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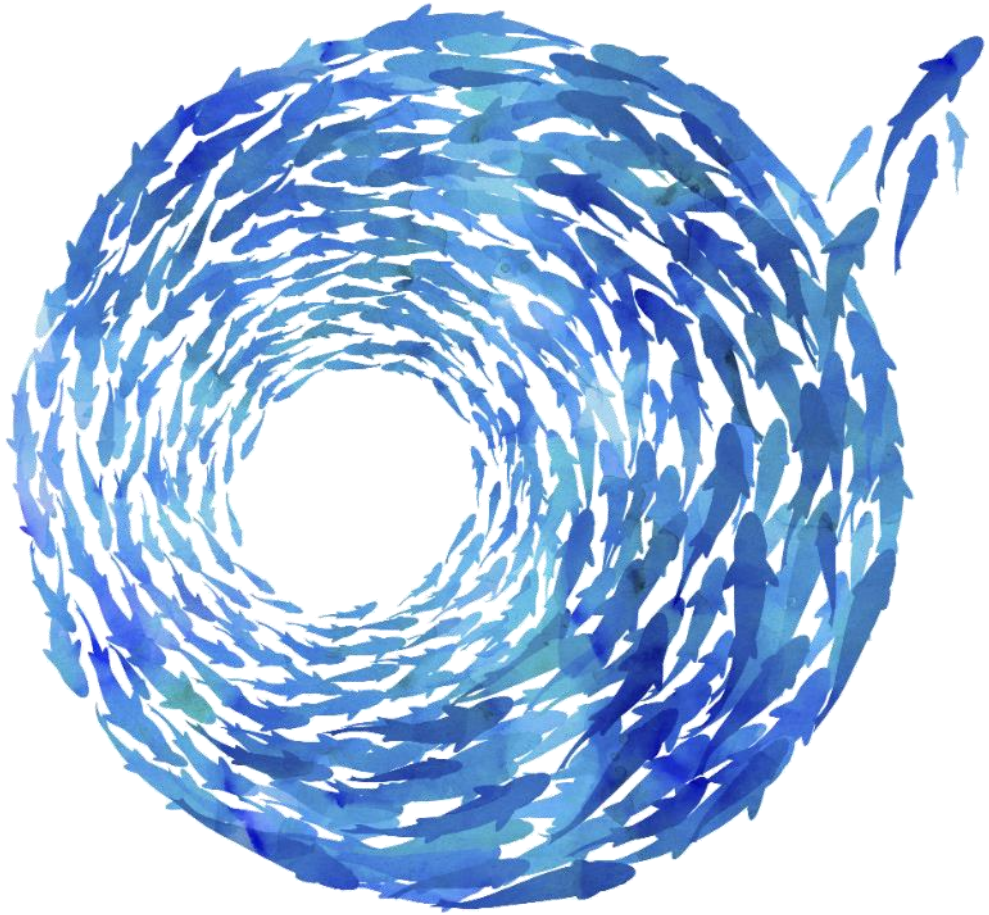

BLOCKCHAIN IN THE SEAFOOD INDUSTRY

Increasing transparency and efficiency in global seafood supply chains

A joint Deloitte and DNV GL report; scoping ecosystem opportunities for sustainable seafood

March 2019

Foreword

This report is intended to be a primer for action on how transparency in the seafood industry can be improved through digital technologies, such as Blockchain, to cater for operational efficiencies, sustainable capacities and accountability. Seafood products are some of the most traded food items worldwide, but around one third of global fish stocks are overexploited. The seafood industry suffers from unsustainable resource management, inefficiencies in operations and distrust across stakeholders in the supply chain.

At the same time, there is an increased demand for more transparency, both to improve operating efficiency across the supply chain, but also to ensure that the end consumers have access to trustworthy product information. From this report we see that digitalization, along with the many benefits of Blockchain technology, could increase operational efficiencies and provide remedies to issues in the seafood supply chain in a cost effective manner. However, this is only possible provided that data sharing and trustworthy transparency starts from the first mile, at the feed production and brood stock, to fishing vessel operators, and to the retailers.

Incentivizing stakeholders to gather and share their data will be a crucial first step towards greater transparency. At the same time, all ecosystem players, sector players and adjacent service providers alike must contribute with incentive schemes for data sharing. It is important that they see the benefit of gaining useful insights into stakeholder operations in a transaction heavy, global, and disaggregated trading sector.

The oceans and coastal areas can only supply seafood products for a growing global population if transparency and trustworthiness is promoted. This must be done in a cost effective and integrative manner in order to sustainably maintain renewable fish stocks and uphold ecological ecosystems.

Deloitte and DNV GL partnership

For this report Deloitte and DNV GL has worked together in partnership, building on our competencies and experience with technological insights within the seafood industry sector. The report is an outcome of four months of collaboration through customer interviews and workshops.

Julian Blohmke, Deloitte, and Sven Edgren, DNV GL
March 2019

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Chapter 1
Introduction

Ensuring transparency in the seafood supply chain

Global seafood trade suffers from a lack of 'one picture of truth', that inhibits both operational and trade efficiencies, leads to mistrust at the end of the supply chain

Background and motivation of topic

Seafood products are some of the most traded food items in the world with USD 143bn in value terms in 2016.[1] At the same time, the ecological footprint of fisheries and aquaculture can be considered as significant.

Almost one third of global fish stocks are overexploited and aquaculture practices have shown to heavily stress the ecological equilibria.[2] Aquaculture and fisheries need to be managed sustainably, also beyond the ecological factors, and in doing so, operational efficiencies can be improved.

The key objective in this report is to highlight key stakeholders' operational challenges in global aquaculture and fisheries from a sustainable supply chain's perspective (see stakeholder map on page 13) and to explore how technology, in particular Blockchain technology, may offer remedies to some of these issues in a cost effective way. By doing so we start to see new ways of generating new value creation and turning the industry towards a more sustainable supply chain management.

Pressing issues in the seafood industry

After having conducted one-on-one interviews with multiple representatives within the seafood industry, we have identified their pressing issues to be:

- Data use efficiency, re-use of data and interoperability of data systems
- How to use data to increase product quality, ensure fish welfare, and gain further insights through data analytics
- Lack of access to a go-to source for trusted information (B2B, B2C)
- How to address the trust gap by enabling and reaching out to end consumers with validated information about the product and thus respond to the trend towards the transparency required and expected
- De-risk supply chain by improving transparency on ecological and social sustainability

[1] *FAO. 2018. The State of World Fisheries and Aquaculture 2018 - Meeting the sustainable development goals. Rome.*

[2] *Pauly D and Zeller D (Editors) (2015) Sea Around Us Concepts, Design and Data (www.seaaroundus.org).*

Ensuring transparency in the seafood supply chain

Interviews with companies and experts in the seafood industry have given insights into challenges, barriers and opportunity areas to meet commercial, regulatory, ecological and customer needs

Scope of investigation

In this report we touch upon the following topics:

- Food safety and traceability of products
- Animal welfare
- Labor working conditions
- Efficiency of bringing trust to consumers
- Friction and data exchange at interfaces
- Ecological sustainability (fish stock control potential)

Note that consumer behavior and retailers' needs, as well as legal and regulatory matters, were not analyzed, and is therefore not part of this report.

Qualitative research

For this report we conducted one-on-one interviews with 20 company representatives and experts across the following sectors:

- Feed
- Farming and production - wild catch and aquaculture
- Wholesale and retail
- Finance and insurance
- Research
- Enablers - IT solution service providers
- Fisheries ministry

Their views have decisively contributed to gaining insights into the challenges, barriers, and opportunity areas, in order to satisfy business aspirations, safeguard natural resources and to help equip the industry to meet stakeholders needs. Especially by fulfilling commercial (efficiency), transparency, regulatory requirements and ecological boundary constraints.

Digitalization and Blockchain as remedy to solve challenges

Digitalization and Blockchain technology can help industry participants address key challenges and open up new business opportunities

Digitalization and industry trends

Large reputable fishing and aquaculture companies and their related supply chain participants want to demonstrate trust and integrity as a business credential as they seek to make this major source of protein a growth factor and a solution towards sustainably feeding global population.

There lies an opportunity in digitalizing production steps and gaining overview of data which pertains to the full supply chain in order to offer demonstrable proof and product integrity through to the end consumer.

Trustworthy supply chain information, consisting of the total contributed and proven information, may be accessed by parties according to certain rules of the game: Operational data, testing and certification results could be made more readily available on large databases where many participants can participate in networks and thereby harness the collective intelligence instead of only their own focused capabilities. To have knowledge of e.g. anonymized best practice benchmarks in form of analytics would enable innovation in the fisheries industry and supply chain management.

In this paper we will introduce digitalization means and Blockchain technology in particular as a realistic path to open up markets, increase collaboration and achieve transparency for more environmental, social and business sustainability.

Blockchain benefits

Blockchain is a technology, relying on well-established cryptographic principles and operating as a distributed repository that provides a way for information to be recorded and shared through a peer to peer community. In this community, participants maintain access to their data on the Blockchain.

As we will explore, Blockchain can play a role towards:

- Transparency and traceability
- Trust in data, facts and processes – for the whole supply chain
- Smart contracts to enable automation and reduce cost of transactions
- Auditability, thanks to the immutability features of the Blockchain
- Tokenisation, the feature of transforming and transporting value, will allow to incentivize and engage stakeholders.

It is also clear that Blockchain technology will only unveil its full potential in conjunction with other technologies such as cloud services, sensors, IoT and data analytics.

Summary of findings and way forward

Towards more transparency, traceability and acceptable transaction costs

Key issues for stakeholders

A. Trust among supply chain partners is a major **hurdle to overcome** and must be 'exercised' in a real life project to harvest overall benefits.

B. The **data already being collected today are 'trapped' in silos** and to connect with other partners (in the supply chain) information needs significant effort of sharing in daily operations.

C. Identify the **priority topics**, which generate a surplus situation for all. Our insights point towards the following topics to concretize such benefits:

- **Traceability:** Finding the means and defining the necessary trusted information to communicate to the consumer in their hunt for a true high quality product.
- **Fish welfare and biology:** use of analytics for better insights into biologics to boost productivity and quality.
- **Innovative finance** and **insurance** products based on better data to make qualified decisions which render benefits for stakeholders.
- **Efficiency gains** in the supply chain, e.g. through standardization, automated documentation and smart contracts.

Benefits and promising ways ahead

To date, we have seen a lack of efficiently functioning market-based solutions successfully tested at scale, acknowledging the global nature of the production value chain.

We believe that to promote sustainable resource use and achieve transparency and traceability at an acceptable transaction cost, a decentralized approach, such as one offered through a decentralized ledger system based architecture, is the way forward. It is likely that there will be a rise in ecosystems, which will at some point achieve interoperability through the synchronization of standards.

Chapter 2
Challenges

Transparency is more than just traceability

It also centers on the information recorded about the product's actual transformation

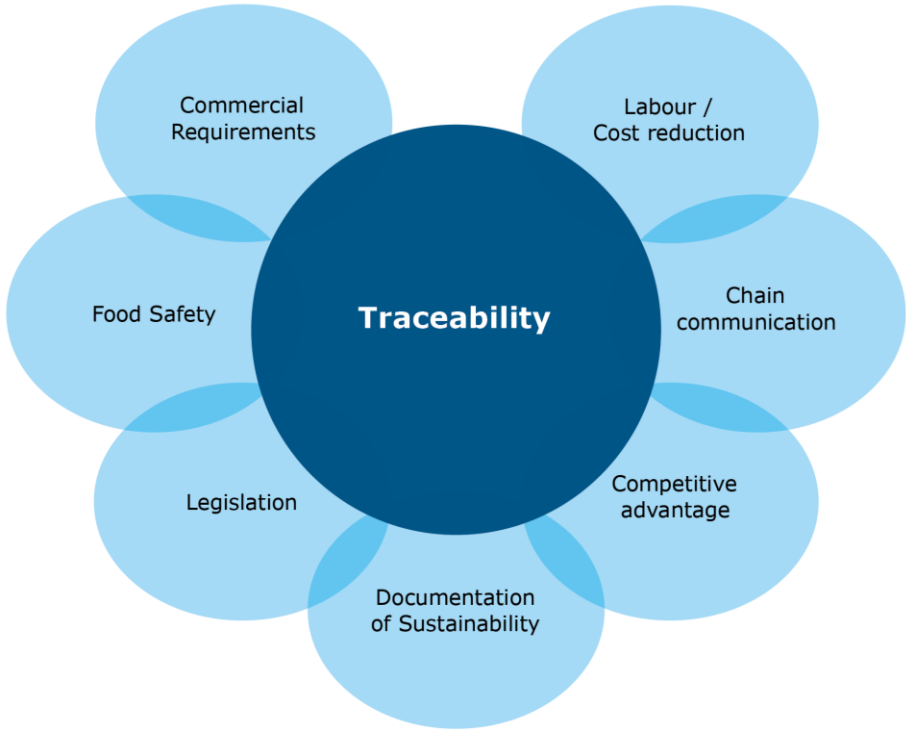
Food traceability

It is of increasing importance for the food industry to have the ability to ascertain the origin of a product, as well as importance attributes. This means being able to have full control of the information flow within the supply chain. From raw material, through processing, to the retailer, and to the end consumer.

This is not just because of increasing regulations due to public health concerns, but also because it can be seen as a competitive advantage, as companies that can more effectively and reliably track and trace a product back and forth throughout the supply chain, will not just have an economic incentive, but also a reputational incentive to do so.

Traceability is more than just supply chain management of a physical product. It also centers on the information recorded about the product's actual transformation throughout every step of the supply chain to the end consumer.

Business drivers for food traceability



Source: Petter Olsen - © Nofima

Key challenges

Feedback from stakeholder interviews

1. Data and information flow

- Lack of interoperability between trading partners' systems, also beyond direct trading partners, leading to integration difficulties of received data, and systematic information loss in the supply chain
- Data quality issues on received data, miscommunication due to glossary used, and lack of granularity of the data calls for standardization
- Tampering of data is possible and leads to a lack of trust in the received data

2. Reputational risk

- Negative news about the seafood industry will often hit all industry players, not just the company in focus
- Brand reputation damage can be challenging, without the possibility to defend oneself against the claims
- Proving best-in-class and providing documentation to the end-consumer is difficult

3. Transparency and consumer engagement

- Lack of transparency requirement setting and focus, due to each party optimizing for internal data use and not to the benefit of the entire supply chain
- Little accountability across complex supply chains
- Proving and documenting provenance to the end-consumer is difficult and limited
- Lack of an efficient end-consumer information and marketing channel
- A lack of understanding of what information the end-consumer requires or wishes to have

Barriers found – a lack of motivation?

Feedback from stakeholder interviews

Technical feasibility

- Although extensive recording of relevant data could be found, it is not always sent or made available to other trading partners
- Existing trading partners' business systems *(e.g. ERP and warehouse management systems)* are not designed to capture and share traceability data
- There is a need for standardization with a focus on the whole chain and between all interconnected actors, instead of relying on solutions that cover only parts of the value chain with proprietary data, recording and protocols

Business case needed

- Cost-benefit analysis on investments in a new traceability system is fragmented and anecdotal, meaning that upsides are difficult to show
- The commercial benefit and improved economic performance of increased transparency is therefore needed
- Financial investments are needed, but there is reluctance to put money into a Blockchain traceability system

Lack of willingness to share data

- There is a general reluctance to share information and data based on the uncertainty around ownership of the data, data permissions and data sensitivity, as well as privacy and data security concerns
- Often immature understanding of the value of data

Lack of awareness and understanding

- The implementation of new traceability systems requires that today's business processes must be reviewed and reworked
- That ingrained business practice is hard to change

Lack of understanding...

- in the importance of having item identifiers
- in the importance of documenting transformations explicitly
- in the importance of granular item information

The relevance of transparency along the seafood supply chain

Solutions in widely dispersed supply chains only work when spanning the whole value chain, from feed producers to retailers and service providers

Aquaculture

- Broodstock and seedling operations want to improve their business and get information on their animal performance further downstream. Upstream information flow could be advantageous. Downstream information flow could be important for social / labor and animal welfare records.
- Feed produces want to differentiate on content and sustainable qualities. The transparency of feed production and origin of raw material as well as its environmental and social standards of production are increasingly in focus.

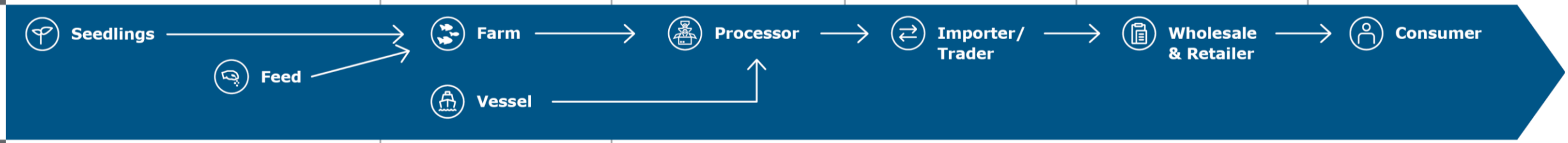
- Fish farms want to increase their efficiency and thus need to understand performance drivers (like feed) and outcome (quality control during slaughter)
- Depend on good reputation
- Traceability from broodstock to farm is a market requirement

- Processors can provide crucial information to upstream stakeholders to increase efficiency (i.e. information on flesh/quality)
- They are an important stakeholder in the transparency value chain

- Importers are an important stakeholder in the transparency value chain
- They are audited by regulators

- Retailers want to provide quality products at competitive prices
- They want to only provide as much information as necessary to not confuse customers
- ESG standards are important for their reputation

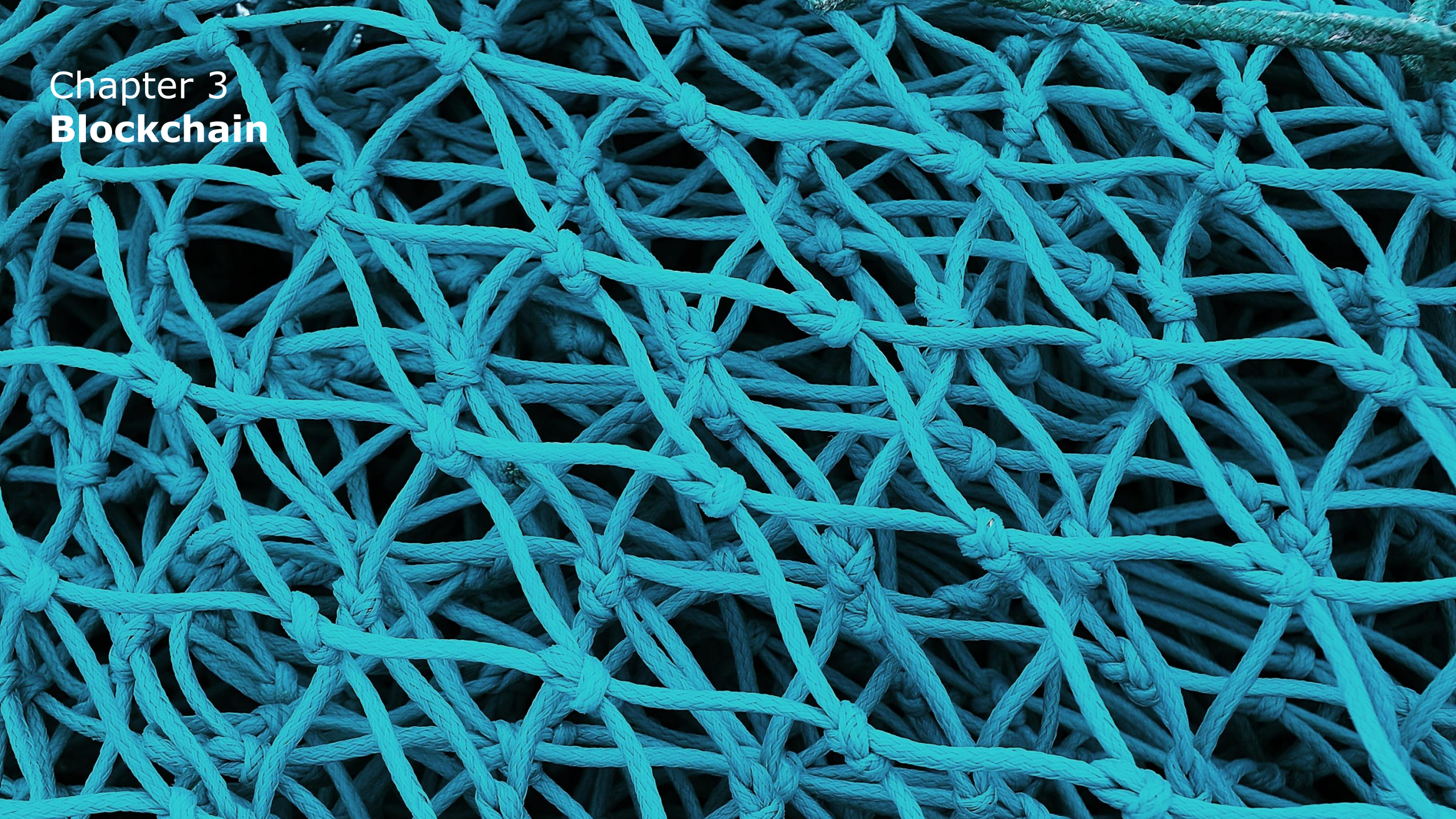
- Consumers are interested in quality and freshness
- They expect transparency on quality of products, which includes also to some extent environmental and social sustainability criteria



Wild fish

- Vessel operators are required to report on their fishing activities, geo-location, catch, labor conditions.

Government authorities	Insurer	Bank
• Regulators control licenses and landing volumes of fish and have an interest in transparency / healthy fish stocks / compliance with ESG standards	• Insurance companies want to understand fishing and transport operations in order to tailor their risk mitigation products to their clients' needs	• Banks want to tailor their financial products to seafood industry operators and logistics / trade activities



Chapter 3
Blockchain

What is Blockchain?

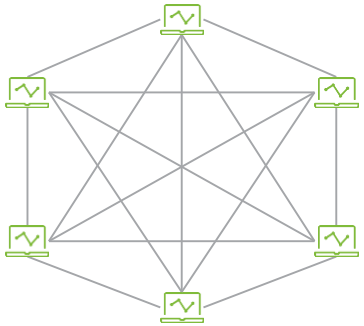
A decentralized, distributed ledger that provides a way for information to be recorded, shared and maintained by a community

Blockchain is a disruptive technology and is …

… a **distributed ledger*** that allows

digital information and assets* to be transacted

in a **real-time, immutable*** manner



* No single ownership, multiple contributors, removal of intermediaries

* Something represented in a digital form that has an intrinsic or acquired value (e.g. information, status, access rights, identity, certificates)

* Cryptographically sealed, transparent, chronologically updated, low friction and irreversible

Key Advantages of Blockchain in Supply Chain Management

A Blockchain-based supply chain network overcomes the issues of traceability, collaboration, and coordination faced in traditional networks

	Visibility	Transparency	Trust/Audit	Automation	Collaboration
TRADITIONAL SUPPLY CHAIN	Each stakeholder maintains their own records, and exchanging data costs time and money. This **impedes the ability to analyze the chain**	A lack of a central repository containing all transactions makes it **difficult to pinpoint the source of a part or product in complex chains**	Complex supply chain networks **opens the system up to bad actors and limits visibility and trust between personas**	Inventory management, trading assets, regulatory compliance, conflict resolution, and tracking **require time and effort, and open the chain up to human error**	With globalization, increasing complexity, and system integration roadblocks, **cross-organizational impacts of decisions and changes are difficult to understand and forecast**
BLOCKCHAIN SUPPLY CHAIN	Each stakeholder has access to see transactions recorded on the Blockchain. This **facilitates analytics and predictive modeling**	With all transactions recorded and verified on a Blockchain, **a part or product can be traced end-to-end** enhancing consumer trust and bolstering corporate responsibility	The distributed ledger builds a shareable record of transactions and updates to an asset. **Every stakeholder can access and audit**	Smart Contracts programmed and implemented on the Blockchain **provide automation for administrative tasks and perform actions** under pre-approved conditions	A single-point Blockchain based system **enables analytics to identify risk, avoid disruptions, and make rapid adjustments to processes**

Case: Fiji Tuna Supply Chain Solution

World Wide Fund for Nature (WWF) engaged in a Blockchain supply chain traceability project in the Fiji tuna fisheries with several partners. The goal of the project was to create a completely transparent and traceable supply chain, while utilizing innovative Blockchain technology, for the fresh and frozen tuna supply chain.

Key Recommendations

Engage early in chain (upstream) with enough supply chain actors, clarify incentives, and have some level of verification and validation on order to circumvent the 'garbage in, garbage out' problem.

Source: WWF – click image for report

Case: Wyoming BeefChain

Wyoming beef producers are committed to their high standards and best-in-class product but rarely receive an adequate premium for the delivered quality. By enabling unique animal identification and ensuring origin, BeefChain allows the rancher to receive premium pricing for premium beef and provides consumers with greater confidence in the meat they consume.

Key Recommendations

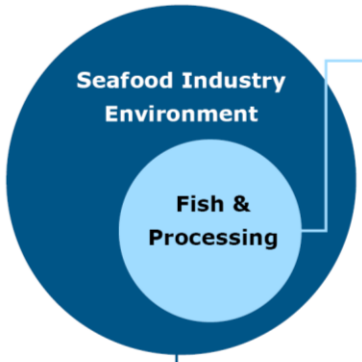
Include all relevant stakeholders (e.g. third-party feedlots and processors) and provide consumer with transparency in order to change consumption patterns.

Source: BeefChain – click image for web page

Chapter 4
Solutions

Solution spaces for seafood trade transparency

Four "data angles" will cater the issue areas and at the same time provide incentives for stakeholders to disclose their data



Data dimensions for transparency		
Fish & Processing	Fish Information	• Information about the farm (code of conduct, people and fish welfare) • Information about the fish (including those that have been imported) • Information of origin (geolocation)
	Quality, Process & Geolocation	• Feed composition, date and type of treatment, result • Description of farm & fishing practices used • Environmental conditions (temperature, humidity, particle matter in water)
Seafood Industry Environment	Finance & Insurance	• Use information on operations and product treatment / conditions to manage risks, financial performance forecasts and derive loan and insurance conditions
	Equipment Platform	• Feed composition, date and type of treatment, result • Description of farm & fishing practices used • Environmental conditions (temperature, humidity, particle matter in water)

Momentum for Transparency

Operational Analytics & Control
- Efficiency in vessel, farm and processing operations, pest control and variable cost reduction

Food Safety
- Track the fish from the first mile to enable fast and effective tracking

Ecological Effectiveness
- Align catch/output with licenses and quota

Product Transparency
- By displaying quality, achieve price mark up and communicate the true story to the consumer

Smart Information Exchange
- Connect with operational data and equipment sensor data and get service price cuts as well as new services and value creation from banks and insurers as well as equipment providers

Designing a seafood transparency platform

Capturing information from the first mile to the end consumer requires the right stakeholders and incentives encourage the sharing of information

Success factors for transparency and efficiency

Achieving transparency and efficiency gains in the global seafood industry and trade requires trustworthy data as well as efficient mechanisms to share data and analyze them.

- **Transparency needs a goal:**
    - Inform end consumers about high quality and targeted product characteristics
    - Ensure food safety for customers
    - Improve seafood industry operations by rendering better insights into inefficiencies and cost drivers
- **Stakeholders should collaborate:**
    - Industry stakeholders from all necessary domains across the supply chain need to be included
    - License to operate requires representation of civil society concerns

Ecosystem for seafood information

An information platform for seafood production and trade needs to play out the full strengths of an ecosystem:

- Representation of all necessary parties across supply chain, including service providers like financial institutions, insurers and government authorities
- Evolutionary set-up of goals and objectives, with clear definitions of each stakeholders' functions in the supply chain
- Incentives for each stakeholder to participate, share information on the platform and know their responsibility and clear benefits
- Nurture supply chain innovation by cross- linking stakeholders on the platform

Chapter 5
Implications

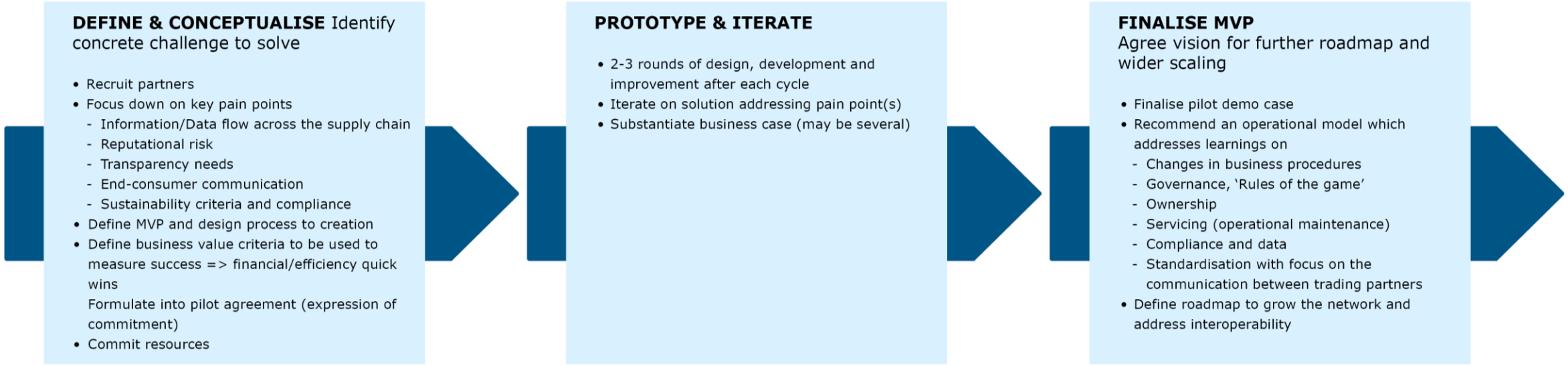
Blueprint for an ecosystem approach

Leading to functional seafood trade transparency

Prerequisites for successful progress

The research highlights that Blockchain technology bears promising features for the seafood industry, yet the technology is at an early stage; however the elements needed to bring together a working ecosystem exist already. A combination of investment and change of business practices is needed. Indeed the most concrete progress witnessed by Blockchain use cases is for supply chain applications such as in data integration and tracking asset status. The seafood industry could build on these experiences.

To take the next step it is important that partners are willing to work together and trust each other to carry out a pilot project. The seafood trade sector carries a global remit, however modern transparency and accountability standards are not being fully encompassed.



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