Electronic traceability: the theory
CONCEPTS
Traceability is:

The ability to trace the history, application or location of an entity by means of recorded identifications. (ISO 8402)

The ability to follow the movement of a food through specified stage(s) of production, processing and distribution. (Codex Alimentarius)
What is traceability?

- Traceability is about being able to recreate the history
- Traceability is about *knowing your food business* and sharing that information when convenient or required
- There are many scopes, many depths, many breadths and many precisions possible

Source: [www.foodtraceability.eu](http://www.foodtraceability.eu)
What traceability is and isn’t:

- Traceability does not refer to the (product) data itself
- There is no such thing as “traceability data”
- Traceability does not mean “ability to identify origin”; that is only part of traceability

- Traceability is the name of the systematic ability to access the data stored about a food item
- Traceable data elements are connected to identifiers, and traceable data elements are connected to each other
Chain traceability visualization

This is the traceability ‘The ability to trace …’

Information (systematic recordings)
What is traceability?

Traceability is

- An *infrastructure*, much like rails
- It connects inputs to outputs, like connecting stations on a railway
- A system of claims which need independent verification

Electronic traceability allows us to

- Transport specific information from A to B just-in-time
- Increase the barrier to fraud
- Connect producers to consumers
- Streamline operations within the company and along the supply chain
Different stakeholders have very different views about food traceability

Main stakeholders
- Consumers and their representatives
- Operation managers
- Supply chain managers
- Quality managers
- Public authority
http://www.foodtraceability.eu/page/consumer-main
Operation managers

http://www.foodtraceability.eu/page/operational-main
Supply chain managers

http://www.foodtraceability.eu/page/supplychain-main
Quality managers

http://www.foodtraceability.eu/page/quality-main
http://www.foodtraceability.eu/page/public-main
EXAMPLE:
BIRDS NESTS
• Birds nests are an extremely high valued product
  – Retail price up to 2,000 USD-10,000 USD/kg
  – By far biggest market: China

• Extremely high fraud rate
  – Approx. 60% of nests in Chinese market are fraudulent

• VeriLabel authenticity solution:
  – Consumers can check each nest at the shop using their mobile phone
  – The application will warn the consumer if there are doubts about the genuineness of the nest
  – The user will also receive specific information about the nest and its processor that will help him to make the purchase decision
How does it work?

- VeriLabel is a patented system for authentication of high-value goods involving consumers as auditors.
- The VeriLabel system relies on traceability information from the supply chain, including the point of sale to determine with absolute certainty whether a product is authentic or not.
- Uses patent for point-of-sales integration hardware that allows the authentication at the moment of purchase with any cashier system.
- For birds nests, the VeriLabel system is used in its simplest form:
  - Processor-driven
  - No supply chain information required
  - Simple camera scan for consumers
The backend process

ID request → ID activation → Goods despatch → Deactivate IDs
What the consumer sees


Our Recommendation
This probably a duplicated product

Check what you buy: Scan, camera: action!

Our Recommendation
Do not buy. We believe this item is false

Check what you buy: Scan, camera: action!
Detail screens
What information does the producer get back?

- Every time a consumer checks a nest, a query is recorded
- Recorded are
  - Approximate consumer location
  - Mobile phone number (if available)
  - Mobile phone ID
  - (optional) Consumer comments
  - Status of the nest (genuine, doubtful, false)
- This will allow the producer to
  - Understand his final consumers better
  - Communicate with the consumers
  - Find focuses of fraud
  - Identify fraudulent traders through fraud location
What do consumers think?

- Initiative created for Malaysian bird nests producers
- Access to market through importers and repackers in China
  - Any branded identifiers difficult to maintain
  - Most of the “submarine imports” come through the same importers
  - Retail has little or no incentive
- Consumers expect safe and wholesome foods anyway
  - Any assurance scheme potentially creating doubts is a danger
  - There is inconsistent appreciation of information
- Premiums are not to be expected
  - Promise of increase market access not sufficient driver for investment
Basic traceability principles

THE CORNERSTONES
Trade units (TU) shall be identified by unique codes in a way that there are no two TUs in that part of the chain that have the same number.
Some definitions

- A **Trade Unit (TU)** is ‘any item upon which there is a need to retrieve predefined information and that may be priced, or ordered, or invoiced at any point in any supply chain’. A crate of fish or crate of meat is often a TU.

- A **Logistic Unit (LU)** is defined as ‘an item of any composition established for transport and/or storage that needs to be managed through the supply chain’. A Logistic Unit is often a pallet.

- A production **batch** is also an important traceable unit which has to be referred to when dealing with internal traceability. A production batch is the traceable unit that raw materials and ingredients go into before they are transformed into products placed in new Trade Units and Logistic Units.
• “Analogue” traceability is traceability without identifiers

• Reasons to use analogue traceability
  – Sometimes sticking an ID on goods is not an option
  – In some processes mixing occurs very naturally and segregation is not possible
  – Unsophisticated logistics might prevent using identifiers
  – Perhaps identifiers don’t fit into working culture or workers’ capacities
Traceability field to reception

Agricultural Practice
- Pruning
- Cleaning
- Fertilising
- Phytosanitary treatment
- Ripeness control
- ...

Harvest
- Polygon
- Parcel
- Grape
- Variety
- Grade
- Quantity
- Start time
- Duration
- Equipment

Reception
- Reception lot
- Variety
- Polygon
- Parcel
- Quantity
- Quality and weight

The next harvest in time for the same location

All receptions within the next number of days for the same location

All harvests for the same location and the same year

Between harvest and harvest for the same location all agricultural practices
All transformations that a trade unit (TU) experiences, such as conversion, split, merge or similar, have to be recorded.
4 steps to document transformations

• Define the Trade Unit in the business under examination.

• Record IDs of received Trade Units (raw materials and/or ingredients)
  – If the received Trade Unit has a unique ID, record it.
  – Else allocate one to it.

• Record the ID of the Trade Units that go into the production, and give all produced Trade Units a unique ID. These IDs shall be linked to a production batch.
  – Where possible and relevant, it is recommended to record the fraction (%) and/or the net weight of each Trade Unit that goes into production.

• Record the ID of all Trade Units dispatched
Transformations

Transformation information per received unit

**Received unit ID 11**

Produced unit ID | % | kg
---|---|---
21 | 100 | 5000

**Received unit ID 12**

Produced unit ID | % | kg
---|---|---
21 | 40 | 2000
22 | 60 | 3000

**Received unit ID 13**

Produced unit ID | % | kg
---|---|---
22 | 100 | 3000

**Received unit ID 14**

Produced unit ID | % | kg
---|---|---
23 | 70 | 7000
24 | 30 | 3000

Transformation information per delivered unit

**Delivered unit ID 21**

Received unit ID | % | kg
---|---|---
11 | 71 | 5000
12 | 29 | 2000

**Delivered unit ID 22**

Received unit ID | % | kg
---|---|---
12 | 50 | 3000
13 | 50 | 3000

**Delivered unit ID 23**

Received unit ID | % | kg
---|---|---
14 | 100 | 7000

**Delivered unit ID 24**

Received unit ID | % | kg
---|---|---
14 | 100 | 3000
Internal and external traceability

CHAIN TRACEABILITY
Internal and external traceability
Internal and chain traceability

These are the units that we need to trace!

Received

Trade units 15510
Trade units 16515
Trade units 16518
Trade units 18771
Trade units 18851
Trade units 19001
Trade units 19432
Trade units 19768

Internal

Raw material batch 151
Raw material batch 156
Ingredient batch 838
Ingredient batch 915

Production

Production batch 211
Production batch 212

Sent

Trade units 21551
Trade units 22199
Trade units 22651
Trade units 23174
Trade units 25009
Trade units 27654
Trade units 28866
Trade units 29702
The internal traceability system links inputs to outputs, i.e. maps the processes *within* a company.

It is the basic building block for a working food information and traceability system.

Operational data should be stored together with food safety/quality data.

To kickstart: make process mapping.
Kickstarting internal traceability

1. **Basis**
   - An in-depth check of available sectorial traceability standards should be made that fit the objective.

2. **Start-up meeting**
   - Discussion of objectives and expectations. Decide on scope of implementation, which ingredients to trace, and which products. A first a product with a simple chain should be chosen for a pilot.

3. **Process mapping of selected product**
   - Document internal material and accompanying information flow, from reception of raw materials and ingredients, through production to shipping of finished products. The purpose of the survey is to identify critical traceability points and the relevant trade unit and:
     - Recommendations for changes in information handling practice.
     - Recommendations for changes in material flow, including batch size, definition of traceable unit, less/more mixing, etc.

4. **Identification of traceable unit**
   - For trade units going out (finished products, units that go to the next company in the supply chain)
   - For trade units coming in (shipments of raw materials and ingredients from other company, units that come from previous link in supply chain) the existing product label and accompanying documentation received must be examined to identify potential codes that can be systematically recorded. If no such codes exist, request from suppliers that they be added, or generate own internal codes upon reception.
   - For internal batches, both raw material batches and production batches, internal codes may be used, but raw material batch codes must be linked explicitly to incoming trade units, and the production batch code must be linked explicitly to the corresponding outgoing trade units.
5. **Data recording routines**
   - Establish internal routines for recording of data, this can be split into several substeps:
     - Select what types of data you want to record.
     - Select the stages for where data recording should take place.
     - Select how transformations should be recorded.
     - Select what product related data should be recorded.
   - The product of this phase is a plan for how manual routines must be changed to enable systematic identification and associated data recording and the physical linking between products and accompanying information (labels, freight forms, certificates, etc).

6. **Mapping of information systems and data capture practice**
   - Data recordings must be linked to the Trade Unit ID
   - It must be possible to document all transformations from raw material to finished product
   - The product of this phase is a description of existing IT systems and necessary changes needed to enable data capture.

7. **Implement changes in software or new software for data recording and management of information.**

8. **Electronic exchange of data**
   - There should be developed modules for dispatch and reception of electronic traceability messages using international standards.
Implementing external traceability

• Point to point
  – Between two business partners
  – Often implemented using particular protocols agreed between business partners

• Chain traceability
  – Between all business partners of a particular supply chain
  – Should be standards-based
  – Relevant standards
    • UBL
    • EPCIS
    • TraceCore XML
Enable Electronic Data Interchange

- Standardize practice
- Standardize format
- Standardize ontology

Standardization essential to enable chain communication by electronic means.
Critical control point methods

PROCESS ANALYSIS
Process followed to elaborate the process mapping
1. Determination of scope

2. Mapping against the flow

3. Moving backwards through the process, pay attention to information loss

4. Create a process mapping report with the following headings:
   - Background. What project, what participants, who funds it, why is the study being conducted, what is the goal, what follows after the study.
   - Definition of scope of study, see above.
   - Overall material flow, may include pictures of sites, batches, TUs, labels, etc.
   - Geographical description as well as actual material flow, description of inputs and outputs for all links.
   - Information flow, in particular information loss, see above.
   - Conclusions, referring to the goal of the study and to what should follow.
   - Appendix: Detailed description of data elements and transformations.
   - Appendix: Interview log with date of interviews, name and occupation of interviewees, company
Critical path methods

• Important to identify critical points where a food item undergoes significant change

• Such points are called tracepoints or Critical Tracking Events (CTEs)
  – “those events that must be recorded in order to allow for effective traceability of products in the supply chain”; “those instances where product is moved between premises, is transformed, or is otherwise determined to be a point where data capture is necessary to trace a product (The Institute of Food Technologists, USA)

• Key Data Elements (KDEs) are then linked to CTEs and used to support product tracing. These include:
  – Physical location that last handled the product, whether the manufacturer or not, and, if applicable, contact information for the broker who handled the transaction
  – Incoming lot numbers of product received
  – Amount of product manufactured or shipped
  – Each physical location where cases were shipped (including individual retail and foodservice locations)
  – Lot number(s) shipped to each location
  – When (date/time) product was received and/or shipped
  – Ingredients with corresponding lot numbers
Thailand – Pomelos

ส้มโอ
Findings from the field

- Farmers accredited via GAP type certification scheme
- Big privacy issues
- Business relationships independent of quality
- No identification technologies, no computers
- Gasoline is main limiting factor, not man time
- Pomelos sometimes sold by weight, sometimes by piece
Photos from the field
Stakeholder view

Farmer

Harvesting collector

Non-harvesting collector

Middleman

Local markets

Supermarket

Collecting house

Exporter

Waxer
Functional view

GROW  HARVEST  GRADE  COLLECT  DISTRIBUTE  WAX  EXPORT

Traceability by weight  Traceability by box ID

unidirectional – no returns
If packed, the box is already destined for one exporter
Upon reception creates message to originator with reception date and received weight

When notified, checks if a DESPATCH has been created with same weight (plus error margin) and time difference smaller than x days. If not, a DESPATCH is created by the system, and the standard DESTOCK action performed.
Results

- Creative lot concept required
- Minimal data capture via mobile phone on-field
- Reports to help participants cope with their red tape
STAKEHOLDER BENEFITS
Traceability drivers in the food sector

Adapted from Petter Olsen 08/09/10 - ©Nofima - May be copied if source is acknowledged
Some drivers for chain food information management

C-FiM
Chain Food Information Management

Sustainability
- Stakeholder involvement
- Key indicator calculation

Marketing and brand assurance
- Authenticity
- Claims management

Trade and efficiency

New business models
- Carbon indexed ingredients
- Dynamic shelf life

Compliance to standards and regulations

Marketing and brand assurance
- Authenticity
- Claims management
Our clients want traceability because...

• Market differentiation by documentation of certain practices of social, religious nature such as fair trade, Halal, or adherence to certain standards

• Production of “local” foods, i.e. foods which originate in a certain area (“Made in ...”) or are prepared in a certain fashion (“Taste of ...”)

• Internal performance improvements such as stock reduction

• Calculation of parameters related to sustainability, such as food miles, carbon foot print, fossil energy savings etc

• Performance feedback, especially for the feed – animal – food chain

• Fraud prevention
Food safety

**What**
- Connection “one up, one down”
- Transport of critical parameters (e.g. additives, shelf-life, temperature, etc)
- Interconnection with eHACCP

**Experiences**
- e-Sporing (Norway)
- M-FIT (Malaysia)
- Smallholder traceability for aquaculture (Vietnam and Indonesia)
- ESIT (Greece)

**Benefits**
- Institutional: disaster management, accountability of FBOs, statistics
- Industry: brand risk management, reduced recalls, shelf-life optimisation, compliance
- Consumers/Citizens: reduced health risk, improved decisions

**Challenges**
- Industry buy-in
- Consumer/citizen interest
- Smallholder integration
- Standardisation
- Governance
### What
- Calculation of key environmental sustainability parameters along the supply chain, such as CO\textsubscript{2}eq, water usage,
- Transport of key social sustainability parameters, such as legal compliance, worker/aboriginal rights, child labour

### Experiences
- (social only) UTZ Certified
- (legal compliance) IUU fishing
- (in preparation) Roundtable for Sustainable Palm Oil and some retailers/manufacturers
- (for biofuels) ISCC

### Benefits
- Institutional: Enforcement aid, accountability of FBOs, monitoring of management goals
- Industry: brand risk management, legality of supply chain, monitoring of mgmt goals
- Consumers/Citizens: informed decisions, peace of mind

### Challenges
- Technical complexity; in some case unclear science
- Industry commitment
- Consumer/citizen push
- Standardisation, in particular of calculation methods
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<tr>
<th>What</th>
<th>Experiences</th>
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<tbody>
<tr>
<td>• Exchange of electronic information for trade relevant purposes</td>
<td>• ASYCUDA (World)</td>
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<tr>
<td>(trade permissions, customs, goods shipped notices)</td>
<td>• eCustoms (Europe)</td>
</tr>
<tr>
<td>• Single window for traders</td>
<td>• Animal passports (Europe)</td>
</tr>
<tr>
<td>• Legality, security, safety of shipments</td>
<td>• ePermit and ePermit1 (Malaysia)</td>
</tr>
<tr>
<td>• Electronic handling of incidences</td>
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<td>• Electronic handling of fees</td>
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<table>
<thead>
<tr>
<th>Benefits</th>
<th>Challenges</th>
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<tr>
<td>• Institutional: More robust trade processes, accountability of</td>
<td>• International standardisation</td>
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<tr>
<td>institutions, increased visibility of trade bottlenecks; statistics</td>
<td>• Interdepartmental collaboration</td>
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<tr>
<td>• Industry: reduction of trade-related bureaucracy; streamlined</td>
<td>• Economic sustainability of systems</td>
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<td>processes</td>
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<tr>
<td>• Consumers/Citizens: fresher products</td>
<td></td>
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SOME REFERENCES
• Global Approaches to Traceability, report for ECR Russia (2013)

Recent Patents on Food, Nutrition & Agriculture, 2013, 5, 19-34

Communicating Food Safety, Authenticity and Consumer Choice. Field Experiences

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• H. Lehr, Recent Patents on Food, Nutrition & Agriculture, 2013, 5, 19-34

• Acceptable and practical precision livestock farming, editor: H. Lehr (for livestock) – available as kindle version on Amazon
Reference documents

• Codex Alimentarius, CAC/GL 60-2006, “Principles for Traceability / Product Tracing as a Tool Within a Food Inspection and Certification System”
• Codex Alimentarius, CCFICS 2003, ”Discussion paper on traceability/product tracing in the context of food import and export inspection and certification systems.”
• ISO, ISO/DIS 22005, ”Traceability in feed and food chain — General principles and basic requirements for system design and implementation”
• EU Common Food Law, 178/2002
• EU Feed Hygiene Regulation, 183/2005
• EU Feed Additive Regulation, 1831/2003
• Can-Trace, Can-Trace reference document
• CIES, ”Implementing Traceability in the Food Supply Chain”
• EurepGAP, ”EurepGAP General Regulations”, “EurepGAP Control Points and Compliance Criteria”, “EurepGAP Checklist”
• ECR, ECR Blue Book, ”Using Traceability in the Supply Chain to meet Consumer Safety Expectations”
• BRC, ”Technical Standard for Companies Supplying Retailer Branded Food Products” (incorporating the old EFSIS standard)
• IFS, ”International Food Standard”
• GS1, ”The GS1 Traceability Standard”
• ... and many others
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