Open Call 2
NextDE–Enabling the Next Generation P2P/Data Economy
Deliverable 3: Experiment Results and Final Report

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Deliverable 3: Part I
Analysis, results, and wider impact

1. Abstract

This Project experimented with innovative NGI technologies and co-designed, together with EU and US parties, a new business process in data sharing (TL3) that aligns and supports the development of an Agricultural EU-US Data Network and targets a FAIR data economy. The primary technology actors are, DjustConnect (EU), which delivers data sharing services, Insurechain SL (EU), which provides smart contracts services and IdPlizz (US), which provides AI technology biometric recognition services. The NextDE services follow a decentralised approach and aim to support the parties establish verified agreements on API data resources usage and gain a share of the benefit from their data.

2. Project Vision

The NextDE Project, with its results, aims to contribute to the development of **an Agricultural EU-US Data Sharing Network** that targets a **FAIR data economy** supported by **NGI technologies and decentralised architectures and systems**.

We share the same vision, with other existing EU and US initiatives like Sitra[1], for a FAIR data economy that accommodates the interests of all types of participants while also providing for a **high level of overall data usage**. As a result, individuals know how their data is being used, freely give and revoke required permission to use their data, and mandate sharing with third parties. We vision to support the participants and especially the **farmers** to gain a share of the benefit from their data, in terms of better services and **monetary form**. Moreover, we envision

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[1] https://www.ngi.eu/blog/2019/04/10/making-the-fair-data-economy-a-reality/

an EU US Data network where intermediary platforms like DjustConnect will collaborate with other service providers to provide data sharing services that deliver added value, trust, and security. With the current AgriFood landscape, data sharing **intermediaries' platforms, like DjustConnect**, play a crucial role in developing regional or national data networks that aim to utilise existing data resources by breaking the data silos. Since the intermediary platforms use centralised architecture models, they act as **master nodes on these data networks**. As master nodes provide a set of data sharing services (broker services, access and usage control on data resource or vocabulary services, etc.), performing all intermediary roles. Consequently, they impose the participants' roles, responsibilities, and rights to support platform business models using constitutive agreements.

By adopting alternative decentralised architecture patterns and technologies, like connectors or **smart contracts and biometric identification**, intermediary platforms like DjustConnect and other service providers can better support **the scale-up of the data economy network**, the **performing of cross border transactions** and the further **automation of data sharing as a way to achieve environmental, economical and social impact in the AgriFood sector**. Therefore, within the NextDE Project, we did the first required step and try to prove by using experiments that the **NGI technologies and decentralisation patterns are significant elements of a Rule Book for a FAIR Agricultural Data Network**. Furthermore, and within the experiments, EU and US service providers collaborate and deliver services that support the setup of verified **EU-US agreements on API resources using Smart Contracts that integrate price assessments for API resources**.

3. Details on participants (both EU and US)

Panagiotis Ilias, Male.   **Role:** Project Coordinator

He holds a Ph.D. in AI and spatial analysis from the Aristotle University of Thessaloniki, with over 20 years of experience in the IT & Geospatial industry. He had an active role in the development DjustConnect platform.

Jürgen Vangeyte, Male.   **Role:** Supervisor

PhD MSc, is the scientific director of the research group Agricultural Engineering. He organises, co-ordinates, and manages the research and the technical activities to support the implementation of scientific research. The group exists of more than 35 researchers supported by technical staff.

Aya Kemeltaeva, Female   **Role:** Junior Business Developer

Aya has a bachelor and master in Bioscience Engineering Technology, and since 2021 she is a new member of the DjustConnect Team, with a responsibility to support use cases building and stake-holder engagement.

Siham Kourdi, Female   **Role:** Software developer

Siham is a researcher and a software developer with experience in the development of LOB appli-cations. She participates in various data sharing activities and projects of EV ILVO responsible for supporting integration activities in WP1 and WP2, and technically the partners in WP3.

Samuel Bosch, Male   **Role:** Senior Software Engineer

Samuel is a senior researcher and software developer, and a member of the DjustConnect team of EV ILVO. He has extended knowledge of DjustConnect components and functionality and can sup-port in application integration and data security activities of WP1.

EU Partner: Insurechain SL

Alan Draguilow, Male.   **Role:** Technical Manager

Consultant for several years in different companies in applying and implementing blockchain soft-ware such as today in Prosegur Crypto. Experience in the development of Smart Contracts (solidity) and PaaS.

Yarón Chocrón, Male.   **Role:** Project Analyst

Graduated in Marketing and Business Management, Master's student in Human Resources, Talent Management, and Leadership; and with experience in training consulting, public bidding, and pro-ject analysis.

Victor Ortega, Male.   **Role:** Developer

Software architect in technology consulting for multinational clients. Experience in DevOps, agile methodologies, Java, Spring-boot, Python, Maven, Git, SonnarQube Jenkins, among others.

Diego Ruiz, Male.   **Role:** Dissemination and exploitation expert

Head of digital customer analytics at Banco Santander. Expert in digital transformation with 20 years of experience in digital environments in the Digital Banking and Marketing sector.

David Jimenez, Male.   **Role:** Developer

Blockchain engineer with more than 5 years of experience in the banking blockchain sector. Specialised in Node.Js, Angular 8, Truffle & Solidity. Technical leader of the platform.

US Partner: IdPlizz

Marc Duthoit, Male.   **Role:** Dissemination and exploitation expert

Serial entrepreneur with over 30 years of proven results. Global experience in term of companies' structure (from private startup-up to public company SWAN with a market cap over $1.52B on the Nasdaq Europe in 2000).

Eric Eva-Candela, Male.   **Role:** Technical PM - Developer

CTO at Swan, with Marc, and other companies, more than 30 years of IT experience specialised in Blockchain and APP and platform development, several US patent applications in networking and security.

Jean-Francois Regnauld*, Male.*   **Role:** Business developer

More than 25 years of experience in Finance in all aspect of treasury and financial markets. Global experience in Private Equity, Venture Capital, Fixed Income and Treasury Management.

Eric Pepin– President, *Male.*   **Role:** Business developer – Data partners engagement

Has been President of large companies like 3Com Europe, Ecke Data Systems. Part of the team that brought an EU-based software company to the highest tech IPO in Europe.

4. Results

This section lists the overall results (Table 1. Project Results), providing references within the text to the KPI table (Table 2. Project KPIs) and the Annexes.

Table 1. Project Results

a/a	Results	Comments
R1	Validated authentication service uses AI and biometric technology, allowing providers and consumers to verify them within the NextDE platform (KPI 1).	Demonstrated to more than ten farmers.
R 2	A Smart Contract Template. Can support the establishment of automated data-sharing agreements within a FAIR Data Economy (KPI2).	The template is using IDSA and SITRA Rule book for a FAIR Economy. The formulation of the template was an extra activity necessary to support the KPI2 and KPI3.
R 3	A formula that estimates the base price of an API resource (KPI7).	For the next version of the formulas, we are palling to collaborate with Professor Murat Yuksel (Murat.Yuksel@ucf.edu)
R 4	A service that allows data providers and consumers to formulate smart contracts on sharing of API resources. The contracts are stored in a blockchain infrastructure (KPI3).	We developed three smart contracts.
R 5	A service that allows data providers and consumers to negotiate on prices for API resources (KPI7).	The service is using the formula as a way to accelerate the negotiation phase.
R 6	A service (a set of deterministic rules) notifies data sharing intermediaries like DjustConnect that signed a contract (KPI5).	Please read for more the section "Next steps and future activities".
R 7	Documentation with screenshots explains how the NextDE UI works and the needed steps (KPI9).	We used the wireframes to collect feedback from the data providers, consumers and farmers. Please read for more **ANNEX A: NextDE User Manual**
R 8	Several preparation meetings and the organisation of two workshops demonstrate real data coming from the participants, validate the proof of concept with EU-US partners, and further support the co-design process (KPI6 – KPI7- KPI8).	Please read for more **ANNEX B: Feedback from the EU US Workshops**
R 9	A survey organised by new three female NGI ambassadors. Performed to EU and US partners to gain feedback on NGI and NextDE priorities for decentralisation in data sharing and self-sovereignty identity (KPI10).	Please read for more **ANNEX B: Feedback from the EU US Workshops**
R 10	An analysis of the survey outcomes. Results and the analysis will be used by Professor Murat Yuksel (Murat.Yuksel@ucf.edu), as	A result of the NextDE Project that was not foreseen but is expected

	material for a post-doc research in collaboration with EV ILVO on the Agricultural API economy.	to have direct outcomes and impact.
R 11	Exposition of 3 APIs resources to DjustConnect and negotiation on API prices (KPI3 – KPI8).	API resources expose machinery data valuable to estimate crop harvest.
R 12	Free access documentation for developers to use their Smart Contracts (KPI9).	Please read for more **ANNEX C: Free Access Documentation**
R 13	Increase the awareness of the AgriFood community and its technology partners with dissemination activities performed by EV ILVO and Insurechain SL (KPI 12 and KPI 13). Additionally, a project outcome is related to the performing of another dissemination activity in the upcoming October, at which EV ILVO will present the project results to the Flemish AgriFood Community/	Please read for more the "Dissemination" section.
R 14	A NextDE website and a Twitter account to increase awareness and support NGI ambassadors approach the AgriFood Community and disseminate project results.	The result of the Project was not foreseen, but it's expected to have direct outcomes and impact.
R 15	A NextDE backlog created and maintained by Insurechain SL (KPI11).	
R 16	Our Project will create the first actual cooperation between a US-based AgriData Initiative: the AgDataCoalition, and an EU data-sharing initiative DjustConnect using Next Generation Internet technology.	

Below in Table 2, we include the Project KPIs as those exist in D1.

KPI#	Description	Target
1	Use IdPlizz technology to verify NextDE users (WP1)	Ensure the real identity of the users. We will demonstrate it with ten physical persons (WP1)
2	Create and sign data sharing agreements (smart contracts) between DjustConnect data partners (WP2)	Close at least five experimental smart contracts. We expect the price to change depending on the negotiations and inputs
3	All the Smart Contracts will write the information in Blockchain (WP2).	Ensure transparency of the system and reliable storage service. Apply to 100% of the experimental contracts (logs)
4	Integrate (register) new APIs in DjustConnect (WP3).	Facilitate the registration of new APIs in DjustConnect. Demonstrate the registration process for one use case to the 30% of the NextDE users (WP1 KPI 1)

5	Automate notification. Smart contract will email the parties involved (not the farmers), notifying them that they could start sharing their info in DjustConnect (WP2).	Automate and decentralised the contractual process within NextDE. Demonstrate it in one use case, for at least 3 APIs.
6	E-auction transaction release 2. First transaction between two parties (WP2)	Gain transparency in all the operations performed within the platform. Demonstrate it in one use case.
7	E-auction transaction release 3 Implementation of transactions with automated price calculation (WP2)	Full implementation of the e-auction system with the fairest possible price within the parties. Demonstrate it in one use case for at least two bilateral calculations.
8	EU-US data transaction between American institutions and data coming from Belgium farmers through the e-auction system (WP3).	Enable transnational transactions and demonstrate them to a group of 15 farmers.
9	Documentation for the community	Technical manuals for the experimentation with the login system, data exchange, and e-auction.
10	Gender balance. Female role models.	The ICT and more specific the NGI community have only 30% female representation. Our project ecosystem will engage at least 3 new Female Ambassadors.
11	AgilePM reports	Development of NextDE Backlog
12	Webinar/workshop 1	Min 30 participants
13	Webinar/workshop 2	Min 30 participants

Table 2. Project KPIs

5. Discussion and Analysis on Results

The NextDE Project is under Topic B, which means that within the Project, we should **experiment** with:

- Privacy and Trust technologies.
- Decentralised data governance
- Discovery and identification technologies

having as the primary goal to develop and test (TRL3) **a new business process to support the establishment of verified smart data-sharing contracts between data providers and consumers**. This business process relied on blockchain technology and adopted a distributed architecture model to store the API contracts. Integration activities were also needed as a way to support a loose federation/interconnection of the platforms that support the delivery of the NextDE core services.

Within the project period, we tried to manage several raised questions, together with our partners, including the following:

- Which are the needed structural elements of a FAIR Data Economy?
- Can alternative decentralised architectural patterns increase trust, efficiency and scalability?
- Does the current architecture pattern deliver trust to all parties? Worries?
- Does the current architecture pattern deliver business opportunities? Obstacles?
- Can centralised Data Access Request services like the one DjustConnect uses support the scale-up of the data economy network? Or it's an obstacle?
- Can centralised Data Access Request service lead to a FAIR Data Economy? Or improvements are needed? Which are those?
- How can we establish an EU-US Data Network, scale up and automate data sharing?
- Which information should contain in the contractual agreement to support the digital sovereignty of the farmers?
- Which tools are needed to increase further their participation in the Data Economy?
- Under which conditions are valuable API price assessment services?
- Which are the control parameters of an API price (number of API resources, number of data endpoints, the scale of the data-sharing network or space)?

Answers to the questions above (ANNEX B: Feedback from the EU US Workshops) are valuable for **DjustConnect (and other intermediary platforms)** that strangle to develop a data-sharing market in the Agricultural sector. Additionally, to decide about decentralisation or not, it's helpful to know **which conditions can support the federation of the platforms and estimate the business requirements and needs that can ensure a sustainable provision of data sharing services**. The performing of business analysis endorsed the identification of the needs and stakeholder engagement and participation. Both delivered valid inputs to the team of NextDE and can support the development of business processes that align DjustConnect business objectives.

Specifically, the demonstrations and survey results helped us better understand how data providers and consumers (DjustConnect customers in the **EU and US) perceive decentralisation and NGI technologies**. For the AgriFood community, it's clear that NGI technologies have a significant role to play and can support the establishment of agreements between the data providers and consumers that:

- It is formulated and agreed upon by all parties.
- Ensure digital sovereignty* of the farmers.
- Follow the Governance Rules of an intermediary like DjustConnect.
- All parties have access to them.

Additionally, the adoption of a more decentralise pattern by DjustConnect (please read the Conclusion and Future Work section, where we present the **NextDE Scenario for DjustConnect**), can:

- Increase the ability to perform cross-border transactions (EU US),
- Support the establishment of verified data sharing agreements, and
- Generate a Low entry-level in a data-sharing network.
- Can Increase the participation of actors like services providers like IdPlizz in the EU-US Data Network.
- Support the Technical Enforcement of data access and usage agreements (Figure 1).

Figure 1 Balance between technical and Organisational/legal enforcement as a way to to support the establishment of data access and usage agreements.

6. Present and Foreseen TRL

Our expectation at D2 was to achieve a TRL3 at the end of the Project and demonstrate the proof-of-concept. However, after these months of development and work between IdPlizz, ILVO and ChangeTheBlock, we achieved a TRL 4 and validated it in a laboratory environment platform.

The laboratory experiment was performed in a dedicated internet domain, where we connected our platform to the Ethereum Blockchain[2] and where the users were able to sign and use actual smart contracts while identifying themselves with the IdPlizz system (Id Verification) (see Annex A).

After these experiments, the users could register their contracts in the Blockchain, signing with their real identity through the IdPlizz App. Based on these testing and the timing for the development, we look to continue improving the platform in the following months.

After our results and the feedback from the experimentation, we expect to achieve a TRL5 in the next few months, where we will be able to use our platform connected to the database of the DjustConnect platform. Implementing this module has some difficulties related to Blockchain technology that we expect to overcome with a new technological approach based on sharing and decentralisation of databases.

We expect to be ready for a TRL6 in Q2 of 2022, where we will have tested the platform on real scenarios with several types of clients. We hope to export the same processes and technologies to other verticals within the AgriFood sector and in different sectors. This platform could improve the efficiency of the processes and the services provided to the final customers in several ways.

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[2] https://www.investopedia.com/terms/e/ethereum.asp

7. Exploitation, Dissemination and Communication Status

Exploitation actions and plans

The platform DjustConnect is a public, private cooperation that provides data sharing services. EV ILVO after the end of the Project, is planning to integrate the identification and the smart contracting technology as new services in the platform. We will consider the final TRL, the related business and cost model, the data partners, and mainly farmers' acceptance of this technology and always after agreement with the DjustConnect steering board. The organised workshops within the NextDE Project have provided valuable feedback to support the further decision-making of EV ILVO.

DjustConnect exploitation plans align with the ones of Insurechain SL. More specifically, after the implementation of the smart contracts' module, within laboratory conditions, the next steps that Insurechain SL (or CTB as brand name) will follow are the complete implementation of the module, adding new types of Smart Contracts that will be executed depending on the users' requirements. Once these modules are finished, CTB will offer the exact implementation to other agro-food platforms, offering fair price calculations and T&C unforgeable contracts. Once these implementations are completed, CTB plans to offer the same services on different verticals looking for this kind of technology and benefit from decentralised databases. The platform CTB will open API access to permit developers to produce applications based on these Smart Contracts accesses.

Dissemination and communication status

- Development of a NextDE Website (see Screenshot 1).
- Presentation of NextDE Project at 2 workshops.
  - The NextDE concept presented on 22/4 at a webinar by Panos Ilias, organised by TNO and the University of Maastrict (see D2 for more).
  - The NextDE concept presented to the Government of Peru on a Webinar on 5/5/2021 by Alan Draguilow. his talk attended by more than 1000 people that work within the Government in different positions. The meeting was part of the innovation week organised by the Government of Peru, the main objective of this workshop's week was to find the most innovative solutions to be applied by the different verticals of the Government, such as agriculture, smart cities, etc.
- Presentation of NextDE results in the Flemish agricultural industry (October 2021) at webinars for the API economy. The webinar is planned to be held in October with two sessions. The webinar's focus will be challenges in data sharing in the food supply chain and how new technologies like Blockchain can help. Invitations will be sent to the NGI Community.

Figure 2. Government of Peru Webinar. For more see
https://www.youtube.com/watch?v=zDxvYfGH5L4&list=PLoIkkZK3CPDGl7BXNydEFJVg23I
vpCDsn&index=19&ab_channel=Gob-p

Screenshot 1. Look and feel of the NextDE website

8. Impacts

The benefits of data sharing for the agro-food sector are essential as innovations are needed to solve the many global challenges related to providing food for the ever-growing population. Several data-sharing platforms, acting as intermediaries or brokers, have the potential to enable data-driven solutions, but interoperability is missing, and systems are fragmented. By adopting alternative decentralised architecture patterns and technologies, like connectors or smart contracts and biometric identification, intermediary platforms like DjustConnect and other service providers can better support the scale-up of the **data economy network**, the **performing of cross border transactions** and the **further automation of data sharing** as a way to achieve environmental, economic and social impact in the AgriFood sector.

The **midterm impact of the first experiment** (WP1 – Biometric identification) and in general, the adoption of Self-sovereign identity (SSI) by the data intermediaries will erase existing technological barriers and allow the performing of cross-border transactions. A whole new market will open for the current DjustConnect users and data providers as data users in the long term. Farmers, agrifood businesses and application builders in the EU and the US will now be able to exchange data. This will accelerate the availability of data on the platform and consequently the development of applications on the platform and allow a cross border transaction for all actors, including the farmers. Additionally, it will give the ability to the farmers complete management of their digital identity.

The **midterm impact of the second experiment** (WP2 – Smart Contracts) is that DjustConnect will enhance the existing consent flow, allow negotiations on API prices and guarantee complete transparency to all participants, including the Farmers. A service that can support the data partners (consumers and the providers) to establish agreements on specific APIs resources, under trust and transparency, sought promising. DjustConnect stakeholders believe that a service like this can support the establishment of data access and usage agreements, further support technical and organisational/legal enforcement, and tackle two main obstacles:

a) The first one is related to the current **lack of trust and transparency**. The Data providers ask, "How I am sure that the data consumer will use my data as he promised to do? What should I do to protect my data". Additionally, the farmers want to deliver their consent and be aware of the agreement's content between the provider and the consumer.

b) The second one is related to the **lack of awareness or knowledge of the actual value of the API resources**. For example, the providers ask, "What is the price of my API?", "Should I ask the same price if the usage period is one year or three years?" or "Should I ask for more when the conditions look favourable, or I should retain the price and keep it irrelevant to the data consumer?". The outcomes of WP2 and WP3 will support DjustConnect stakeholders in deciding how to proceed after the end of the Project.

In Table 3, we link the project results with the expected impacts (Table 1)

Results (Codes from Table 1)	Impact
R1, R3, R4, R5, R8, R9, R10, R11, R12, R13, R14	Reinforced collaboration and increased synergies between the Next Generation Internet and the Tomorrow's Internet programmes.
R3, R8, R9, R10, R16	An EU - US ecosystem of top researchers, hi-tech start-ups / SMEs and Internet-related communities collaborating on the evolution of the Internet
R1, R2, ,R3, R4, R5	A FAIR AgriFood EU US Data Network (trust, fairness and transparency)
R1, R4, R6, R11,R16	Decentralised data sharing patterns AgriFood enabling new Governance and Business Models at which more service providers can have a role in Agricultural Data Sharing like App developers. By implementing Blockchain technology and applying the P2P concept to our transactions, users of the platform in the US or the EU; trade directly with their counterparties without any intermediary. Using Smart Contract for our new e-auction system based on external Oracles (data centres) will ensure all the parties complete decentralised management of their trading.
R8, R9, R10, R13, R14, R16	Enhanced EU – US cooperation in Next Generation Internet, including policy cooperation.
R1, R4, R16	Performing of cross border transactions. Our experiment, namely the interconnections of DjustConnect (EU) with the (US) ID verification platform IdPlizz, will be that a whole new market will open for the current DjustConnect users as well data providers as data users. Farmers, AgriFood business and application builders in the EU and the US will now exchange data in complete trust.
R3, R4, R5, R6	Automation in data sharing
R4, R9	Farmer Digital Soverneinty ("who is using their data, for how long, for which application, how many times and under which terms & conditions").
R1, R2, R4, R16	A new market for the current DjustConnect users, as well data providers as data users.
R9	Encourage more companies to delegate the role model to more women in traditional and innovative sectors
R1, R4, R11, R16	Developing interoperable solutions and joint demonstrators, contributions to standards. NextDE can deliver Smart Contract services to other platforms or share SmartContracts agreements between platforms. Platform users log in by using their Belgian ID and a login system(the mobile App Itsme® which is an eIDAS (EU electronic ID standards) certified App meeting the PSD2 EU open banking regulation and the GDPR. However, this trustworthy login system can only be used by Belgian farmers and platform users due to limitations. Our interoperable solution based on NGI identification verification technology will allow farmers and users from other countries, including the US, access to the DjustConnect data sharing and data access control services.

**Table 3. NextDE results and impacts. R1 equals to Result1 of Table 1.**

9. Conclusion and Future Work

As we have stated in other sections (see "Discussion and Analysis on Results", "Impacts" and "Results" but also ANNEX B: Feedback from the EU US Workshops), the adoption of a more decentralise pattern by DjustConnect that NGI technology enables, can support the establishment of a FAIR AgriFood EU US Data Network. More specific can:

- Increase the ability to perform cross-border transactions (EU US).
- Support the establishment of verified data-sharing agreements.
- Generate a Low entry-level in a data-sharing network.
- Can Increase the participation of actors like technology services providers.
- Support the Technical Enforcement of data access and usage agreements (Figure 3).

The adoption of a decentralised architectural pattern concerning the provision of the services, like the one presented in Figure 3, by DjustConnect is appealing to the AgriFood community because it delivers flexibility, business opportunities, and trust. Those are the needed elements of a FAIR Data economy.
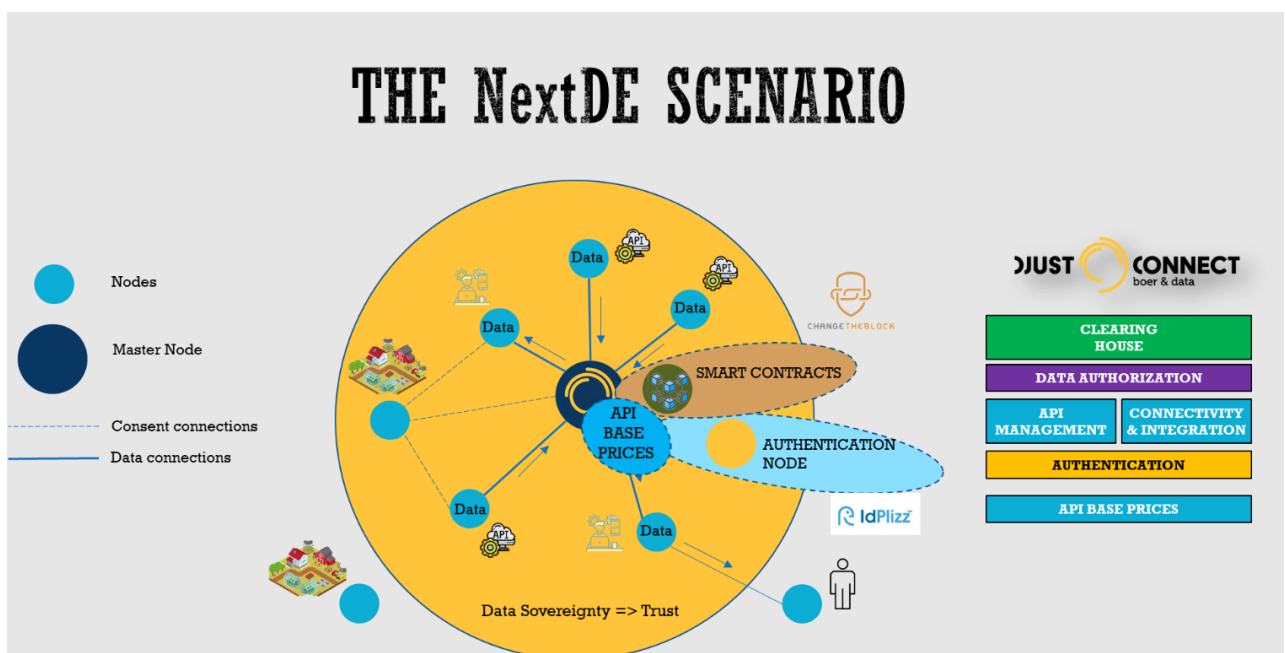
Figure 3. The NextDE architectural pattern applied in DjustConnect data sharing platform.

Related to the future work, based on our customers' results and the feedback, and as explained in the Present and Foreseen TRL section, we expect to achieve a TRL 6 in the Q2 of 2022.

The main idea of our new release will be implementing the Smart Contracts module within the DjustConnect platform, where the users from any state (Globally) will be able to sign contracts in a transparent, decentralised intuitive way. To do so, we will implement the module directly together with the DjustConnect platform. The users will require only to connect to one platform to get all the benefits from Blockchain technology and a decentralised

database. To increase the number of contracts accepted within the platform we will open an API infrastructure where different developers can program their apps reliably and securely. This activity will ensure the protection of the data while promoting the creation of new ways of using it.

On top of that and to ensure the reliability of the data, we are planning to implement a sharding connection for the database. This kind of system allows us to have different databases shared between several nodes, ensuring that no single person has access to the information, reducing the possible cyber-attacks against it. This new sharding system is based on Blockchain technology, so as we already have some part of the platform based on this technology, the movement will be smooth for our users.

This new interoperable database will increase the trustworthiness and resilience of our system as it will be distributed entirely among many nodes, which will generate a better transaction speed and better availability of information. One of the most important points that we will need to tackle is data privacy, as all the info will be shared in different private nodes; we need to ensure that none of them could have access to the information they are keeping.

The best approach to do so is sharding[3] as the nodes only have one encrypted part of the information, and to access the whole data, they need to have a password and what is called the path. This path is to know the correct pieces for a determined part of the info, and to solve this puzzle, you could only do it if you are the owner of the info and you are the one that shared the information.

Last but not least, we expect to fully implement an ID verification system that will work equally for US and EU citizens, reducing the costs associated with these processes. To do so, we want to implement and connect the Belgium Id System within the IdPlizz platform and connect the new software in the DjustConnect smart contracts platform.

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[3] https://www.digitalocean.com/community/tutorials/understanding-database-sharding

10. Glossary (preferably in tabular form like below)

5G	Fifth Generation (mobile/cellular networks)
NGI	Next Generation Internet
R&D	Research and Development
SDN	Software Defined Networks
TRUST-IT	TRUST-IT (Project Partner)
VNF	Virtual Network Function
WIT	Waterford Institute of Technology (Coordinating Partner)
TRL	Technology Readiness Level
SSI	Self-sovereign identity
DAR	Data Access Request

13. **ANNEX A: NextDE User Manual**

The documentation below describes the steps that need to be followed in order to complete the signing of a verified smart contract by all parties. Screenshots present the UI as a way the users to become familiar with the software. For the IdPlizz biometric identification, a How it Works documentation can be found on the company website.

Action 1: The first step to creating a Contract based on templates already uploaded by the NextDE team.
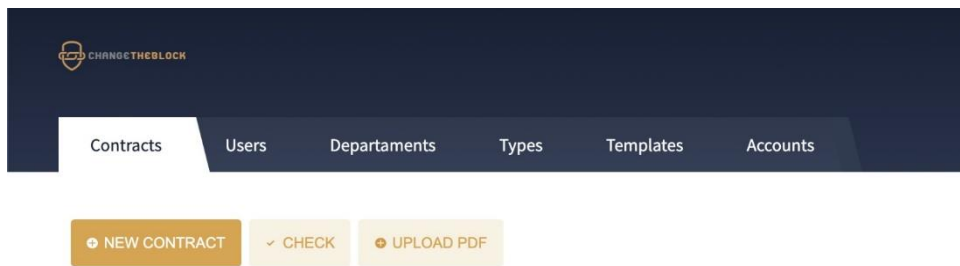
Screenshot 2

Action 2: Once the New contract button is pressed, it shows a screen automatically where the user could decide the name of the contract. We added this possibility to make it easier to the users to classify their contracts
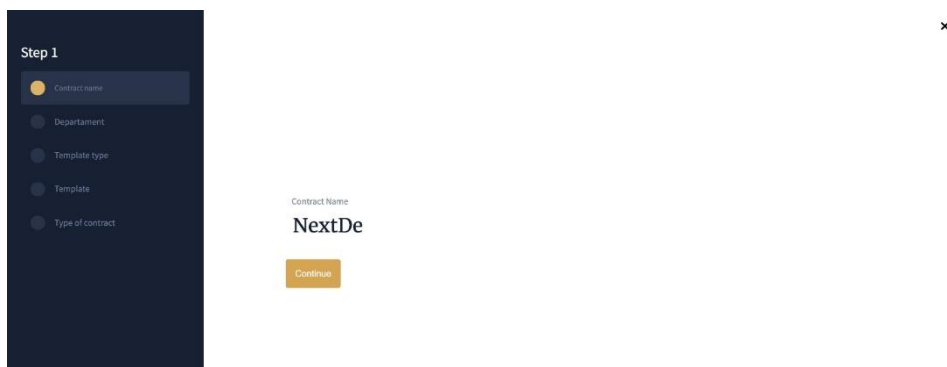
Screenshot 3

Action 3: Once the name of the contract is defined, we need to select the department where this contract belongs. The department's option is based on the different divisions that a company usually has. For example, commercial, administrative, HHRR departments that all of them have a different kind of contracts based on their daily routine.
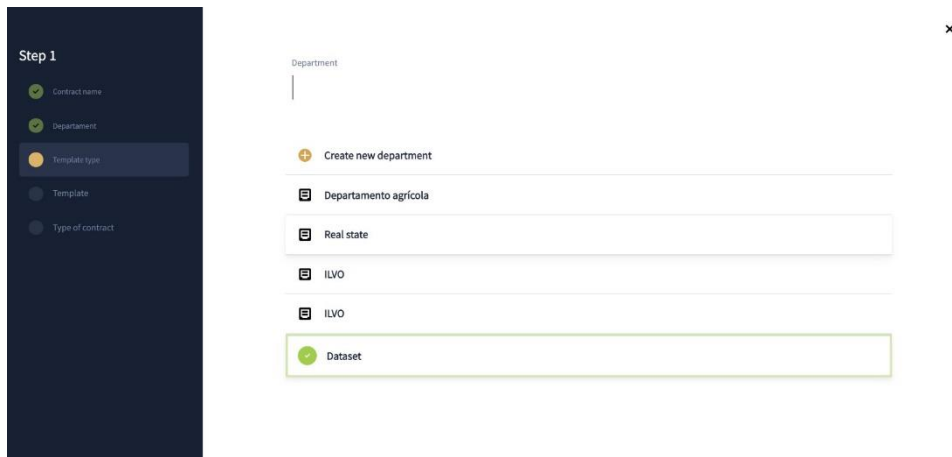
Screenshot 4

Action 4: Once the user selects the department, they need to decide the type of contract they will use within the departments. Within a department such as the commercial one, we could find contracts such as NDAs, contracts as providers, or even consumers.
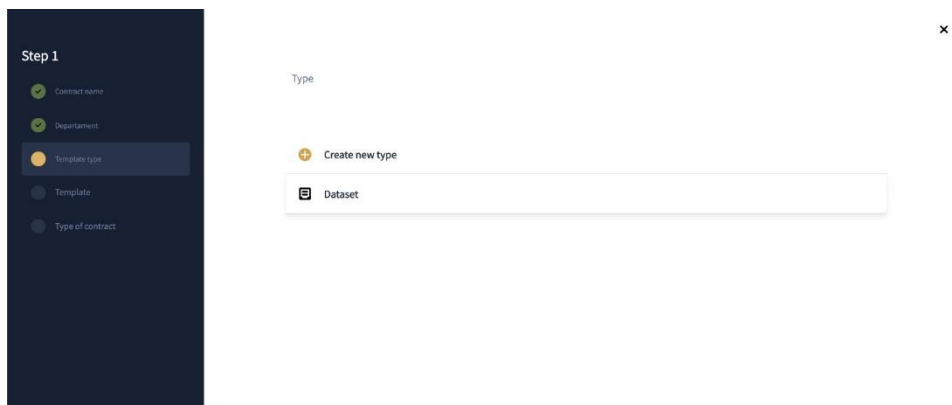
Screenshot 5

Action 5: After selecting the department and the type, we, as NextDE in this experiment, have uploaded different types of contracts, and in the future, we expect them to have different templates based on different languages as we work in a transatlantic environment. So, any company could have contracts in Spanish, Flemish, English, etc., as templates to work faster.
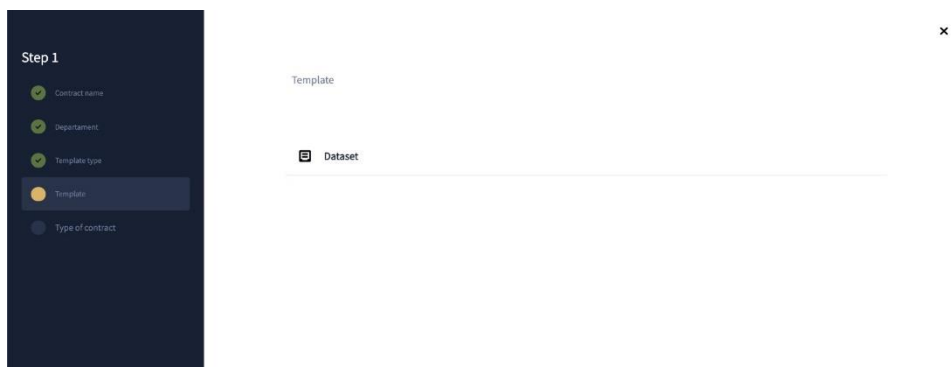
Action 6: Once we have selected all the options, in this experiment we have created a front-end where the providers select some important variables such as the price of the Api access, the name of the consumer, the name of the APi, duration of the contract, etc. The most important part of this screen is while the user is feeling these blank spaces on the back end we are building the Smart Contract that will automatically execute notifications and actions.

Screenshot 7

Action 7: The user fills the template with the information required. The platform shows the number of questions that are not finished, the total number of questions and the ones answered
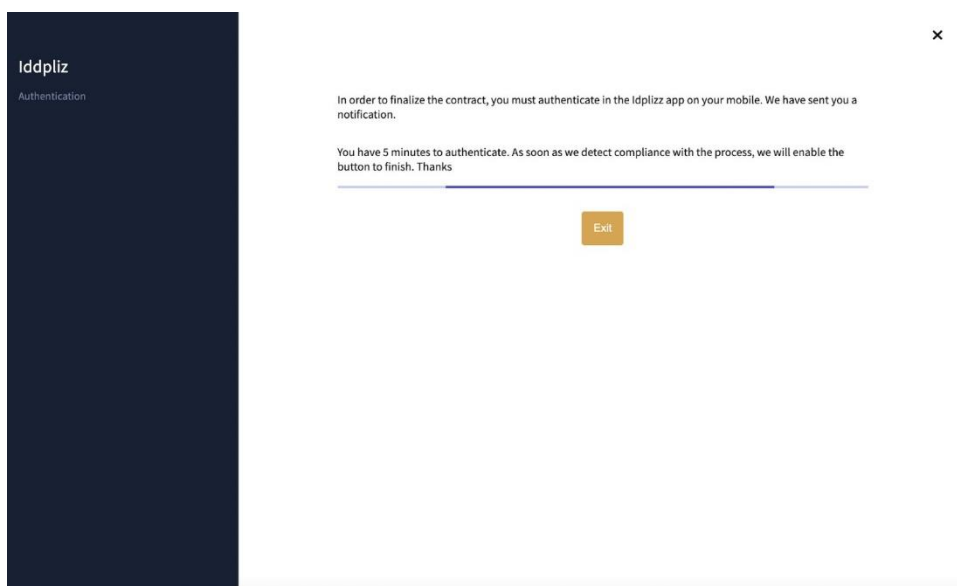

Screenshot 8

Action 8: When the user finishes filling in the questions and answers, they select to whom they are going to send the contract to be signed
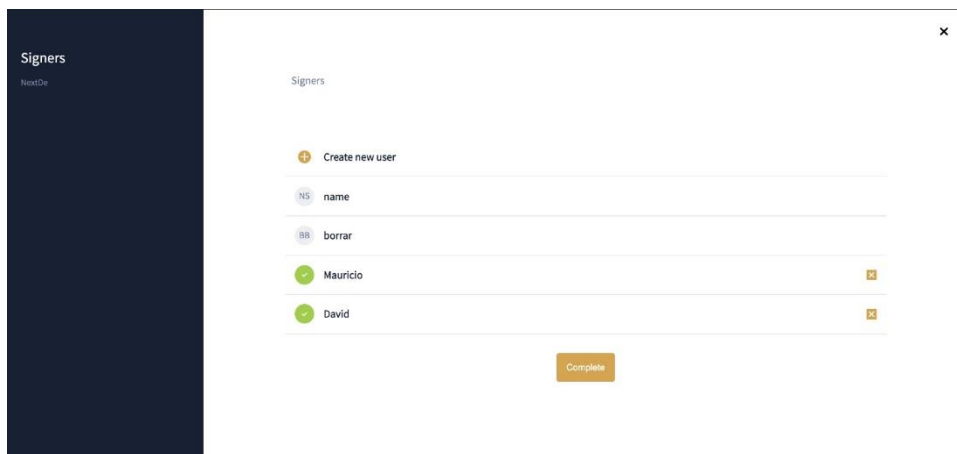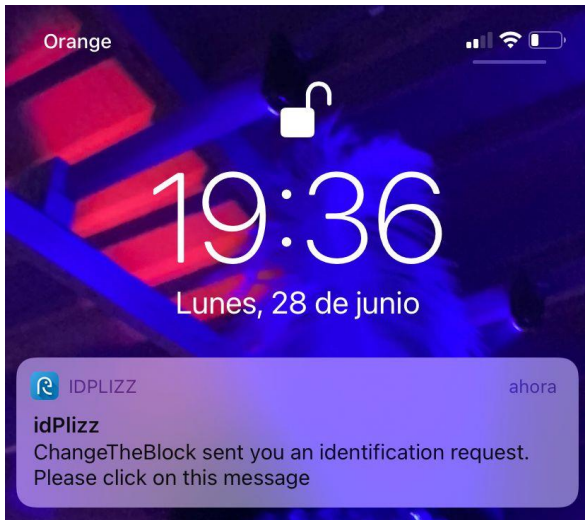
Screenshot 9

Action9: To send the contract, the platform asks the user to identify himself through the IdPlizz App. If the identification fails, the user cannot send the contract to the customer

Screenshot 10

**Action 10:** Identification through the idplizz App. To do so the user must register in the IdPlizz App and then confirm his/her identity. To do so, he/she must upload a selfie smiling to be sure that the person is alive and confirm that the request for creation of the contract is something that they ask for and that they are really the person that is supposed to sign.

Screenshot 11
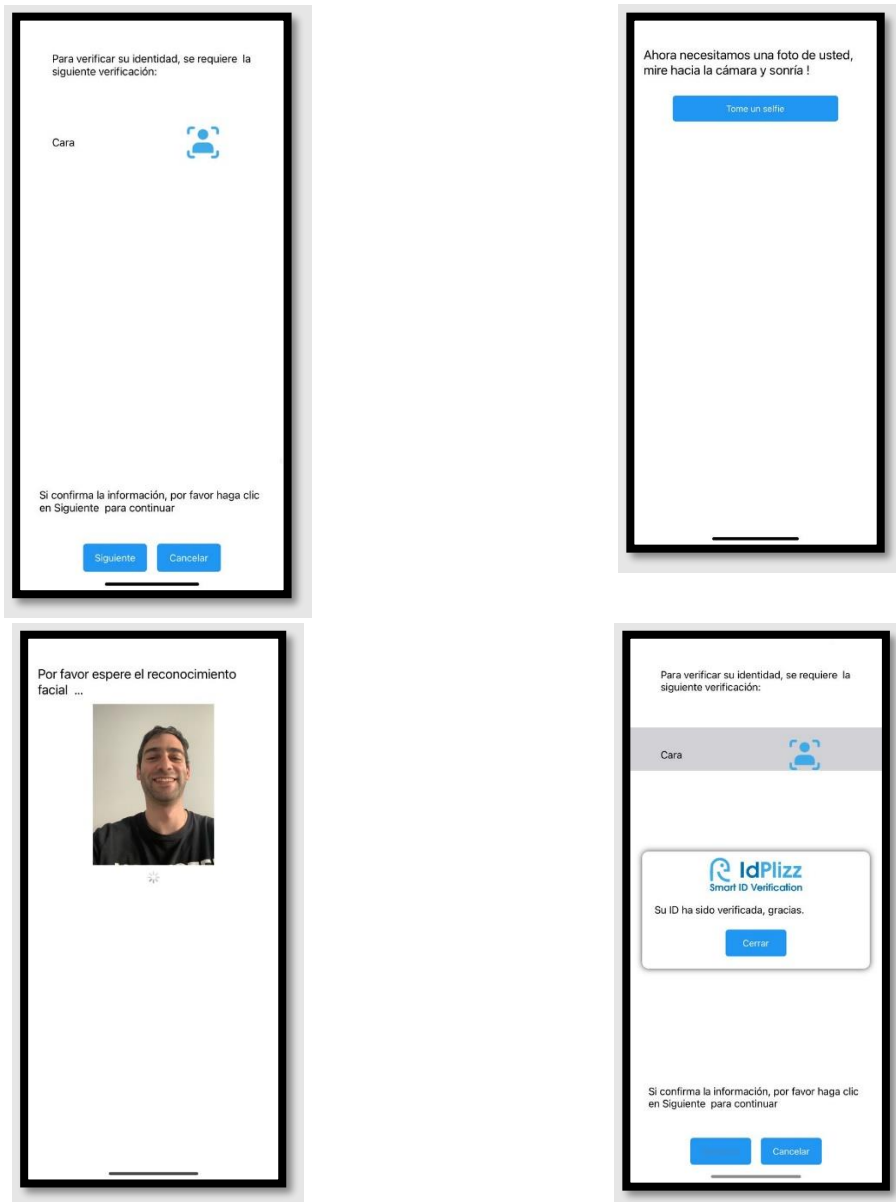
Screenshot 12

Action 11: The consumer receives the notification through email that a new contract was created. He signs in with his user on the platform and signs the contract. Once this action is performed, the Smart Contract starts working on the back end

Screenshot 13

14. ANNEX B: Feedback from the EU US Workshops

In the following annexe, we will summarise participant's feedback getting from the EU US Workshops. During the workshops and after the demonstration of the NextDE services we performed a survey as a way to understand:

- User knowledge of NGI technologies.
- User acceptance on decentralisation concepts in data sharing.
- User acceptance of the NextDE solution.

Summary of the NextDE Workshop

In order to contribute to the development of an Agricultural EU-US Data Sharing Network, two workshops took place with EU_US participants from Digital Innovation Hubs (Agristo and AVR) and Agricultural Data Coalition (several AgriTech Companies) to test and evaluate the innovative NGI technologies experimented within the Project. In general, the content of the workshops included a demonstration of the Project and NextDE services and a survey conducted in an environment of solid interaction and discussion.

The survey included questions to determine and understand participants' awareness and acceptance of the new technologies experimented within NextDE services. The survey consisted of **32 questions divided into 3 main sections**. We had summarised the most of the responses by highlighting the most critical ones:

- Questions about Current State of Organization/Company,
- Questions regarding NextDE New Business Process
- Questions about Decentralization and Fair Data Economy.

In the first section about the current state of the organisation/company, questions focused on:

- Knowledge and awareness of new technologies like smart contract and biometric recognition.
- Future/current perspectives on new technologies, data exchanging, connectors and decentralisation.
- The scale of data sharing.

The findings in the **first section** can be summarised as follows.

- The awareness and knowledge of all participants from the EU and the US on the new technologies like smart contracts and biometric recognition are at a moderate level, and they believe that these technologies can fill the trust gap in the future.
- Participants have all currently exchanged data, or they plan to exchange data, and they believe decentralised data sharing and intermediaries like DjustConnect have a role in

the future. Survey takers from both continents emphasised their positive approach with data transactions that could take place between the EU and the US.

- With the question on a scale of data sharing, we observe some differences between participants both from the EU and US regarding their role in data sharing. The EU indicates they are acting as provider/consumer, and the US took more roles. There were also differences in the capacity of their business, with US having more consumers, API's and resources.

- Despite they all have good knowledge about APIs and the API life cycle. They don't have experience with defining or estimating API prices.

The **second section** about NextDE New Business Process included the questions about acceptance of NextDE services:

- In this section, it was understood that although all partners are optimistic about the NextDE smart contract and biometric identification services, they were sceptical about the NextDE base API price service.

- EU partners pointed out that using smart contracts can deliver trust to data owners as a benefit. And US partners listed the benefits of using smart contracts as increasing transparency, reducing risk and increasing stability, operating within a data network with fair rules, reducing the dependency from one central authority or one platform.

- Survey-takers were asked about their willingness to participate in similar projects in the future. Their responses were mostly positive, and they highlighted that it could be more interesting and effective if they can participate as a full partner.

- Finally, in order to better understand their approach to the API prices, the participants were asked how they would fix the APIs prices if they have 100 APIs and a market of 1000 potential consumers. Answers differed according to the professions of the participants, not according to their country. While the answer of the farmer from Agri Data Coalition emphasised negotiations per case, the answers of the other participants from different professions dealt with **Electronic Auctions and Smart Contracts**. The answers given to this question showed that there might be differences in the perspective regarding innovations between other occupational groups.

The questions in the **third section** focused on **Decentralisation** and F**are Data economy**.

- The participants were asked to comment on if the current DJustConnect DAR service supports the scale-up of the data economy network? To this the EU partner responded as unsure, but US partners' responses were positive.

- The partners were asked to indicate which information should be contained in the contractual agreement to support the digital sovereignty of the farmers. API prices, terms and conditions of the data network/platform and the share of the value to the parties were listed as answers. In addition, the EU partner commented that the purpose of the data should be included.

- When were participants invited to choose technologies that are needed to increase further providers, consumers and farmer participation in the Data Economy? The EU

partner highlighted biometric identification for cross border transactions and connectors as a way to decentralise the data sharing flows.

- US partners choices listed a distributed ledger technology for immutable contracts, biometric identification for cross border transactions, connectors as a way to decentralise the data sharing flows and cryptography.

- Partners were asked to respond to two questions about a centralised architecture pattern controlled by a single authority, namely whether they believe this can deliver trust to all parties and if this can deliver new business opportunities. The answers given on the first question by EU and US partners were "yes under certain conditions". To the second question, US partners responses were positive, but they highlighted that there are limitations, and EU partner responses were negative.

- With another question, we asked if alternative decentralised architectural patterns increase trust, efficiency and scalability. All responses to this question were positive.

- It has been understood in the workshop that US partners find API price assessment services valuable under the condition that they have a lot of resources to share with a large number of data endpoints and if they participate in an extensive data-sharing network. And it was determined that for the EU partner, the necessary criteria is to have valuable data.

- They were asked to indicate the needed structural elements of a FAIR Data Economy.
  - The answers of the EU partner were a code of conduct, a business model and technology for trust.
  - The answer of US partners was: code of conduct, constitute agreement (Governance Model, Terms and Conditions), legal enforcement, business model, technology for trust, ethics.

At the end of the workshop, the open-ended part of the questionnaire followed where their feedback and ideas were asked on how we can establish an **EU-US Data Network** and scale up and **automate data sharing.** A number of additional things were defined as ways to improve an **Agricultural EU-US Data Network**.

- US partners commented on the need to start small with people/entities possessing the incentive to bring about this change. It would likely involve entities with international exposure, significant end-user driven demands for more information, involving high-value transactions. There were comments on the importance of data quality and processing all the information from different sources to an understandable, standardised format. They mention that the main focus should be on data transformation from the raw data to the required format. They comment that it is important to facilitate processes necessary to better understand the technology and increase awareness and knowledge about the topic. It is also essential that producers should stay in control of the data without intermediaries involved.

- EU partner emphasised the precautions to be taken to overcome the difficulties about legal, ethical issues and regulatory constraints.

15. ANNEX C: Code of the Smart Contracts

Calculator Smart Contract

Using this code written with solidity language, any user could create a Smart Contract connected to a database to use our formula to calculate the fair price of future transactions and include it within their code. This formula takes the last prices and creates an average based on the prices that the user will include within the Smart Contract

```solidity
pragma solidity ^0.4.0;
import "github.com/Arachnid/solidity-stringutils/src/strings.sol";

contract CalculatorContract {

    using strings for *;

    constructor() public { }


    function calculate(string memory prices) public payable returns (uint) {
        uint result;
        strings.slice memory s = prices.toSlice();
        strings.slice memory delim = ";".toSlice();
        uint lengthPrices = s.count(delim) + 1;

        for (uint a = 0; a < lengthPrices; a++) {
            string memory aux = s.split(delim).toString();
            uint price = stringToUint(aux);
            result = result + price;
        }
        result = result/lengthPrices;
        return result;
    }

    function stringToUint(string s) returns (uint result) {
        bytes memory b = bytes(s);
        uint i;
        result = 0;
        for (i = 0; i < b.length; i++) {
            uint c = uint(b[i]);
            if (c >= 48 && c <= 57) {
                result = result * 10 + (c - 48);
            }
        }
        return result;
    }

}
```
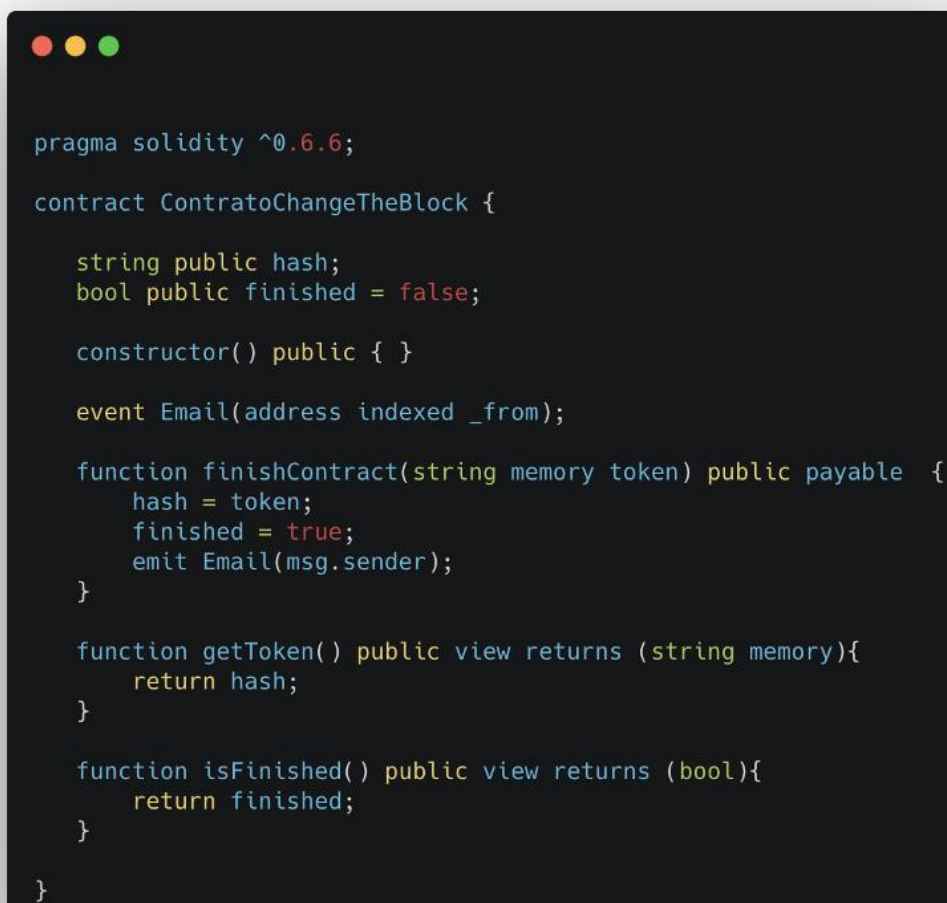
Oracle Contract

These types of contracts are used to keep track of information that occurs out of the Blockchain. In our case we included this new type of Smart Contract to keep a control of the signature process of the Smart Contract.

Adding these lines of code of any application based on solidity developers could have a track of different signatures that occur on the system, and also they could change it to do the tracking of another type of information.

```solidity
pragma solidity ^0.6.6;

contract ContratoChangeTheBlock {

    string public hash;
    bool public finished = false;

    constructor() public { }

    event Email(address indexed _from);

    function finishContract(string memory token) public payable  {
        hash = token;
        finished = true;
        emit Email(msg.sender);
    }

    function getToken() public view returns (string memory){
        return hash;
    }

    function isFinished() public view returns (bool){
        return finished;
    }

}
```

In this particular case, it primarily defines when a user signs the contract and defines the status of the signature process, which is the base for the control of the system participation by the different users that work with our platform.