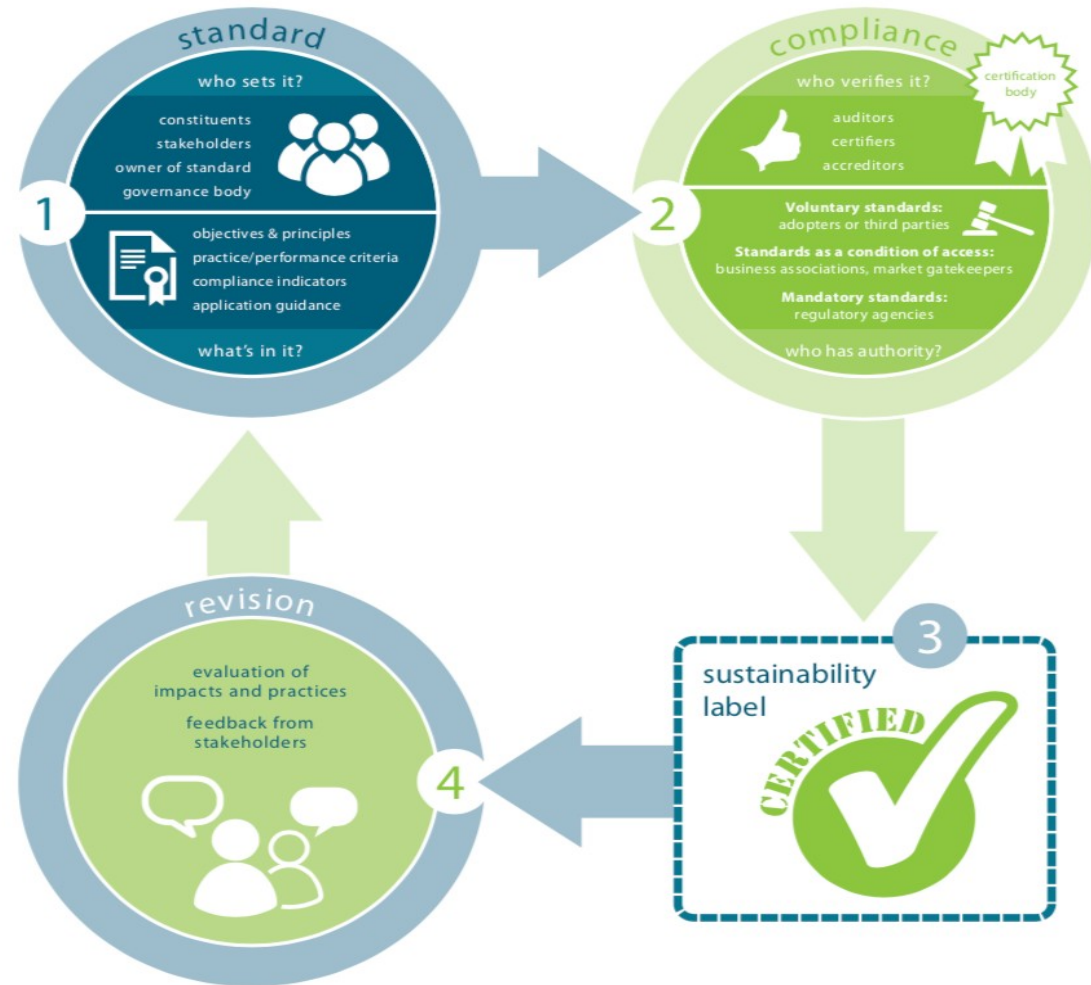
Label-based traceability



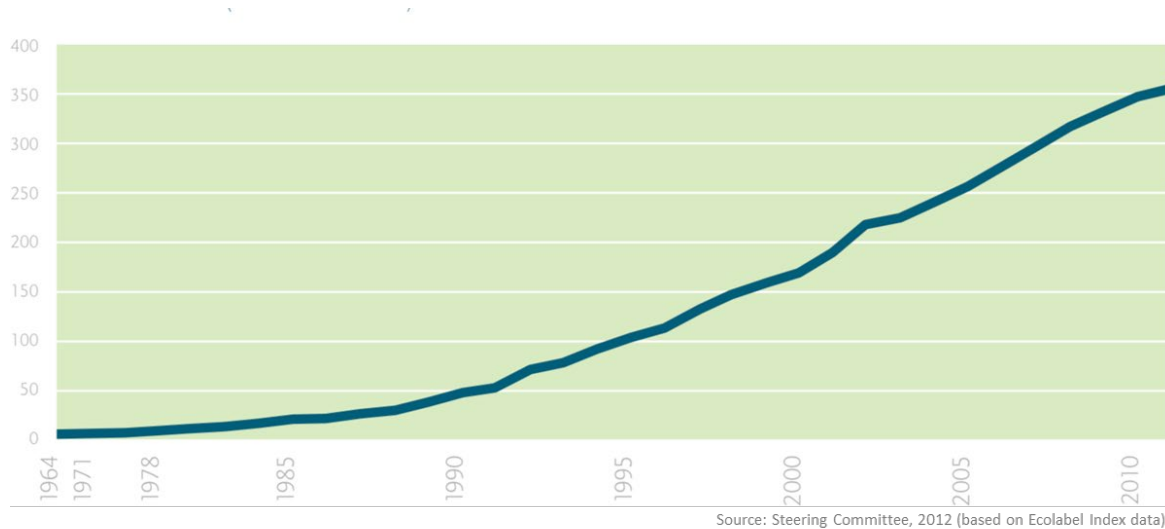


# What is a certification system?

- **Standard** – definition of sustainable products and related practices
- **Compliance verification** through certification and monitoring process
  - ✓ Certification systems also offer implementation support to actors along the supply chain through guidance, tools, training and funding
- **Label (optional)**
- **Revision**



# Variety of sustainability certifications



Ecolabel Index (2014) identifies 108 labels and certification schemes in the Textile, Leather and Clothing (TLC) sector.

## Key message:

- Multiplicity of these ecolabel based CoC is a concern.

**Environmental labels**  
emphasis on ecological criteria

**Sustainable labels**  
holistic approach ecological & social criteria

**Social labels**  
emphasis on social criteria

**Single-attribute labels**  
- one stage of the product's life cycle

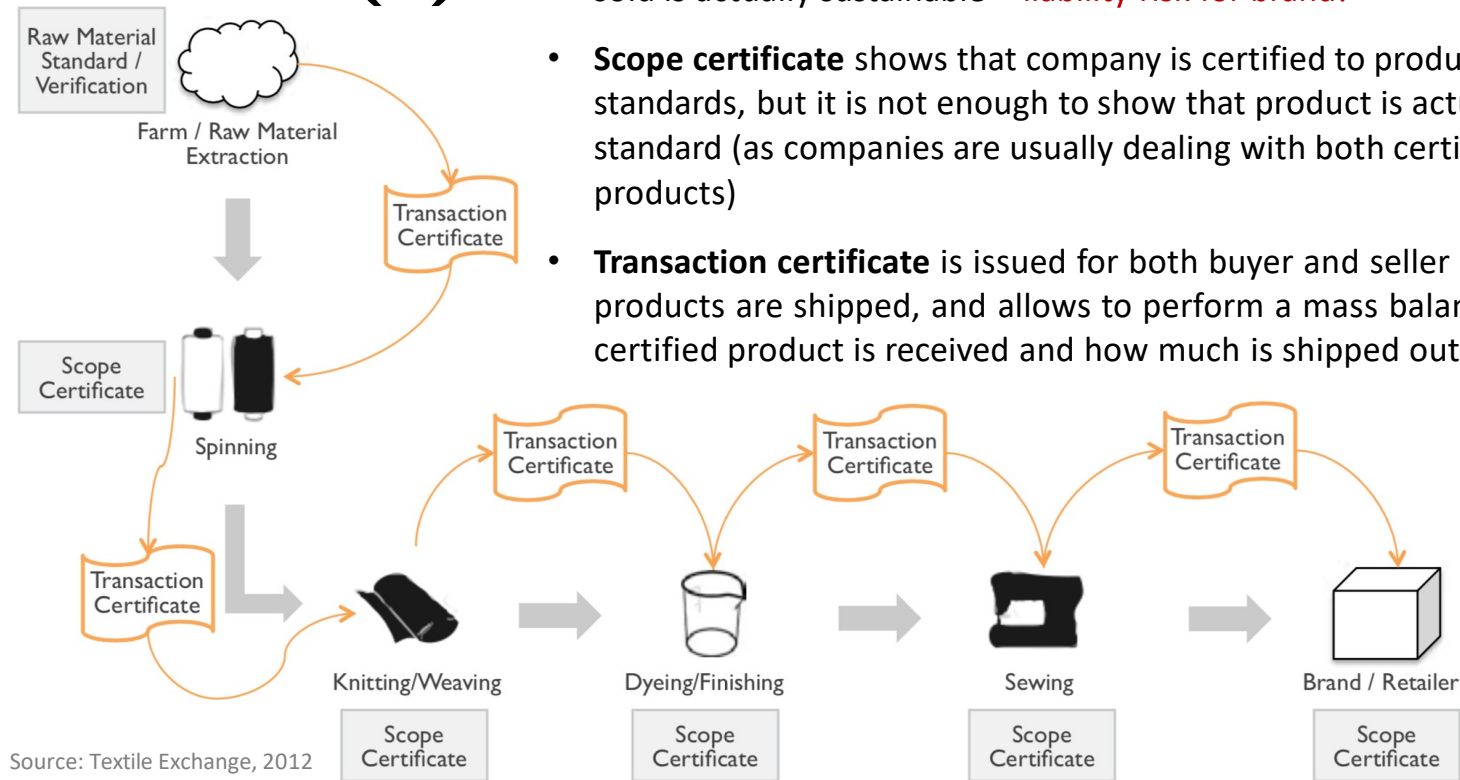
**Multi-attributes ecolabels**  
almost every life cycle stages but acts on different stages separately

**Life cycle-oriented labels**  
assessing the life cycle as a whole

<b>OEKO-TEX®</b> standard 100  <b>OCS-Organic Content Standard</b>	<b>BCI-The Better Cotton Initiative</b> <b>e<sup>3</sup>™</b> sustainable cotton program	<b>Fairtrade Standard</b> for cotton  <b>CARE &amp; FAIR RUGMARK</b>
The EU Ecolabel  The bluesign® standard	<b>GRS</b> -Global Recycled Standard  <b>STeP</b> - Sustainable Textile  <b>GOTS</b> -Global Organic Textile Standard	
	<b>Cradle to Cradle</b>  <b>SMaRT</b> -Consensus Sustainable Product	

Source: Koszewska, 2015

# Traceability based certification mechanism (1)



- **Raw Material Standard/Verification** – the minimum certification which is needed to label products as sustainable, e.g. organic, but doesn't guarantee that product sold is actually sustainable – **liability risk for brand!**
- **Scope certificate** shows that company is certified to produce to the given standards, but it is not enough to show that product is actually produced to that standard (as companies are usually dealing with both certified and non-certified products)
- **Transaction certificate** is issued for both buyer and seller each time the certified products are shipped, and allows to perform a mass balance test - how much of certified product is received and how much is shipped out

# Traceability based certification mechanism (2)

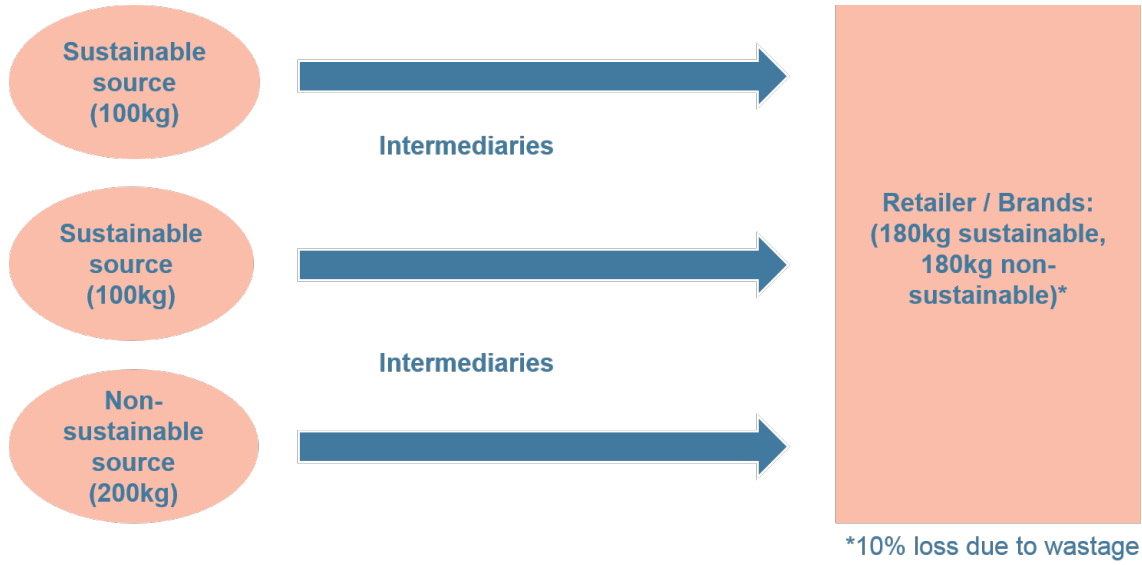
- **Scope Certificate** and **Transaction Certificate**, when applied together, allow tracking certified products from the certified farm, through all steps of processing, and into the final product – protection from liability!
- When a transaction certificate is attached to all shipments that contain certified input, complete **chain of custody** is possible (e.g. OE certification)
  - Chain of custody allows establishing a traceability system



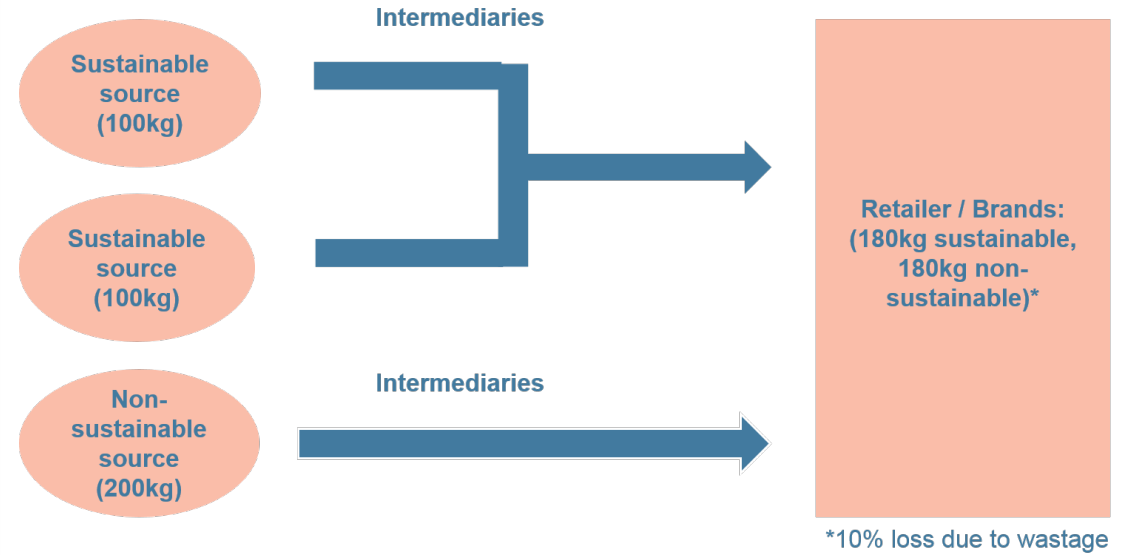
# Understanding traceability models

- Different sustainability certification systems use different traceability models:
  - Identity preservation
  - Bulk segregation
  - Mass balance
  - Certificate trading or 'book and claim' model

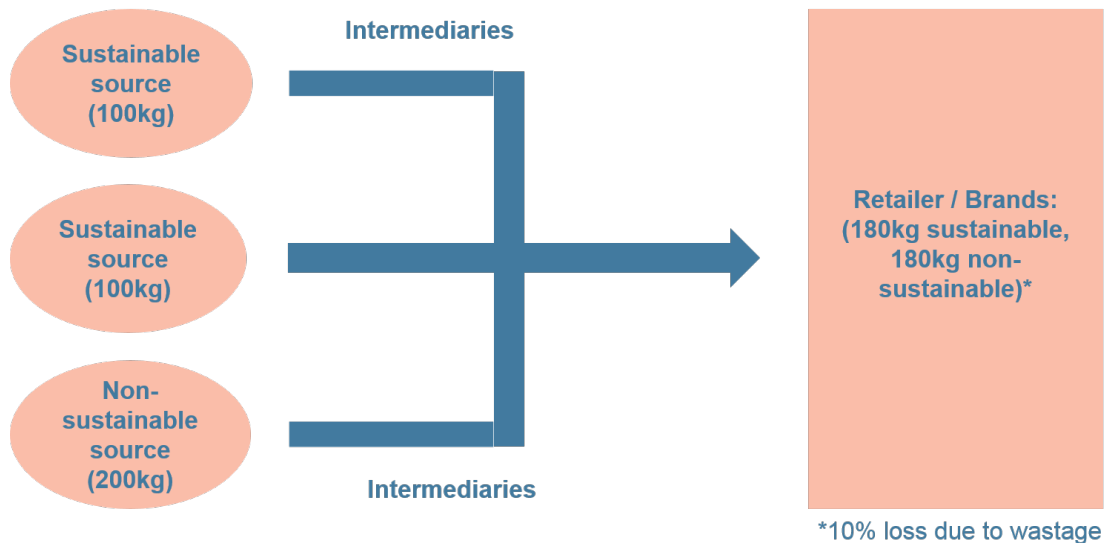
### Model 1: Identity Preservation



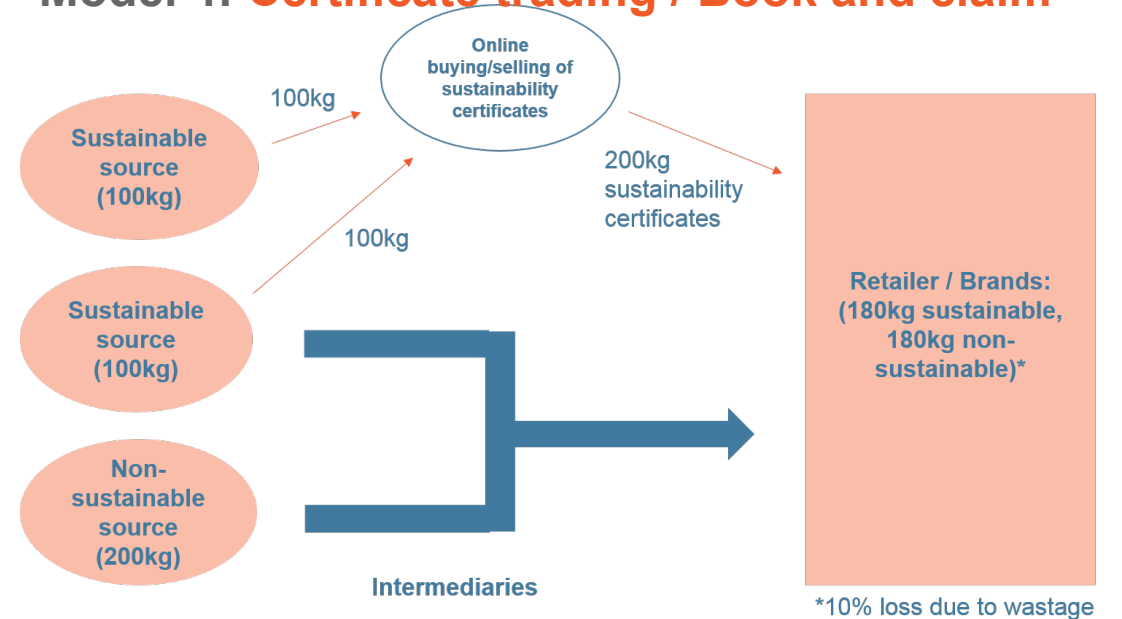
### Model 2: Bulk segregation



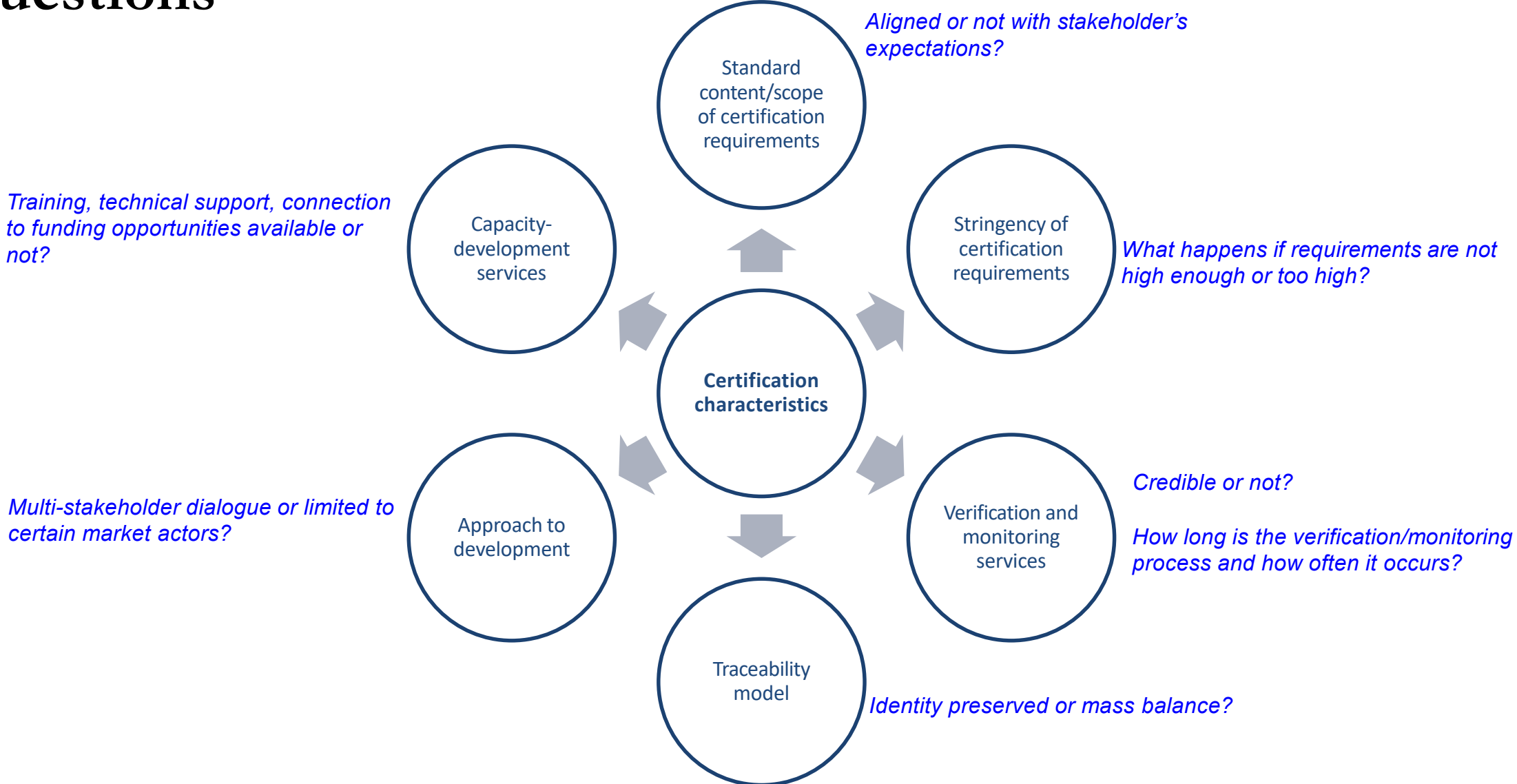
### Model 3: Mass Balance



### Model 4: Certificate trading / Book and claim



# Certification characteristics/design - Key questions



**Thanks**  
Questions?

[rudrajeet.pal@hb.se](mailto:rudrajeet.pal@hb.se)