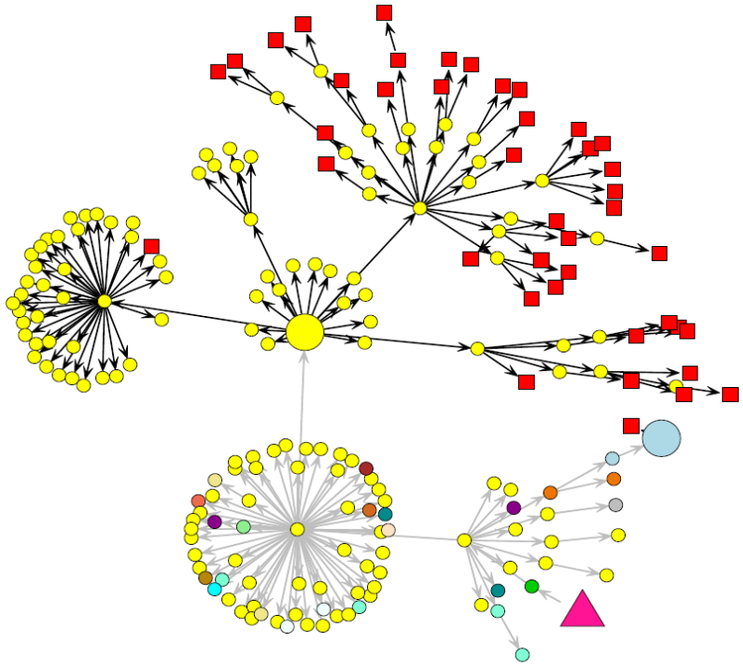
FEDERAL INSTITUTE FOR RISK ASSESSMENT

Bundesinstitut für Risikobewertung

Introduction to FoodChain-Lab
Schematization and Visualization of Food Chains



Food Chain Lab

Armin Weiser, Christian Thöns, Alexander Falenski, Matthias Filter, Annemarie Käsbohrer, Bernd Appel

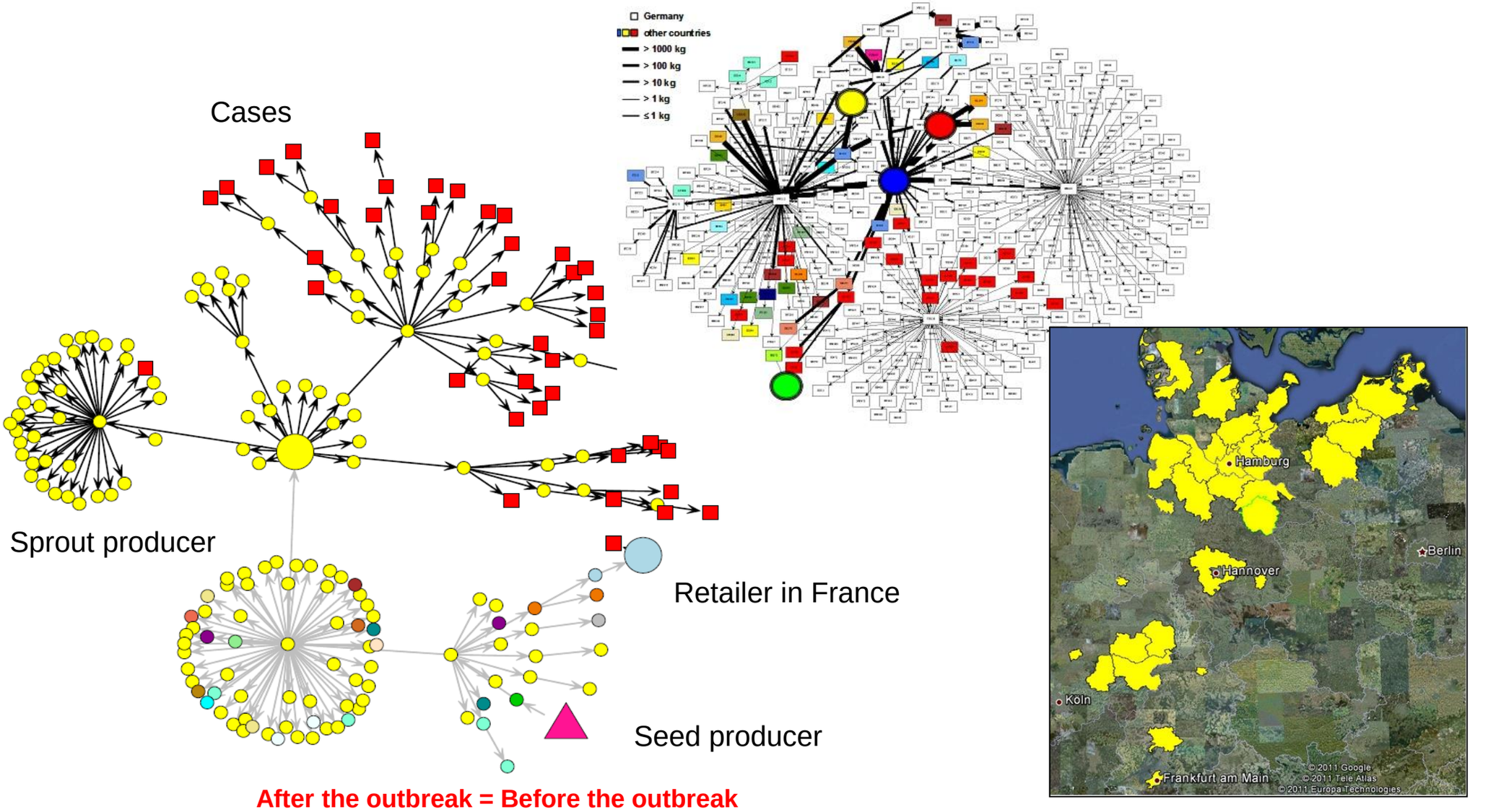
Aims of the Workshop

- FoodChain-Lab
  - Analysis & Visualisation
- Data Collection & Validation
  - Detection of errors
  - Improvements / Optimization
  - Exchange of experiences
- Redistribution of FCL
  - Application of FCL on historical and new outbreaks

    (autonomously or at first supported by BfR/EFSA)
- Perspectives of FoodChain-Lab and Tracing in general
- Future contact points

FoodChain-Lab – Why did we do it?

FoodChain-Lab – ad hoc



After the outbreak = Before the outbreak

Weiser et al., 2013: “Trace-Back and Trace-Forward Tools Developed Ad Hoc and Used During the STEC O104:H4 Outbreak 2011 in Germany and Generic Concepts for Future Outbreak Situations“, **Foodborne Pathog Dis. 2013**.

SiLeBAT (2010-2014)

Integration of scientific solutions for

Prevention & Limitation of damage

Risikobewertungen (zeitnah und fundiert)

Probenvorbereitungs- und Nachweisverfahren

Handlungsempfehlungen

Kosten-Nutzen-Analysen

Einschätzung der Gefährdungslage

Spezifische Verfahren zur Früherkennung

Vulnerabilität von Warenströmen

Schulung, Übungen, Beratung

Wissen über Agenzien (Verhalten, Gefährdungspotential)

Supply Chains and its structures

Optimale Interventionspunkte

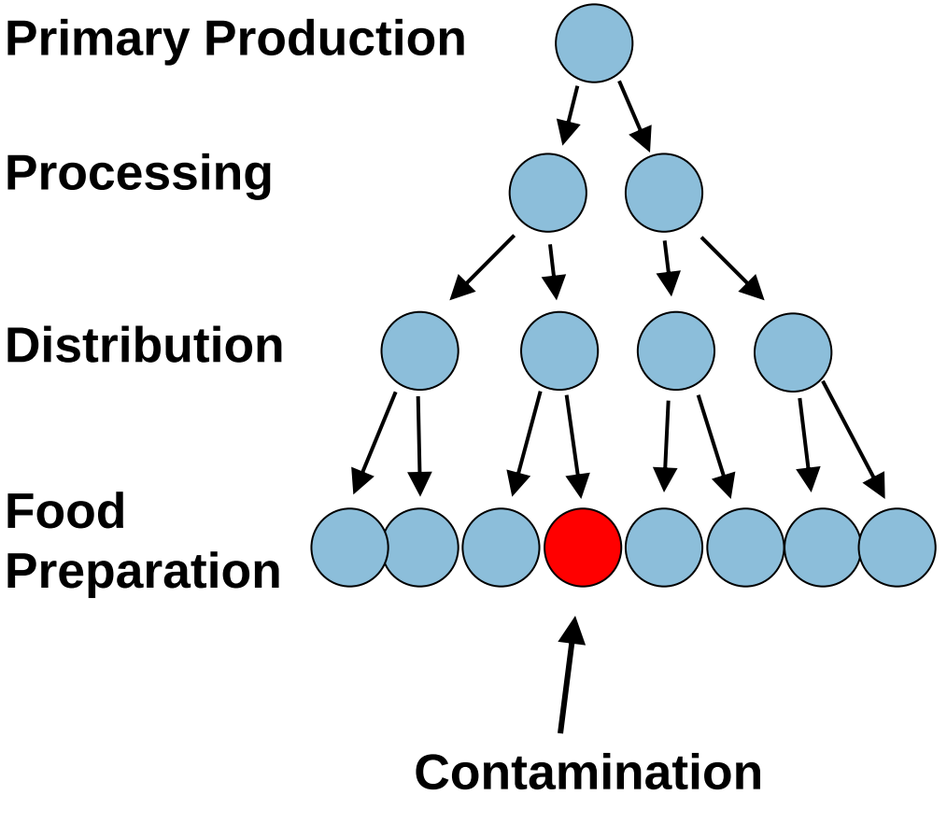
Entsorgung, Dekontamination

Freigabe von Produkten

Braunschweiger grob
(S. Muenchen)
Mettbrötchen
Schweinebacke
Brustspitzen-paniert
(negativ)
Hackepeter
Schinken-
Teewurst
(S. Muenchen)

Outbreak Scenario 1:

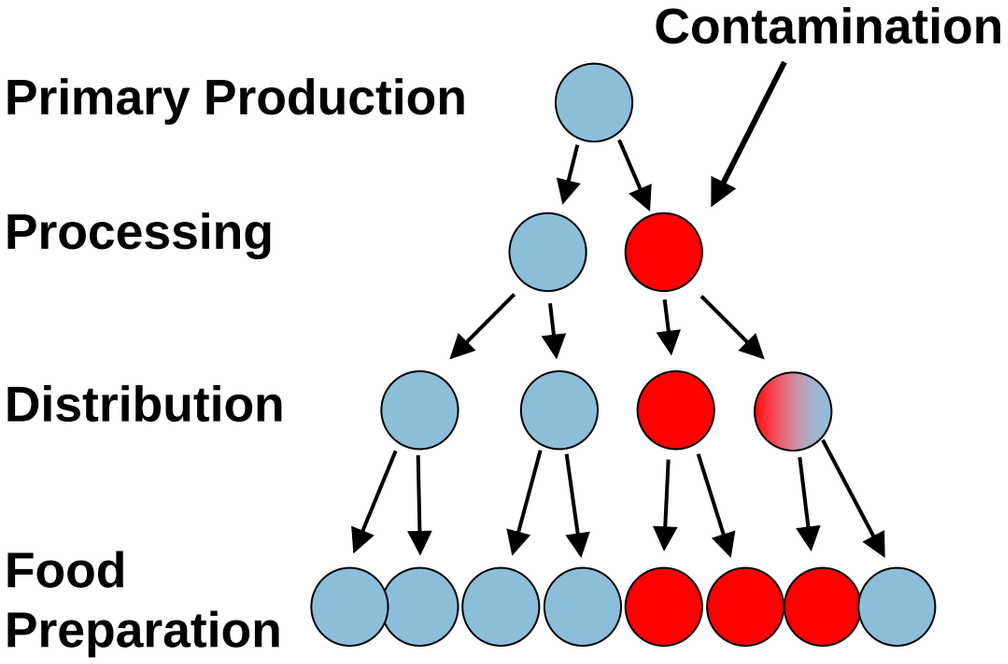
Restricted to one Location



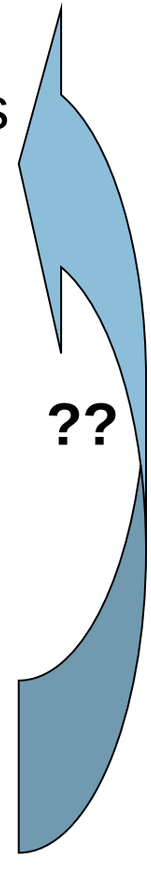
- Often caused by mistake during food preparation
- Acute outbreak
- High dose
- High infection rate
- Local investigation

Outbreak Scenario 2:

Affecting Multiple Locations/Countries

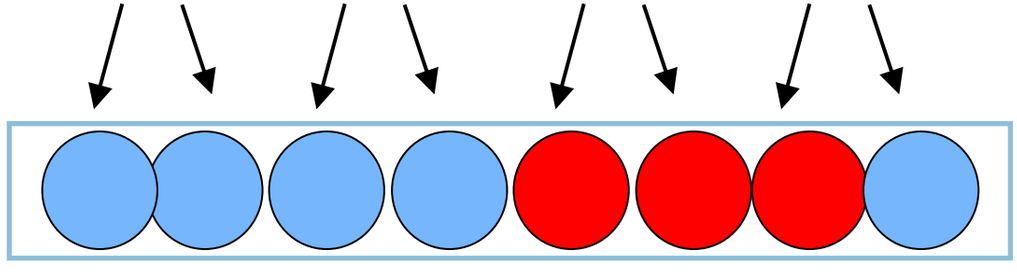


- Contamination during production/processing
- Diffuse distribution of cases
- Low dose
- Low infection rate
- Complex investigation



The outbreak investigation team see:

Cases



REGULATION (EC) No 178/2002, Article 18, 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**.

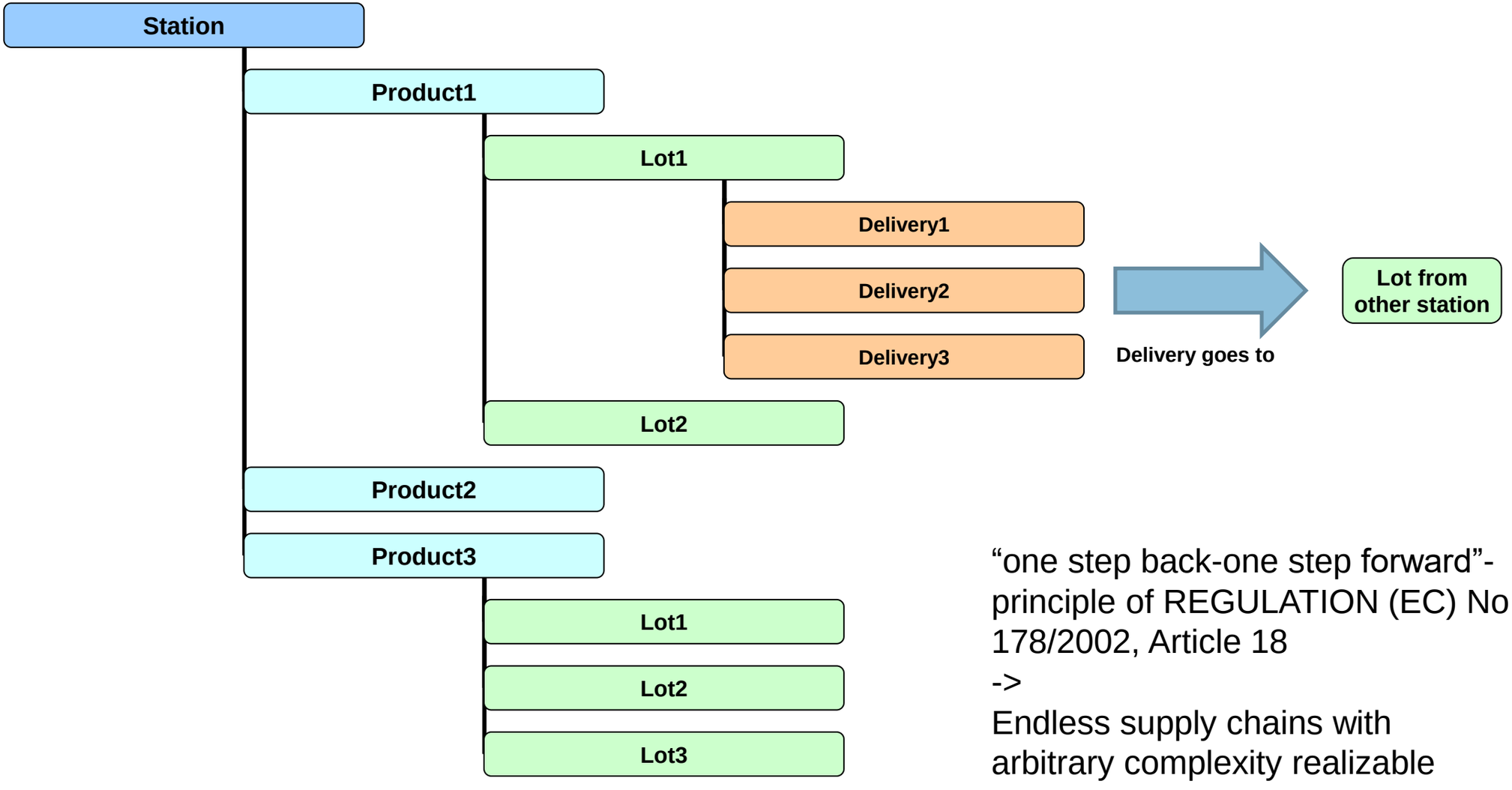
(2) **Food and feed business operators** shall be able to **identify any person from** whom they have been **supplied with** a food, a feed, a food-producing animal, or any substance intended to be, or expected to be, incorporated into a food or feed.

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**.

(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**.

Database – Structure for Food Chains

Station Product Lot Delivery



“one step back-one step forward”-principle of REGULATION (EC) No 178/2002, Article 18

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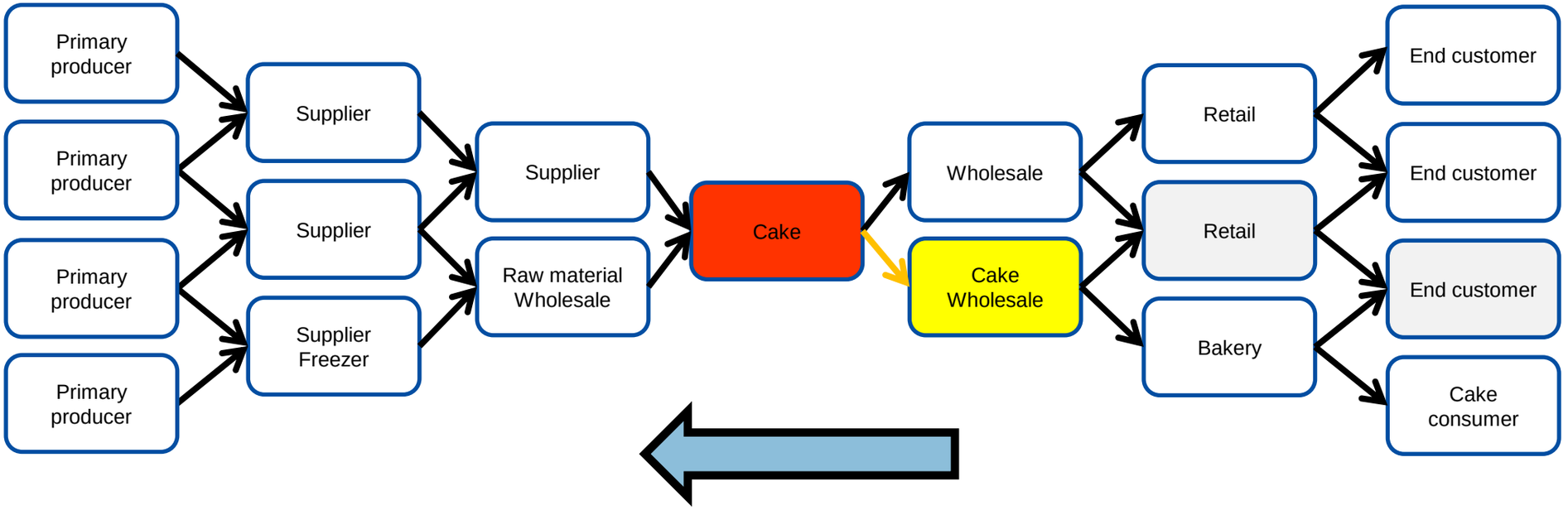
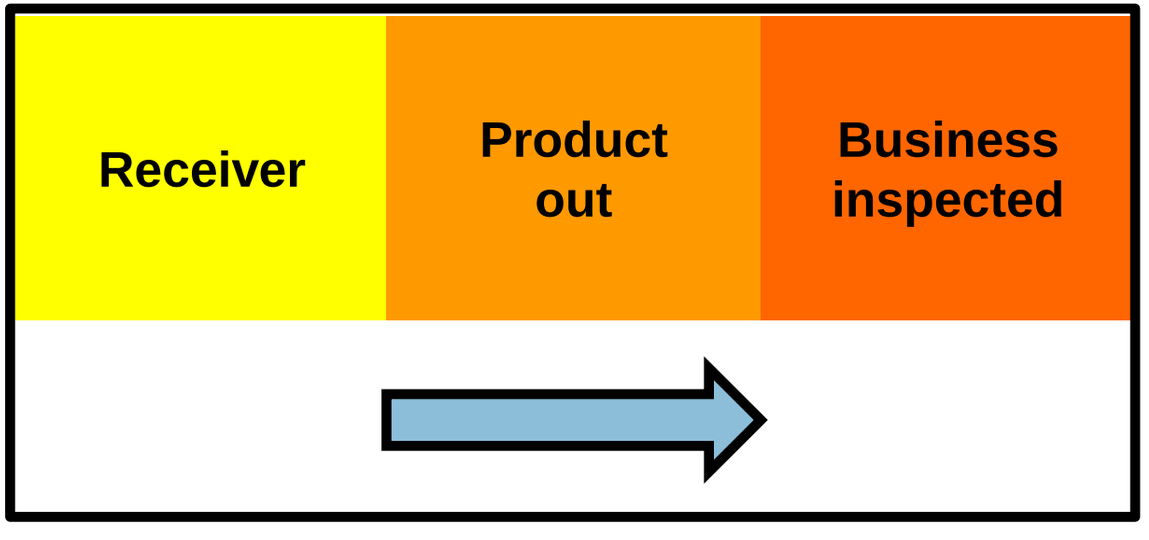
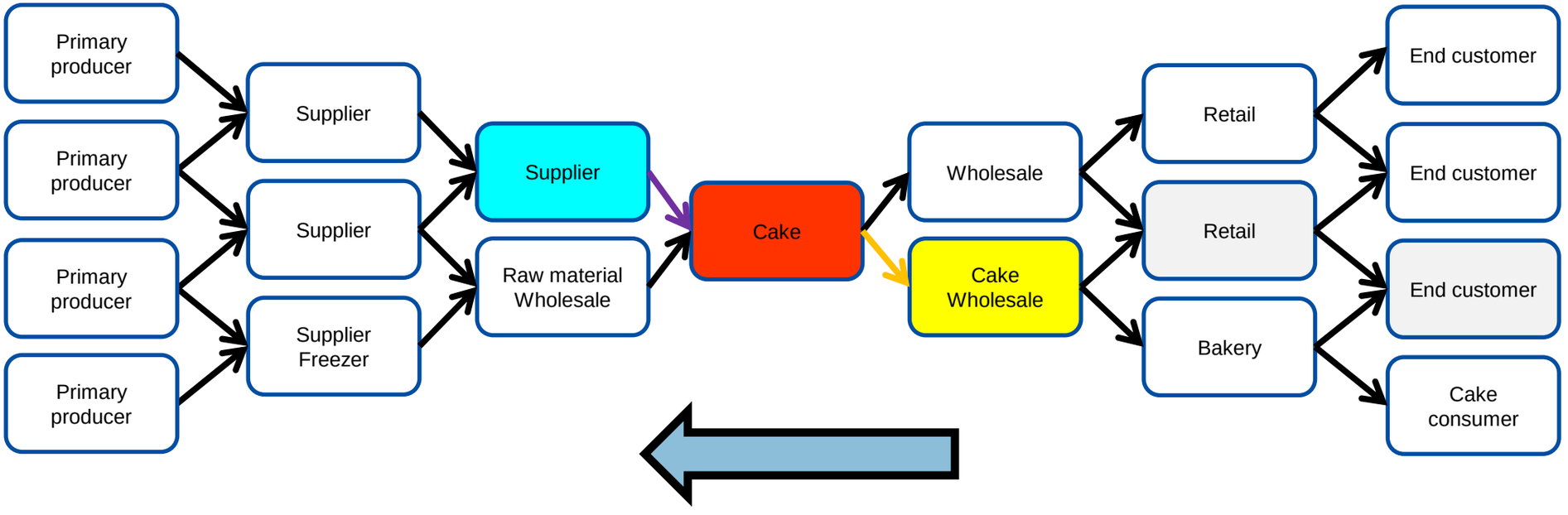
Endless supply chains with arbitrary complexity realizable

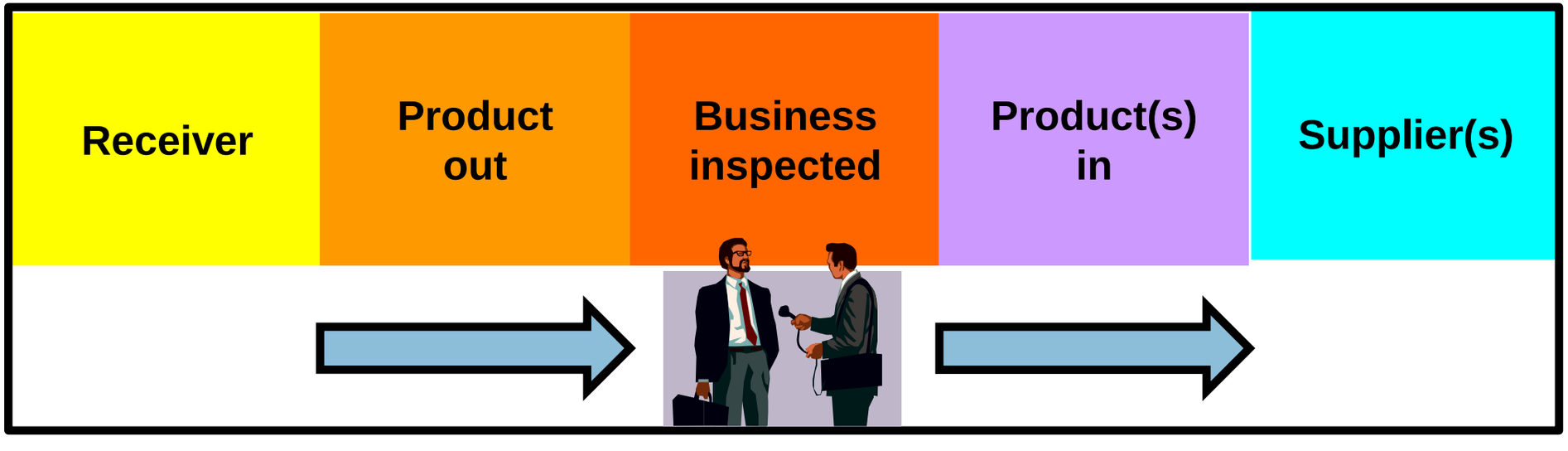
Principle of tracing back – Data gathering





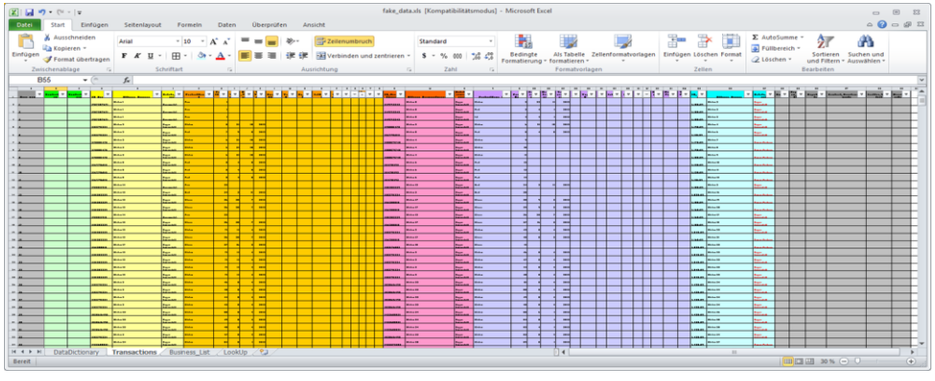
Principle of tracing back – Data gathering





Data gathering – Development of a new “simple” template

old:



“one step back-one step forward”-principle of REGULATION (EC) No 178/2002, Article 18

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Endless supply chains with arbitrary complexity realizable

new:

Backtrace_request_3001_Caterer 01.xlsx - Microsoft Excel

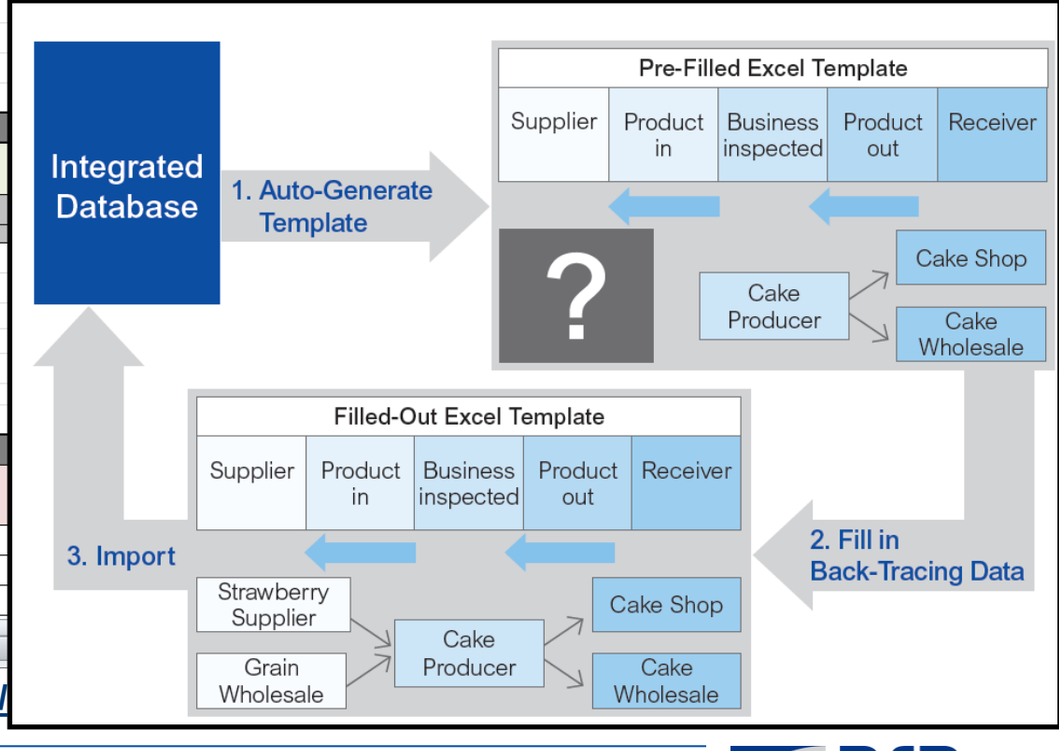
Datei | Start | Einfügen | Seitenlayout | Formeln | Daten | Überprüfen | Ansicht

E30

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Reporter Information												
2	Reporting Officer	Reporting Date	Reporting Remark										
3													
4													
5	Station in Focus:	3001	Caterer 01										
6													
7	Products Out												
8	Product Name	Lot Number	Delivery Date Departure			Delivery Date Arrival			Unit weigt/vol./pck.		Recipient		
9			Day	Month	Year	Day	Month	Year	Quantity	Type / Unit			
10	Menü 1	M01	3	9	2014	3	9	2014	62	Portionen	9012		
11	Menü 2	M02	3	9	2014	3	9	2014	101	Portionen	9008		
12													
13	Lot Information												
14	Lot Number of "Product Out"	Lot size											
15		Quantity	Type / Unit										
16	M01	900	Portionen										
17	M02	900	Portionen										
18													
19	Ingredients for Lot(s)												
20	Ingredient Name	Lot Number of Ingredient	Delivery Date Departure			Delivery Date Arrival (if departure unknown)			Unit weigt/vol./pck.		Supplier		
21			Day	Month	Year	Day	Month	Year	Quantity	Type / Unit			
22													
23													
24													

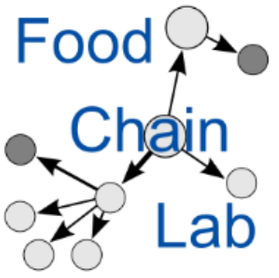
Stations | BackTracing | ForwardTracing_Opt | LookUp | Help

Bereit



Online Validation: https://foodrisklabs.bfr.bund.de/templatevalidator/

What is FoodChain-Lab?



- Open source software

  http://foodrisklabs.bfr.bund.de

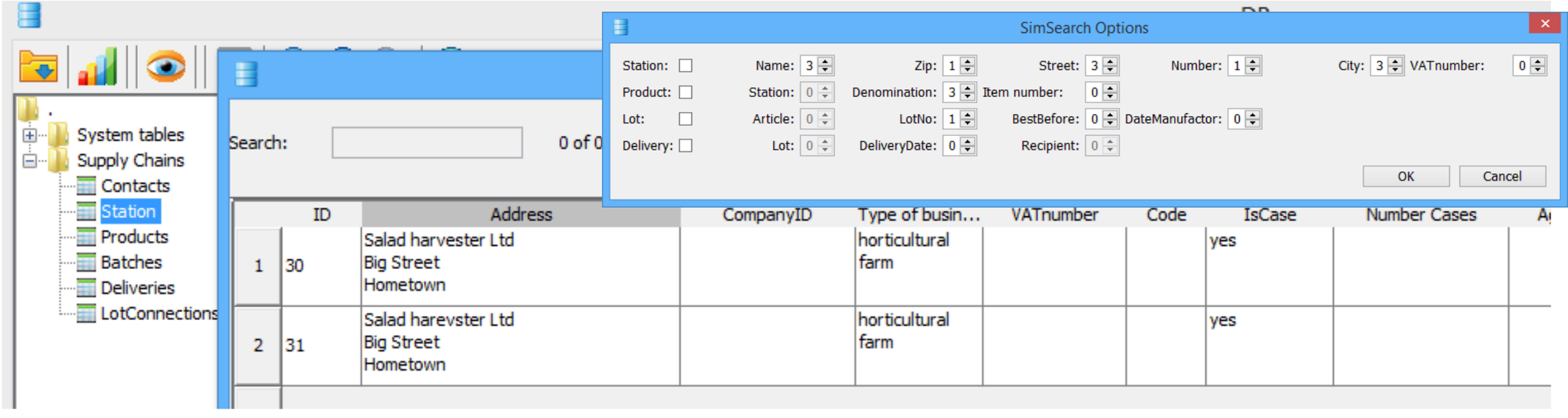
- Database for managing food tracing data

- Tool for data cleaning, enrichment & processing
  - Validation (also online: https://foodrisklabs.bfr.bund.de/templatevalidator/)
  - Cleaning (e.g. Duplicate Detection)
  - Enrichment (e.g. Geocoding)
  - Analysis (Clustering, Tracing, Scoring, etc.)

- Tool for visualization and interactive reasoning

FoodChain-Lab

Data cleaning



Levenshtein distance

M	A	Y	O	N	N	A	I	S	E
=	=	=	=	=	-	=	=	=	=
M	A	Y	O	N		A	I	S	E

B	I	O	M	R	A	K	T
=	=	=	=	-	-	=	=
B	I	O	M	A	R	K	T

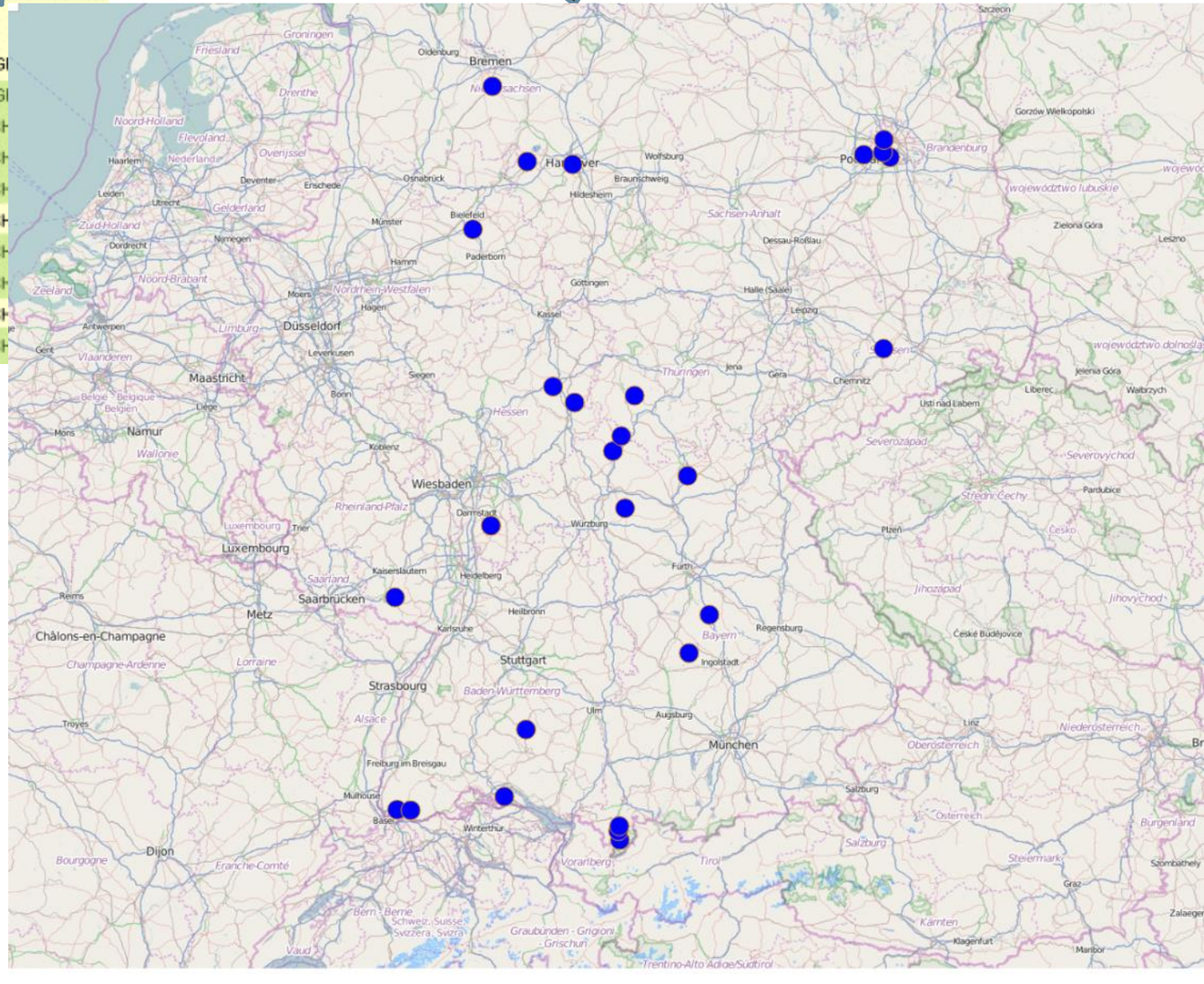
E	L	E	P	H	A	N	T
=	=	=	**O**	-	=	=	=
E	L	E	F		A	N	T

Works well for finding typos

FoodChain-Lab

Data Enrichment – Geocoding

Station	
ID	INTEGI
Products	INTEGI
Name	VARCH
Street	VARCH
House Number	VARCH
P.O. Box	VARCH
Zip Code	VARCH
City	VARCH
County	VARCH
Country	VARCH



Available Providers:

- (Google)
  - Web service
- MapQuest
  - Web service on open data
- Gisgraphy
  - Locally installable
  - **Confidentiality** of data ensured!
  - No request limit!

FoodChain-Lab

Scoring

Definition:

Trace = path, a contamination can take via the food chain network

- Visualization of backward / forward “trace”
- Simulations based on
  - Cross Contamination
  - Regional Effects (e.g. environmental contamination)
  - Weights for Outbreak Stations
- Tracing score as simulation result

  ~ likelihood a station is involved in the outbreak

Math:

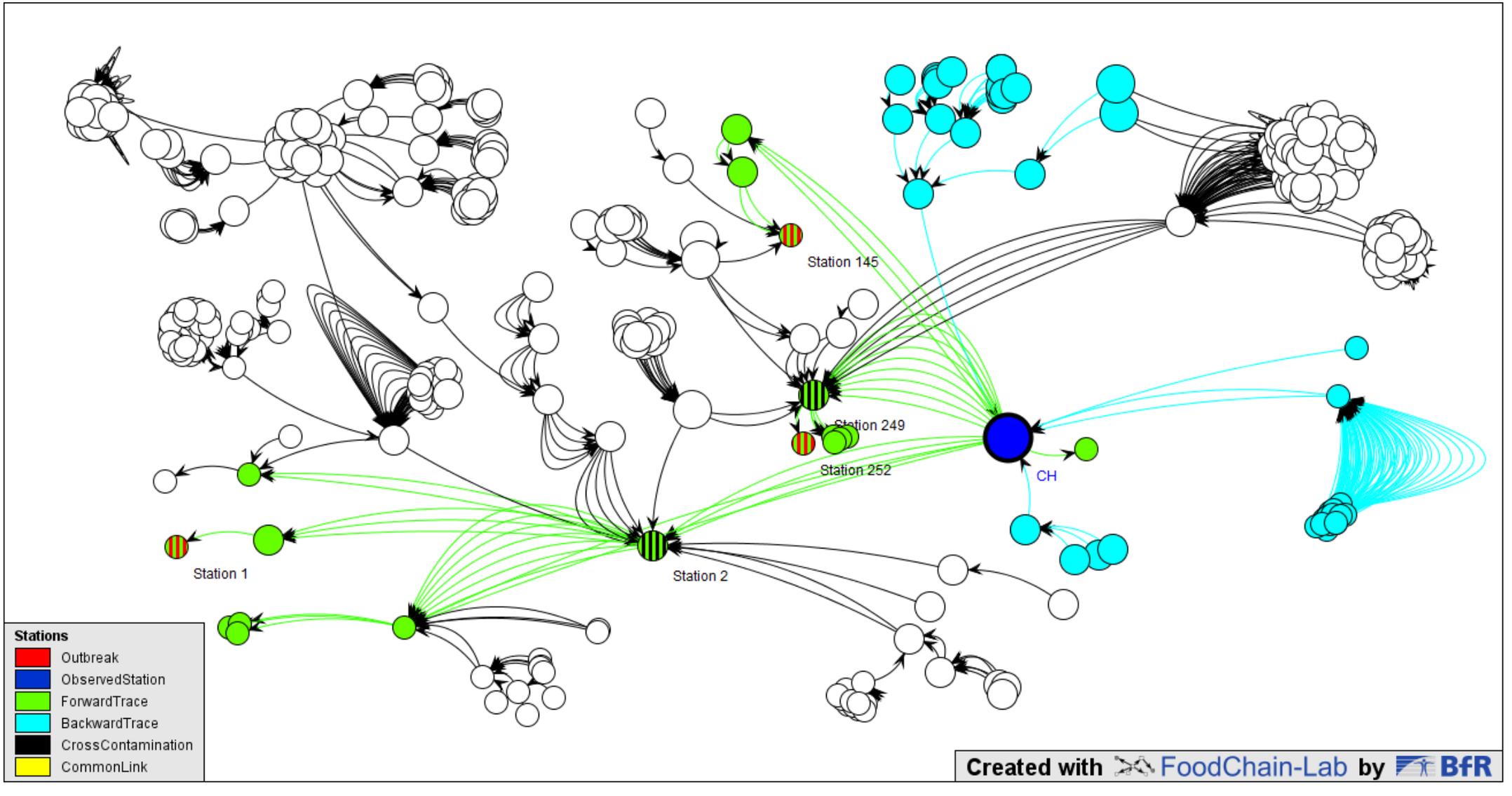
$$\mathrm{Score}(s_i) = \frac{\sum_{j=1}^{n} w_j t_{ij}}{\sum_{j=1}^{n} w_j}$$

s_i:	Station **i**
w_j:	Weight of station **j**
t_{ij}:	1 if there is trace from station **i** to **j**
	0 otherwise
n:	Number of stations

FoodChain-Lab

Data visualization of Traces

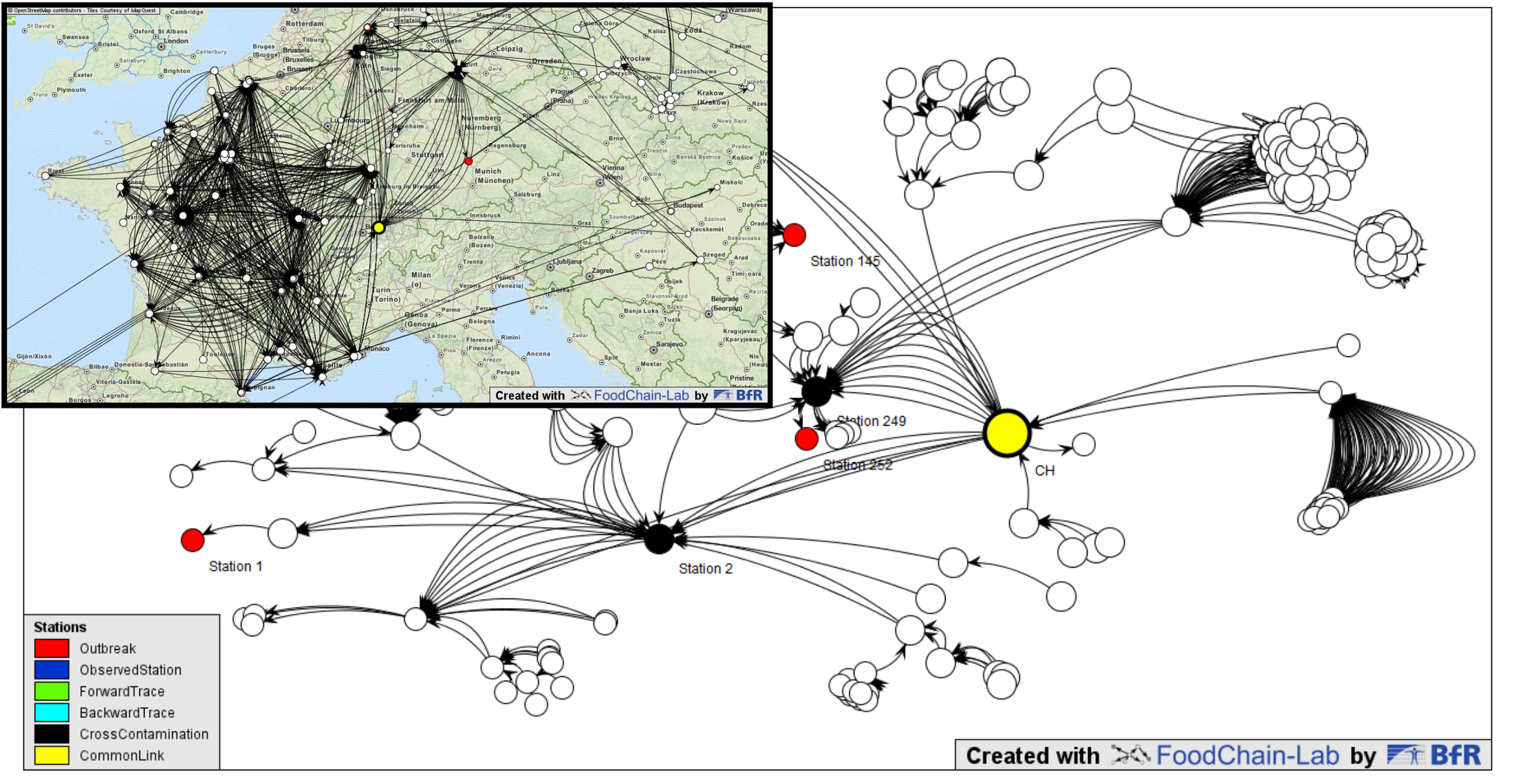
Traces of the products of the blue station. All 3 outbreak stations (red) are reached by the forward trace (green).



FoodChain-Lab

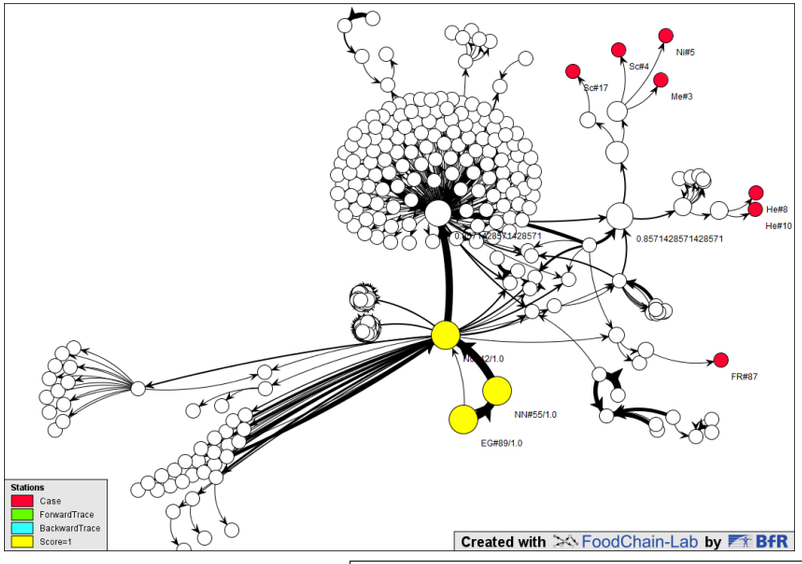
(Geo-) cluster analysis

Synchronized network- and map-view.
Manually or automatically defined regions may be treated as one station. This allows analysis of regional causes of the outbreak..

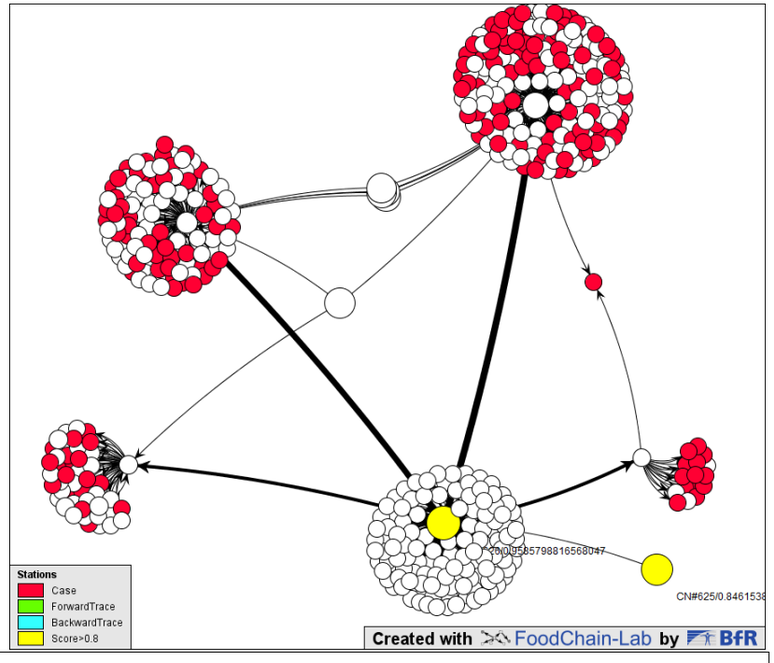


Real world applications

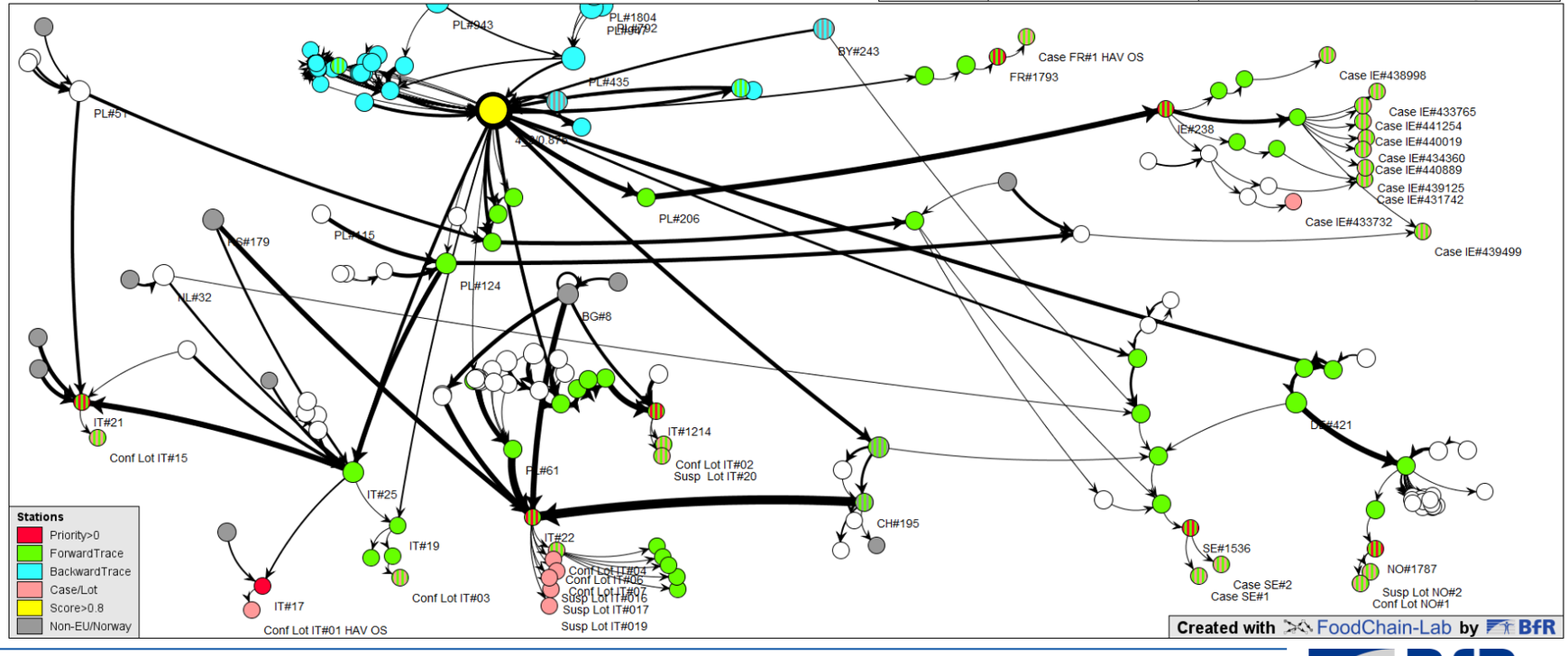
EHEC 2011



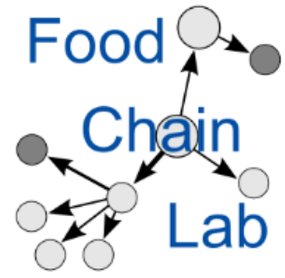
Norovirus 2012



HAV 2013

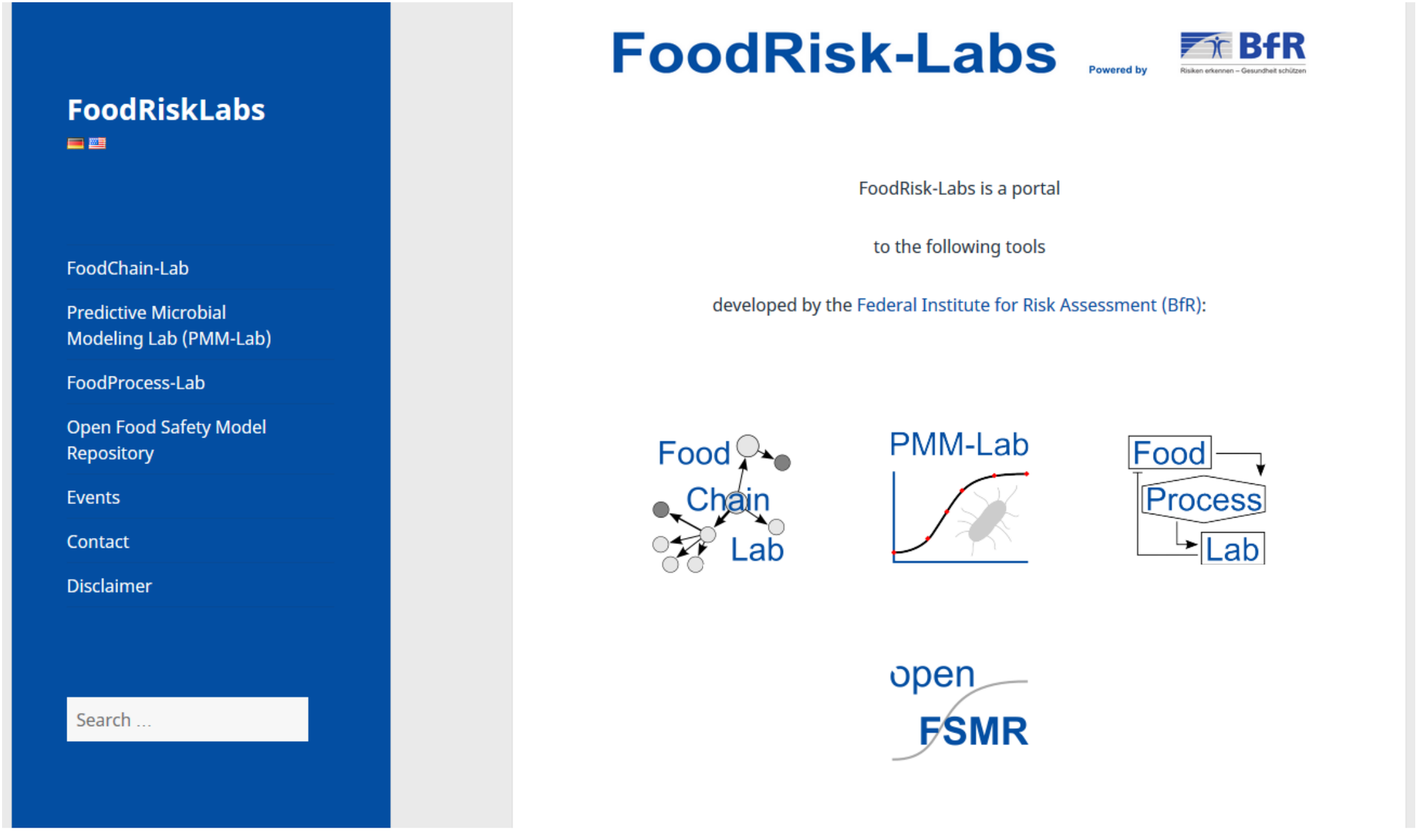


FoodChain-Lab - Features
Summary



- Data validation and enrichment
  - Online validator (https://foodrisklabs.bfr.bund.de/templatevalidator/)
- Visualization
  - Automatically arranges graphs in a pleasing way
- Analyses and Simulations
  - Weights, Cross Contamination, Geoclustering -> Score
  - Trace back / forward
- Helps during Outbreak Investigation:
  - Assists in Brainstorming / Prioritizing
  - Identifies missing data
  - Tests hypotheses and generates new ones

http://foodrisklabs.bfr.bund.de



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BfR
Bundesinstitut für Risikobewertung

Thank you for your attention

Armin Weiser

http://foodrisklabs.bfr.bund.de

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