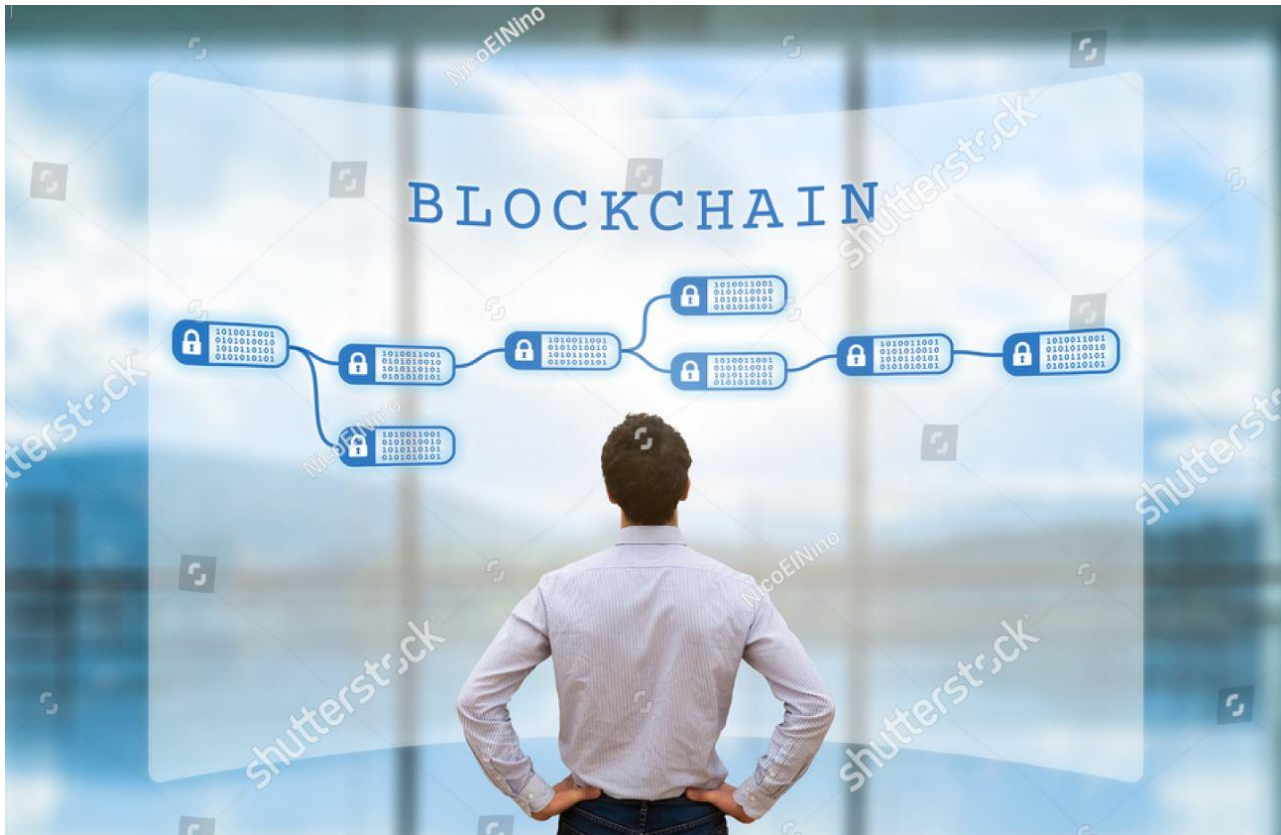


# Blockchaining food chains: novel data approaches for sustainability



EFFoST, October 22th, 2021

**Henning Høgh Jensen**

**Head, Food Technology**

**Technical University of Denmark**

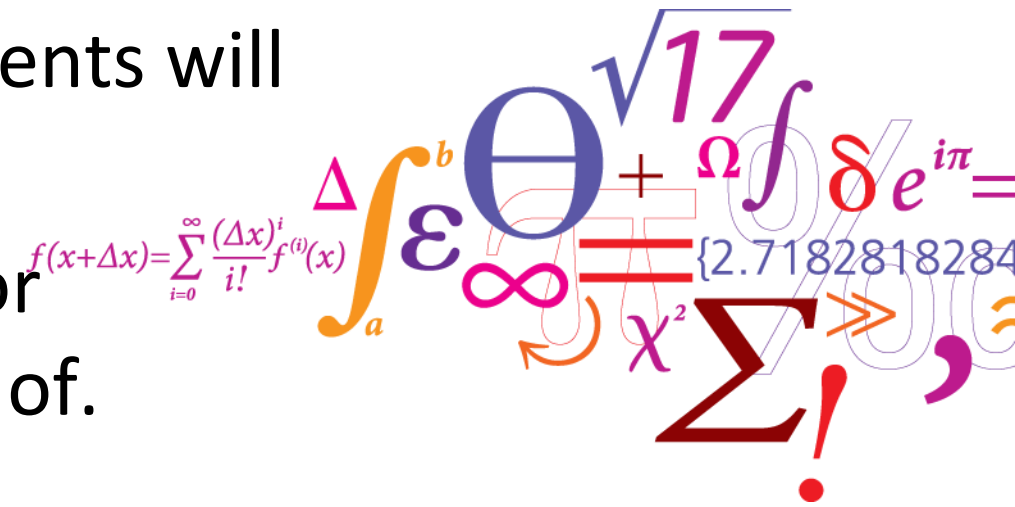
$$f(x+\Delta x) = \sum_{i=0}^{\infty} \frac{(\Delta x)^i}{i!} f^{(i)}(x)$$

A collection of colorful mathematical symbols and formulas, including  $\int_a^b$ ,  $\epsilon$ ,  $\Theta$ ,  $\Omega$ ,  $\delta e^{i\pi}$ ,  $\infty$ ,  $\chi^2$ ,  $\Sigma$ , and  $!$ .

# Abstract

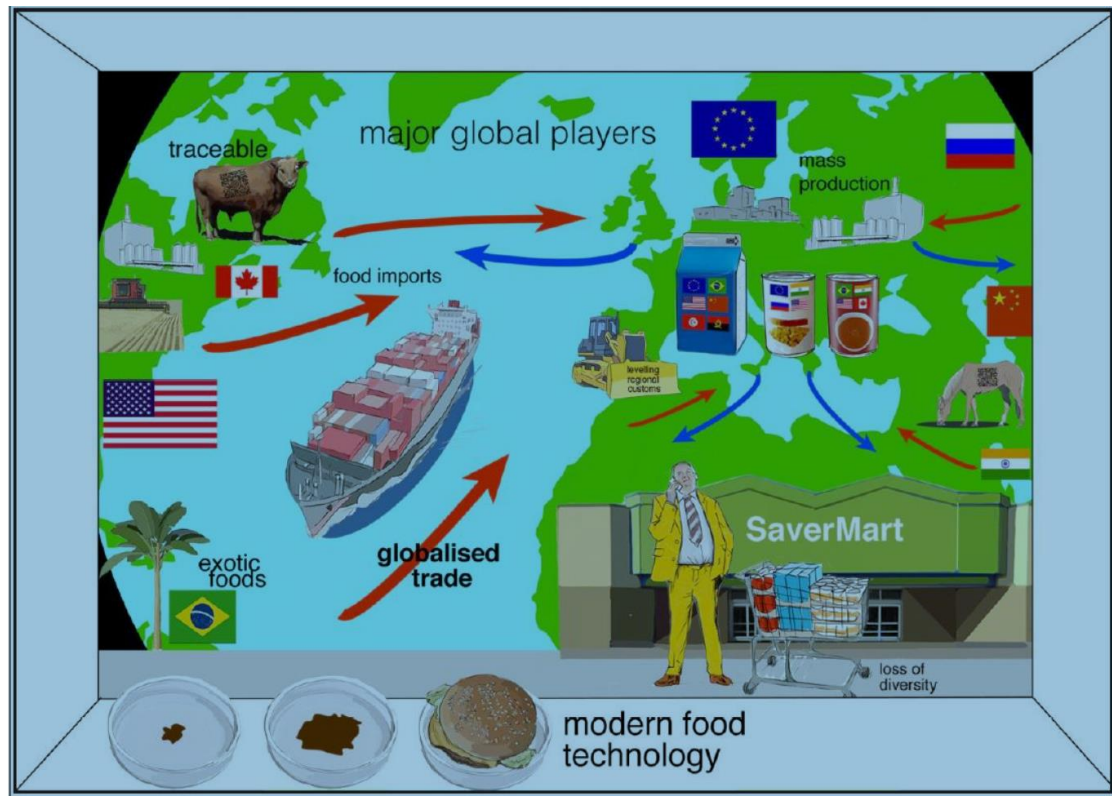
New developments in Food-Tech and Digitalization-Tech will greatly influence our capability to govern food chains towards more sustainability, while simultaneously the same tech-developments will change the food chains them selves.

This pitch will highlight some of the major developments that you should be aware of.

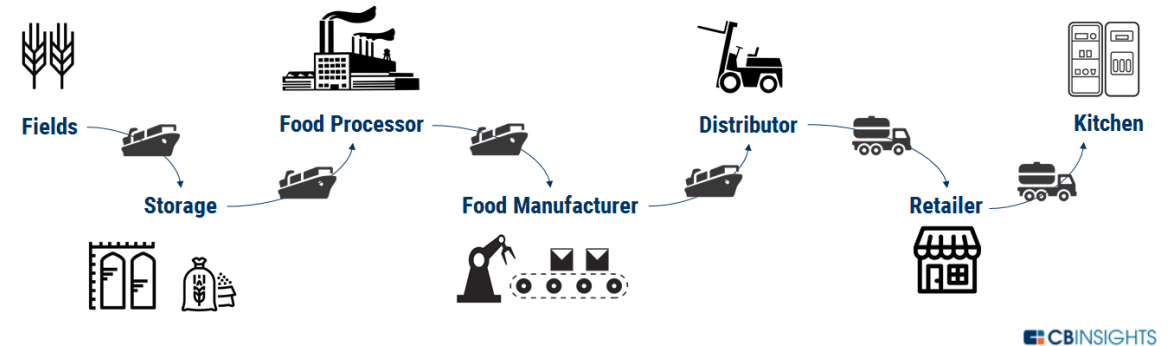


# Globalized food value chains

**- can all these broken chains be mended by tech?**



The complex global food supply chain



- Traceability and fraud of valuable products = authenticity vs. control and chances of being caught vs. punishment
- Trade barriers / Paper based bureaucracy in an increasingly digital world
- Distrust between authorities and business (safety above all)
- Consumers search for sustainable and healthy foods /we have become urban dwellers
- Businesses' dislike of sharing data

# Why we should show this interest

Actors in value chain	• Wants....
<b>Consumers</b>	<ul style="list-style-type: none"> <li>• Wants transparency</li> <li>• Wants healthy products</li> <li>• Wants provenance</li> </ul>
<b>Retail</b>	<ul style="list-style-type: none"> <li>• Wants a loyal consumer base (consumers)</li> <li>• Wants insight and trust in their supply chains</li> <li>• Wants efficiency in their supply chain/no waste</li> <li>• Wants to contribute to the green transition</li> </ul>
<b>Processors</b>	<ul style="list-style-type: none"> <li>• Wants a loyal consumer base (retailers)</li> <li>• Wants insight in their supply chains</li> <li>• Wants efficiency in resource use</li> <li>• Wants stable suppliers</li> </ul>
<b>Producers</b>	<ul style="list-style-type: none"> <li>• Wants efficiency in their production</li> <li>• Wants documentation of their products quality</li> <li>• Wants to reach the market with their up-market products</li> </ul>

# First - consumers

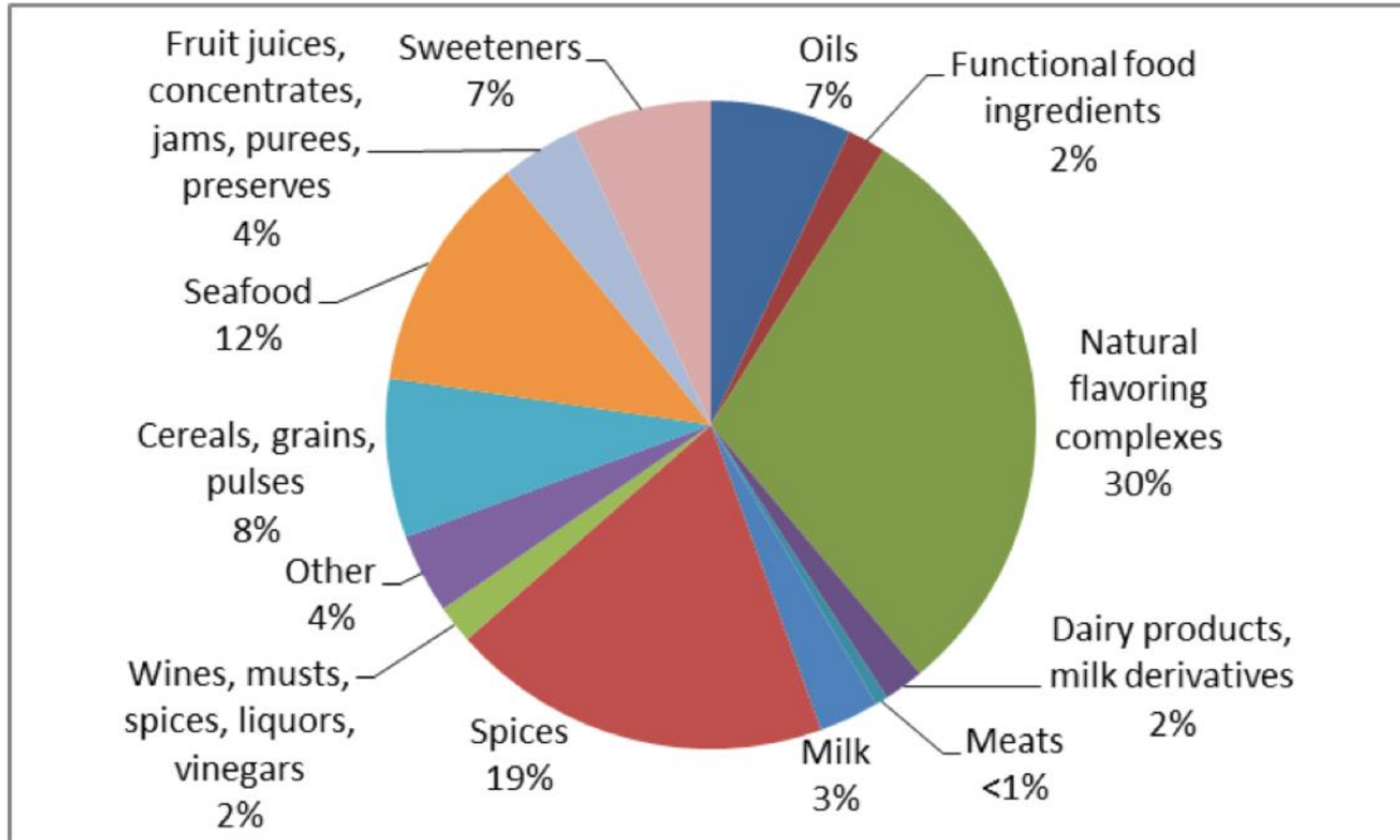
## Four key-trends

- Food markets are rapidly changing towards healthy, sustainable, “planty” foods
- Consumers wants transparency about how healthy and sustainable the foods offered are
- Serious lack of consumer trust in companies’ and authorities’ claims and labels
- Climate accountability is now on top

# Articles on Food Fraud and Adulteration (EU Feb 19)

1. Feb: a survey by University Exeter (UK) on **fish** & chips shops: protected spiny dogfish and shark were sold
7. feb: Dutch judge found trader guilty of commercialising **eggs** contaminated with fipronil. Further the eggs were falsely labelled as from "free range"
7. feb: Uni of Guelph (Canada) mislabelling of **seafood** frequency was 18% in import, 24% in processing and 38% at retailer. Cause fraud and rules that vary between countries.
8. feb: One tonnes **of rotten** food seized in two Italian supermarkets and four restaurants. Labels missing.
8. feb: Italy 3.000.000 litres of **wine** seized as mislabelled ad PDO
12. Feb: Italy found company that fraudulently added sugar to **wine** to increase alcohol content. 450.000 litres of wine seized.
- 14.feb: Uni of Guelph (Canada) found 14% of **sausages** were either mislabelled or cross-contaminated with other meat species than those on label.
- 14.feb: Italian authorities report that most fraud affects **wine, meat and sugar** (?)
- 15.feb: Europol dismantled a criminal organisation that counterfeited trademarks and labels of a famous **winery** in Florence.
16. feb: 27.000 fipronil tainted **eggs** reached marked in Taiwan within last month.
18. feb: Brazilian authorities initiated activity to stop fraud in **rice** sector by mixing high quality with low quality based on samples that indicate 40% does not meet requirement.
19. Feb: Italian found butcher that sold regular beef as Japanese Kobe **beef**.
- 19.feb: Waldeorras in Spain to initiate project to create database with fingerprint information of its wise of **PDO** quality.
- 19 feb: Italian authorities seized 11.000 mislabelled bottles and 1000 littles of **olive** mislabelled as extra virgin.
- 20/2: Portuguese authorities have seized 400 tons of misdescribed **fish**, cheap ones replaced expensive ones.
- 21/2: Evora Uni in Portugal develops and apply analytical fingerprinting of **olive oil** of PDO, PGI and organic origin.
- 23/2: Portuguese authorities have seized 15 tons of **meat** that were non-labelled, half unfit for human consumption
- 26/2: Consumer organisation in Portugal reported 20 samples of minced **meat** to contain sulphite (forbidden) and not stored at right temperature
- 26/2: Nature paper reports on contaminated **berries** from Cherenabyl to be mixed with not-contaminated to fulfil international standards and then sold in Europe

# Food segments where fraud is documented 1998-2010 USA data



Kilde: Johnson 2014  
CRS report

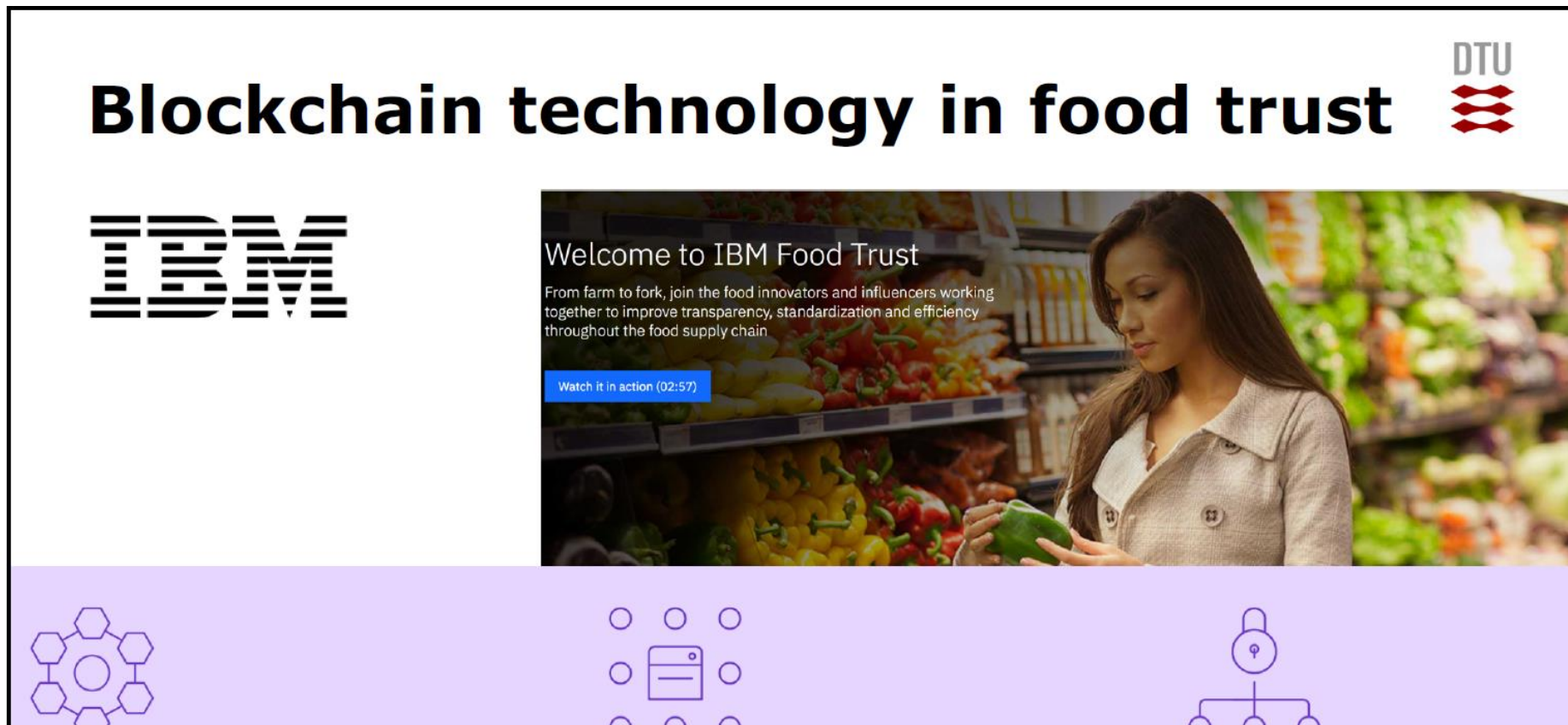
# Secondly - Retail

## Four key-trends

- Simple linear food (block)chains are easy and being rolled out
- Do not want to link to authorities' wish for control and traceability
- Retail try to balance trust on labels and save work on being more open
- Pandemic has changes retail



**After 18 months of testing, IBM's blockchain-based food traceability platform went live in Oct 2018 for global use by retailers, wholesalers and suppliers across the food ecosystem (Aaron Stanley in Forbes, Oct 8 2018)**



The screenshot shows the IBM Food Trust website. At the top right is the DTU logo. The main heading is "Blockchain technology in food trust" with the DTU logo to its right. On the left is the IBM logo. The central video player features a woman in a grocery store examining a green pepper. The video title is "Welcome to IBM Food Trust" and the description reads: "From farm to fork, join the food innovators and influencers working together to improve transparency, standardization and efficiency throughout the food supply chain". A blue button below the video says "Watch it in action (02:57)". The bottom of the page has a purple bar with three icons: a network of hexagons, a server rack, and a lock with a question mark.

Price starts at 100\$/month for SMEs

# Carrefour extends food traceability blockchain

10 months ago | by [Nicky Morris](#)



In March Carrefour launched the first European food traceability blockchain for its Quality Line chicken from Auvergne. Last month the supermarket group extended the coverage to Carrefour Quality Line tomatoes.

# COOP



# A SHOE WITH A PASSPORT

Oh, how we miss travelling. If only one could be a Kamala boot, you would have been strolling straight through Europe this spring:

From the farmlands of Denmark, over a spa stay in Germany and down to the rolling hills of Tuscany.

Kamala's adventures are all well documented in her passport. And that you can see yourself by scanning the QR code in her lining!

Her journey started on a small farm in Southern Jutland, where we found the leather.

Then she headed on to the last remaining Danish tannery, on the island of Fyn.

She then jumped on a truck to Germany and arrived at one of the few gold-rated tanneries in Europe.

Here she got her that luxurious texture and soft matte finish and her deep black colour. It was a real spa treat for her.

Taking her next ride, Kamala travelled to our factory in Florence. United with the rest of the components – the heel and the sole and the insole – she was transformed by hand into the gorgeous stiletto boot you are looking at now.



**Every shoe has a story to tell.  
And we can trace each one  
back to the very beginning.**



**roccamore**

DANISH DESIGN ITALIAN ATTITUDE

## CASE STUDY

OPEN ACCESS

ISSN Print: 2516-3949

doi: 10.31585/jbba-1-1-(10)2018

# Food Traceability on Blockchain: Walmart's Pork and Mango Pilots with IBM

Reshma Kamath<sup>1</sup>*Northwestern University, Chicago, IL, USA***Correspondence:** reshmakamath2017@gmail.com**Received:** 1 June 2018 **Accepted:** 9 June 2018 **Published:** 12 June 2018**Competing Interests:***None declared.***Ethical approval:***Not applicable.***Author's contribution:***RK<sup>1</sup> is the primary author responsible for data collection and writing the manuscript. The Blockchain Research***Abstract**

In response to food contamination scandals worldwide, retail giant Walmart is tackling food safety in the supply chain using blockchain technology. In 2016, it established the Walmart Food Safety Collaboration Center in Beijing and plans to invest \$25 million over five years to research global food safety (Yiannas and Liu, 2017). Using IBM's blockchain solution based on Hyperledger Fabric, Walmart has successfully completed two blockchain pilots: pork in China and mangoes in the Americas (IBM, 2017). With a farm-to-table approach, Walmart's blockchain solution reduced time for tracking mango origins from seven days to 2.2 seconds and promoted greater transparency across Walmart's food supply chain (Yiannas, 2017). IBM

# How Bumble Bee Foods And SAP Use Blockchain Technology To Track Fresh Fish From Ocean To Table

[https://www.youtube.com/watch?v=-bq8fp7\\_I4k&ab\\_channel=ServicesandSupportfromSAP](https://www.youtube.com/watch?v=-bq8fp7_I4k&ab_channel=ServicesandSupportfromSAP)



**Bernard Marr** Contributor   
Enterprise & Cloud

Shoppers buying Bumble Bee branded tuna later this year will be able to take advantage of blockchain technology to ensure the fish they are buying is fresh and from a sustainable source.



# Thirdly - Processers

## Four key-trends

- Bigger companies have the competencies and muscles
- SME's do not although they often produce upmarket products
- No horizontal integration / Vertical – yet to be seen
- Blockchain solutions merge with other TEK solutions (smart contracts, Tokens, AI, etc)

# Twisted Leaf

PRODUKTER

VORES HISTORIE

KAFFEBØNDER

KAFFEBLADET

KONTAKT

FORHANDLERE

EN

We love moments  
and reasons to love





## Examples of companies that work with blockchain from the USA market



# Fourthly - Producers

## Four key-trends

- Agriculture/horticulture digitalise big time /farmers are being data platform managers
- Seeking digital ways for being integrated with their supporting business (agrotech, etc)
- Trying to go green/up-market to survive as mass produced products are under pressure
- Sharing of data is a great challenge / culture change

# East Africa export to the EU

- The newspaper "Politikken" July 8<sup>th</sup> 2021

On average, to export a bucket of cut flowers to the EU, goes through 30 steps (tax, health, export, import, transporters) that all requires a piece of paper and a stamp- it accumulates to 80 pieces of paper to fill out.

After 2 years of development and testing, the company IOTA launch their solution. To be expanded to fish, coffee, tea, etc.

Britain wants the same system ..

trene lunere, så sneen smelter tidligere og ressurserne. De rekorthule temperaturer omfals naturligt nok i fiske, svenske og norske medier, men også britiske Guardian har beskrevet hedeølgen. Ekspertter kæder

vien som 10-15 grader varmere end normalt, og da system i Canada ramte 49,5 grader skrev han: 'Jeg troede ikke, at det var muligt i hvert fald ikke i min levetid.' Her er et billeb vil der blive sat som århundreder.

Heden både i USA og Canada og i det

drøjer.

Vi ved, at klimaet vil give mere skærsnit, men om et enkelt øvej eller en hedeølge skyldes, at jorden er blevet varmere, kan være svært at sige. Jestrømmen

menter de.

Vi må ierbølge de kunstige grænser mellem vejr og klima, som eksisterer i vores forskning, i vores uddannelsessystem og i den offentlige samtales.

[www.dtu.dk/nyheder](https://www.dtu.dk/nyheder)

## Østafrika overhaler EU indenom og omfavner med glæde ny teknologi

Efter en dansk idé er handelsvejen fra Østafrika til Europa blevet til en motorvej, som det britiske eksportråd også gerne vil ind på. Men digitaliseringen går noget trægere i Europa end i Afrika.

**TECH** JENS BOSTRUP

**N**år en buket afskårne blomster fra Kenya lander i dit supermarked, har den været gennem 30 forskellige led - toldkontor, sundhedsmyndigheder, eksportkontrollør, importkontrollør, transportør - der hver især skal have et stykke papir med et stempel fra det lo- regulerende led i kæden. I gennemsnit skal en afrikansk virksomhed udfylde 96 styk- ker papir for at nå frem de europæiske hylder.

Med inspiration fra en dansker og øko- nomisk støtte fra EU har Kenya digitalise- ret processen, så det nu er væsentligt hurtigere og billigere. Efter et par år med op- bygning og test blev systemet tirsdag medt kørelært.

Og dermed overhaler Kenya Europa in- denom.

Det britiske eksportråd, der efter Brexit har lært EU's handelsbureaukrati at ken- de på den hårde måde, presser på for at få indført systemet på vore breddegrader.

Indførelsen Frank Matsaert, direktør for Tra- deMark East Africa, der står for det.

Systemet bygger på den samme tekno- logi, der bruges til betalinger med den di- gitale valuta lota.

»Det betyder, at der er samme sikker- hed for dokumenternes ægthed, som der er omkring en pengeoverførsel«, forklar- er Jens Munch, chef for handel og forsyn- gskæder i Iota.

Tidligere arbejdede han i A.P. Møller- Mærks afdeling for socialt ansvar, hvor han fokuserede på at mindske bureaukra- tiske handelshindringer i Østafrika. »Det er en af de mest effektive veje til at skabe udvikling og flere arbejdspladser, siger Jens Munch.

Da han for fire år siden skiftede til Iota, indså han, at den nye form for block- chain, der oprindeligt blev udviklet til be- talinger, også kunne give den gamle kæp- pehed helt nye digitale kræfter. Frank Mat- saert var helt med på ideen og hyrede Iota til at udvikle systemet.

**Derefter fisk, kaffe og te**

Med de kenyanske blomster og hele den grundlæggende infrastruktur på plads er strategien at udvide med stadig flere øst- afrikanske lande på den ene side og sta- dig flere sektorer på den anden. De næste er fisk, kaffe og te.

Fidusen i systemet er, at eksportøren kun skal afgive oplysningerne én gang, hvorefter alle de øvrige aktører kan tilgå den del, der er relevant for dem, og svinge det digitale stempel. Og de skal ikke vente

på, at det forrige led har givet deres. Sam- tidig bliver det helt åbenlyst og gennem- sigtigt, hvis en af de offentlige myndighe- der forsinket processen uden grund. Det er en kilde til ekstrastress for embeds- mændene - og til frustration for de hand- lende - at man ofte er nødt til at smøre sy- stemerne med lidt bestikkelse for at få pa- pierne godkendt, især hvis man har travlt.

»Med digitalisering og automatisering forsvinder muligheden for korruption ud af ligningen«, siger Frank Matsaert.

Men giver det ikke modstand fra embeds- værket, når en mulig indtægtskilde forsvin- der?

»Vi har mødt modstand, men generelt mest på de lavere niveauer. I toppen og på det politiske niveau er der en helt klar for- stæelse af, hvor meget det her betyder for Østafrikas udviklingsmuligheder, siger Frank Matsaert.

Desuden er det bliver væsentlig svære- re at forklæde khat, en euforiserende plante, som blomsterne bliver skåret af og sendt af sted, til de står på hylderne i EU fra 5-6 dage til 3-4 dage - en uhyre væ- divedt faktor for produkter med kort levetid.

**Drives af en fond**

Den underliggende teknologi er en vide- reudvikling af blockchain, der blev op- fundet i 2008 til brug for bitcoin. Proble- met med bitcoin er, at det kan være rela- tivt dyrt at få godkendt transaktionerne. Prisen er tilmed uforudsigelig, da den af- hænger af udbud og efterspørgsel. I april nåede det gennemsnitlige gebyr op over 380 kroner, men er siden faldet til lidt un- der 50.

Iota har fundet en sikrere måde at få godkendt transaktionerne på, som gør

det fuldstændig gratis. Systemet er udvik- let og drives af en almennyttig fond, der ikke skal tjene penge på det.

Samtidig kan Iota system, kaldet Tang- le, håndtere mange flere transaktioner. Hvor bitcoins blockchain kan klare 7 i se- kundet, kan Tangle ekspedere over 1.000.

»Det giver mulighed for at tænke i helt andre forretningsmodeller. Det kan f.eks. blive en vigtig brik i den cirkulære økono- mi,« siger Jens Munch.

»Vi kan mærke hver eneste stykke pla- stemballage med oplysninger om, hvor- dan det kemisk er sammensat. De oplys- ninger kan aflæses af sensorer, som kan sikre en helt præcis sortering, det gør af- faldet meget mere værd,« siger han.

Det kan også bruges til at mærke selve produkterne med oplysninger om, hvor- fra det kommer, og hvilke forhold de er produceret under.

»I dag kan vi se, at en container med blomster kommer fra Kenya. Men der er intet i vejen for at mærke hver enkelt bu- ket, så du kan se, hvilken farm den kom- mer fra,« siger Jens Munch.

**Digitalt foran Europa**

Det er ikke første gang, østafrikanerne er længere fremme i skoen end europæer- ne. MobilePay blev introduceret i Kenya under navnet M-pesa, 10 år før det kom til Danmark.

»Jeg oplever en meget større appetit på at omfavne ny teknologi i Østafrika end i Europa, måske fordi udviklingen i det h- le taget går så meget stærkere i den del verdens,« siger han.

Som it-rådgiver for det britiske pa- ment oplever Jens Munch også fra Iota parket, hvor meget trægere det går i EU pa.

»Selv om det britiske eksportråd ser på for at overtage det nye østaf- ske handelssystem, tager det nogle- gere tid at få sat britiske og euro- politikere og embedsværk i bevægelse,« siger han.

[jens.bostrup@iota.dk](mailto:jens.bostrup@iota.dk)

# Outstanding issues

## Four key-trends

- Processers and Producers struggle with ESG (e.g. Danbreed – last week)
- Startups goes for disruptive innovation – bigger do not
- Data is key in future, data-driven economy, 4<sup>th</sup> industrial revolution
- Tech developments are being interwoven

# Smart contracts – now startups enter this arena



The screenshot shows a news article on the website of the Danish Financial Supervisory Authority (FT). The article is titled "ZTLment indtræder i FT Lab for at teste afvikling af betalinger ved brug af blockchain". The article is dated 22. APR. 2021. The article text discusses ZTLment's business model and its participation in the FT Lab to test decentralized payment processing using blockchain technology. The article is written in Danish.

**FINANSTILSYNET / NYHEDER OG PRESSE / PRESSEMEDDELELSER / 2021 /**

**OPRETTET: 22. APR. 2021**  
**OPDATERET: 22. APR. 2021**

## ZTLment indtræder i FT Lab for at teste afvikling af betalinger ved brug af blockchain

*ZTLment ønsker at gennemføre betalinger ved brug af en af virksomheden udviklet smartkontraktløsning. Testen skal give et dybere indblik i betryggende brug af blockchain og smartkontrakter til at afvikle betalinger decentralt.*

ZTLments forretningsmodel er en ny måde at understøtte afviklingen af betalinger på.

Under testforløbet skal det afklares, hvordan betalingsløsninger baseret på smartkontrakter kan håndteres indenfor rammerne af den finansielle lovgivning. Potentialet og risiciene ved brug af smartkontrakter på blockchain til afvikling af betalinger skal også belyses. Testforløbet vil være med til at bidrage til en bedre forståelse af, hvordan blockchain kan anvendes på betalingsområdet.

**DEL ARTIKEL**    

**KONTAKT**  
Kontorchef  
Tobias Thygesen  
+45 33 55 82 70  
tot@ftnet.dk

**NYHEDER OG PRESSE**  
Pressemeddelelser  
Sektormyt  
Information til pressen  
Advarsler fra andre tilsynsmyndigheder



## Nature Preserve exists to enable a transparent and sustainable future.

Nature Preserve was born in 2018 with the mission of fighting food waste. We have experimented with dehydrating surplus fruits and vegetables for smoothies and even developed a mobile food pureeing unit to minimize food waste.

In early 2020, we went looking for services to understand the impact of our own production. The services we found were either too expensive, too static, or too generic. Besides all, we could not see how this extra cost could make us more environmentally and financially sustainable.

Unable to find a sensible tool or service, we did what any nerd would do – build our own system!

Today, we are growing our traceability and climate impact analysis solutions and still working hard to improve the food supply chain.



# Sustainability, traceability, trustability is getting interwoven



## **Example 1: No waste in 10 years**

Tech-developments like precision fermentation builds on data catalogs of where waste is available in what form to produce cheap animal-like proteins cheaper than traditional livestock husbandry

Consequences: disruption of livestock sector (strong environmental benefits), strong reduction of waste, what waste there are is being upcycled

## **Example 1: Winning the loyalty of consumers**

All food items are documented in terms of provenance, production conditions, and climate footprints

Consequences: Blockchain technologies merge/combines with the enormous amount of data from primary agriculture with LCA technologies to estimate footprints. This in open source databases that startups are basing their business on



Contact:

Henning Høgh Jensen  
Head of Division

Technical University of Denmark  
DTU Food  
Kemitorvet  
Building 201, Room 228  
DK-2800 Kgs. Lyngby  
Mobile: +45 40251222  
hehje@food.dtu.dk

[www.dtu.dk](http://www.dtu.dk)

Follow us on:

