Blockchain and other new technologies for the transmission of traceability information and other data in the seafood supply chain

Webinar

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Report

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INTRODUCTION

- **Opening Message by Kenn Skau Fischer, Executive Committee Chair, NSAC**

Kenn Skau Fischer opened the webinar by explaining the aim of the event, which was to explore applicability of emerging technology of blockchain.

He noted that there was a digital revolution ongoing with mobile technologies, smart technologies, drones, remote-sensing, distributed computing, blockchain, the Internet of Things and artificial intelligence.

The digital revolution seems crucial in the current state of affairs exposing the fragility, but also importance of seamless supply chains. Disrupted supply chains are fishermen's and aquaculture farmers' biggest challenge, and the same holds for processors, wholesalers and retailers. Perishable goods require systems that are seamless, efficient and effective. Consumers demand systems that are reliable, fair and transparent. We need food that is sustainable.

This webinar with its prominent speakers, academics, policymakers, technology experts and enthusiasts, and perhaps most importantly, users, tried to shed a light on the benefits and challenges of current and new seafood traceability tools, with a focus on blockchain.

Its applicability was examined through the lens of European policy – ongoing revision of Control regulation introduced provisions to ensure electronically recorded traceability information, supported by the Farm to Fork Strategy highlighting the new regulation's contribution to the fight against fraud through an enhanced traceability system.

Besides traceability information, blockchain can also be a tool for transmission of other data along the chain with specific purposes, such as fisheries control, fight against food fraud, product labelling, information to consumers, voluntary sustainability claims, and certification schemes.

Primary producers, both fishers and aquaculture farmers, are the first and crucial link in the seafood value chain. It is important that input data reflects, as much as possible, the reality on board and on the farm, and that the data is securely stored and managed.

This offers a potential way for our fishermen and aquaculture farmers to prove compliance. It is therefore important to investigate it with an objective stance and open mind. With this, the event was launched with first expert presentations summarised below.

- **FAO's work on blockchain in fish value chains - Presentation**

  Nada Bougouss, Senior Fish Value Chain Expert, FAO

Nada Bougouss kicked off with a presentation of the FAO document on Blockchain application in seafood value chains published in 2020.

She noted that blockchain technology can potentially be used to enhance traceability and transparency of agri-food value chains and specifically seafood value chains as well as to contribute to socioenvironmental sustainability of the food systems. It is important to further explore the capacity of such digital tools in the midst of a new digital era of innovation.

These tools shall be explored to improve livelihoods, working conditions, security transparency and traceability for farmers and small-scale producers. This will ultimately aim at stopping the paradox of small-scale farmers or fishermen being at risk of hunger and malnutrition this being the core mandate of FAO.

FAO started to look at blockchain in seafood value chain in 2020 and published a document to demystify blockchain technology and provide thoughts on the opportunities and challenges in order to implement it, having in mind small producers and developing countries. So far there had been many studies and applications in finance and global trade but limited applicability studies in seafood value chain.

Ms Bougouss presented its **five objectives:**

- Objective 1: Provide a review of blockchain technology and general applications in food production systems.
- Objective 2: Review digital tools and technology adoptions in seafood value chains.
- Objective 3: Review and analyse applications and opportunities of blockchain technology in fisheries and aquaculture value chains.
- Objective 4: Present public policy and trade implications of the application of blockchain in fisheries and aquaculture value chains.
- Objective 5: Provide policy recommendations for governments and international organizations.

FAO looked at seven case studies through a communality analysis and there were mainly **five similarities across these:**

1. Clearly defined value chains with known actors: Most of the projects had relatively short and clearly defined or vertically integrated value chains where the actors were known. This is an important feature in order to apply blockchain particularly in the

seafood value chain where the supply chain is more a system than a clearly defined value-chain given the numerous stakeholders and actors.

2. High-value fish species: Projects focused on tuna and Patagonian toothfish species, which are considered high-value commodities.
3. Link between digital and physical: All projects rely on some way to link the physical with the digital, either through tagging individual fish or some other means of recording units of catch data.
4. Immutability of data and secure data sharing: These were the most common reasons for utilising blockchain technology.
5. Use of QR codes on product packaging: This method was favoured, possibly because of its utility.

Four challenges were identified:

1. Complex seafood value chain scenarios untested: Solutions were not tested in real-world complex seafood value chain scenarios where the value chain actors were unknown.
2. Tagging and labelling of fish: Physical fish tags/labels could be lost or damaged while transporting the fish or could potentially be tampered with.
3. Reliance on human input: Most of the projects rely on human input of fish data, which themselves could be open to tampering.
4. Verifiability of private and consortium blockchain platforms: By their very nature, these types of blockchains are not open to the public and transactions on them cannot be independently verified.

Main recommendations:

1. Critical forethought needs to be given to traceability along the value chain before considering blockchain as an application or a tool for traceability in the seafood value chain:
    - Need for an exhaustive understanding of all possible – as distinct from desirable – supply-chain events and scenarios under consideration so that traceability can be sustained.
    - Need to be a clear definition of CTEs (critical tracking events) and KDEs (key data elements) to be covered. CTE = points in supply chain where data need to be recorded and KDE = elements corresponding to those CTEs.
    - For regulatory purposes, the segments of the analysis need to consider the administrative, logistic and legal aspects associated with the types of "States" having custody of fishery products.

- Need to be a clear understanding of the current operational and logistic limitations of the current traceability system in existence.

2. <u>Critical forethought needs to be given to blockchain as an appropriate tool for traceability:</u>
   - Use a well-designed decision tree, or other decision model, to determine whether it is the right tool to use or if a data base is better suited.
   - If blockchain is chosen as the appropriate tool, then attention still needs to be given to:
     - Operational considerations,
     - Security considerations,
     - Electronic data interchange,
     - Regulatory uncertainty,
     - Increased responsibility of the user

Final/General comments:

To summarize, technology applications should be fit to the right scenario where a technology choice such as blockchain is to follow strict due diligence, legal, commercial and operational level prior to commitments when value and practicality compared to simpler options are demonstrated. The concern is one of the digital divides that organizations such as FAO tries to breach and not to exacerbate when dealing with stakeholders of developing regions bearing in mind the digital divide that small producers or developing countries can encounter comparing to developed countries.

- **Slovenian Presidency priorities on blockchain technology - Presentation**

  Nena Dokuzov, Head of Project Group for New Economy and Blockchain Technologies, Ministry of Economic Development and Technology, Slovenia

Nena Dokuzov presented ongoing work on blockchain at EU level:

- **In 2018** EU blockchain Observatory and Forum was established in a form of a think-tank at the EU level where critical and key knowledge is being accumulated in different areas. **After 2018,** the declaration was signed by 23 Member states on the establishment of a European Blockchain Partnership (EBP). The functioning of EBP was explained further:
  - Every Member State nominates its official representatives for the government and experts.
  - EBP Policy group has a co-chairing system (European Commission and Member States) and is divided into policy group with representatives of Member States, technical group with experts and three working groups (Self-Sovereign Identity, Notarization/Authentication, Taxation and Diploma).
  - EBP has relations with foreign countries, organisations and other EC directorate.
- **In 2019,** a mission statement was adopted with a definition of EBP focus:
  - Sharing experiences, best practices key learnings, close cooperation of policy and regulatory cooperation between Member States towards the creation of a European ecosystem.
  - Promoting interoperability amongst relevant public-sector and private sector blockchain infrastructures.
  - Creation of a new EBSI (European Blockchain Services Infrastructure) User group.
  - Most importantly agreed on the co-chairing system based on the EC Presidency "trio".
- **In 2021:**
  - Digital Europe Programme was adopted.
  - The recovery and resilience programmes were approved.
  - Currently a blockchain strategy within the EBP and upgrading EBSI is in preparation.
  - Two aspects to be focused on in terms of interoperability and traceability are:
    - European early adopters programme with use cases which adopt blockchain and EBSI at an early stage of development.
    - Competence centre where knowledge can be also shared, disseminated, collected, accumulated and then used for specific types of use cases.

Slovenian Council Presidency priorities in terms of blockchain applicability were listed:

- Strengthening the role of EBP in the EU Blockchain Ecosystem.

- Strengthening the role of blockchain technology in the European digital Landscape;
- Further development of EBSI, together with the integration of national blockchain infrastructures for upgrading of EBSI.
- Strengthening of knowledge, skills and competences.
- Identification of the early adopters Use Cases in the field of:
    - Traceability
    - Notarization,
    - Skills,
    - Energy efficiency,
    - Smart cities and communities.
- At the same time, the Presidency foresees the activities in the EBSI regarding national recovery and resilience fund. Here they are connecting further development of EBSI with the use cases that will be developed at the national level.

On the structure of EBSI the following was noted:

- Nodes are set by EC, MS or associated countries.
- Public access to public data to business and civil society (pre-defined data available only to state stakeholders).
- Cross-border interoperability.
- Three-layer architecture: infrastructure layer, service layer, and business for services outside EBSI.

Further considerations:

- Combination of technologies: Blockchain technology can be used in some cases, however not all cases can be predefined for which blockchain could be considered an appropriate technological solution. On the other hand, this technology could be combined with functionalities of other technologies, particularly artificial intelligence. While blockchain is a data-based protocol storing the data and enabling peer-to-peer communication, the AI is collecting and structuring data and provides appropriate information to create the block in the chain of blocks which are constituting blockchain.
- Case-by-case approach: Blockchain is not appropriate for every use case worldwide, however if it is used for industrial deployment and in combination with other technologies it can be valuable and very useful.
- Benefits for Public and private sector: blockchain is strengthening digital capacities of public sector:
    - in terms of digital knowledge and skills, which is directly connected with the higher efficiency in the human resource implementation.

- in terms of better access of the companies to the services of the public sector (through digital identities of the companies and digital identities of the persons)
  - Reducing administrative barriers for private parties when interacting with the public authorities.
  - Reducing cross border barriers.
  - Strengthening the attractiveness of EU national economies and EU as a whole for foreign investors.
  - Legal settlements for better stability and predictability of business environment.

- Blockchain and traceability of seafood supply chain: it is important to examine how blockchain can be integrated in the traceability of seafood supply chain. It could be considered a useful technology for this use case, and it could also be further developed within the use case that is currently being developed within EBP.

Q&A

Question: In any of the studies that have been looked at, were there any interoperability that occurred?

Answer:

Nena Dokuzov: The legal government and the technical interoperability have been analysed to see what the challenges and the solutions are. The challenges identified were:

- Cross-border data recognition: Challenges on the recognition of the data cross-border and on the recognition of the setting of the standards for acceptability of the data have been discovered in the analysis of agri-food traceability use case. This is not the case within the inter-EU use cases due to the same regulatory base for all the countries, but it is more challenging for extra-EU. The standards and the non-equal treatment of the data as well as the accessibility of the data was one of the main challenges for traceability of agriculture. These challenges would likely be faced in the seafood supply chain as well.
- Legal aspects: Some general laws and some industry specific laws can conflict with one another. For example, competition law can conflict with measures for certain types of industries. The accessibility of the data within the clusters can also be challenging.
- Customers are unknown: There can be public blockchain or the public part of the wallet where we can define who can enter the chain and who identifies with which identifier. This is in connection with the digital identity or self-sovereign identity that is taken into consideration with the revision of e-IDAS regulation. Verification and authentication of the person at the end of the chain needs to be ensured. There are different kinds of

data to approach this issue: one is to provide the Know Your Customer (KYC) and the other is the automatic verification through smart contracts where the encriptors need to be defined in advance. There is currently clarification missing with the smart contracts however the definition of the right standards and interoperability between the different regions and sectors should be ensured in a very short time.

Question: Is the EU Presidency focusing on blockchain as the only tool for traceability or are there other tools being analysed?

Answers:

Nena Dokuzov: Other tools are possible such as the internet that can be used to follow the documents. Blockchain is not the only tool, but it is considered the tool for enabling traceability due to its ability to subscribe documents one by one, building the blocks on the basis of the information received from different sources. It is considered the most effective tool for traceability due to the characteristics of the existing technology. Quantum computing can be used for computing of large amounts of data, which can be stored in a cloud. Blockchain can support the traceability of the data in real time. The purpose of an in-depth analysis is to show what are the benefits of this technology to ensure traceability.

Nada Bougouss:

- Regulatory aspects: They are also analysed in the FAO publication and constitute one of the major challenges.
- Interoperability and traceability: For traceability, another tool can help but not solve the problem. There is a need to have a more or less common agreement on the value chain steps that are considered critical and the data needed at that stage. Once the minimum requirements are there in these two aspects, it contributes a lot in setting up the basis for interoperability.

Question: What about permanently storing data versus meaningful duration of data. In agri-food for example, for fish from catching to eating the fish, data are stored for 2, 5 or maximum 10 years, but with blockchain data are stored for ever. Has anybody thought about cleaning up old data or will they be stored for ever?

Answer:

Nena Dokuzov: It depends on the type of data needed. If data are needed for analysis, then historical values are very important. If data are needed only for verification and for security and safety reasons, then when the situation ends the data can probably be used for another

purpose because in blockchain data are accessible in real time therefore they can be used in multiple ways. It considers the efficient use of the data and the efficient use of the data as sources. The question should be the opposite: how we manage these data to be used in multiple situations that can serve and can support certain actions to verify, authenticate and confirm its authenticity? From the original data to the last chain in the block we can rely on that data because it can assure that it is regular, proper and can be verified.

Question: Is blockchain seen by the EU as a means of gathering and storing data or as a tool to help the buyer of the products follow the process along the chain to ensure this fish is sustainable and ensure trust in the product's information?

Answer

Nena Dokuzov: We have infrastructures for sharing, securing and tracing the data and, in another hand, we have use cases like fisheries and food supply chain that is also for the other part of the question. So, we go in both directions.

PRESENTATIONS BY EXPERTS

- **Should seafood traceability systems be based on blockchain technology? - Presentation**

  Petter Olsen, Senior Scientist, Nofima

Petter Olsen started off by clarifying the basic understanding of blockchain technology. He noted that there is some confusion between the advantages of digital traceability systems and the specific advantages or the characteristics of one based on blockchain technology. Nofima has been working with blockchain on several international projects including regional and EU projects.

According to Mr Olsen, traceability is probably the most natural application of blockchain in the seafood industry but there are other use cases where blockchain can be applied in the seafood sector.

Mr Olsen's presentation focused on the components of traceability systems and the attributes of blockchain technology to see how they fit.

Traceability systems have three components:

- Identification of the traceable resource units (TRUs) (the traced unit);
- Documentation of transformations (transformation of inputs to outputs and mutations in the chain);
- Attributes of the traceable resource units (TRUs) (e.g., the weight, the species and the amount).

Mr Olsen offered some background to the emergence of blockchain and general observations and facts:

- A credit crisis in September 2008 that led to a specification of a peer-to-peer system in October 2008 (a system that needed no authority to verify the data such as the bitcoin).
- There had been a lot of euphoria and publicity created around blockchain leading to incorrect information. On the advantages of blockchain, the public is comparing an old or manual traceability system with a digital system, thinking that the advantages of a digital system can be transposed to a blockchain system. That is a misperception, but there are still some advantages.
- Blockchain is an incorruptible digital ledger of (economic) transactions that can be programmed to record not only financial transactions but virtually everything on the value (originally used for transactions from one account to another).

- Blockchain is a database of transactions, a way of storing and organising data.
    - Regular characteristics: online (many users), distributed (many copies), synchronized, encrypted and immutable.
    - Problem: Blockchain is a virtual, online system whereas the fish and food we produce and consume are in the real physical world. Therefore, there will always be a challenge to get accurate data into the blockchain.
    - Advantages: there are some advantages once you put the data into the system.

Mr Olsen further explained how blockchain could improve the traceability systems:

- Identification of TRUs: blockchain cannot improve this since information is observed by real actors and data is entered physically.
- Attributes: blockchain could help, dependingon the accuracy of the attribution.
- Documentation of transformations of data blocks: blockchain excels in that.

In summary, Mr Olsen concluded that:

- Blockchain is an exciting technology that has the potential to underlie a major technological paradigm shift.
- Solution providers are currently overselling the benefits of systems based on blockchain technology.
- Confidentiality and speed can be a challenge for traceability systems based on blockchain technology, but otherwise the technology is well suited for purpose, improving and simplifying interoperability.
- For traceability in the supply chain, blockchain can remedy some potential issues. While claims that are recorded in the blockchain might be erroneous, it will be immediately observable who made such claims, and further it will be visible which claims have not been tampered with.

Nofima report on the subject.

- **Increasing trust and transparency in fisheries with emerging data technologies - Presentation**

  W. Nikolaus Probst, Senior Scientist, Thünen-Institute of Sea Fisheries

Nikolaus Probst opened his presentation with some general observations:

- Everybody produces data in real time (smartphones, computers, etc.)
- The data is connected.
- Connected data can be stored, processed, analysed and converted into new products and services.

From a consumer's perspective, these are the aspects to consider:

- When we have a meal of seafood in front of us, we have questions associated: Where does it come from? What is it? What kind of species? How was it caught? How was it produced? Who made it?
- On a second level we have some deeper thoughts: Hopefully bycatch was not too high. Did the workers have good working conditions? Or hopefully no habitat was destroyed.
- We have those concerns because:
    - Many countries import a significant amount of seafood where the supply/value chain is not very clear, and it is quite hard to trace back what we actually consume in many circumstances.
    - Fisheries is a global and elusive enterprise. Elusive because what happens at sea is hardly observed. The fishing operators are on their own and operate pretty much without observations except for some observers at sea programs which have a very low coverage rate. There is a high level of bycatch of invertebrates or of fish that are not always recorded, we could even say that in most circumstances are not recorded.
    - It is a global enterprise that has expanded the effort through the years (increased totally and spread wider across the globe). Fishing is intense and we often do not know exactly what happens on a vessel.

Mr Probst offered some examples of food traceability i.e., the Egg code

Transparency and traceability are not only issues for fisheries but also for other food products. With the egg code, we can observe some sort of digitalised and standardised traceability system where one can learn: where the egg comes from (countries), how it was reared and who produced this egg. Even though it is not related to blockchain, it relates to data, data storage and big data.

Three technologies that are changing the course of traditional traceability systems are as follows:

- Blockchain: database distributed on many servers and synchronized, updated and can store information.
- Real-time automized data mining (big data): looking at big data, storing and processing big data in real time.
- Artificial intelligence (AI): link with the real-time automized data mining, but AI looks for patterns that are not clearly detectable using algorithms to do so.

Mr Probst further presented examples of joint up technological approach (linking technologies and transforming them into concrete solutions):

- To track the supply chain: A combination of AI and big data analysis together with blockchain can be used to follow the supply chain to eventually allow the consumer to accurately identify the provenance of seafood (what kind of seafood, where it comes from and the conditions on which it was produced).
- Identify catches for the administration or for scientists: Big data or AI can be used to identify what kind of elements are in the catch. It can be processed, analysed and transferred to the administrative authority which records this data and advances it further to the legal enforcer, who then double checks at sea what is recorded on board (in order to verify the accuracy of the data that have been transmitted). Trade quotas and catches: can be similar to real blockchain assets or assets that can be traded on blockchain such as cryptocurrencies. Administration can issue catches and quotas as assets to fishing operators that can buy those and re-trade them amongst them and then report these trading to the administration or to the port (quota allocation and transfers)

- **Decentralised trust in food supply chains – Presentation**

  Tomaž Levak, Founder, Trace Labs Group

Tomaž Levak explained that blockchains are trust networks. They are decentralised protocols (meaning no central authority) that bring trust to the data and value exchanges by enabling:

  - Tamper-proof shared transaction ledger that you can be leveraged and used in many ways.
  - Decentralised identity which is crucial when trying to design certain things that should work without a central authority, you have to rely on identities and replication of social relations.
  - Decentralised finance that might be seen as controversial but are very powerful drivers for innovation and for new models to start to appear.
  - Tokenisation.

When we look at this trust network, we have to look at other tools that have been built on top of them and see that as a tool for this particular use case of food supply chain.

Mr Levak went on to explain what blockchain is not:

- Magical tool that you can buy, and everything will be solved.
- A very performant database for supply chain use case because we have restrictions in terms of data handling by design. By design, it pushes you to publish as little data as possible on such network which is not good for supply chain because we want a lot of data and a lot of descriptions.
- It will not on its own solve the problem, but it is an important factor when it comes to trust.

As a solution Levak offered Knowledge Graphs which are semantic networks and as such an important complement to the blockchain:

- Interesting technologies that were used by Google to map the worldwide web, by Amazon to link the different products, by Netflix for movie recommendations.
- Everywhere you have connected and linked data appearing many times and that is where knowledge graphs make sense.
- In food supply chain, there are a lot of connections (many companies or individuals involved).
- A middle ground should be found where there is the neutrality and the integrity of a decentralised system ensured. Same approach is taken in handling structured data and

linking data very performantly. In this way we can offer something which actually functions and not something that will be forced onto everyone in terms of a system change.

Mr Levak further presented Origin trail, the world's first decentralised Knowledge Graph

- It is Knowledge Graph technology joined with decentralised network to reach the benefits of both technologies.
- Its main mission is to take assets to make them discoverable, verifiable, and valuable.
- It is a move from physical to digital being aware that things can be on paper and can be moved into digital format.
- When we are creating these data, we need to transform them into assets.
- It is a move from web2 data silos to the semantic web3.

Use cases of OriginTrail were listed:

- Trusted factory (BSI and SCAN are using OriginTrail protocol to ensure the integrity of security audits for over 40% of US importers)
- Pharmaceutical industry (in collaboration with BSI AidTrust was launched to bring increased transparency and trust to this industry)
- Food and beverage traceability (examples of Nature Premium and Irish distillery)
- Rail travel safety (Ensuring the safety of train travel by tracking every piece of rail track material used by the Swiss Federal Railways)

Mr Levak concluded with thoughts and recommendations, whereby the following should be understood:

- Blockchains should be considered as trust networks.
- Blockchains are not a silver bullet.
- OriginTrail DKG is great for handling connected data in a trusted way.
- Global adoption is ongoing, fear of (unsuccessful) trailblazing is redundant. Time and effort should be invested to understand the implications for any particular industry.

- **Implementing blockchain in seafood – challenges and opportunities - Presentation**

  Frank Fleming, Founder & CEO, Verifact

Frank Fleming explained that Verifcat provides (mainly to seafood industry) software and support services and delivers sustainability, food safety and quality projects. Verifact has a deep knowledge on seafood industry and on the challenges especially on traceability. Their customers are producers, processors, retailers and State bodies. They use cloud-based infrastructure and blockchain platform to deliver services.

Mr Fleming offered a general definition of blockchain:

- Traditional supply chains depend on the labelling of products from one supply chain participant to another - only meeting the legal requirements of 1 step up and 1 step down.
- Upon introduction of blockchain technology, information is captured on a digital platform shared under a set of permissions with stakeholders to improve the safety, efficiency, value and sustainability of seafood supply-chains while increasing consumer trust.
- For example, a fishing vessels lands products and at points of the supply chain the product might be tested for quality. Traditionally this information would not be available to the vessel itself however using Blockchain technology this information can be share easily among selected participants along the supply chain, including the vessel itself.
- Other benefits include being able to share the story of the product with consumers. For example, through the use of QR Codes on pack.
- An incremental approach could be taken where Blockchain technology could be implemented by sharing data between two or three supply chain participants and eventually moving on to integrate data from scientific data collection and regulatory authorities.

Mr Fleming went on to identify the usefulness of such a traceability system:

- Increasingly, there is a clear added value for participants required.
- In order to keep fishing or the processing industry engage and proactive, there is a need for value proposition.
- Two case studies: Bord Iascaigh Mhara (Irish case study) and Fisheries innovation Scotland (Scottish case study) identified the usefulness of such a project

Challenges and opportunities identified along the way were:

- Challenges:

- Even though the technology might make a lot of sense, taking data can be challenging and that is the case even when the company is willing to give you the data.
- Accessibility for large and small players alike (scalability).
- Solution must be low impact, non-invasive and adaptive. To implement blockchain in seafood supply chain companies do not need a huge capital investment to make this all work. What needs to be done is to take data from existing systems and integrate them.

– Opportunities:
  - Improving supply chain validation.
  - Differentiation of seafood products: catching sector wants a way to add value to their products by showing provenance (as a way of from other products).
  - Food safety benefits.

- **Q&A**

Question: What practical role can blockchain play int the small-scale artisanal fishing fleet?

Answer:

Frank Flemming: It can play a huge role for the small fishing vessels. Most of the entities adopting blockchain are large and often integrated companies that can invest into the technology because they have the financial stability, capital and vision. What needs to be considered is how small players can fit in. For instance, a portal could be used to log on and put information in. It is important that smaller entities take part There is an opportunity to work with both as long as this integration is carefully thought through.

Question: In your study on blockchain technologies, what did you find in terms of interoperability between various blockchains?

Answer:

Peter Olsen: Interoperability is probably the biggest advantage of blockchain over traditional technologies (relational databases). These advantages are mostly for actors downstream, as hey are the ones that have the biggest challenge in merging data. Retailers have relations with a lot of suppliers and the information are requested to be submitted to you electronically, there is a challenge with integrating the data and that is partly the reason why consumers are not getting all the information. Blockchain databases are in their nature more similar than relational databases and simpler for data integration.

Question: What are the prospects of coupling blockchain with automatic image recognition and other AI capturing data at the source as a way to mitigate the problem of garbage-in garbage-out?

Answer:

Nikolaus Probst: There a quite some prospects however it is very much dependent on the AI systems and on what these systems are able to capture. When a catch is occurring it is not only on board, the catching process starts already in the water. Bycatch can occur, which slips off the net before the net lands on the deck. The question is how much of these catch processes or components of the catch an AI system can pick up. Quite some advances in identifying several fish species can be expected, contribution to identification of the distribution of sizes, weight of certain fish species passing a conveyor belt etc. If AI is fast enough and precise enough it will be able to identify fish at species or family level. This would help get more data and fill the gaps of observers at sea who would then only participate in a fraction of fishing trips that occur. If fishing vessels are equipped with these AI systems, they can complement or even eventually replace many of the observers-at-sea trips.

Question: Can blockchain also complement or even replace seafood certification such as MSC?

Nikolaus Probst: In a way it can because you can consider some products as assets that are handled in the blockchain, like cryptocoins. There is potential to proof to the producer or to the industry that something is produced sustainably and in a way the consumer wants it.

Peter Olsen: No, it cannot. MSC certification happens in the real world. You have to make assessments of stocks sustainability, of stocks impact on the seabed and so on. Blockchain can protect the data once it has been stored because it is nothing more than a database. In the case of MSC, blockchain can be used to store the data and ensure that the data is not tampered with and that certificates are not reused. To some degree it can prevent people who are not MSC certified from using MSC certification or not to use MSC certification on products that shouldn't have MSC certification. Blockchain can only help once the data is recorded. MSC certification is a lot more than recording data because it is also implying a process in the physical world.

Tomaž Levak: Blockchain is not a substitute but an enhancement. All sectors can benefit from additional element of trust being introduced. A certification that currently takes place in one way can be improved or optimised by having a component that allows to carry out the part of certification through a trusted data exchange or a trusted data flow. It can help but will not

replace the entire industry and will not make it totally obsolete. There is a lot of expertise that goes into creating a standard or a certification scheme that is required.

Frank Felmming: It can help us because the MSC standards or other standards require a chain of custody to be in place and digital solutions to prove that chain of custody can support better the data that comes from MSC certification. MSC on its own looks at the biological status of the stocks and the technology is not going to replace that but it can improve the chain of custody element where that product is from.

Question: If blockchain were to be made obligatory for seafood in the EU to what extent would that prevent trading of IUU fish?

Answer:

Frank Flemming: If you have knowledge of what has been traded and sold in the supply chain and you can see the origin that has a very large implication for curbing IUU fishing. If you have vision on one system at retail level and volumes and you can see back to the catcher that is a huge improvement compared to traditional systems. It can be very helpful in that regard.

PANEL DISCUSSION

- **Welcome Message by Alexandra Philippe, Executive Committee Vice-Chair, NWWAC**

Alexandra Philippe started off by stating that improving traceability is one of the major challenges for the fisheries and aquaculture sectors in the coming years.

It is clear the European agenda has put the emphasis on traceability in the "Farm to Fork Strategy"- which will hopefully be "From Sea to Plate" - but also in the revision of fisheries control.

This is a question of resource conservation, consumer protection and fair competition for our operators.

To that extent, she noted, we need the most developed technologies to ensure traceability of fisheries and aquaculture products throughout the value chain.

Therefore, we need to learn about the different technologies available to us such as blockchain or a combination of these technologies.

Traceability is a question of control, and it is fundamental, but it also an opportunity for the fisheries and aquaculture sectors to valorise their products, she concluded.

- **Experiences of seafood supply chain operators**

  ***Fisheries*: Patrick Murphy, CEO, Irish South and West Fish Producers Organisation - Presentation**

Patrick Murphy provided participants with some context: Irish South and West Fish Producers Organisation has a membership of 90 vessels in South West Ireland (demersal, pelagic, inshore).

On blockchain and fisheries Mr Murphy noted the following:

- Blockchain is down to individual streams of data that is to be controlled by the different actors in the chain.
- One implements own data, which is deemed to be secured to that individual actor that put the data in, whether it is the fishing boat or the retailer or the processor.
- Each individual person gets to enter their data and that data is secured to them.
- One needs to do this to give trust to the consumers on the products that are being put on the shelves.
- Fishing boats are regulated to a high degree. Each day before fishing vessels leave the port, they have to call in to the authorities to let them know they are leaving. They have systems on board of the boats that track them. They have electronic logbooks that have to be updated every night and they also have to show each area where they fish and the fish that they are allowed to catch.
- By using blockchain, this data should be married into the products they are catching so when they come on shore these can be secured and passed on to next player or actor in the chain.
- The data should belong to the actor. The data should be owned by the one who is filling in the blockchain. It is open to any participant in the blockchain, but nobody can corrupt it nor interfere with it.
- The data should be finished when the fish is consumed. If you keep storing every bit of data, it will become an issue.
- It shouldn't be used for control purposes. about the purpose is getting a better value by creating trust for consumers.
- Vessels and participants of this program would need to see a guaranteed return on investment (willingness to act). If they are to ensure that the consumers are getting a premium product that is trustworthy, they need to be remunerated for this.

Blockchain could be used in other areas such as carbon footprint of the seafood product.

Aquaculture: **Alf-Gøran Knutsen, Managing Director, Kvarøy Fiskeoppdrett AS – Presentation**

Alf-Gøran Knutsen provided the context around the organisation he was representing: Kvarøy Fiskeoppdrett AS is a family-owned farm of salmon in the North of Norway. A small farm where a lot has been done with marketing and own brand in the US.

- Mr Knutsen shared his experience with blockchain. He noted that his organisation was:
  - Working with blockchain for two years, trying to find a solution that could help it be more transparent.
  - A company has full control over the chain of production. It has the possibility to share as much information as possible with the customers and it needed to figure out how this information could be shared as easy as possible.
  - It was a long and time-consuming process, but the objective has been achieved.

At this point, he noted, a push from customers is needed. Mr Knutsen informed that throughout the covid period they have observed that customers are pushing from more traceability, for more openness about production, how the fish is produced and what ends up on the plate.

Processing: **Angel Matamoro Irago, Chief CSR Officer, Nueva Pescanova - Presentation**

Angel Matamoro Irago offered the following context:

- Pescanova is an integrated company among both hemispheres and in more than 19 countries.
- Pescanova blue is a sustainable programme that aims to provide consumers with responsible animal proteins in accordance with the GDST traceability.

On experience with traceability technologies, Mr Matamoro noted:

- The sustainability of marine produces is a mechanism that supports sustainability while providing a tool against IUU fishing. Traceability offers transparency across markets.
- It is important for Pescanova to have an extended traceability over marine products. Therefore, GDST standards has been chosen as mechanism to support the traceability of the products. Among the available technologies, IBM Food Trust has offered the data and traceability required from the markets.
- The new project on traceability have been implemented in their branches in Argentina and Ecuador.

Wholesale: **Britta Gallus, Head of Corporate Responsibility and Transparency, METRO AG - Presentation**

Britta Gallus started off by providing background to Metro AG: Metro is an international food wholesaler represented in 34 countries, 97.639 employees, 25.632 million revenues with 678 locations.

- The main customers are hotels, restaurants, caterers, and traders (business-to-business company).

Regarding their experience with traceability technologies, Ms Gallus noted that:

- Metro started years ago in several countries with a digital traceability solution to comply with regulations (where traceability is a must) and due to the need to provide professional customers with information. The most efficient way was to use a digital solution.
- The digital solution used by Metro is based on globally harmonized GS1 standards with GS1 barcode using EPICS as the technical backbone (not blockchain).
- On the process: There are two data bases fTRACE (used by many retailers and many suppliers) and PIER (in house solution). Both systems are based on the same standards therefore it is easy to connect them. Metro's products are labelled with a GS1 barcode. For seafood, the barcode contains a lot number on the products and the suppliers can chose the database they upload the information in (fTRACE or PIER). All relevant data to be seen and transmitted to our customers are stored in fTRACE or PIER. Due to the labelling of the products with GS1 barcode, check outs are able to read these barcodes and trace them. In addition, customers can scan the barcode and access all the information that are uploaded in the database. This solution is not only used for fish and seafood, but also for meat.
- On main learnings she noted that alignment with Global Dialogue on Seafood Traceability standards (GDST), cooperation with stakeholders and suppliers' commitments are crucial, and that the usage of standards eases the data exchange.

- **Q&A**

Question: Describe the process your company went through to implement the traceability solution. Where there any unexpected obstacles that came out during the implementation?

Answers:

Britta Gallus: It is important to do a proper suppliers onboarding. We rely and depend on the information we receive from the suppliers, from the producers. To do the suppliers onboarding properly and to control the accuracy of the data are of outmost importance. For

that purpose, several means are available. For the supplier onboarding, Metro has a team capable of speaking several languages and able to clearly explain the solution. It is also important to have a variety of options to upload data and an easy process is required. Technology is not helpful if we don't have the commitments of the suppliers to deliver accurate data.

Patrick Murphy: This process is new in the fishing industry. It shows that the industry is constantly working to improve in order to make sure costumers can trust the products. We do need the other actors in the chain to assist us and there must be a financial retribution back to the vessels. Otherwise, you are just adding more regulation and more work on the vessels, and it will break them. It is not possible to keep adding every year more obligations on vessels owners and operators without return.

Angel Matamoro Irago: Our Norwegian colleagues are a step ahead when it comes to traceability. However, we are taking steps forwards to identify where data needs to be collected. Capturing data while you are on a ship is not an easy task. Therefore, supporting mechanism are welcomed.

Alf Goran Knutsen: It is a very expensive and time-consuming process to be implementing all of this. We did not do well enough onboarding of all external data sources. We have been struggling to get everything connected and realise there is no easy fix on this. This is a long way to go and we need to onboard all the systems in a good way. First start easy then add on, going forward. We took in too much from the start and had to go back two steps to make it a bit easier.

Question: Do your suppliers and customers use different traceability systems? How easy or difficult is it to share data across different solutions?

Britta Gallus: There are different maturity levels on the suppliers' side so Metro is offering different possibilities from a manual data upload or the most mature being a one machine-to-machine communication. We need to adapt to the capabilities of the suppliers to make it as easy as possible to ensure that the uploading of the data and the connection of the systems are working.

Alf Goran Knutsen: For the suppliers side it was not a problem. The data are there and transferrable. We have other customers that use systems where we have to manually put all the data into the system and then the processors use that data. What we wanted was a fully automated data system that transfer the data without any manual input.

Patrick Murphy: Blockchain is about information and who inputs the information to make sure that in blockchain this information is secured. It is not about sharing the information unless you put it in a program where there is a specific code for you that makes it secured. Traceability is therefore a different concept. Blockchain is a sealed component of information with an identification number that is specific to the person that inputs that data. Then the next actor in the chain, the processors have their own area where they put in that data that nobody else can corrupt or change or contaminate. It is different when you look at traceability. We have vessels that have a massive number of regulations to comply with to remain legal on the waters. It is always a little bit disturbing when people say that we don't have any information on what is happening on board because they are monitored 24/7. They know exactly where they are at all times. You can use that data stream that is already present if you want to build it in a blockchain. What is important is to put back trust in the consumers to ensure them that the products they are getting is being caught sustainably, under MSY rules and that the countries are abiding by the quotas they are given. The information is there, we just need to share it. My concern is that this information is used far from that purpose of enhancing trust for the consumers but in return they must understand the cost of this.

Question: How do you see the use of these traceability technologies in blockchain in small artisanal fleet?

Patrick Murphy: They have the same requirements as the larger boats. If they are to share the data through blockchain, they have to get access to a portal where they can input that data that is secured. In return you have full traceability back to the vessels. It is not a matter of size of the vessel it is a matter of return they get and whether they are able to do it or whether it is financially viable for them. There is a cost to this, and it has to return to people that participate to this.

Angel Matamoro Irago: Supporting the solution for artisanal fisheries requires incentives for artisan fisheries to adopt digitalization. In order to do so, it is required to provide resources and guidance.

Nada Bougouss: Concerning incentives, some blockchain initiatives have worked because they have some kind of vouchers or tokens for small producers or fishers, so they are on board on blockchain applications. Fishers will see the incentives and will join the project otherwise it will not work. We need to take into account that whatever happens in the business sphere, if that is to be upscaled there has to be a legal framework or a state of readiness for a whole country to adopt IT or digital solutions. It does not apply to all countries and blockchain is not the only solution. It could or could not work at a big scale if the state of readiness does tick all the boxes. There is a lot of things to think about before adopting it.

Question: If artisanal fisheries cannot access this system the result will be that the industrial fleet will have a competitive advantage over small-scale fisheries. This is already happening with MSC. Could this not that lead to the exclusion of the artisanal products in a large part of the EU market?

Patrick Murphy: It is not expensive per se to upload data into a portal. What is interesting is to have a certain premium or incentives to do this because otherwise we don't speak about ensuring trust for the consumers but about regulatory framework. It is about creating trust for the consumers not about creating more regulation or control. If it is the latter, then it will go against what the industry goes for.

Angel Matamoro Irago: Any tool for traceability needs to be inclusive. As it was mentioned before, this cannot be a barrier to enter the market. Also, I understand there are technologies out there available a low cost.

Question: What could regulatory institutions, including the European Commission and EU Member States and multi-stakeholder groups such as Advisory Councils do to help for the transmission of traceability information and other data as well as to further related technologies?

Britta Gallus: We mentioned already the fisheries control regulation that is under revision and that includes "lot-based" traceability. How to ensure traceability is up to the different stakeholders. It is not easy. The hope is to have a rule base in the new fisheries control regulation saying that it is digital traceability that should be established. That would help the entire supply chain. There will be different tools to allow digital traceability and we need to ensure interoperability and exchange of data but that would be for the companies to decide. In general, digital traceability needs time, support and patience.

Alf Goran Knutsen: There is going to be a lot of solutions and standardising the data is important because we must be careful not to exclude any technology or producers. The difficult part is not to make it mandatory but to create incentives to encourage people to implement systems. It is time consuming and costly therefore we need to find better ways to implement it.

Angel Matamoro Irago: Standardization must be constructed around functional pre-existing frameworks that are inclusive and with the capacity to have a global reach.

Patrick Murphy: If you do encourage people to be good actors then it is in their best interest to do that. These initiatives are welcomed but at the same time it can put you out of business. Instead of incentivising compliance, you are leading people the other way. The food producers

are expected nowadays to do a lot more with a lot less. If you make it regulatory and force people into this, you are going to create problems. The EU can encourage not only the producers but the entire value chain. It is important that everybody is brough together in this.

Question: What made you decide to go with a blockchain solution rather than a more traditional technology? What were the main costs and benefits you considered for your decision?

Alf Goran Knutsen: We wanted a fully automated system for data. As farmers we have all the information already, but we needed to have a system where you cannot manipulate the data.

Patrick Murphy: For us it just the beginning. We use an outside person. It is something that the vessel owners want to embrace but they want to make sure that it is not the stick but the carrot.

Angel Matamoro Irago: Blockchain is not the only technology that can transmit information in a safely manner. Personally, I consider that companies should have right to choose. The immutability of the data is the key feature of blockchain that we consider that has an added value in traceability.

Question: What were the key learning from implementing traceability in your businesses?

Patrick Murphy: We learned that we need to move forward to meet consumers expectations on sustainability and information need and to be aware of all the possibilities there is.

CONCLUSION

- **Concluding Message by Guus Pastoor, Chair, MAC**

Guus Pastoor concluded the webinar by summarising the main observations, stemming from the presentations of policy makers, experts and stakeholders. The common denominator appears to be obvious: the joint wish to work on the best possible traceability of seafood.

He noted that the policymakers have their own ideas and want solutions mainly to ensure that the products are in line with regulations. The experts want solutions to provide the knowhow and the tools. The stakeholders are keen to demonstrate compliance with legislation and industry standards.

All of this, he added, should end to the best possible guarantee for consumers' confidence in our seafood

Looking at the presentations and debates, we have seen many different elements.

- Blockchain: It is an instrument and not the goal as such. It is a database. The goal is full traceability than can be achieved in different manners, dependent on the specific situation.
- Traceability: Do we speak the same language when we talk about traceability? Several elements were mentioned: some were looking at the sustainability elements, others were looking at added value for the operators, still others talked about legal requirements and also food safety. There are different ways to look at traceability and blockchain would be an instrument to combine all these elements.
- Value chain: We must also think that there is no such thing as the seafood value chain. There are numerous value chains. It is not a matter of one-size-fits-all but a tailor-made application. Per value chain, you need to assess what the needs are and how you will implement the instruments. In this debate, specific attention was asked for small-scale artisanal fisheries. What are the incentives for the operators to cooperate? Is there a willingness to provide all these data? Do we need a legal requirement for digital traceability, or do we need economic incentives from the market?
- Data: Blockchain requires the right data to get to the right result. Are we in a position where we can provide such data? Is there willingness from people to provide these data? Most likely it will require some parties of the value chain to take the lead. In some case it is at the beginning of the chain and in many cases, it is at the end of the chain. Most likely integrated companies will have an advantage because they can work within their own company on data whereas others will have to work with different stakeholders.

Blockchain is all about trust networks without central authority. The question is are we directing it at consumers or at authorities? We have heard many positive ratings on blockchain, and we also heard some critical comments on what we can and cannot expect from blockchain. There is a long way to go in a number of these debates.

SPEAKERS

Moderator:

Philip L. Heggelund, Senior Traceability Expert and Senior Full-Stack Software Engineer, Institute of Food Technologists (IFT) works in the seafood traceability industry and has a deep understanding of software development, data science, traceability systems, and traceability standards. Mr Heggelund co-led the writing of the Global Dialogue on Seafood Traceability (GDST) Technical Standard, participated on the EPCIS 2.0 working group, and has co-designed and developed a traceability solution for seafood. He continues to work on enabling interoperability in the traceability industry and aims to make interoperability as easy as email.

Introduction:

Kenn Skau Fischer, Executive Committee Chair, NSAC is the CEO for the Danish Fishers PO, one of the largest producer organisations in the EU. Mr Skau Fischer has more than 20 years of experience working with fishery policy and management in Denmark and in the EU. He also chairs several positions at national level, including the Danish umbrella organisation, the Fishing Branch, promoting fish and fish products in Denmark.

Nada Bougouss, Senior Fish Value Chain Expert, FAO is part of the Value Chain Development Team (NFIMV), FAO's Fisheries and Aquaculture Division. Within NFIMV, Ms Bougouss worked on post-harvest issues, eco-labelling, certification and traceability. Previously, Ms Bougouss served as quality and marketing specialist for seven years at the Centre for Marketing Information and Advisory Services for Fishery Products in the Araba Region "INFOSAMAK". She also worked as monitoring and outreach officer for one eco-labelling scheme owner. Nada holds a M.Sc in Food Science from the Institute of Agronomy and Veterinary Science Hassan II (Rabat, Morocco) and a M.Sc in Aquatic Food Security from the University of Stirling, UK.

Nena Dokuzov, Head of Project Group for New Economy and Blockchain Technologies, Ministry of Economic Development and Technology, Slovenia, encouraged and led the preparation of the Action Plan for Blockchain Technology, which was adopted by the Government of Slovenia in May 2018. Ms Dokuzov is a national representative at the European Blockchain Partnership. In 2019, she became Head of Delegation of Slovenia at UNECE and was a member of the expert team at UN/CEFACT in the preparation of the white paper on blockchain and practical implications of blockchain technology for the achievement of SDGs 2030. She is also a member of the OECD's Blockchain Expert Policy Advisory Board and a Vice-Chair of the Advisory Group for Advanced Technologies at UNECE.

Presentations by Experts:

Petter Olsen, Senior Scientist, Nofima works with applications of information and communication technology in the food industry, especially related to information logistics, traceability, Internet of Things, blockchain technology, authenticity, fraud, production management, simulation, sustainability and decision support systems.

W. Nikolaus Probst, Senior Scientist, Thünen-Institute of Sea Fisheries, is a fisheries biologist and works on the implementation of fisheries and conservation policies. Mr Probst was involved in several ICES activities around implementing the Marine Strategy Framework Directive. Working on the boundary between fisheries science and management, he was intrigued by the technology of blockchains and sketched some ideas on how new digital technologies could improve the trust and transparency in fisheries in a paper, which is among the first to review blockchains and big data in fisheries.

Tomaž Levak, Founder, Trace Labs Group is also co-founder of OriginTrail, the world's first Decentralised Knowledge Graph. Based on blockchain, OriginTrail connects the physical world and the digital world in a single connected reality by making all different assets discoverable, verifiable and valuable. It is being used by world class companies (e.g., over 40% of US imports including Walmart, Costco, Home Depot are exchanging security audits with OriginTrail DKG) in multiple industries. From physical to digital. From data to assets. From Web2 to the semantic layer of Web3.

Frank Fleming, Founder & CEO, Verifact is a former commercial fisherman. Mr Fleming established Verifact in 2009 to provide software solutions to the seafood industry focused on sustainability, food safety, and traceability. The Verifact blockchain platform is currently used in supply chains in Ireland, the UK, and mainland Europe.

Panel Discussion:

Alexandra Philippe, Executive Committee Vice-Chair, NWWAC is the Fisheries and Maritime Affairs Advisor for the European Bureau for Conservation and Development (EBCD). Ms Philippe holds a Bachelor's degree and a Master's degree in Political Science from the Université Libre de Bruxelles as well as a Master's degree in European Affairs from the College of Europe in Natolin. She worked for eight years in the European Parliament, mostly as parliamentary assistant to the Chair of the Committee on Fisheries.

Patrick Murphy, CEO, Irish South and West Fish Producers Organisation started fishing inshore with his father at eight years old during his school holidays. From a small island off South West of Ireland, Mr Murphy finished school at 18 and began a professional career on the water, progressively as inshore fisherman, offshore gillnet fisher, seine net and later qualifying as shipmaster of passenger vessels. For 25 years, he has been a director, owner, producer and aquaculture farmer. He has been CEO of IS&WFPO since 2016.

Alf-Gøran Knutsen, Managing Director, Kvarøy Fiskeoppdrett AS is a former economics teacher and a recognised pioneer in the aquaculture sector. Mr Knutsen's farm, Kvarøy Arctic, helped to define the Whole Foods Farmed Salmon Standard and is the only farm to have the ASC, SFW, BAP, Global GAP, IBM Food Trust block chain and American Heart Association's Heart Check Seal at one time, effectively making it the most certified and recommended salmon farm in the world.

Angel Matamoro Irago, Chief CSR Officer, Nueva Pescanova oversees Pescanova's Responsible Action and Sustainability Strategy. Mr Matamoro has great experience in consumer food products and has held different management positions in the Nueva Pescanova Group prior to his current responsibilities.

Britta Gallus, Head of Corporate Responsibility and Transparency, METRO AG, in more than 20 years of professional experience, gained a lot of expertise in wholesale and retail business and a profound knowledge in trade associations. Since 2013, Ms Gallus is highly engaged in fish and seafood traceability. Ms Gallus is steering METRO's traceability solution PROTRACE and promoting overarching transparency initiatives with the aim to foster a community approach. Outside METRO, she is Co-Chair of the advisory board of fTRACE and Co-Chair of the Global Dialogue on Seafood Traceability (GDST) Steering Committee.

Conclusion:

Guus Pastoor, Chair, MAC is the Chair of the board of AIPCE, the European Federation of Fish Processors and Importers and has over 25 years of experience in the fish sector. Mr Pastoor is also Chair of the General Assembly of the North Sea Advisory Council and of the North Atlantic Seafood Forum. At the national level, he chairs the Dutch Fish Federation (Visfederatie), the Inter-branch Organisation for Brown Shrimp Fisheries, and is Vice-Chair of the Dutch Fish Marketing Board. He graduated at Rotterdam's Erasmus University with a degree in business and fiscal economic. Prior to his work in the fish sector, he worked as a manager and business consultant in the dairy industry for several years as well as the logistic sector.