Fighting Food Fraud:
When all you have is a hammer, everything looks like a nail

(Maslow, 1966)

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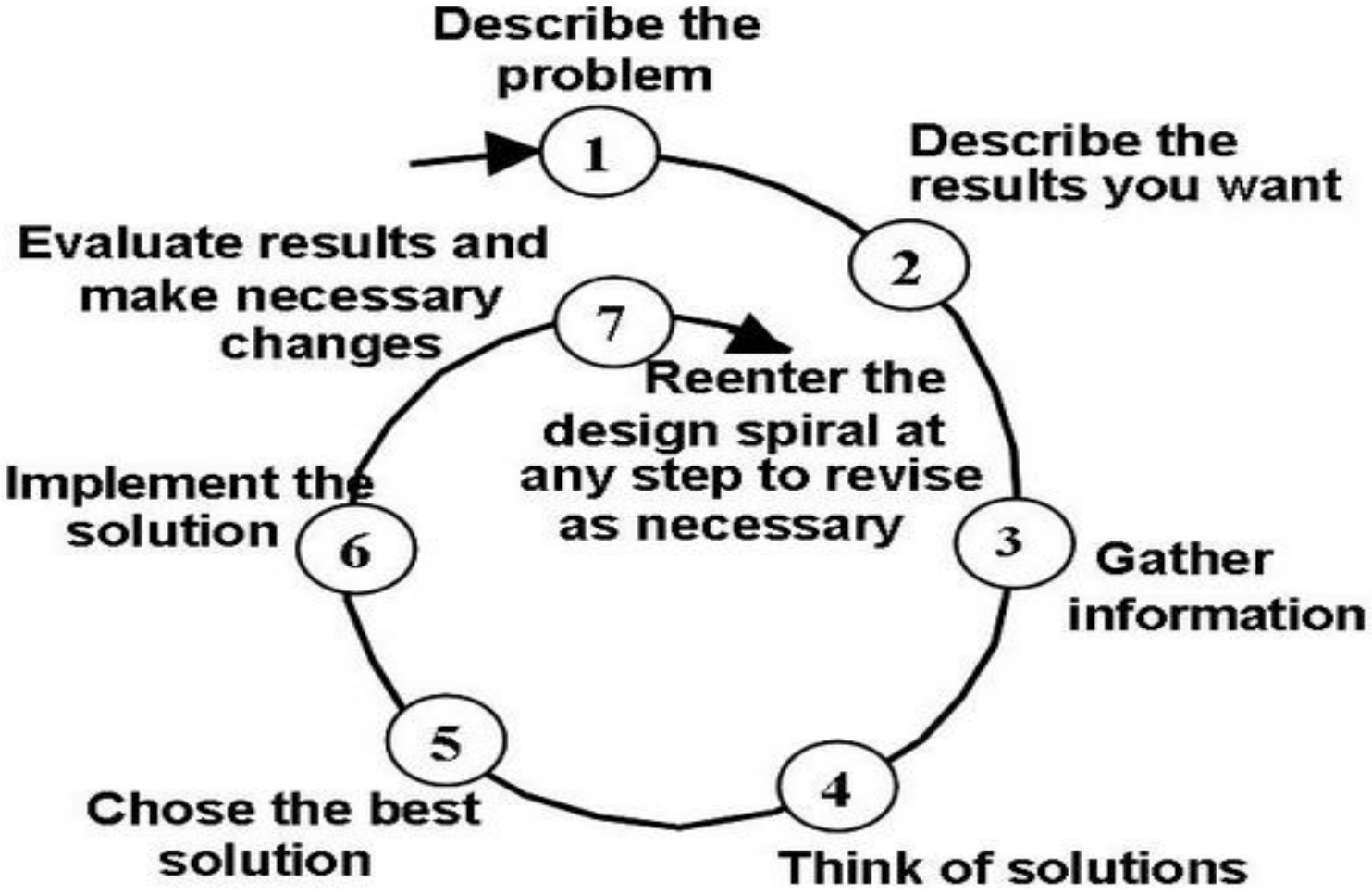
Nofima, Tromsoe, Norway

Food Authenticity & Fraud session
Prague - November 4th 2015

The scientific method applied to problem solving

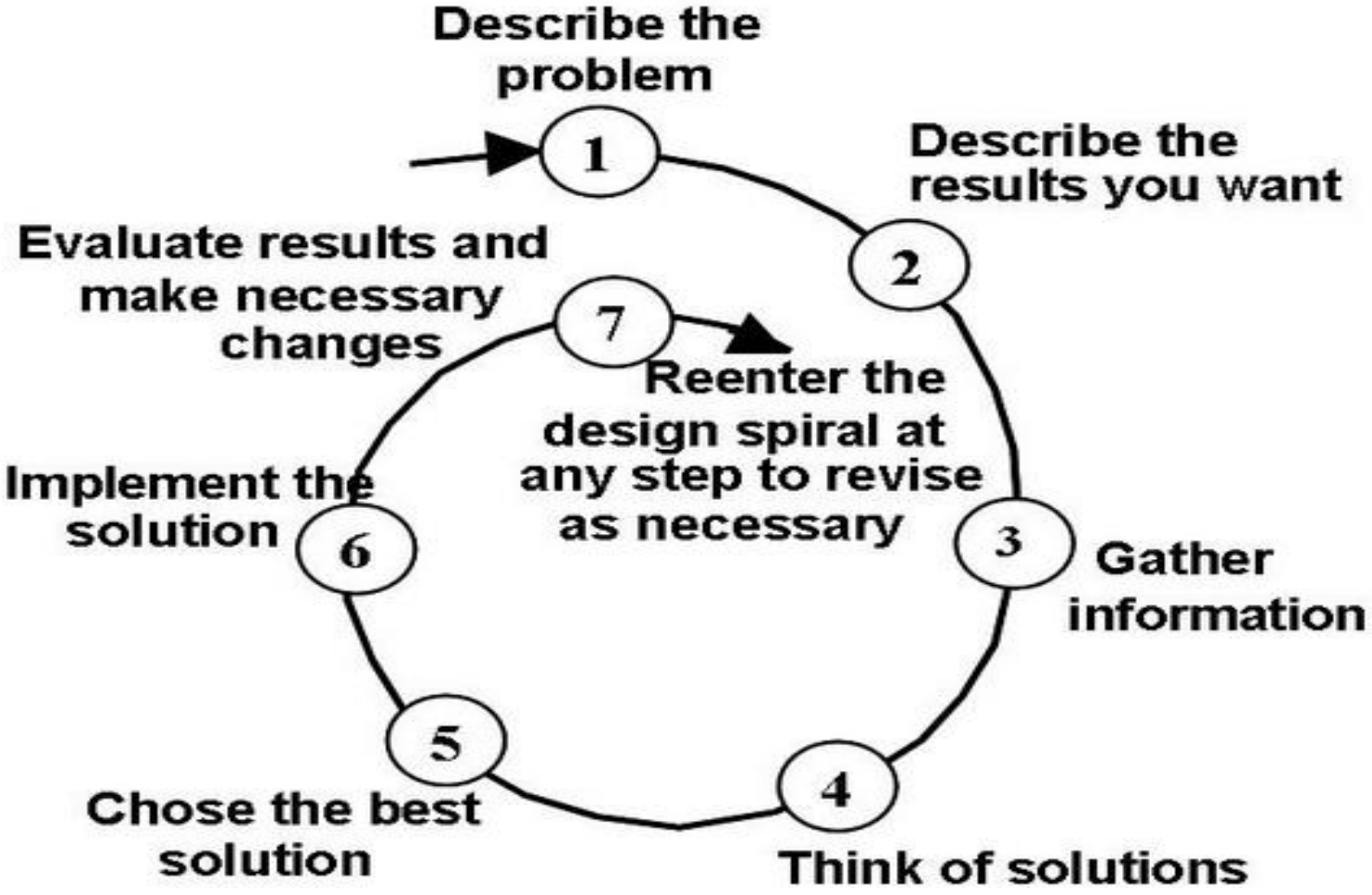


The golden hammer method

1. I have a method that I have invested a lot in, and I think it has many excellent and under-developed applications
2. Select a problem that your method might help solve
3. Implement the solution

When trying to ensure food integrity or trying to fight food fraud, the golden hammer method seems to dominate.

The scientific method applied to problem solving



Food Fraud Definition

Deliberate and intentional:

- Substitution
- Addition
- Tampering, or
- Misrepresentation

Of food, food ingredients, or food packaging

Or false or misleading statements made about a product, for economic gain.

Spink and Moyer (2011)

Food Fraud Incident Types

Term	Definition	Example	
Adulteration	A component of the finished product is fraudulent	Melamine added to milk	✓
Tampering	Legitimate product and packaging are used in a fraudulent way	Changed expiry information, product up-labeling, etc.	(✓)
Over-run	Legitimate product is made in excess of production agreements	Under-reporting of production	✗
Theft	Legitimate product is stolen and passed off as legitimately procured	Stolen products are co-mingled with legitimate products.	✗
Diversion	The sale or distribution of legitimate products outside of intended markets	Relief food redirected to markets where aid is not required	(✗)
Simulation	Illegitimated product is designed to look like but not exactly copy the legitimate product	"Knock-offs" of popular foods not produced with same food safety assurances	(✓)
Counterfeiting	Intellectual Property Rights infringement, which could include all aspects of the fraudulent product and packaging being fully replicated	Copies of popular foods not produced with same food safety assurances	(✓)

Spink and Moyer (2011)

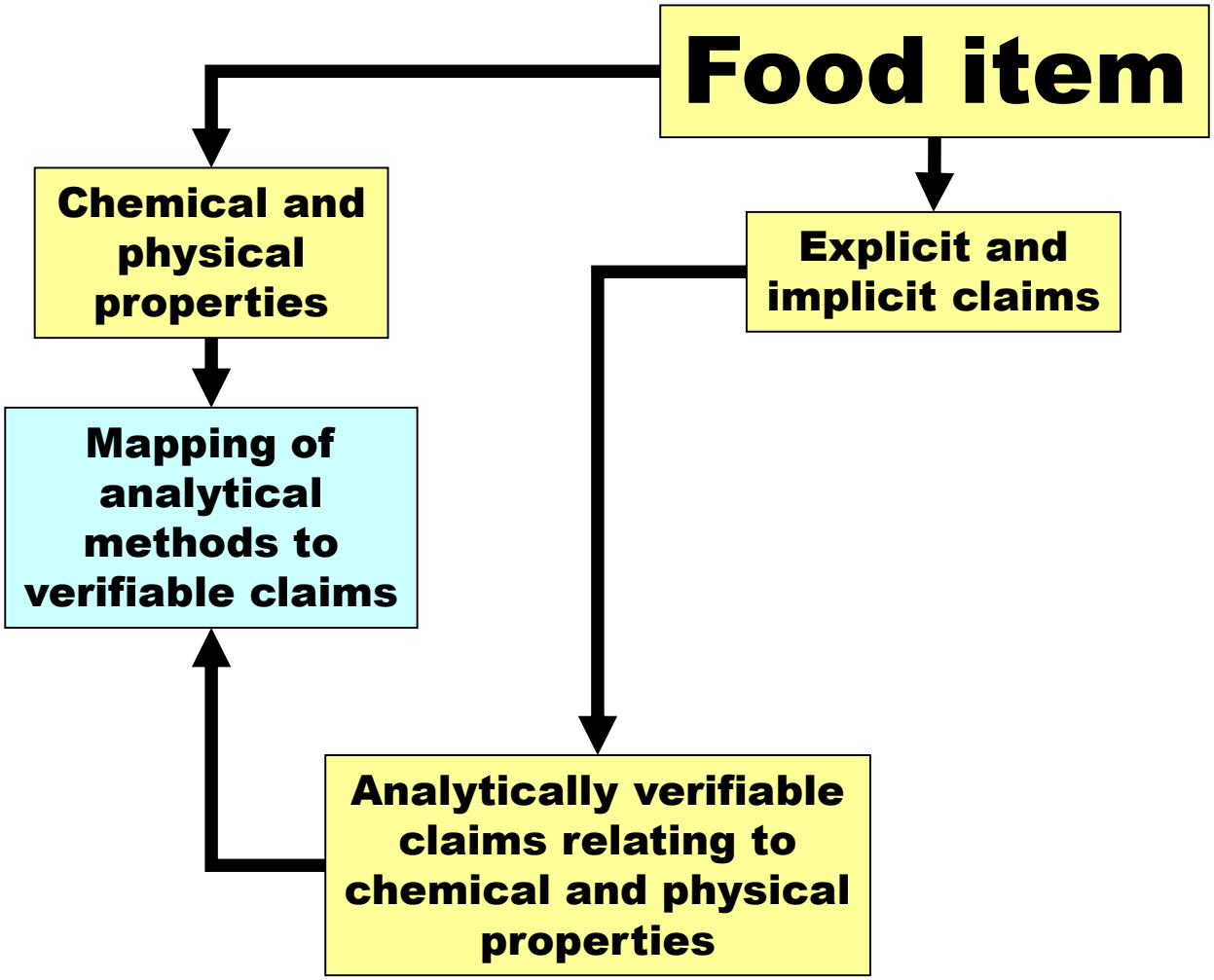
Relevance of analytical methods

Relationship with food safety

- Food safety has a biochemical or physical component
- Food safety issues can normally be detected analytically (by testing the biochemical and physical properties)
- The fact that analytical methods are important for food safety is more or less given
- While method selection is important also in relation to food safety, the question is more "*What analytical method should I use?*" rather than "*Should I use an analytical method for this; is testing food samples in a laboratory environment the best or only way to reach my goal?*"

However…

- Food authenticity is not the same as food safety
- Many food fraud incidents do not have a biochemical or physical component
- While analytical methods are important also for detecting food fraud, a more holistic approach is needed

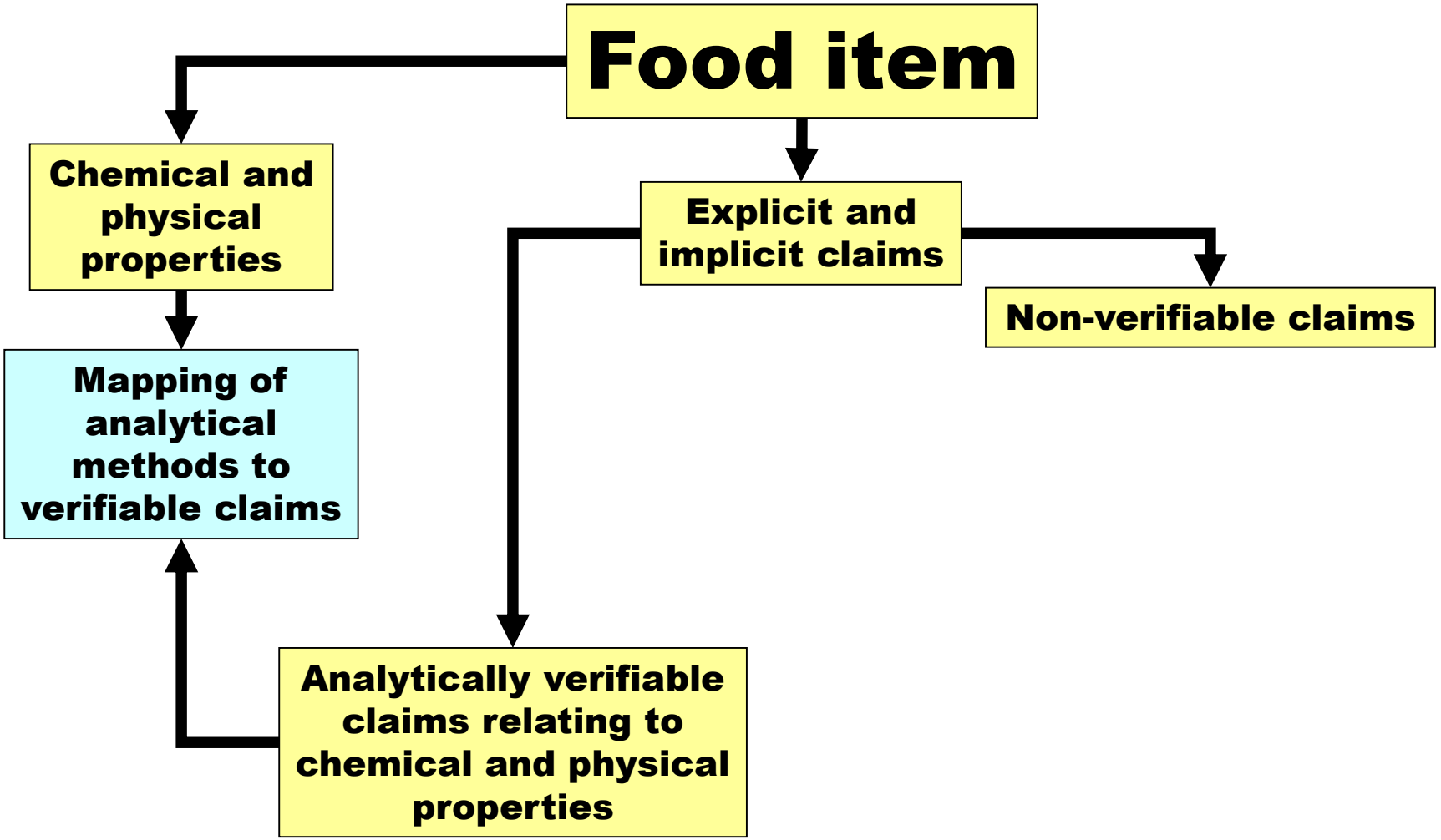

Food item
Chemical and physical properties
Explicit and implicit claims
Mapping of analytical methods to verifiable claims
Analytically verifiable claims relating to chemical and physical properties

Analytically verifiable properties

- Species, Geographical origin
- Farmed or wild (for salmon, typically)
- Fresh or frozen, then thawed
- Presence of bioactive compounds, pathogens
- Presence of undeclared / unwanted additives

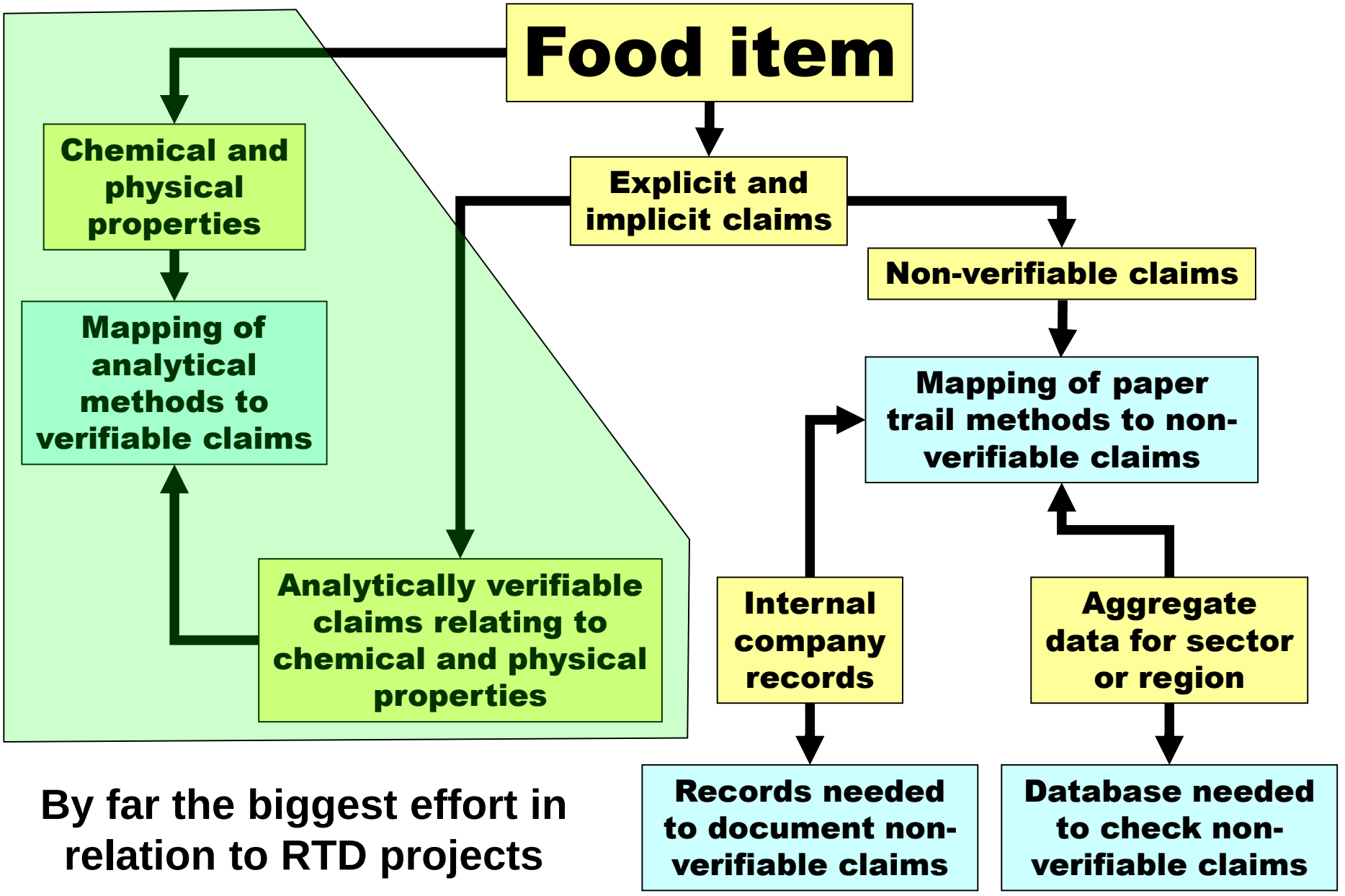
Examples

- Dioxin in Belgian chicken feed
- Cadmium in salmon feed
- Sudan Red
- Nitrite in smoked salmon
- Wrong species declaration for sushi fish
- Horsemeat sold as - / mixed with beef



Properties not (or only partly) verifiable by analytical methods

- Volume, Weight, Amount, Value
- Batch / lot number, Owner
- Origin, country of origin
- Eco-label, other value adding labels
- Organic production (also has some analytical components)
- Halal, Kosher (also has some analytical components)
- Most properties relating to sustainability or ethics



By far the biggest effort in relation to RTD projects

A lot of fraud and misdescription happens here also, and it needs to be dealt with

Why is seafood a special case?

- Seafood is traded internationally more than any other foodstuff, often seafood is processed and then traded
- More than 1700 species of fish are traded internationally
- For many species of fish, there is no internationally agreed upon commercial name, same name is used in different countries to refer to completely different species
- Seafood is a valuable commodity with great potential for economic differentiation between species and products
- Between 14% and 33% of captured fish (FAO estimate) is from illegal, unreported and unregulated (IUU) fisheries, and fraudulent claims related to origin routinely occur to enable this fish to enter the normal and legal supply chain and be sold there
- There is a great concern relating to sustainability of many fish stocks, a sustainability claim is valuable
- **Seafood is among top #3 misdescribed foodstuffs**

Pink river dolphin becomes key ingredient in catfish fraud

Listeria traced to Hjerting Laks despite fish products passing tests

Post a comment

Consumers kept in the dark on seafood origins after Senate vote

August 29, 2015

NC Seafood Firm Sentenced for Mislabeling Imported Shrimp as 'Wild-Caught'

MSC trials traceability tool against seafood fraud

By Rick Pendrous+

19-Aug-2015

Last updated on 20-Aug-2015 at 10:26 GMT

Is That Grouper on Your Plate? Seafood Fraud Hits Diners Hard

by 3p Contributor on Tuesday, Aug 25th, 2015

Too cheap to be true

SEAFOOD FRAUD IN BRUSSELS

November 2015

Seafood fraud in Brussels

- 380 seafood samples taken in restaurants in Brussels
- 15% of these from EC and EP restaurants
- 32% total mislabeling (wrong species)
- Not bluefin tuna – 95%
- Not cod – 13%
- Not sole – 11%
- Pangasius common

Brussels locations

Oceana Report
November 3rd 2015

http://ec.europa.eu/avservices/video/player.cfm?ref=I111181

FoodIntegrity objectives

1. To design, create and begin to populate a database suitable for documenting the degree and scope of seafood misdescription in Europe
2. To do spot checks for selected products and analyse to what degree analytically verifiable claims about seafood products are true
3. To develop a coherent and integrated toolbox, linking seafood product claims to analytical and paper-trail methods, to facilitate authenticity of seafood products

Seafood misdescription incident database

News items and popular science articles (newest first):

Inclusion criteria: Refers to seafood fraud or misdescription, Overall reference to food fraud or misdescription, Refers to data-analysis based methods for fraud detection
Exclusion criteria: Refers mainly to new analytical methods or new instruments for detecting (sea)food properties

Date:	Source:	Article name:	Comment:
November 3rd 2015	E		
November 2015	C		
October 28th 2015	S		
October 20th 2015	S		
October 19th 2015	A		
October 15th 2015	A		
October 14th 2015	I		
October 1st 2015	N		
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September 4th 2015	V		
August 29th 2015	T		

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Other news items and popular science articles (newest first):

As our correspondents keep feeding us links to (admittedly fairly relevant) news items that relate to other specific food items or to application of analytical methods (none of these issues are in the FI WP6 domain) we've created this place for them, so that we can retain a link to news stories that might be relevant if you want to get an overview of the whole food fraud picture (and perhaps until another home and another administrator can be found for this list). Note that news stories relating to seafood fraud and to overall food fraud goes in the original list, and not here.

Date:	Source:	Article name:	Comment:
September 5th 2015	Teatro Naturale	Olive oil traceability concerns cultivars and stable isotope analysis [in Italian]	Variability in isotopic data in olive oils is determined by a complex combination of environmental, physiological, genetic and biochemical parameters. From experiences with Leccino, Frantoio, Moraiolo and San Felice to a National project on traceability?
August 26th 2015	FoodQualityNews.com	Agroisolab UK launches SIRA food authenticity service	Agroisolab UK has launched a food authenticity service using a technique to verify the origin of foods and boost traceability efforts.
August 21st 2015	FoodQualityNews.com	US researchers uncover mislabelled meat in two studies	Mislabelled meat - including horse - has been found by US researchers in two separate studies who said reasons for the finding could vary from economic adulteration to accidental cross contamination.
August 19th 2015	AgroIsoLab	Combating food fraud in practice: the Jamaican Coffee Police	...In Jamaica, a task force has assembled. In an effort to combat rampant fraud, the Coffee Industry Board of Jamaica (CIB) are continuing efforts to ramp up efforts to protect the country's national premium export "Blue Mountain Coffee."...
August 17th 2015	FoodQualityNews.com	Genetic ID launches PCR test for oregano authenticity	Genetic ID (Europe) has launched a rapid detection method of myrtle and olive leaves in dried oregano.
August 16th 2015	ffington Post	Tracking the origin of food: the intriguing case of [illegible]	...Once again, illustrator Nicholas Blechman has graced the pages of the *New York Times* with an infographic meant to help readers navigate the [illegible]
August 15th 2015	The Yorkshire	[illegible] future horsemeat scandals	[illegible] industry, could be consigned to the past thanks to revolutionary technology developed in Yorkshire.
August 10th 2015	Chromatography Today	Fake rice? Chromatography searches for a grain of truth	Food adulteration and labelling issues is a problem for consumers all over the world — but surely rice is safe from disreputable practices. Unfortunately not.
August 4th 2015	Securing Industry	New adulterated [illegible]	[illegible] in products sold by the Auchan supermarket chain in Russia, according to a government agenc
August 3rd 2015	FoodManufacture.co.uk	RSSL offers tests for adulterated oregano	A new service for verifying the authenticity of dried oregano has been launched, following news of high instances of adulteration of the herb on sale in the UK.
July 31st 2015	New Food	RSSL addresses concern over oregano adulteration	RSSL ha launched a new service for verifying the authenticity of dried oregano.
July 28th 2015	Swissinfo.ch	Bacteria to protect Appenzeller cheese from fakes	Researchers from the Swiss agricultural research centre Agroscope have isolated unique lactic acid bacteria that can serve as a "barcode" to help
		origins after Senate vote	takeaway shops to disclose if their seafood is local or imported.

More correspondents welcome!

List Ai

Citizen science: Seafood sampling in restaurants

Step 1: Go out for dinner!
Step 2: Order something fishy
Step 3: Place a small amount in the provided tube*
Step 4: Send it back to us.

The results are that FoodIntegrity will get an amazing sample set… and you will get into the prize draw to win an amazing prize!

If you want to get involved, contact Miguel (mpardo@azti.es)

*We will send you a protocol and everything you need to do the sampling

Seafood sampling and analysis

200+ samples collected from 7 EU countries

100 samplers, some have not been very active yet

Sampling will continue for the rest of the year, then analysis will start, and comparison with claim

Input-Output analysis

For companies, sectors or regions: Compare records and reports showing landing, production and export.

Where did the fish come from?

Reported amount fish / product landet or transported into region:						
1000 tons	Landed	Finnmark	Troms	Nordland	Other	Sum
Finnmark	61254		1439	0	217	62910
Troms	70853	163		513	0	71529
Nordland	88188	0	128		85	88401
Andre	49005	0	0	212		49217
			567	725	302	272057

Reported amount fish / product used or sold						
1000 tons	Processed	Norway	EU	Russia	Other	Sum
Finnmark	20131	11324	18244	10695	7549	67943
Troms	20028	10014	17167	12160	10014	69383
Nordland	26520	14144	25636	12376	9724	88401
Andre	15257	8367	14273	8859	4430	51186
Sum	81937	43849	75320	44090	31717	276913

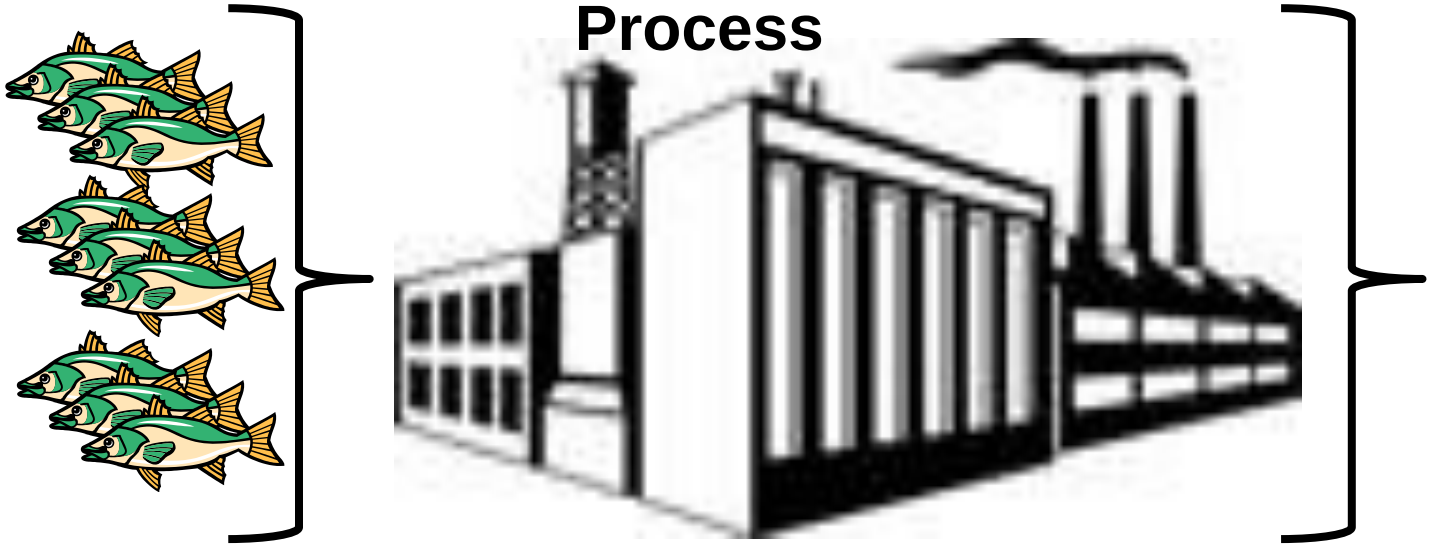
Significant discrepancy!

Where did it go?

Extensive seafood value chain analysis in H2020 project PrimeFish

Mass balanse accounting

For processes: Using our knowledge of the raw material and the process type to establish typical or optimum conversion / yield factors, and then comparing process input with process output.



Batch 112
Batch 112
Batch 112
Batch 112
Batch 112
Batch 112
Batch 112
Batch 112

Raw material used to produce Batch 112: 10t

Significant discrepancy!

Amount of fillet in Batch 112: 8t

5) Choose the best solution

Analytical methods

- Can detect misdescription on actual samples, for the product being investigated
- Can detect the most dangerous forms of misdescription related to food safety
- Can provide fairly definitive results, usable in court of law that are difficult to argue with e.g. DNA based methods
- Proven scientific methods, based on well-established body of knowledge
- Can be non-intrusive i.e. intelligence gathering

Strengths ⟷

Paper trail methods

- Can detect misdescription related to any food product properties
- Can detect volume and scope of misdescription
- For food safety incidents, can be used to find source of contamination
- For food safety incidents, can be used to effectuate recall

Nofima market

Analytical methods

Weaknesses ⟷

Paper trail methods

- Can only detect misdescription on the tested samples, not the overall volume or scope and rarely in real time, i.e. production run has already been distributed / consumed
- Can only detect misdescription related to the actual chemical and physical properties of the food
- May be very expensive or time consuming
- May require expensive equipment

- Can normally only detect that misdescription happens, not exactly where, when and by whom
- Can normally only detect contradictions, that a claim somewhere does not match a claim somewhere else
- On company level, requires access to company records which means formal powers of entry
- On sector or national level, requires extensive recording and access to data

Summary and conclusions

- Analytical methods are essential, but they cannot alone solve the problem of ensuring food authenticity
- Some food fraud types do not involve any change in biochemical properties
- Some food fraud types involve faking claims that cannot be verified analytically
- Paper trail methods are also needed
- Paper trail methods can make analytical sampling more efficient by indicating where, when and who to sample
- Eating fish in Brussels is not a good plan

Thank you for your attention

Petter Olsen

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The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 613688 – FoodIntegrity and from the Horizon 2020 Programme (H2020/2014-2020) under grant agreement n° 635761 – PrimeFish.