

Big Data applications in Food Safety

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- Brief Introduction to Nestlé Research
- The Changing Reality Framing Food Safety
- What does success looks like?
- Data analysis for a New Game
- Summary



Nutrition & Healthcare

11%

Pet Care

12%

Confectionery

11%

Nestlé Waters

8%

Milk Products & Ice Cream

20%

Prep. Dishes & Cooking aids

16%

Powdered & Liquid Beverages

22%



Turnover 2014: CHF 91.6 billion

>330'000 employees in 150 countries

>440 factories in 86 countries

>2,000 brands

OVER 1 BILLION
PRODUCTS SOLD
EVERY DAY

Science & Technology

- Scientific advances
- Agri-food technology
- Safety testing tools
- «Big Data»
- Analytical technology

Social & Cultural

- More foodborne disease
- Distrust
- Consumer expectations
- Consumption patterns
- Media and Social Media
- NGOs
- Crowdfunding/sourcing
- Food Ethics

Environmental

- Water
- Climate
- Dwindling bio-resources
- Soil integrity
- Contamination



Business

- Increasing food & water crises
- Food Fraud
- Complexity
- Costs

Regulatory

- Lack of harmonization
- Increasing complexity
- Increased product monitoring
- Limited understanding of complex food systems

Science & Technology

- Anticipation of new advances
- Science => superior products
- Lower uncertainty
- Data sharing

Social & Cultural

- Decrease in foodborne disease
- Food industry trusted
- High confidence in safety
- Innovations welcomed
- Food data accessible

Environmental

- Sustainable practices
- Adaptation to climate change
- Increased efficiency
- Reduced waste



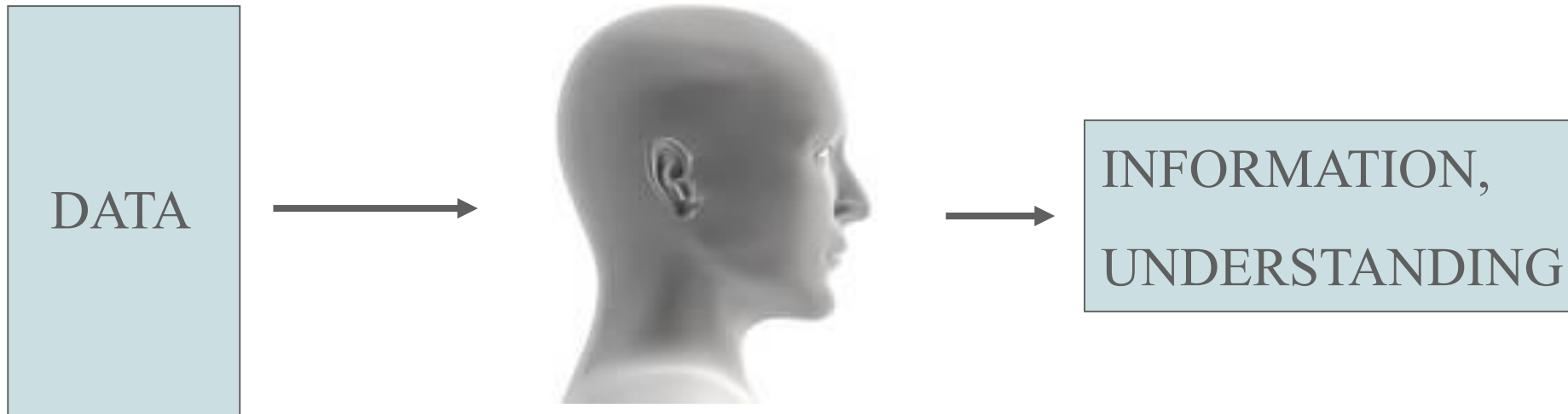
Regulatory

- Internationally harmonized
- Secure international food trade
- Systems approach
- Targetted risk management
- Fewer crises and incidents

Business

- Fewer recalls
- Few food crises
- Minimal food fraud,
- Innovation driven business

First Rule: Get on top of the data technology revolution!



«Data» is not information!

«*Information is not knowledge!*» (Einstein)

Knowledge is not action!

Caveats!

If a man's knowledge is not in order, the more of it he has the greater will be his confusion

Herbert Spencer

The illusion of understanding, or how everyone thinks he knows what is going on in a world that is more complicated (or random) than they realise

Nassim Nicholas Taleb

Challenge: Explosion of literature data

2X:	Annual growth in worldwide data creation
8 Zettabytes:	Estimated worldwide data creation in 2015
28,100:	English language peer-reviewed journals
2.5 million:	Papers per year (~5 per minute)
3.5-5%:	Annual increase in published papers
2.5 billion:	Full-text downloads per year
270:	Articles read by average scientist per year
30 minutes:	Average reading time per article (down from ~45 minutes in the mid-90s)

+

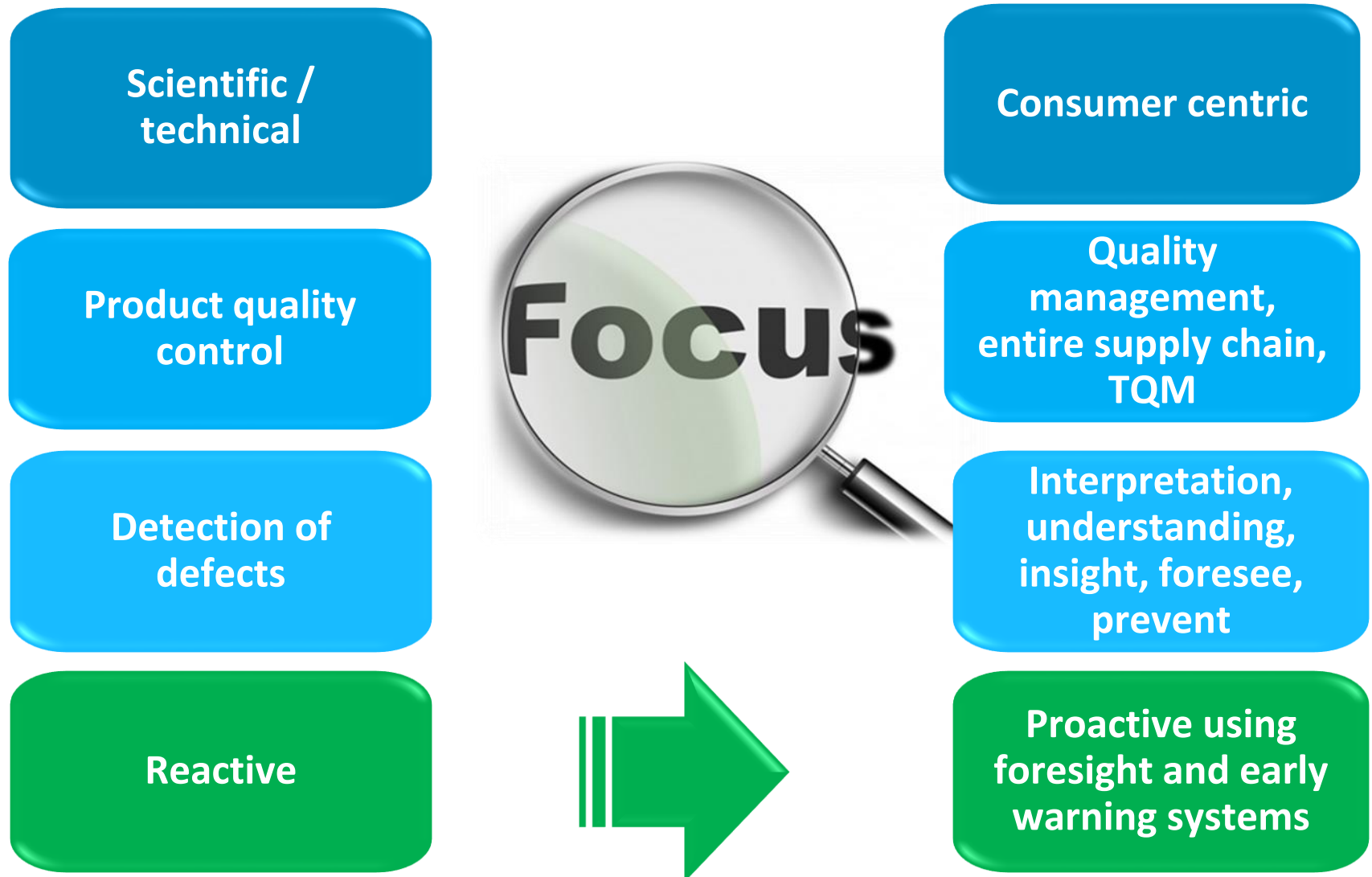
Peer-review process malfunctioning
Increase in retraction rate



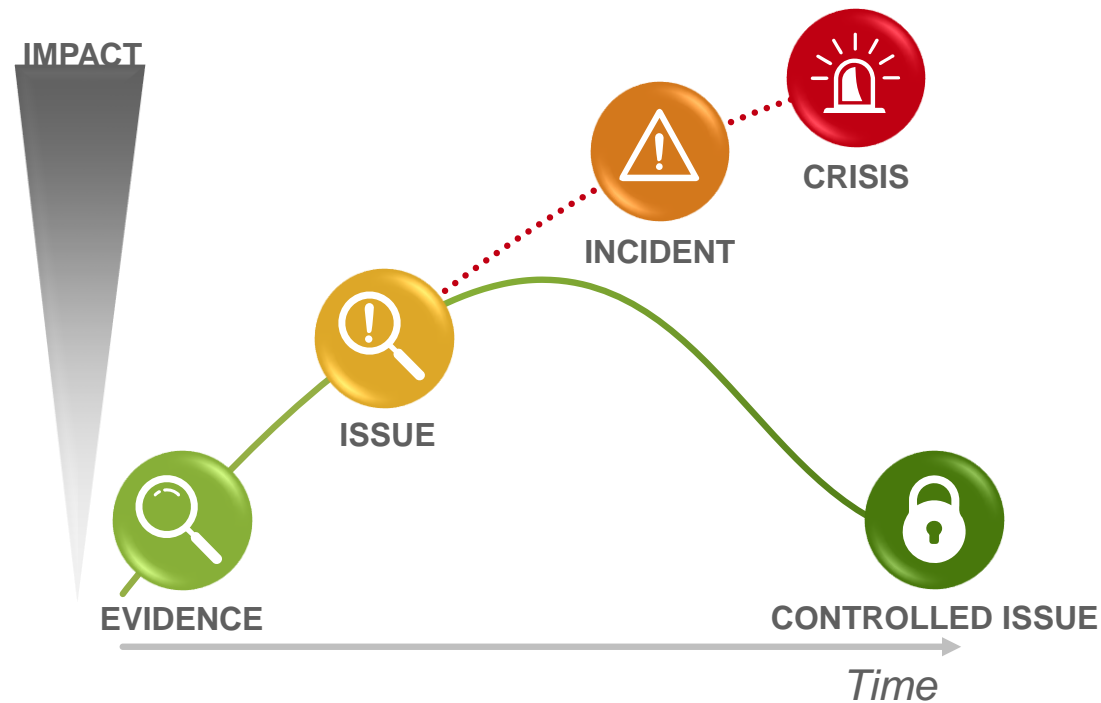
Acute effect on multidisciplinary sciences like food safety

- Food safety early warning systems
- Search engine queries to detect disease outbreaks
- Whole genome sequencing data from environmental, food and clinical pathogen isolates
- Metagenomics data from food and environmental samples
- Non-target fingerprint data sets for food authenticity and adulteration
- Satellite imaging data to detect illegal fishing
- Meteorological data to predict mycotoxin risks in crops
- GIS data to detect food fraud
- Social media analysis to understand consumer concerns and preferences
- Traceability and RM/ingredient data
- Image analysis and automated processes
- Computational microbiology, chemistry and toxicology

A change in focus is necessary

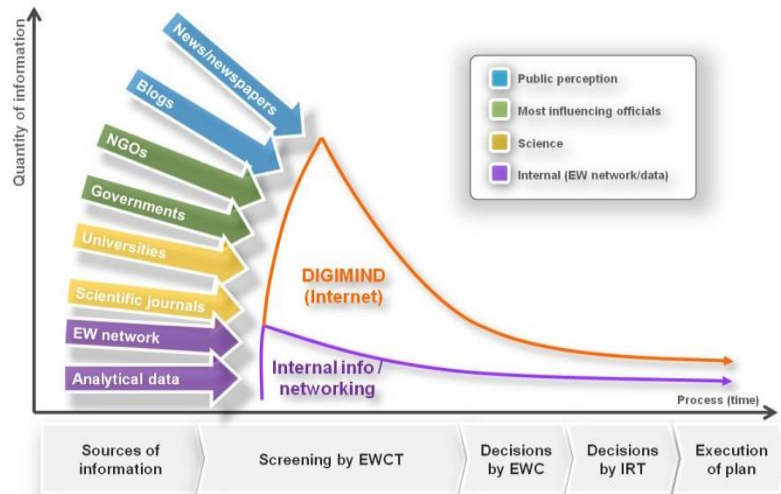


Early Warning Principles



Food safety challenges ***continue to increase*** and must ***be addressed through multiple competencies***

Anticipating food safety issues: Early Warning System



Early Warning Expert Network

- Global reach
- 150 people
- Multi-disciplinary
- R&D and Operations experts

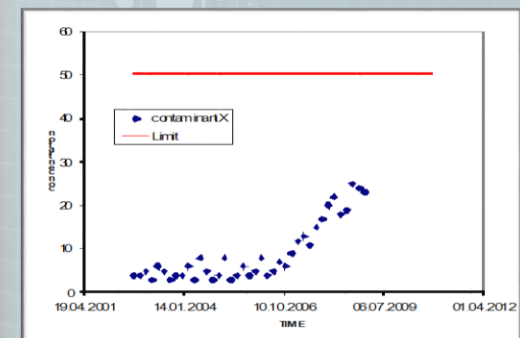
Webscouting

- 8000 websites per day
- 300,000 articles scouted per year
- 10,000 articles kept in a database for knowledge building
- 1000 RSS food safety flashes
- 12 Issue Round Table presentations



- 26 big laboratories
- 1000 people
- 3.3 million of data /year

- TREND ANALYSIS OF DATA ON CONTAMINANTS IN FOOD RAW MATERIALS
- DETECT ABNORMAL TRENDS
- ROOT CAUSE ANALYSIS TO FIND THE RIGHT ACTIONS



Example: abnormal trends for arsenic in rice in Malaysia



THE PROBLEM

- Arsenic level in rice were getting higher in Malaysia
- We use rice to produce baby food
- Levels would potential have exceeded safe levels if we did nothing

THE ANALYSIS AND SOLUTION

- Root cause analysis
 - Correlation between the yield improvement made by farmers (they wanted to go from 2000 tons/hectar to 8000 tons/hectar and increasing levels of arsenic in rice
 - The main cause was identified to be the fertilizers
- Working with farmers allowed to still increase the yield while lowering the level of arsenic in rice by optimizing the usage of fertilizers



FISH

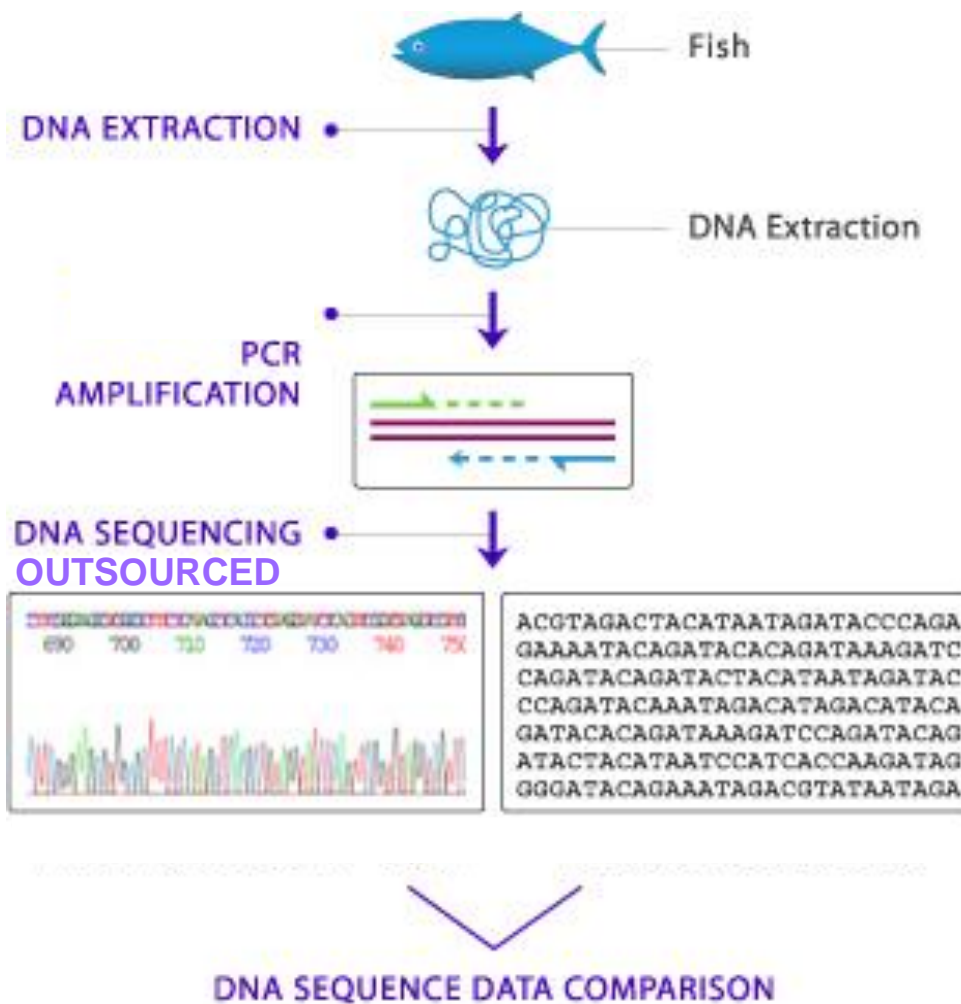
- One in five fish eaten in the world is caught illegally
- USD 10-23 Billion
- Seafood fraud: 25-70%
- Potential for food safety implications
- Fish stocks are depleted
- Waste associated with non-target catch: ~1 million tonnes pa; >USD 1 billion.
- Preventive approaches based on «big data» applications
- New analytical tools show promise



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Fish DNA Barcoding is based on PCR and DNA sequencing



Initiated in 2003 by taxonomists to create a genetic database of all living organisms

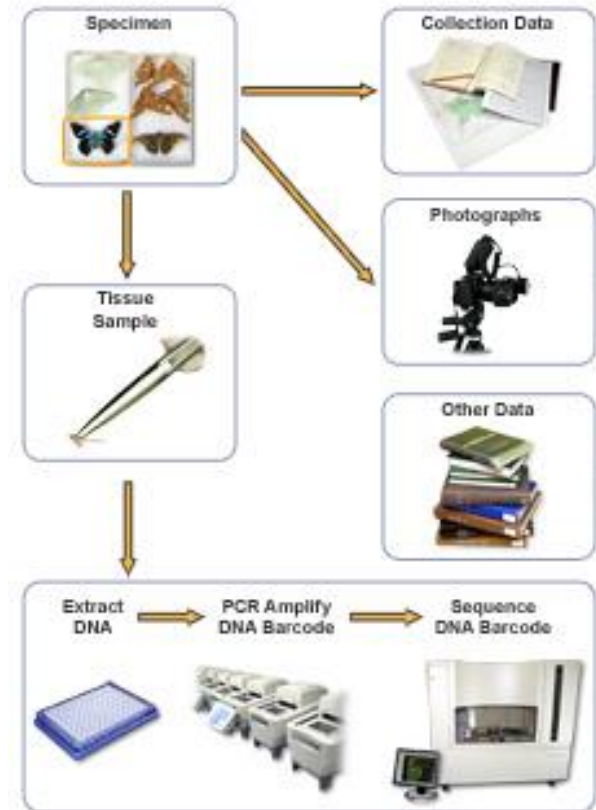
Sponsored by 25 nations

- National Institutes
- Museums
- Universities

~ 100000 species recorded

~ 10000 fish species

international
BARCODE
OF LIFE



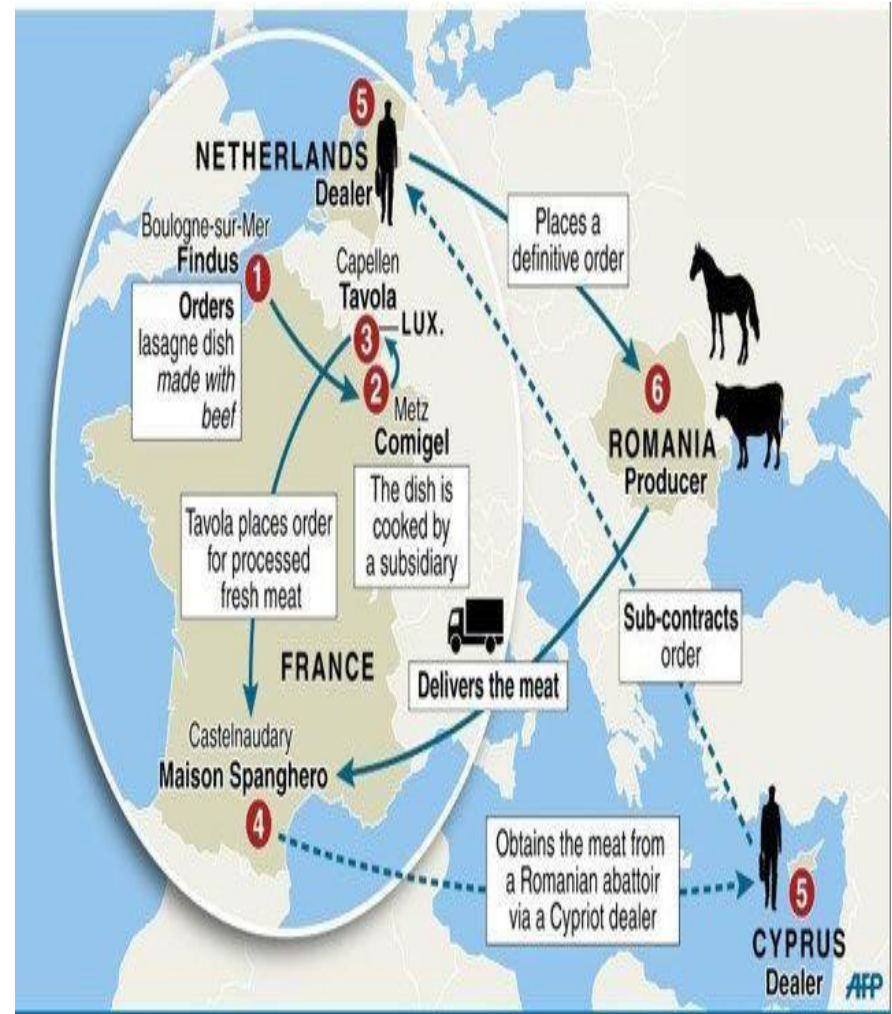
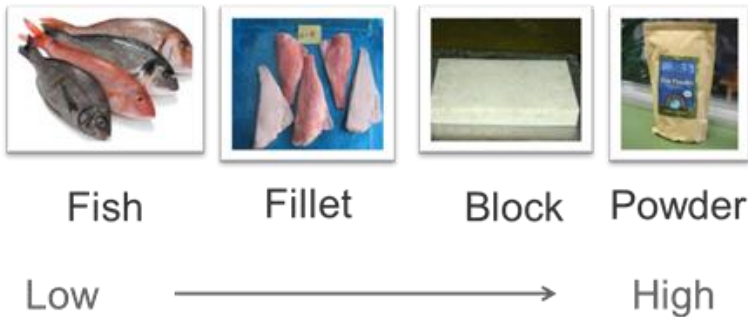


MEAT

Data enables the application of Systems Thinking to prevent food contamination and fraud

- Recent crises highlighted the **complexity** of food supply networks
- International food trade** increases the possibility of food fraud

Understand and map vulnerabilities



Source: www.thenewstribes.com

Detection of food adulteration: Don't forget to start with visual inspection!



It worked for the Ale Conner!



Horsemeat



Beef

THANK YOU!