





The challenge to trace
the source of contamination
in the international
food and feed supply chain

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- Complexity of Tracing
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- The revised data model

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EFSA's Mandate


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EFSA'S ROLE IN OUTBREAK INVESTIGATIONS

When EFSA gets involved...



Member states recognise foodborne outbreaks


EFSA coordinates multi-national tracing and evaluates evidence on request of EC

ECDC connects different outbreaks via an European outbreak definition

Commission (RASFF) collects and exchanges European information on suspected food items

Member states perform food tracing in their countries

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MANDATE FOR FOODBORNE OUTBREAKS

In accordance with article 31 of EU Regulation 178/2002, EFSA is requested to provide scientific assistance in the area of food-borne outbreak investigation. In particular, EFSA is requested to: (...)

2. When more information on a specific outbreak becomes available, and upon specific request of the Commission, to further collaborate with ECDC in the food-borne outbreak assessment by providing **in-depth analysis of the food data including the robustness of the link to the suspected food source**, based on epidemiological data.
3. **Upon specific request** of the Commission, to **provide technical assistance to the Commission in its conduct of tracing-back and forward analysis** of incriminated batches of animals, food or feed in the affected Member States. (...)

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PERSPECTIVES

Tracing is in all interest

Industry

- Optimization
- Ensure supply
- Ensure quality


Consumer

- Guarantee origin
- Ensure quality
- Ensure sustainability

Administration

- Ensure food safety
- Prohibit food fraud
- Ensure food security

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MOTIVATION OF TRACEABILITY SYSTEMS

- Production optimisation / competitive advantages
- Quality assurance / certification
- Sustainability / animal welfare
- Chain communication / trade globalisation
- Food safety / legislation
- Bioterrorist threats

Reference: Karlsen et al. (2013)

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PERSPECTIVES

but not one fits all

Industry

- Optimization
- Ensure supply
- Ensure quality

Tracking

Consumer

- Guarantee origin
- Ensure quality
- Ensure sustainability

Certification

Administration

- Ensure food safety
- Prohibit food fraud
- Ensure security

Recall

Tracing

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GENERAL FOOD LAW / EC REGULATION 178/2002

Article 3(15):

Traceability means the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution.

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SEVERAL DEFINITIONS OF TRACEABILITY

But one important distinction¹:


“**Tracking** is the informative process by which a product is followed along the supply chain keeping records at each stage, (...)” (Prospective data collection)

“**Tracing** is defined as the ability of reconstructing the history of a product, identifying its origin (...)” (Retrospective data collection)

| | | |
|------------------|---------------|-------------|
| Forward Tracing | Recall | Tracking |
| Backward Tracing | Tracing | |
| | Retrospective | Prospective |

¹ Pizzuti & Mirabelli (2015): The global track&trace system for food

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SEVERAL DEFINITIONS OF TRACEABILITY

- **Product traceability** is the reconstruction of the physical product flow, the location of a product at any stage of the food supply chain.
- **Process traceability** is the reconstruction of all transformations of the product, including interactions with physical/mechanical, chemical, and environmental factors.
- **Genetic traceability** is the reconstruction of the genetic constitution of ingredients of the product. This is used to identify ingredients, their origin, or if they are genetically modified.
- **Inputs traceability** is the reconstruction of types, source and supplier of all ingredients used during production and processing.
- **Disease and pest traceability** reconstructs the epidemiology of pests and biotic hazards that may contaminate food or feed.
- **Measurement traceability** is the reconstruction of data and quality of measurements.

Reference: Opara (2003)

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SEVERAL DEFINITIONS OF TRACEABILITY

There exist no common definition of traceability, but several approaches¹

Working definition of (product) traceability

Traceability is defined as the ability to retrospectively follow the movement of food, feed, food-producing animal or substance intended to be, or expected to be incorporated into or in contact with food or feed, through all stages of production, processing and distribution by means of recorded data.

¹ Olsen & Borit (2012): How to define traceability

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GENERAL FOOD LAW / EC REGULATION 178/2002

Article 18: 1-step back/ 1-step forward traceability

1. *The traceability of food, feed, food-producing animals, and any other substance intended to be, or expected to be, incorporated into a food or feed shall be established at all stages of production, processing and distribution.*

“Traceability of food should be established at all stages of production, processing and distribution”

2. *Food and feed business operators shall be able to identify any person from whom they have been supplied with a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed. To this end, such operators shall have in place systems and procedures which allow for this information to be made available to the competent authorities on demand.*

“Food business operators shall be able to identify any supplier”

3. *Food and feed business operators shall have in place systems and procedures to identify the other businesses to which their products have been supplied. This information shall be made available to the competent authorities on demand.*


“Food business operators shall be able to identify any client”

4. *Food or feed which is placed on the market or is likely to be placed on the market in the Community shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions.*

“Food shall be adequately labelled or identified to facilitate its traceability”

5. *Provisions for the purpose of applying the requirements of this Article in respect of specific sectors may be adopted in accordance with the procedure laid down in Article 58(2).*

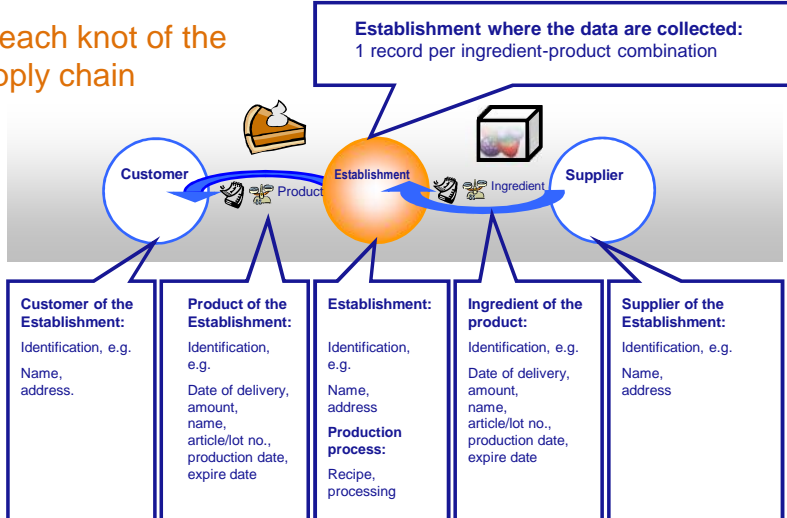
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DATA COLLECTION FOR TRACING

Data at each knot of the food supply chain


Establishment where the data are collected:
1 record per ingredient-product combination



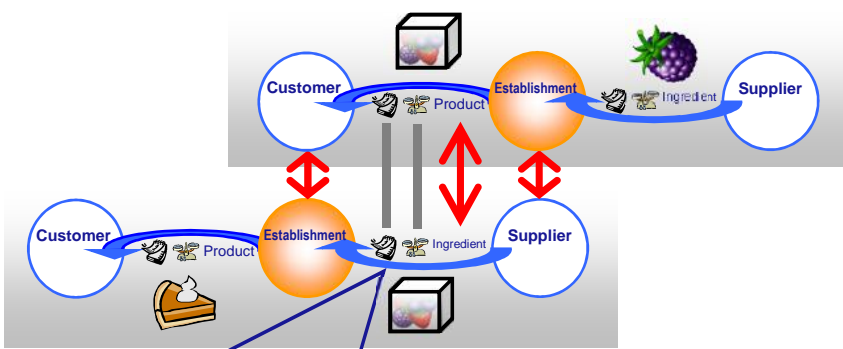
| | | | | |
|--|--|---|---|---|
| Customer of the Establishment: Identification, e.g. Name, address. | Product of the Establishment: Identification, e.g. Date of delivery, amount, name, article/lot no., production date, expire date | Establishment: Identification, e.g. Name, address Production process: Recipe, processing | Ingredient of the product: Identification, e.g. Date of delivery, amount, name, article/lot no., production date, expire date | Supplier of the Establishment: Identification, e.g. Name, address |
|--|--|---|---|---|

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DATA ANALYSIS: BUILDING THE FOOD CHAIN



Identification of common links by Customer=EstablishmentA / EstablishmentB=Supplier / Product=Ingredient
Verification (proof of consistency) by correct date of delivery / correct amount of the product

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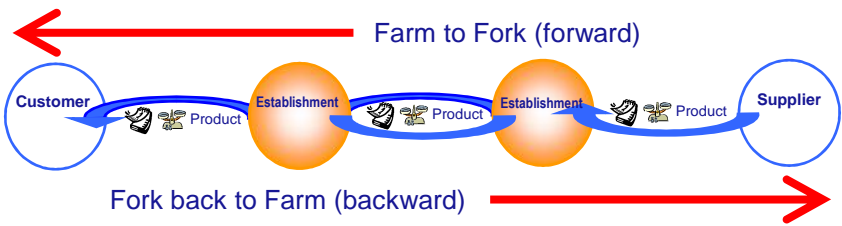
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RESULTS: FOOD SUPPLY CHAIN

Results per analysis:

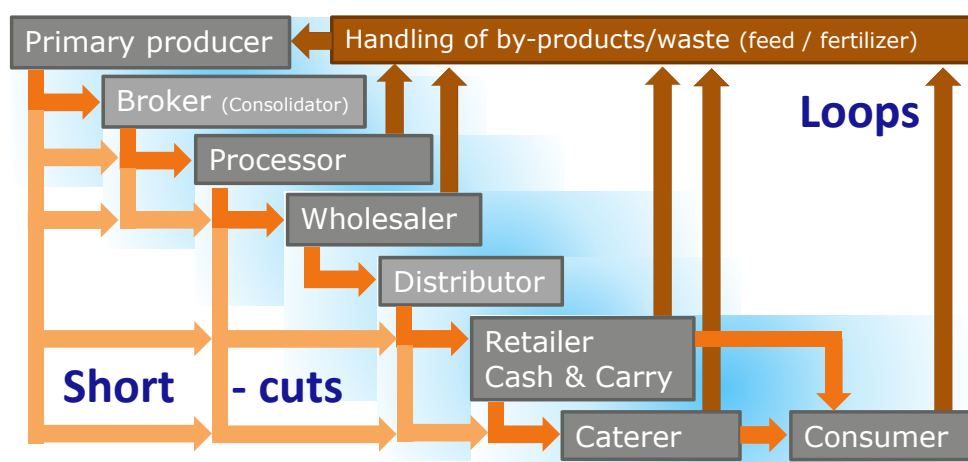
- Already established parts of the food supply chain
- Open knots (establishments) with missing data
- Missing amount of material (lost in tracing)



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A FOOD CHAIN WITH ITS STAGES / ACTORS



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TOOL: FOOD-CHAIN-LAB

Primary production
Processing
Distribution
Final preparation

Specialized software:

- collects data in the right structure / performs data validation
- filters and visualizes food supply networks
- performs data analysis: Scoring, cross-contamination, regional analysis


BfROpenLab: <http://silebat.github.io/BfROpenLab/>
 Support / contact: Marion Gottschald marion.gottschald@bfr.bund.de
 Authors: A Weiser, et al., German Federal Institute for Risk Assessment (BfR), Berlin

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The Complexity

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THE DEMOS PROJECT

Review of tracing methodologies


WP1: General data structure to collect tracing data

- Extensive literature search on existing guidance
- Expert hearings for several food areas: fresh meat, fish, ready-to-eat food of animal and non-animal origin, and the retail sector
- Draft report for public consultation

WP2: Guidance on data collection / including regional data

WP3: Guidance on data analysis / review of the methodology

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TRACEABILITY SYSTEMS

How to evaluate and define a traceability system:


Data structure:

| | |
|---------------------------|---------------------------------|
| Primary activities | Traceable resource units |
|---------------------------|---------------------------------|

Data collection:


| | |
|--------------------------------|--------------------------|
| Critical tracing events | Key data elements |
|--------------------------------|--------------------------|

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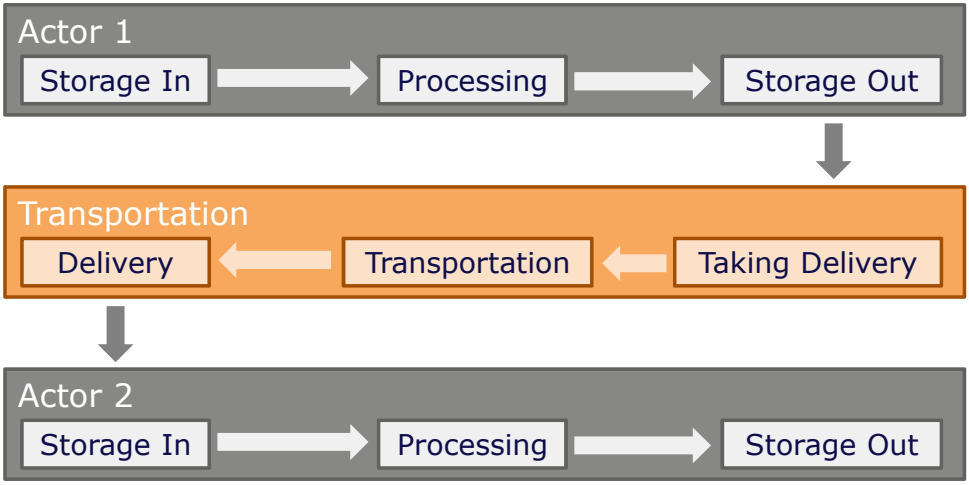


Which data do we need to reconstruct the history of a food item (suspected to be the cause of a disease) ?

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MICRO STRUCTURE



```

graph TD
    subgraph Actor1 [Actor 1]
        direction LR
        S1[Storage In] --> P1[Processing]
        P1 --> SO1[Storage Out]
    end
    subgraph Transportation
        direction RL
        TD[Taking Delivery] --> T[Transportation]
        T --> D[Delivery]
    end
    subgraph Actor2 [Actor 2]
        direction LR
        S2[Storage In] --> P2[Processing]
        P2 --> SO2[Storage Out]
    end
    SO1 --> TD
    D --> S2
    
```

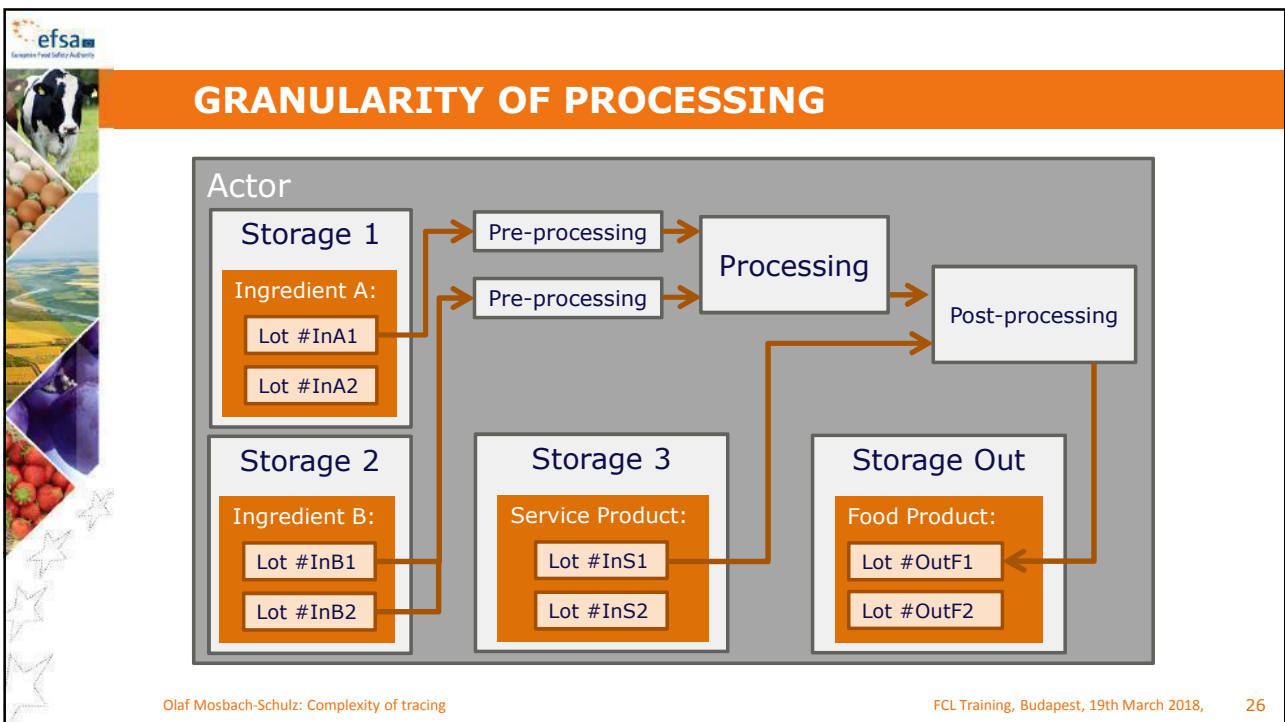
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1st step: Processing

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TRACING UNIT FOR PROCESSING

The natural **Tracing Unit** for processing is a **lot (or batch)**:

*A lot/batch is "is defined as a quantity that has gone through the same process at a specific place and time period before moving to another place. 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."*¹

¹ TraceFood, Wiki, <http://www.tracefood.org/>, accessed 09th Nov. 2015

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DEFINITIONS

'Product category' identifies the general type of a food item. Food items of the same product category have usually same food safety characteristics.


'Product' identifies the kind of the food item in the usual terminology in the food chain (e.g. product type, brand, package size etc.). Food items with the same product name are usually exchangeable in the food chain.

'Lot / batch' identifies the production process in which the food item was produced. This includes the producer, the location and the date of production. Food items with the same product name and lot number were produced under equal conditions, e.g. equal ingredients, equal production line, equal time slot of production.

'Consignment / trade unit' identifies the single unit of a product which is not divided during transportation. Food items of the same product and consignment had the same provider and recipient in the food chain.

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PROCESSING

Processing is any change of the product:

| Name | Change |
|-------------|------------------------------------|
| Preparation | New product / new lot (time) |
| Storage | New product characteristics / time |


Processing at distribution:

| | |
|---------------------|--|
| Trade | New contact (information owner) |
| Blending, repacking | Merged lots / new consignments |
| Dividing, splitting | Splitted locations / multiple consignments |

Transport as processing:

| | |
|-----------|---------------------|
| Transport | New location (time) |
|-----------|---------------------|

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PRIMARY ACTIVITIES

Assemble/ load

Mix

Transport

Trade

Repack

Primarily produce

Produce / manufacture

Deplete (exit)

Join / merge

Blend

Distribute

Import

Relabel

Retail

Consume

Unload

Export


Store

Primarily process

Process / transform


Catering

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2nd step: Transporting

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COMPLEXITY OF CONNECTIONS (I)

The units of transportations are Logistic Units, e.g. palettes, container etc.

Taking Delivery 1

| | |
|-------------------|-------------------|
| Trade Unit # G1.1 | Trade Unit # G2.2 |
| Trade Unit # F1.2 | Trade Unit # G2.1 |
| Trade Unit # F1.1 | Trade Unit # G1.2 |

→

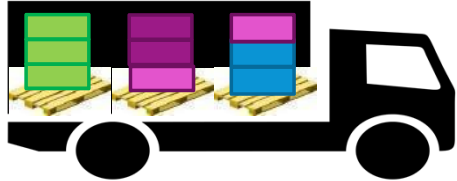
Delivery 1

| | |
|-------------------|-------------------|
| Trade Unit # H1.3 | Trade Unit # G2.2 |
| Trade Unit # H1.2 | Trade Unit # G2.1 |
| Trade Unit # H1.1 | Trade Unit # G1.2 |

Taking Del. 2

| |
|-------------------|
| Trade Unit # H1.3 |
| Trade Unit # H1.2 |
| Trade Unit # H1.1 |


Logistics provider



Delivery 2

| |
|-------------------|
| Trade Unit # G1.1 |
| Trade Unit # F1.2 |
| Trade Unit # F1.1 |

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DEFINITIONS


'Consignment / trade unit' identifies the single unit of a product which is not divided during transportation. Food items of the same product and consignment have the same provider and recipient in the food chain.

'Logistic unit' is defined as an item of any composition established for transport and/or storage that needs to be identified and managed for logistics.

'Lot transaction' identifies the single transportation unit of a lot which is not divided during transportation. Food items of the same product, lot and consignment had the same provider and recipient in the food chain.

'Package unit' identifies the minimal trade unit, which could not be divided into smaller trade units.

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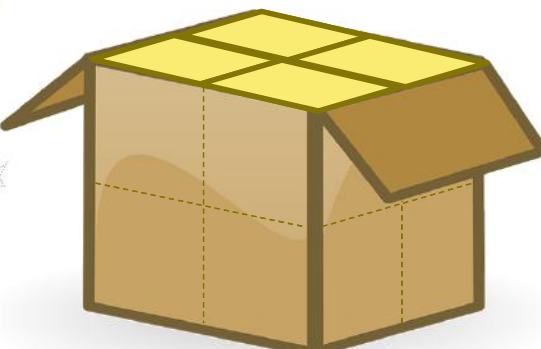


DIVISION OF PRODUCTS DURING DISTRIBUTION


The trade units can change in the food chain, ...

... but they are usually defined in the **Product Information Sheet**


Trade Unit of production,
e.g. = 8 boxes = 64 cans




Trade Unit for distribution,
e.g. 1 box = 8 cans



Trade Unit for the Consumers,
e.g. 1 can




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3rd step: Information flow

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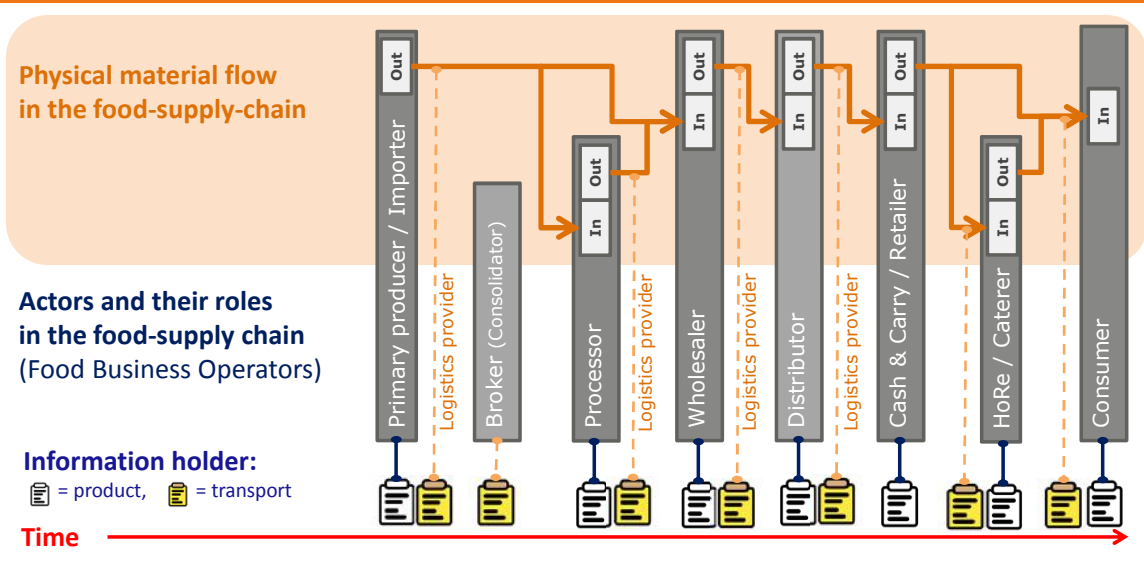
DIFFERENT LAYERS OF TRACING

Physical material flow in the food-supply-chain

Actors and their roles in the food-supply chain (Food Business Operators)

Information holder:
 📄 = product, 🚚 = transport





Time →



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INFORMATION

Typical documentation







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DEFINITIONS


- 'Information owner'** is a person or an entity, who generates or collates an information on a food item. This person is able to change or correct the information (and decides on confidentiality).
- 'Information holder'** is a person or an entity, who has access to an information on a food item. This person is able to regularly retrieve the information.
- 'Contact person'** is a person in a food business, who is contacted by food safety administrations in case of requests.
- 'Food business operator'** means the natural or legal persons responsible for ensuring that the requirements of food law are met within the food business under their control (EC 178/2002).

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Granularity of tracing information

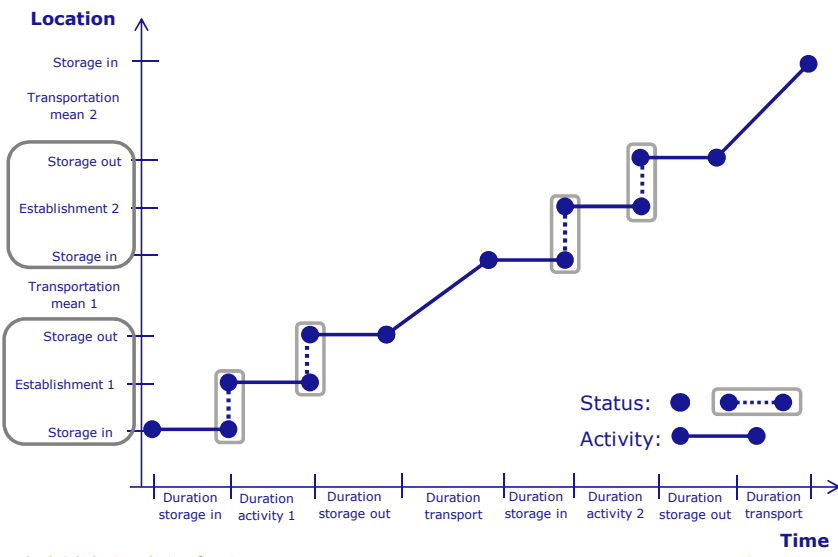
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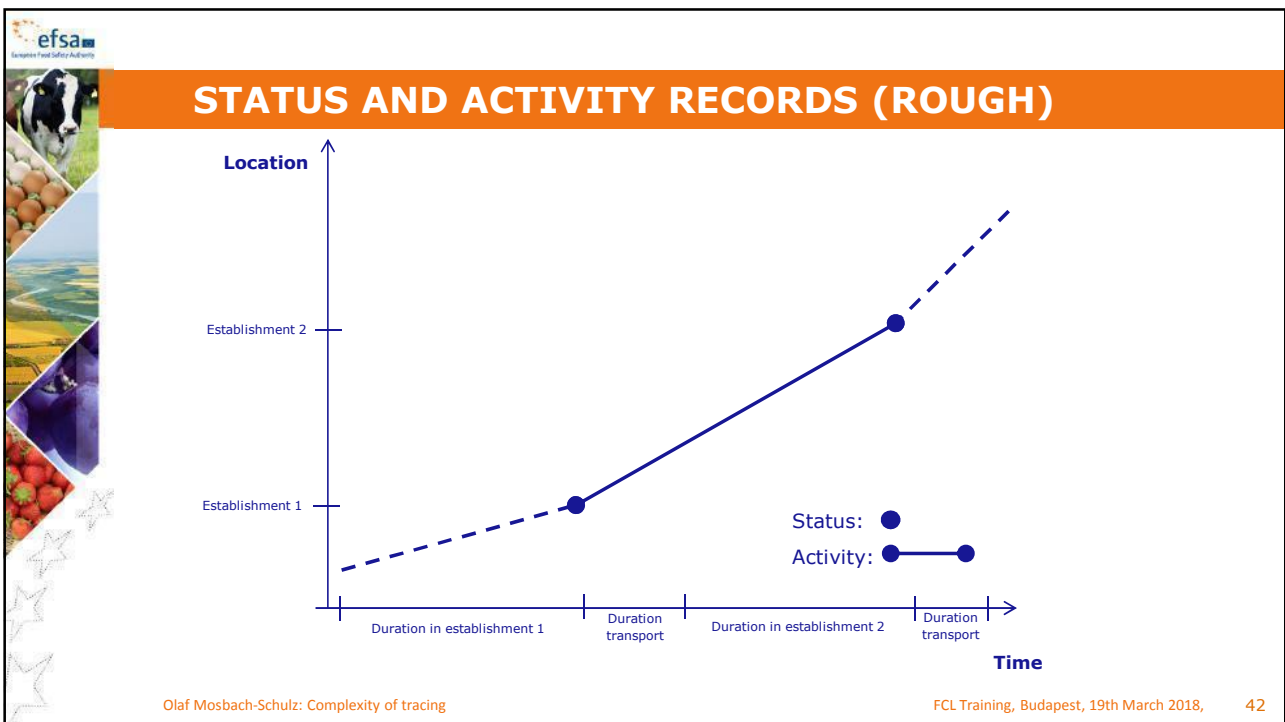
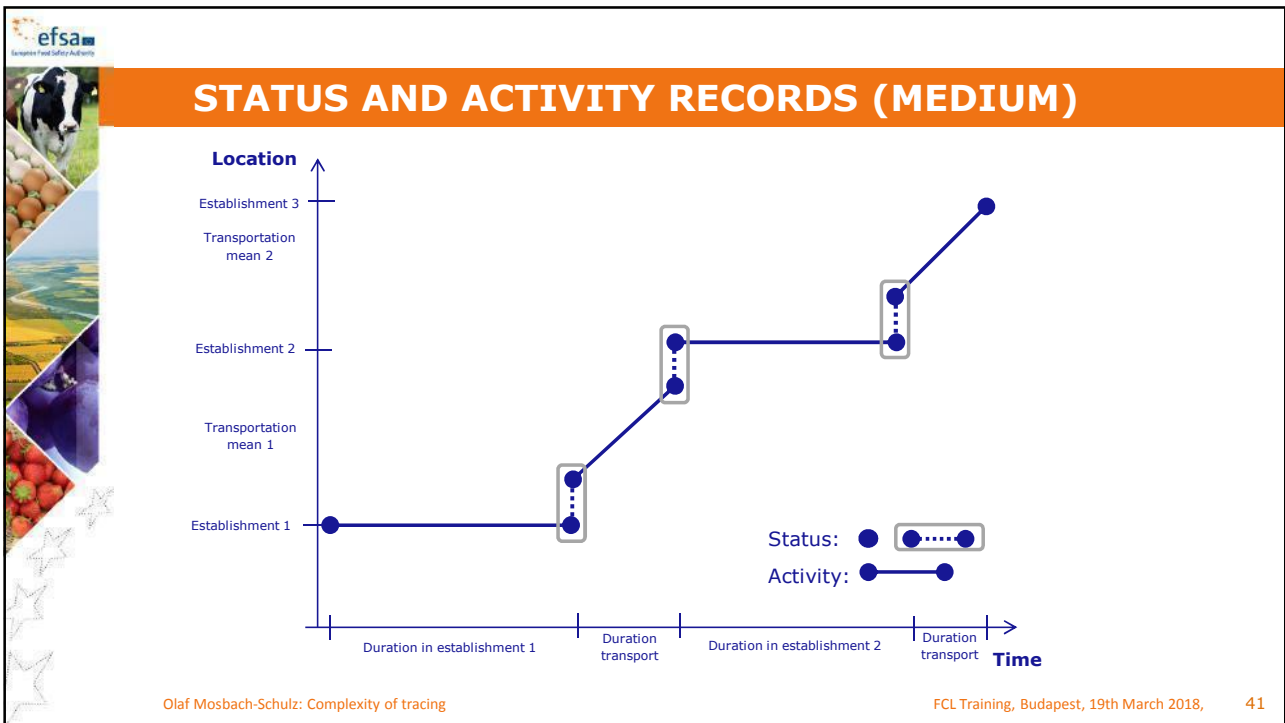
STATUS AND ACTIVITY RECORDS (DETAILED)


Location

- Storage in
- Transportation mean 2
- Storage out
- Establishment 2
- Storage in
- Transportation mean 1
- Storage out
- Establishment 1
- Storage in



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QUALITY OF TRACEABILITY SYSTEMS

- **The precision** is mainly described by the granularity of the differentiation of the traceable resource units and activities.
- **The completeness** is mainly described by the percentage of necessary information, which it is possible to retrieve retrospectively.
- **The reliability** is mainly described by the accuracy of the stored information.

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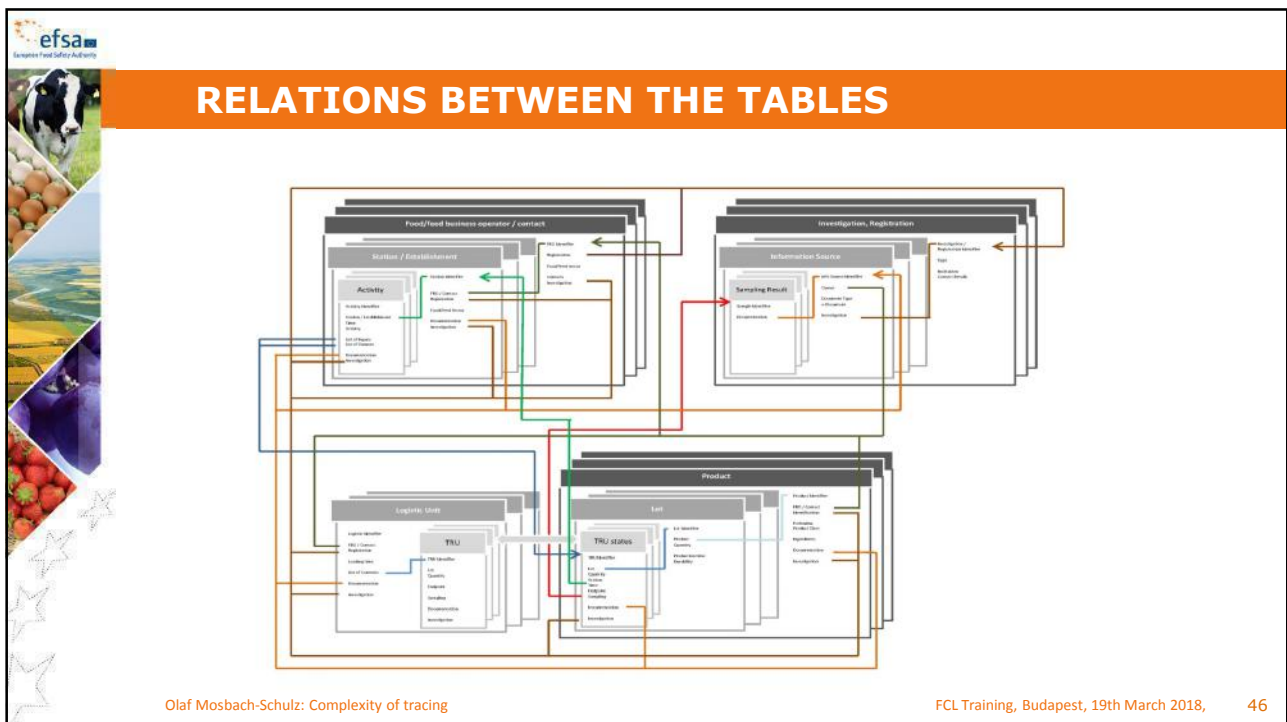
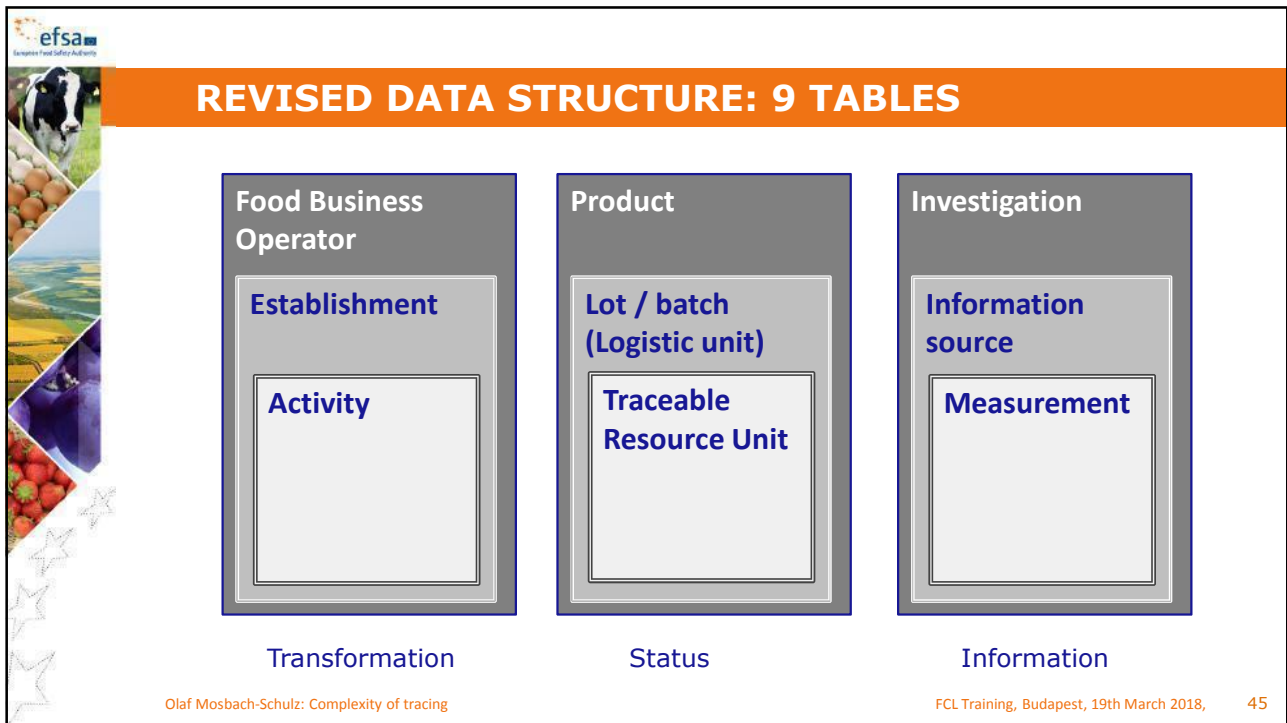
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The revised data model

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REVISED DATA STRUCTURE

Main concepts

- Comprehensive structure for tracing
- Flexible for inputs:
 - Fine to rough traceability systems
 - Low data quality / incomplete data
 - Covers different perspectives
- Master plan for coming solutions

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FOR EXAMPLE: STATUS IN RASFF


Product

- Product Identifier
- FBO / Contact ID
- Packaging
- Product class
- Ingredients
- Info Source ID
- Investigation ID

Products

| | |
|----------------------------|--|
| Product name: | sesame paste - Sesamcreme |
| Product category: | nuts, nut products and seeds |
| Product description | |
| Product name on label: | Sesam ████ Creme |
| Brand/trade name: | ██████████ |
| Product aspect: | Glas mit Schraubdeckel |
| Barcode no.: | |
| Other labelling: | |
| Weight: | 320.0 g |
| Temperature: | ambient |

| | |
|----------------------|--|
| Notification number: | 3272 ████ |
| Reference: | 20 ████ 0408 |



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THANKS FOR YOUR ATTENTION



(Thanks to an unknown lady who permitted this photograph of her tattoo, 2016, photograph by Olaf Mosbach-Schulz)

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