Virtual Finland

A project headed by the Ministry for Foreign Affairs of Finland, is to make it easier for foreign employees, companies, and students to interact with Finland using data.

Virtual Finland is constructing a data sharing infrastructure that can help transform the current disconnected public services into smooth service paths without the need for massive integration processes. Based on the data sharing principles outlined in the European Commission's European Strategy for Data, the national infrastructure can help foreign employees, students, and companies to interact with Finland more easily.

Nordic Smart Government & Business

NSG&B (Nordic Smart Government and Business) is a Nordic collaboration program between over 20 Nordic authorities in collaboration with external stakeholders, lead by the five Nordic Business Registries and with financial support from Nordic Innovation.

The vision of NSG&B is to create value for the SMEs by making real time business data accessible and usable for innovation and growth across the region, in an automatic, consent based and secure manner.

IOXIO Ltd

IOXIO Ltd is a Finnish technology company specialized in governmental and industrial data sharing using data spaces. Experts on data productization, data sharing, and connected user-centric data economy technologies. Over a decade of experience in real time economy, open banking, post-trade digitalization and trade automation.

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White paper

Case Nordic Smart Government & Business

Enabling cross-border company data sharing in the Nordics using dataspaces

Use case:
Establishing a compliant and trustworthy non-listed company remotely in another Nordic country

Ver 1.0
13.6.2023

IOXIO

Pirkka Frosti
Henna Suomi

Executive summary

Despite the enormous amount of digital information available globally, the much talked about data economy is still in its infancy. One of the main reasons is that much of the data remains unstructured, rendering it virtually useless from an economic standpoint. Being able to agree on data standards is therefore a key ingredient in becoming a data economy forerunner. The Nordic countries have the potential to assume such a role, but it will require a both Nordic and state-level strategy as well as consistent public-private cooperation.

At the same time, the European Union is pushing a series of regulations, such as the Data Act, for boosting data access and transparency between public and private sector organizations to share data. All this puts a high pressure on organizations to improve their data sharing capabilities with solutions that is easy to use for cross-organization and cross-border organization. However, similar solutions remain mostly inexistent which calls for practical actions to seek solutions for the trusted company data sharing.

In 2019, the Nordic Prime Ministers agreed on a new vision for the Nordic cooperation, Vision2030, which holds that the Nordics is to be the most sustainable and integrated region in the world by 2030. The vision includes that the Nordic countries become a leading region in digitization, ethical artificial intelligence and the responsible use of data. In order to make this vision more concrete, The Ministry of Foreign Affairs of Finland started a project called Virtual Finland in 2021 which is a Finnish cross-border digitalization program building the first governmental cross-border dataspace to realize the Vision2030. Dataspaces are the next evolution of data integration systems which enable cross-organization and cross-sectoral trusted data sharing more easily compared to the traditional integration solutions. Through open standards and the framework for agreeing data exchange rules, dataspaces offer easy to use and scalable building blocks for connecting any Internet service with any desired data source in a trusted and secure manner.

This white paper is a result of an experimentation on cross-border company data sharing done between the tax and business register authorities in Finland, Norway, Sweden and Iceland between April 2022 and April 2023. The focus was in secure and remote digital cross-border company establishment between nations built on European data economy principles and productized data sharing. The project was done as a collaboration effort between Virtual Finland, the Nordic real-time economy collaboration program Nordic Smart Government & Business (“NSG&B”) and IOXIO Ltd. as a data economy professional and dataspace service provider lead and delivered the experimentation for the Foreign Ministry of Finland.

The experimentation and its prototype implementation covered two main use cases that could in the future answer to the challenges of the companies’ data access. *How to establish a company digitally and as easily as possible* across Nordics which is a baseline for starting digital and automated company processes. Another use case focused on *how the digital and structured data created and hosted e.g. by the authorities can be used by the online services that companies use for more seamless administration and how it can be shared* not just openly but also in a controlled and confidential manner with the company’s consent which support the legal and business frameworks of companies.

The experimentation resulted in the following main results

1. The analysis of the company value network, process and information in the current company establishment process proved the similarities of the business registry processes in different Nordic countries. This means that the company data can be structured and standardized for better interoperability across Nordics.

2. The experimentation project identified business data that is crucial for running and administering companies that has relevance across multiple processes and services that companies and authorities use. This high-volume business data such as *company business extract*, *beneficial owners*, *signatory rights* were standardized and productized in the experimentation and solutions that makes the data more easily available digitally either openly or with the companies consent were tested end to end with real business registry data from different Nordic countries. The data consenting was used on a test level and requires further development to be feasible for future use.

3. The experimentation showed that when using data productization and a dataspace, the needed business data can easily be made available and shared from the source that the data originally exists. In the future, combining dataspaces with the emerging self-sovereign and wallet-based solutions (e.g cross-Nordic strong authentication / eIDAS2.0) provides a promising combination to fulfill the data sharing and access challenges of companies and the authorities to be able to realize the vision of the real-time economy.

Conclusions

The main conclusions were that there are very little differences between the Nordic nations in terms of legislation, company legal roles and the ways the companies are established and registered. It seems realistic to create a common framework for providing the interoperable digital trust and data sharing capabilities now missing in the Nordics. The level of digital readiness among the business registers is very high in each country studied. The capability to query company data is on a solid footing already in each of the country yet the capability to register the company and share data with the business register APIs from e.g., banking services vary between countries. Norway and Sweden offer the registration APIs in production as Finland has not yet implemented them. In addition to these APIs, the common Nordic foreigner authentication solution for company representatives, data sharing consenting service and the common Nordic non-listed company identity needs to be quickly brought into use. The project recognized that the Nordic countries could move faster by recognizing national authentication solutions and agreeing to make them interoperable.

The key take away is that the Nordic authorities have the readiness to commonly structure and define the data needed to build the functioning digital markets. The registered business data can be harmonized between the governments and methodologies exist to make each country's authorities capable of agreeing on the data formats around the Nordic businesses. The experimentation showed that while this is possible, there is still little effort yet done to establish a continuous structure between governments to create and maintain common master models for company and economic data. To build widescale interoperability for company data other authorities and especially private sector stakeholders such as banks, accounting and auditing firms, post-trade, insurance, other

financial industry companies and other company service providers should be included in this work.

Moving forward

From a company end user perspective the results offer a way to make the companies' life much easier and enable them to use services and get daily business done much faster, with a lower cost and more securely in another country than today. One reason for this is that most of the processes are manual and the digital services are not available for foreigners. By using dataspaces, governmental data can be shared and combined with other industries' data sources such as accounting, logistics, trade, and banking. This means Nordic companies can have a growing number of digital services that work seamlessly and consistently for any business event they participate in. This will lead to more automation and efficiency in company operations, resulting in significant improvements both in public and private business services. As company service providers, the public and private sector could develop interoperable digital services faster and that would allow reaching a much wider audience in the Nordic scale. This would widen the customer base for the businesses, expand the reach for resources from other countries and also help authorities to digitalize the processes between their borders.

The experimentation encourages to expand the already built cross-border company data sharing ecosystem with new use cases and experimentation steps. By adhering to the principles of European data sharing the experimentation has now proven that business registers when holding high quality data can be used as trust anchors to enable trust in our Nordic digital economy when companies and data move cross the borders. Moving forward, the experiment could be expanded next to connect Nordic banks, accounting companies and other authorities, bringing the Nordics one step closer to realizing the vision of the most integrated region.

Moving forward, the experiment could be expanded next to connect Nordic banks and accounting companies to test out how they can share company and accounting data to fuel the different use cases. This requires further strengthening of strategic cooperation and co-investments to secure the continuation for cross-border data sharing between the Nordic countries To secure the continuation for cross-border data sharing development between the Nordic countries would require further strengthening of strategic cooperation and co-investments. In addition to practical demand, success would also require a common plan for the implementation of Vision 2030 and political commitment. This would enable the development of the world's most integrated region and especially the construction of an infrastructure for cross-border reliable data sharing.

Terms and acronyms

Term / Acronym	Description
AOA	Articles of Association
API	Application Programming Interface
NSG&B	Nordic Smart Government and Business
VF	Virtual Finland Project by Ministry of Foreign Affairs of Finland
YD	Yrityksen Digitalous (Fin). Finnish RTE program lead by PRH.
CSD	Central Securities Depository
eIDAS	Regulation on electronic identification and trust services
EU	European Union
HTTPS	Hypertext Transfer Protocol Secure
JSON	JavaScript Object Notation
ISIN	International Securities Identification Number
OpenAPI	The OpenAPI Specification, previously known as the Swagger Specification, is a specification for a machine-readable interface definition language for describing, producing, consuming and visualizing web services
LLC	Limited Liability Company
SSI	Self-sovereign identity (SSI) is an approach to digital identity that gives individuals control over the information they use to prove who they are to websites, services, and applications across the web.
NLC	Non-Listed Company
PCI DSS	Payment Card Industry Data Security Standard
PRH	Finnish Patent and Register Office (fin. Patentti- ja Rekisterihallitus)
REST	Representational State Transfer
RTE	Real Time Economy
SHA	Shareholder Agreement
SME	Small and Medium Enterprise
TLS	Transport Layer Security
VAT	Value added tax (fin. varainsiirtovero, VSV)
VPN	Virtual Private Network
VRK	Population Register Centre (fin. Väestörekisterikeskus)
VTJ	Population Information System (fin. Väestötietojärjestelmä)
YTJ	Business Information System (fin. Yritys- ja Yhteisötietojärjestelmä)
eID	An electronic identification ("eID") is a digital solution for proof of identity of citizens or organizations.
SaaS	Software as a service is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.
Breg	The Brønnøysund Register Centre has 17 registers, as well as several other services in Norway. Register of Business Enterprises.
SDGR	EU Single Digital Gateway Regulation or SDGR
OOP	EU The Once Only Principle System

Motivation, background, and targets

Why do we need digital companies and data sharing around them?

The Nordic countries are leading digital societies with high rankings in open democracy, rule of law, and overall wellbeing. However, their economies face challenges from aging populations, large public sectors and strong global competition, which may threaten to undermine their core values. The small internal markets are relying on heavy industries and service sectors to drive growth and on numerous SMEs to create most of the new jobs. However, there are worrying signs that the digital business landscape in the Nordic region can't deliver the automation and growth the business and the supportive public sector would need. For example, the SMEs which consist more of that 90 % of all businesses in the Nordics still face laborious and often manual administrative processes, especially when doing business cross-border.

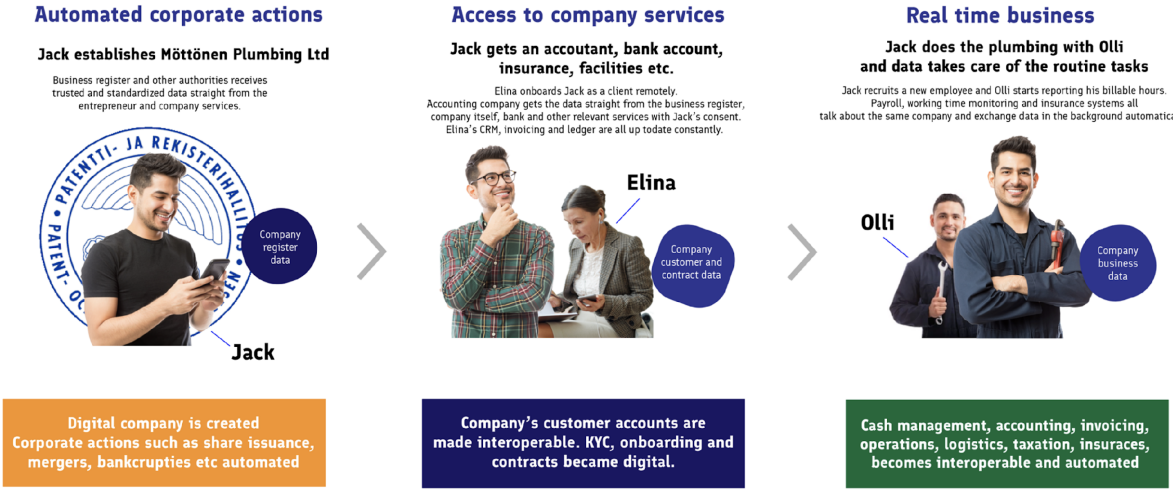


Figure 1. *Data interoperability enables born digital companies to conduct real time business with minimal administrative overhead also cross the Nordic borders.*

The European Commission is driving the nations to adapt new regulation and rapidly build capabilities to create the harmonized single digital markets. This mainly means facing the requirements to enable the digital trust for identities and digital rights (eIDAS 2.0) and cross-governmental data sharing (Single Digital Gateway Regulation or SDGR) especially when companies, goods, and assets cross-European borders. The requirements also cover the legal entities and mainly targets the large SME sector in the EU and the Nordics.

The Nordics drive to build the harmonized digital markets for companies

The Nordic Council which is the official body for formal inter-parliamentary co-operation between Nordic nations, has set the vision for the Nordic region to become the most sustainable and integrated region in the world in 2030. If this vision is realized, the Nordics could become the 11th largest economy in the world with the highest GDP per capita in EU uniting 27M people and millions of businesses. Today, the company data doesn't move across borders easily and digital interoperability between nations leaves room for improvement. Despite the Nordics being the most digital ready nations, the countries lack the interoperable and secure digital capabilities needed to support the trusted and harmonized business data sharing between the countries. To meet both the EU and the common Nordic goals would mean rapid investments in a completely new common digital

business infrastructure to build interoperable and unified digital markets for companies to born and operate in any of the Nordic countries digitally.

This experimentation was needed to build further common understanding for the Nordic real-time economy community, the Nordic Smart Government and Business, (NSG&B) members in *how interoperability and trust capabilities between existing digital systems could be built and how dataspaces as the new emerging solution based on the common European level principles can fit in delivering the new envisioned digital services for companies as well as world class public service experience.* Dataspaces are the next evolution of data integration systems which enable cross-organization and cross-sectoral trusted data sharing more easily compared to the traditional integration solutions. Through open standards and the framework for agreeing data exchange rules, dataspaces offer easy to use and scalable building blocks for connecting any Internet service with any desired data source in a trusted and secure manner.

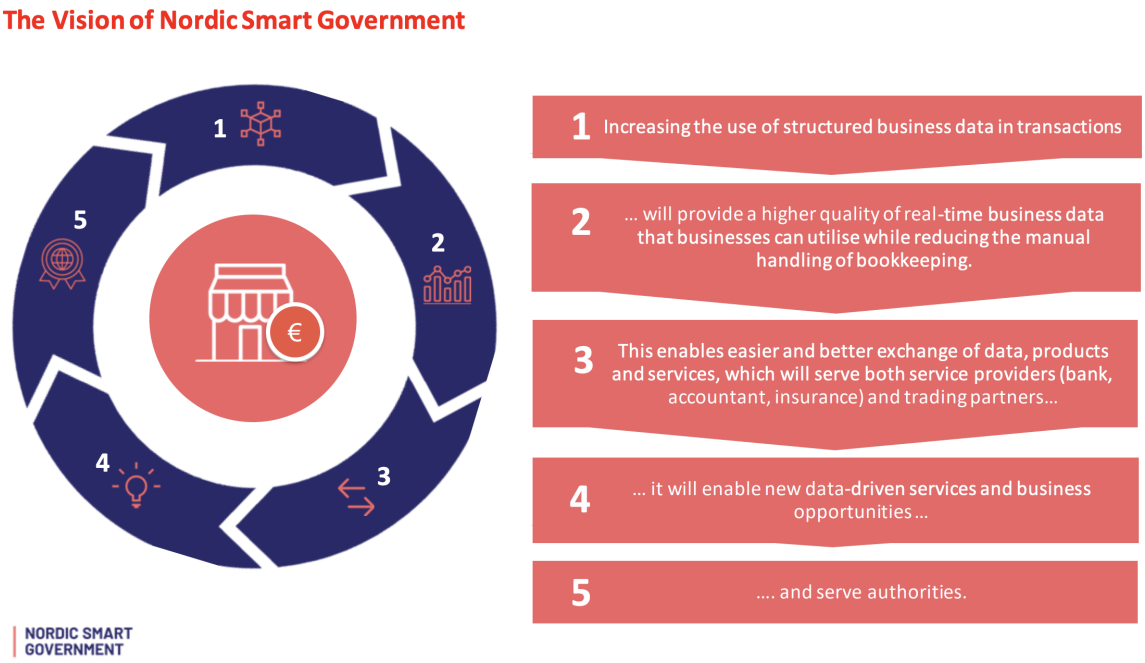


Figure 2. *NSG&B vision driving the experimentation.*

Case description and targets

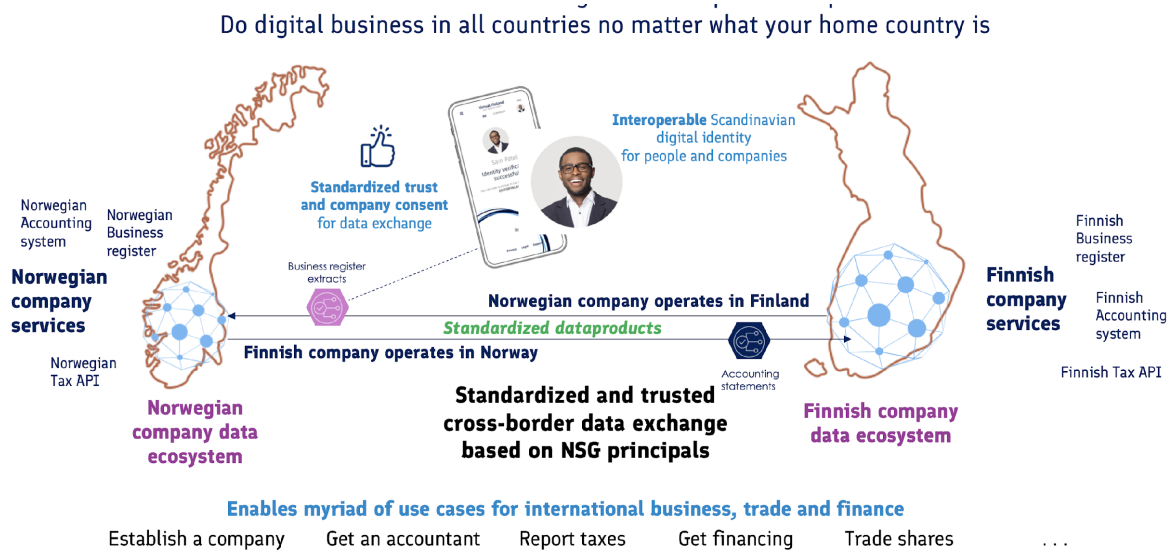


Figure 3. *Nordic digital single market would allow companies to operate remotely in any country as trusted and standardized data can be shared cross the border*

To seek solutions for advancing the real-time economy in practice, the NSG&B initiated a collaboration with the Finnish cross-border initiative called Virtual Finland, lead by the Ministry for Foreign Affairs in Finland. The Virtual Finland program develops and brings together solutions that help e.g. foreign employees and companies to interact with Finland digitally. The Virtual Finland project operates an open dataspace testbed to test out and pilot various trusted cross-border data sharing use cases for the benefit of people, companies, and government authorities alike. The Virtual Finland project partners with the data economy technology company IOXIO for operating the testbed.

The experimentation itself essentially focused on two use cases around non-listed companies to better understand what born digital means in practice:

Use case 1: Establish a company in a digital form in any Nordic country.

Use case 2: Share key company data in digital and structured format for better automation and improved services and less manual work both for companies and public sector officials.

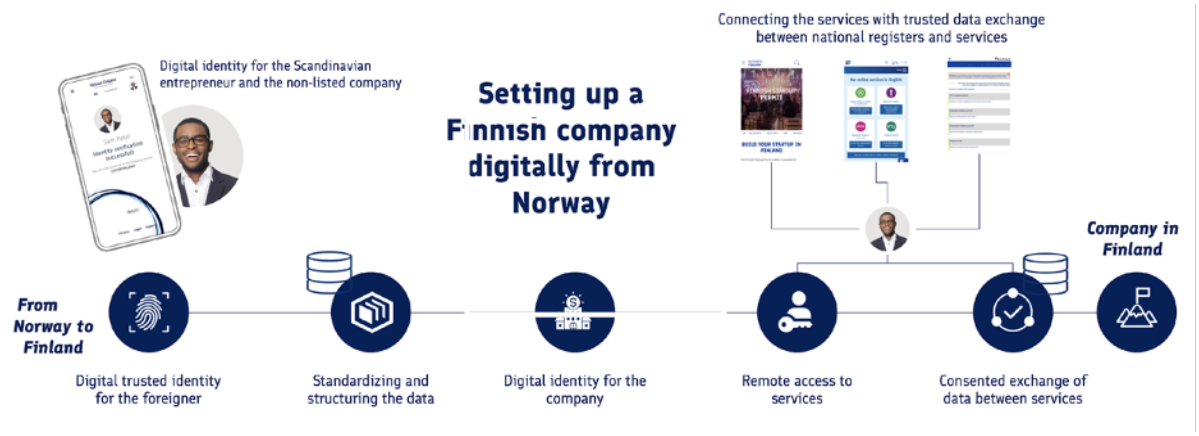


Figure 4. *Establishing a company in another Nordic country requires digital trust and productized data sharing based on real world rights and consent. Tested in use cases.*

The experimentation consisted of three parts. In the first part, the company establishment process including company value network and information modeling in different Nordic countries were investigated and analyzed to achieve a common understanding of the similarities and differences across Nordic countries. Thereafter, the key company data sets in company administration were recognized and standardized to test and experiment how it could help in various company administrative processes between companies' and authorities. Finally, the standardized data sets were turned into *data products* on the Virtual Finland testbed to experiment how they can be associated with the necessary authentication and consent mechanisms to control the data sharing in different services and connected in the same dataspace environment in prototype applications that represented any public or private service used by the companies themselves or authorities.

Members in the experimentation

NORDIC SMART GOVERNMENT & BUSINESS	NSG&B is a Nordic collaboration program between over 20 Nordic authorities in collaboration with external stakeholders. The vision of NSG&B is to create value for the SMEs by making real time business data accessible and usable for innovation and growth across the region, in an automatic, consent based and secure manner.
NSG&B members:	
Brønnøysundregistrene	The Brønnøysund Register Centre is a government body under the Ministry of Trade, Industry and Fisheries, and consists of 17 different national computerised registers in Norway.
Skatteetaten	The Norwegian Tax Administration
PRH	The Finnish Trade Register is a public register that contains information on traders and businesses. The majority of businesses are limited liability companies and private traders. The register contains official details of businesses all over Finland.
VERO SKATT	The Finnish Tax Administration
Bolagsverket	The Swedish Companies Registration Office (Bolagsverket) shall create conditions for a business community where people can trust each other. The core of our mission is to quality assure and provide business information that creates value for society.
Skatteverket	The Swedish Tax Administration
Enablers:	
Real Time Economy	The real-time economy project is part of Finland's sustainable growth programme, which supports ecologically, socially and economically sustainable growth in line with the goals set out in the Government Programme. The vision of the Real-Time Economy project for 2030 is to build a national digital ecosystem for business actors that would be compatible with similar systems in other Nordic countries.
VIRTUAL FINLAND	The Virtual Finland project under the Ministry of Foreign Affairs promotes the Finnish cross-border competitiveness and offered the national data economy testbed for the experimentation.
IOXIO	As the main dataspace technology partner IOXIO was responsible of the project execution, deliverables, and the implementation of the experimentation. IOXIO's architecture and concept as well as the Dataspace SaaS was used in the Virtual Finland Testbed to enable the semantic and secure sharing of productized data.

Outcome and results

How to build digital non-listed companies and trusted data exchange?

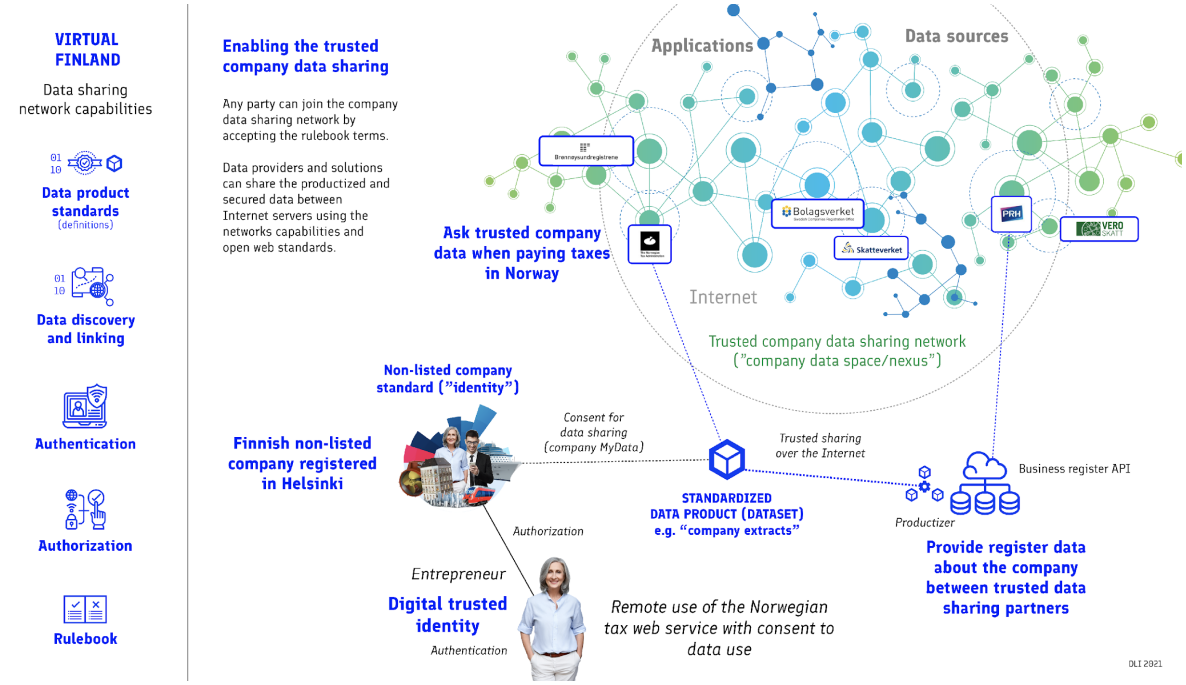


Figure 5. *Vision for trusted data sharing enables the use of verified and standardized data to be shared in decentralized web data sources with consent provided by trusted digital identities*

The NSG&B members set the target on what they call born digital companies meaning businesses where data follows the full life-cycle and all the business events the company performs. To establish these kind of novel businesses means making it possible to run your company from the initial business idea to having the company registered and operational under the local legislation. To build the harmonized Nordic markets and enable the company data to move on the Internet between private and public web services, the digital companies must share the same interoperable Nordic foundations. NSG&B has done a lot of work around this topic and identified the core capabilities needed. These key capabilities are the digital identities for natural persons operating behind the companies and for the companies themselves, interoperable identifiers for these entities needed for data linking, digital consenting and authorization capabilities built on trusted digital company roles enabling the automated data release between online data sources and the semantic capabilities to enable structurization and discovery of any web data around the company business events. These capabilities were asked to be tested in practice.

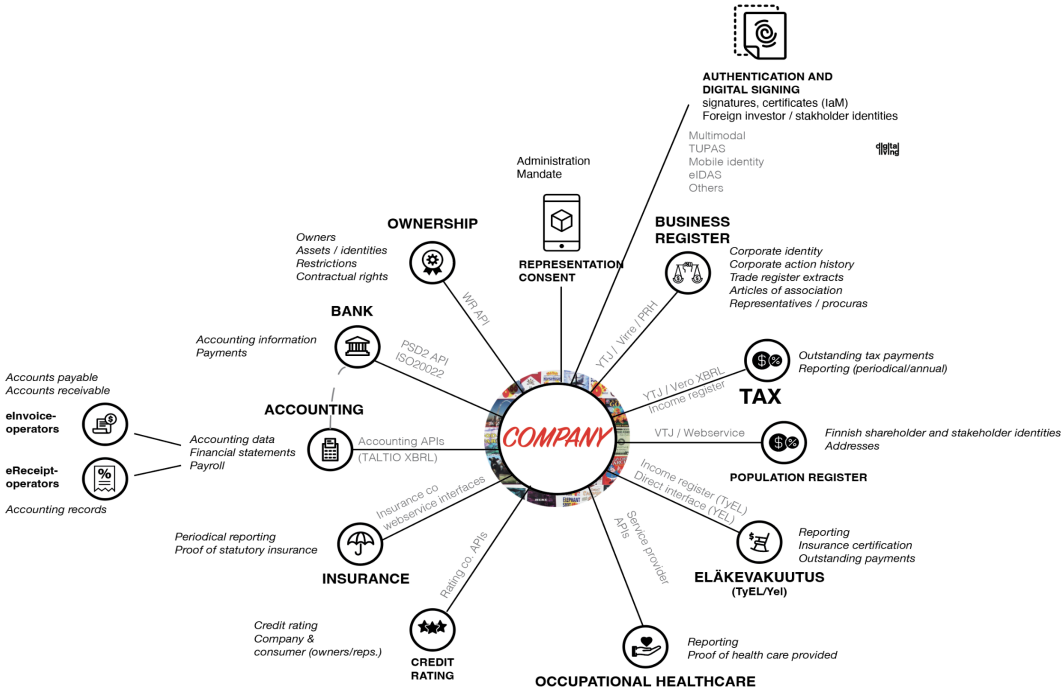


Figure 6. *Non-listed born digital company must allow trusted data sharing between all legally mandated services and core operations needed to operate the company.*

Modelling the Nordic born digital companies

To start the experiment, IOXIO's experts analyzed the value networks surrounding three types of non-listed companies in Finland, Norway, and Sweden. Together with the specialists from NSG&B they wanted to understand the unique legislative, role-based, and relational factors that define these companies in each country. Using this information, they mapped out the digital identities, roles, and relationships that were needed to create authentication and authorization capabilities for each role in the experiment. They then used key user roles (such as founders, company board members, business register officials, and tax authorities) to create detailed process models for digital company establishment in both Finland and Norway. This helped to create new understanding on how to model the Nordic born digital companies and how to scale them in the future for any other use cases.

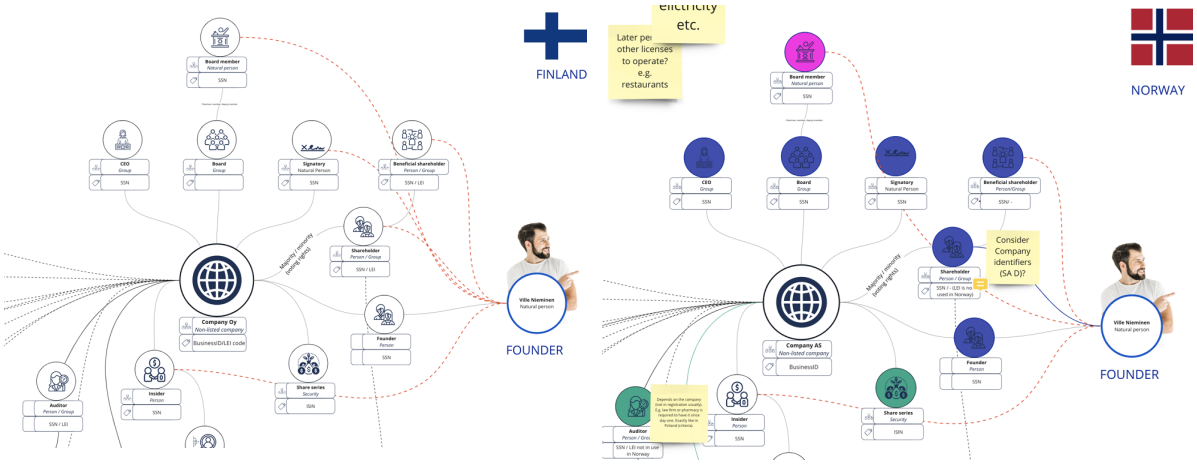


Figure 7. *Legislation and terminology base was harmonized by modelling company value networks in Finland, Norway and Sweden*

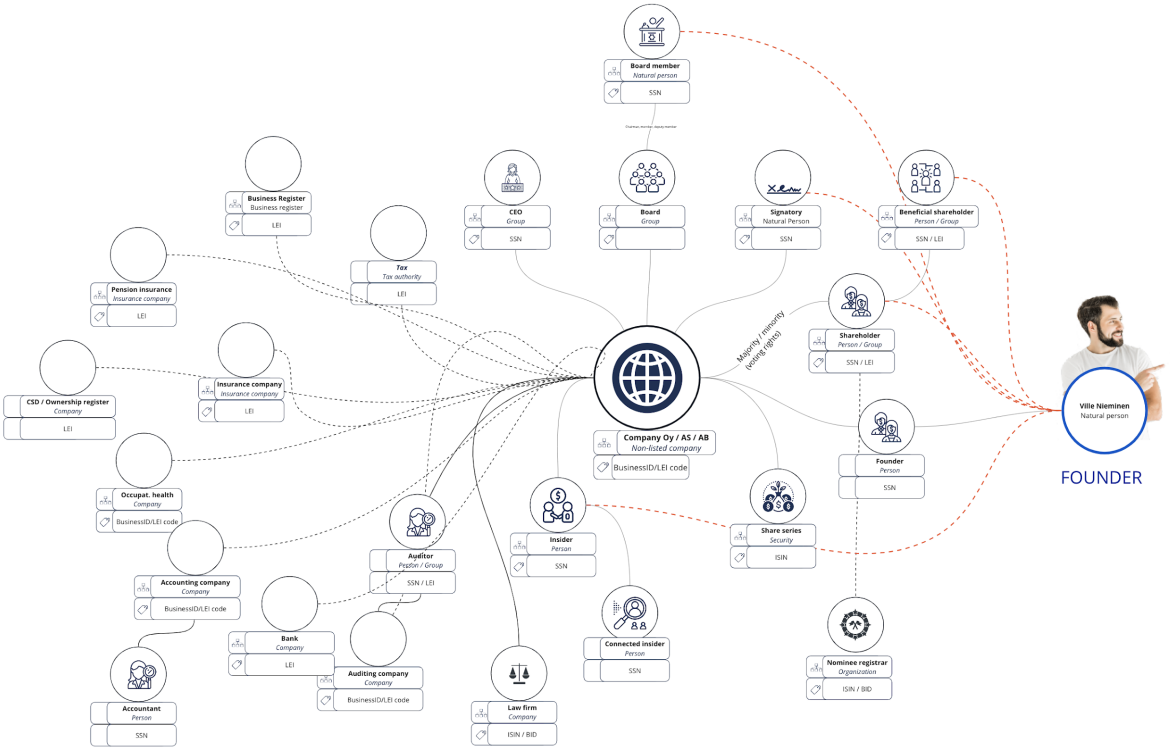


Figure 8. *Based on the analysis a common Nordic born digital company model was created*

Harmonizing the processes and information

After understanding the real-world steps involved in establishing a company, experts from NSG&B, Virtual Finland and IOXIO created a common model for remote company establishment by mapping out data flows, trust requirements, and regulatory needs for each step of the digital process.
They also considered the digital capabilities already in use in each country and the EU eIDAS digital authentication and authorization regulation, as well as the use of decentralized trust mechanisms using emerging digital identity wallets based on the European framework. This delivered the methodology framework that can be used in any context to digitalize business events and to extract the requirements for interoperable data sharing.

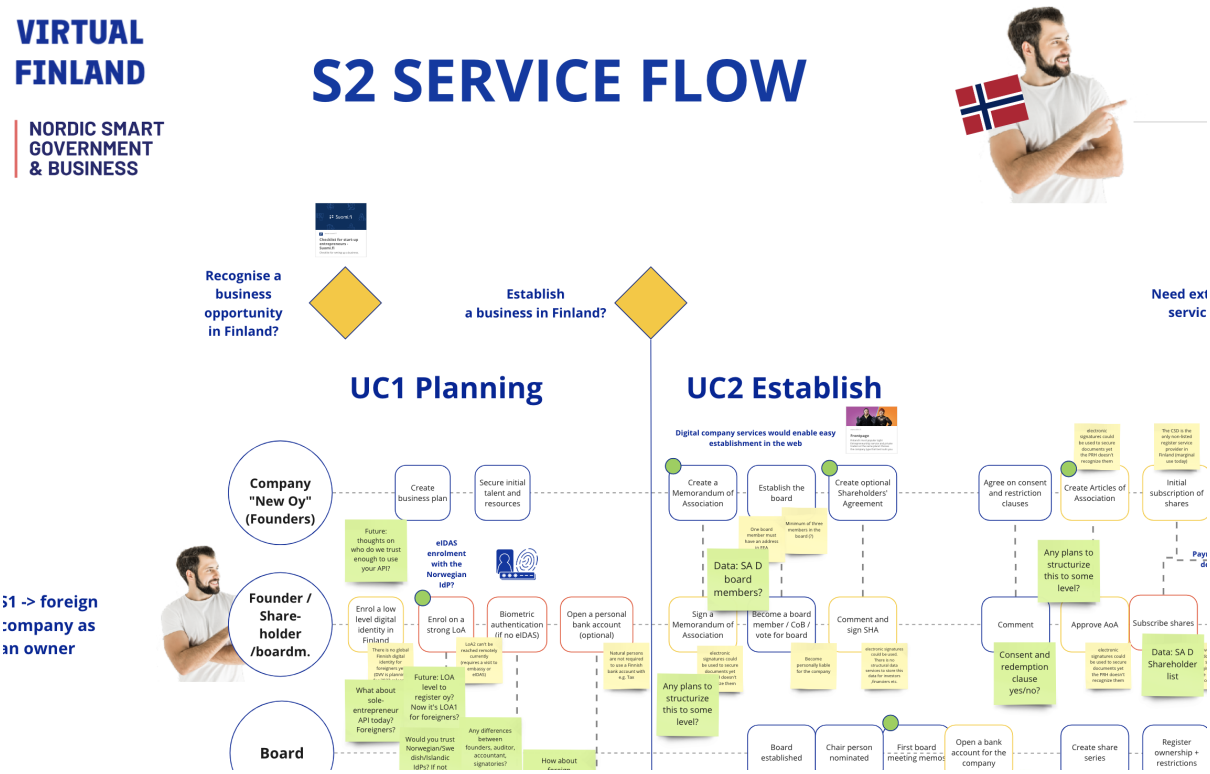


Figure 9. *Detailed analysis was conducted to understand the establishment processes, regulation, information, and trust guiding the data sharing between countries.*

The main conclusions were that there are very little differences between nations in terms of legislation, company legal roles and the ways the companies are established and registered. It would seem realistic to quickly create a common framework for providing the interoperable digital trust and data sharing capabilities now missing in the Nordics. The level of digital readiness among the business registers is very high in each country studied. The capability to query company data is on a solid footing already in each three countries yet the capability to register the company and share data with the business register APIs from e.g., banking services vary between countries. Norway and Sweden offer the registration APIs in production as Finland has not yet implemented them. In addition to these APIs the common Nordic foreigner authentication solution for company representatives, data sharing consenting service and the common Nordic non-listed company identity needs to be quickly brought to use. The project recognized that the Nordic countries could move faster by recognizing national authentication solutions and agreeing to make them interoperable.

Proposed capabilities behind the secure company data sharing

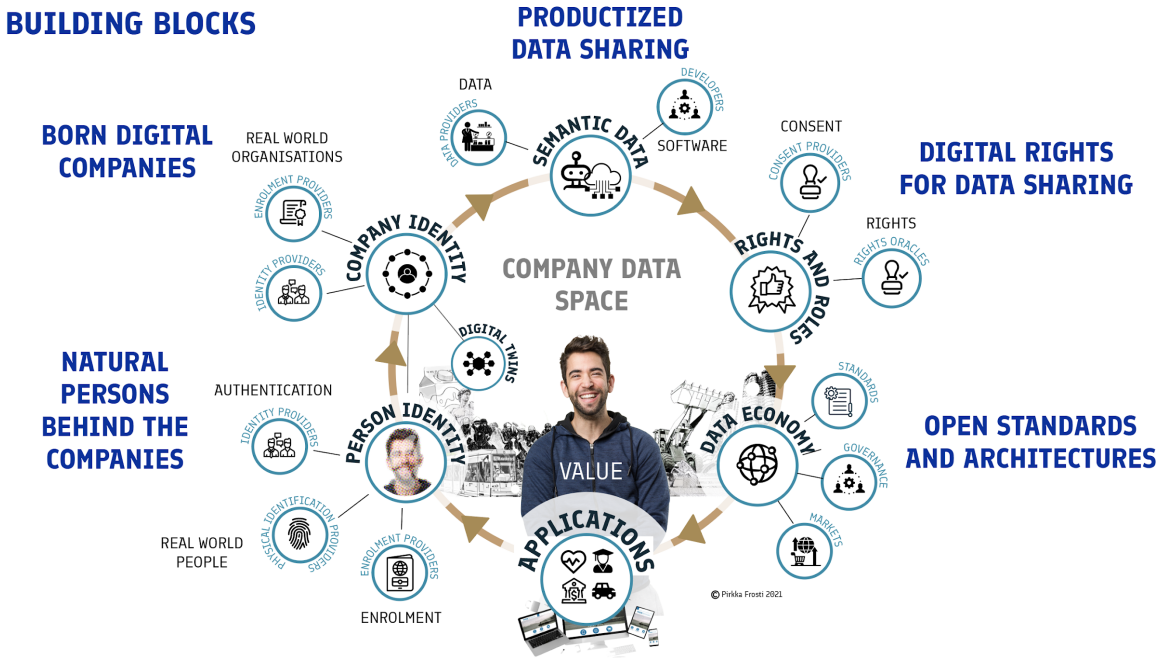


Figure 10. *Key capabilities identified in the NSG&B work was mapped to European data sharing principals. The rise of the fully automated company services demands trust and semantic interoperability to be built to enable seamless access to data cross the Nordics.*

Dataspaces and productized data sharing

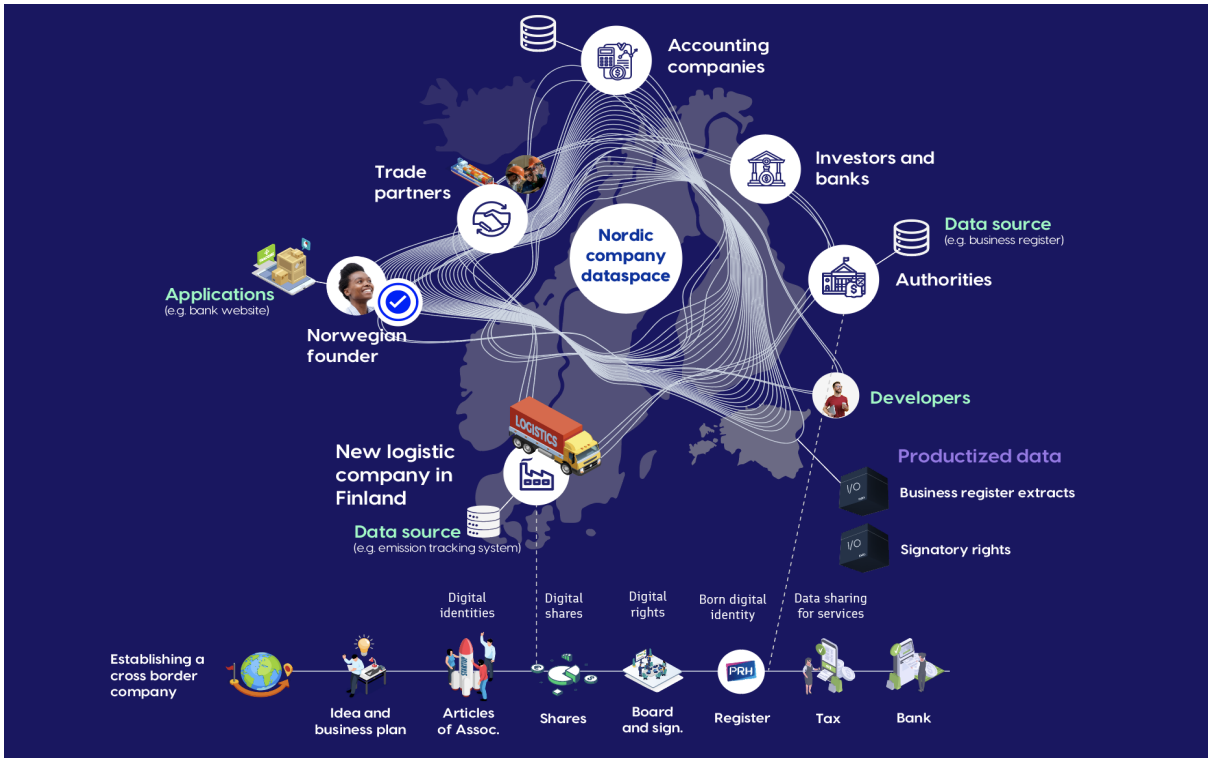


Figure 11. *The proposed data space behind the Nordic Single Digital Market promotes the use of productized and decentralized data and trust. This was tested on the Testbed.*

As the current IT system integration market doesn't yet fulfill the needs for enabling digital companies and data sharing, new solutions both on business, governance and technical levels are needed to fulfill the needs of the companies in terms of data accessibility, scalability, and federation, making it easier for organizations to leverage their data assets effectively. The following sections introduce the emerging solutions for solving the company data accessibility and issues in practice.

A dataspace is a solution that refers to integrated, and scalable environments for managing and sharing data. Dataspaces serve both application and data providers and offer a simple and a unified way of using and managing data from different sources, formats, and locations, making it easier for organizations to access and manage data. Currently, the European Commission is investing heavily on building the dataspaces and several development communities have emerged around the development of the dataspaces (e.g. IDSA, Gaia-X). The European data communities have defined the common design principles for dataspaces and the open architecture used in the Virtual Finland testbed is following those principles that means the data is served for sharing from its original and most trusted source in order not to copy data unnecessarily into new data storages or environments.

However, dataspaces are not working effectively without *data productization*. The data productization implementation is a feature that is still much lacking from the Gaia-X and IDSA dataspace initiatives and is something that the Virtual Finland data economy architecture and solutions are ahead compared to the other European counterparts. All the value creation starts from defining and standardizing the data contents (i.e. data sets) so that it is both human and machine readable and thereafter building the desired level of trust features around them. Data products that the Virtual Finland dataspace architecture supports essentially three aspects:

1. ***Interoperability*** via real-world contextual data modeling and definition
2. ***Trust*** via both authentication and data consenting
3. ***Value creation*** via the option to set a price for the data available via the dataspace

To make the data move the dataspace architectures also propose the use of data discovery and transaction capabilities needed for developers and systems to find and offer standardized data easily without costly point-to-point integrations. Also, the data consenting that can be tied straight to an individual data product definition is a crucial feature that needs to be tackled for realizing the data sharing issues faced today. The Virtual Finland architecture support an open data consenting protocol that could potentially in the future support and be tied to certain ongoing wallet-based implementations such as EUDI wallet.

The descriptions of the Virtual Finland testbed dataspace architecture that was used in the experimentation is openly available in more detailed here. The documentation also covers how to connect applications as well as data sources into the dataspace.

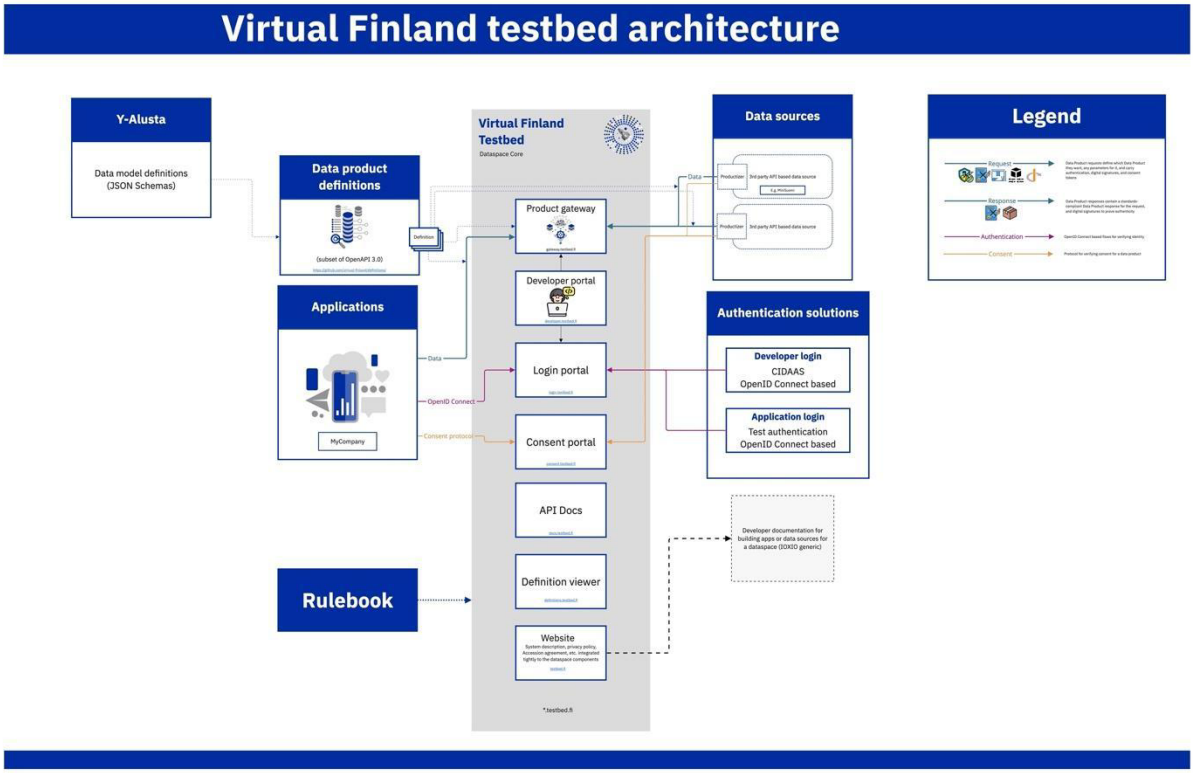


Figure 12. *The current Virtual Finland testbed architecture implementation.*

Semantic interoperability and harmonization of web data

There is a dedicated work stream in NSG&B named SA-D working on the data itself, its reliability and quality, and focusing on the common standardization of the company data. The data standardization specialists from each country defined the first common Nordic data sets that were also used in the experimentation. The first standardized data sets were the non-listed company basic business register extracts (so called Agent -data model) providing the key company registration data and the legal status of the company in the public register, the list of company signatories and the list of beneficial owners. These three key datasets constitute the digital foundations of any non-listed company offering the markets the capability to receive and validate the company existence, status, publicly registered trade names, addresses, representatives, and their roles as well as the true beneficiaries and decision makers behind the business they are offering services online. These data definitions were made publicly available using the Finnish open data ontology service.

The key takeaway is that the Nordic authorities have the readiness to commonly structure and define the data needed to build the functioning digital markets. The business data can be harmonized between the governments and methodologies exist to make each country's authorities capable of agreeing on the data formats around the Nordic businesses. The experimentation showed that while this is possible there is still little effort done yet to establish a continuous structure between governments to create and maintain common master models for company and economic data. The NSG&B authorities are ahead of the development. To build widescale interoperability for company data other authorities and especially private sector stakeholders such as banks, accounting and auditing firms, post-trade, insurance and other financial industry companies and other company service providers should be included in this work.

Digital trust for secure company data sharing

The authentication, and authorization mechanisms as well as the data security capabilities needed to safeguard the data exchange between data sources and applications in the web should be built without copying the company data into any new silos. Interoperable data sharing governance models and regulation is crucial to build an infrastructure fit for societal use.

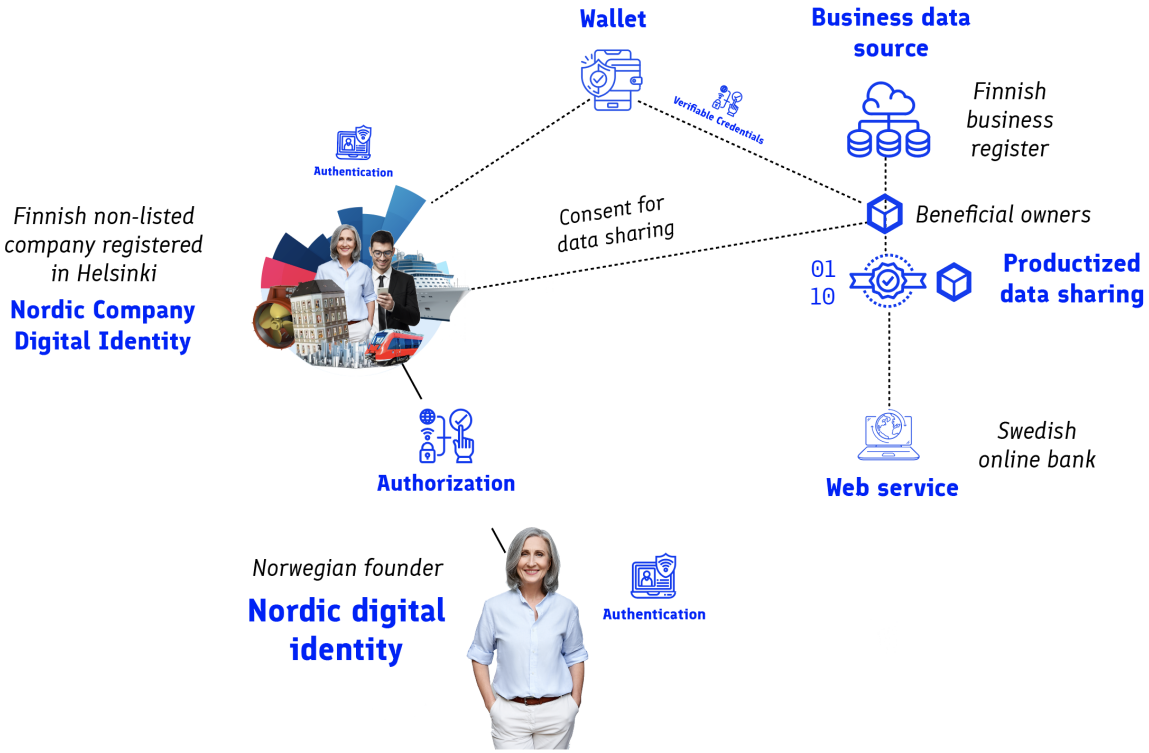


Figure 13. *Trust in the digital company identities is built with trust in natural persons acting on behalf of the companies based on verified public data. Identities and trust can be built using secure credentials shared directly from secure web sources or digital wallets.*

The control and liabilities for the data should be kept with the companies and the respective registers and data sources online to ensure the integrity and traceability of the information. The Nordic principles for transparency, compliance, and fair markets must be met by ensuring the governmental trust behind the company data.

Cross-border digital identities are the foundations for the digital markets

The company law is similar in all the Nordic countries also when it comes to liability for corporate actions and business. Natural persons are the founders, board members, signatories, auditors, CEOs and accountants to name a few behind all the companies. Building digital trust in all the authorized representatives enables to build trust on the born digital companies.

Companies are also legal entities in the face of the law and must have their own digital identities that can be authenticated and detached from the natural persons connected to the company at any given time.

To enable the cross-border data sharing the Nordic countries must recognize each citizen and company using the same interoperable identities and means for authentication.

Standardized trust in business register data used to validate the up-to-date status and validity of the company using services and sharing data in the web.

European Commission is driving for the adoption of the cross-European eIDAS digital identity framework which naturally must be used as the core foundation when developing trust for the foreigner identities. It is fair to say that the full road to adoption in widescale use is rather slow and the Nordic countries should consider faster routes to recognize the dominant secure authentication methods between countries already in daily use in each country.

Publicly trusted business registers are the main source for trust

Leveraging the use of population registers and government issued anchor identities for each citizen the companies should be rooted to the business register of their domicile. The availability of business register APIs and matured markets already utilizing the data gives a strong background to build the Nordic born digital company identities and deliver the fundamental trust in the data the companies share remotely between public and private web services.

As this experimentation demonstrated we can create common standards to this end. The key business register extracts, signatory rights and registered beneficial owners provides solid basis to validate the identity and data shared by or in relation to any Nordic company.

Moving towards also the digital wallets and verifiable credentials this real time capability to check the company validity in full faith and trust must be kept and improved further between all the Nordic countries with productized data sharing.

MyData and Self Sovereign principles promises the fair use of company data

Based on the authenticated digital identities and the digital consent the authorized persons could provide for data sharing empowers the companies to control how the data between the data sources and web services in the dataspace is shared. The introduction of the productized company data would also allow the use of digital identifiers for various data to be linked with the companies and the people representing them. This semantic linking is required to ensure that so-called Company MyData can be used effectively and precisely. The current web technologies and standards can deliver these capabilities already today.

Promising benefits can be seen in the use of the so-called self-sovereign identity systems, where individuals and linked companies possess a digital identity that is based on decentralized, cryptographic principles. They have ownership of their identity data and can selectively disclose information as needed, while maintaining privacy and control over their personal details. The issue with this approach is still the nascent nature of the technologies supporting the SSI-principles and the missing identity providers offering the solutions.

The imminent solutions should be built on the existing public and private identity providers as the current public and practically all the private sector company services are relying on them and centralized identity management. The governmental base registers already offer secure APIs that can be standardized and used as decentralized sources for secure company identity data.

Data consenting is a cornerstone for building trust for data sharing

Data consent is crucial for protecting privacy, complying with regulations, fostering trust, promoting ethical practices, enabling personalization, and maintaining data accuracy. It establishes a foundation of transparency and respect in the handling of both personal and company confidential information, benefiting both individuals and organizations in their data sharing ecosystems.

The Virtual Finland architecture used in the experimentation supports an open consenting protocol that is tied into the individual data product definitions (i.e the data consents that is desired to be shared). The Virtual Finland dataspace architecture supports an open data consenting protocol, and the current testbed implementation supports data consenting self-service on a demo-grade level now. The production grade consenting solutions are being investigated evaluating the feasibility of the wallet-based solutions offers one route for implementing the feature for the real production use.

Wallets and use of verified data

Verified credentials refer to digitally authenticated and tamper-proof records of an individual's but also companies' qualifications, achievements, personal information, or any other relevant information that needs to be validated. The W3C-standard and open architecture also promotes the use of semantic data to describe the data secured by the cryptographic means behind the standard. This standardization should be seen beneficial to drive the faster adoption of digitally signed and verified data over the paper or non-binary company data. Also the capability to digitalize the key company roles and rights proposes a promising way to digitally sign and validate credentials to control the productized data sharing between company data sources in the web.

Wallets are digital tools that securely store and manage these credentials, empowering individuals to control and share their verified information as needed. When it comes to identity wallets capable of authenticating natural persons but also companies there seems to be good progress ongoing in Europe especially in relation to the eIDAS 2.0 digital identity and authentication regulation. Using the proposed EUDI (The European Digital Identity Wallet Architecture) identity wallets should offer faster routes to building the cross-Nordic digital secure identity both for the companies themselves but mainly for the people behind them.

When it comes to replicating and storing company data in the wallets there seems to suitable use cases to eradicate paper in case no real time available data source is available online for data sharing. The use of wallets as data sources should be carefully evaluated on each use case to justify the benefits of copying the data away from the original data source and losing the connection to the most updated information. Following also the main principals of the European data spaces the data should not be copied into new silos and kept as much as possible where it already is.

The used dataspace architecture already suggests building sustainable roadmap towards the decentralized use of data and maximizing the use of already well used and widely adopted web standards well before the wallets can be utilized in the market. On the Virtual Finland Testbed the parties host their own public keys using JSON Web Key Sets, which then are used for verifying tokens and messages, as well as encryption, whenever it is needed. Trust in JWKS is brought by the existing mechanisms on the internet, DNSSEC, SSL certificates (incl. Extended Validation), and so on.

JSON Web Tokens, IETF HTTP Message Signatures and JSON Web Signatures, as well as JSON Web Encryption provide a solid set of tools for providing trust on multiple layers, including verifying authentication or consent tokens, to ensuring data hasn't been tampered with, or confidentiality.

Support for open standards and transparent governance is vital

To build open and functioning company data markets in the Nordics with public and governmental stakeholders involved in data sharing it must be ensured that the selected governance models support cross-sectoral but also cross-authority data sharing in transparent and societally sustainable way.

As the companies and cross-border business must be the key beneficiaries for the digitalization the created governance models should similarly favor open, fair, and competitive markets that enables a level playing field and voice for all Nordic companies. It is crucial that the industries are allowed to co-develop but also co-invest in the same infrastructure that the public sector invests in. The open architectures, standards and most importantly common semantic data standards are needed to ensure technology independent way forward for all companies and authorities to build their digital services as they wish. This should result in natural interoperability between all the stakeholders but requires highly functional ways to govern and agree together on the mechanisms and rules the visioned Nordic single market would be built and operated with.

The ethical principles and compliance to law must also be carefully uphold and enforced in data sharing. Use of so-called fair data economy principles and rulebooks together with a societally sustainable governance model should provide good tools going forward in creating a data space with fair, transparent but also competitive operations.

From technical perspective the open web standards and widely adopted methods of using them should always be favored over closed and proprietary architectures and standards. Following the IETF and W3C standards for all the layers behind the company data sharing promotes longevity and technology independence also in the possible company dataspaces.

Experimentation in practice

Data product definitions based on the real-world process and data modeling work

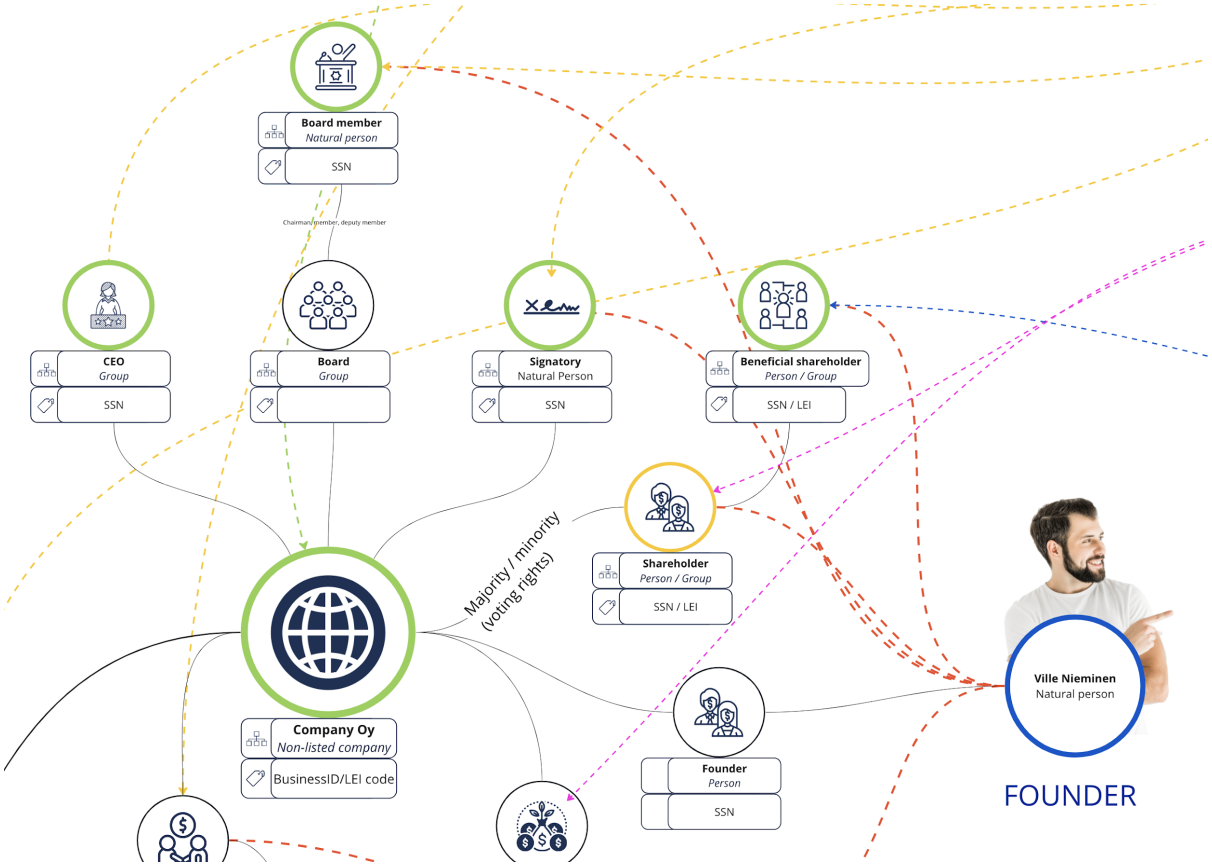


Figure 14. *First shared data products were mapped to the created Nordic born digital company value network model. This created a scalable model to standardize and share any company data in the future.*

The project mapped the co-created company datasets against the company establishment processes created with the SA-C specialists and the created common Nordic digital company establishment process created in the first stage. The Virtual Finland team turned the open data models into open semantic data product definitions on the Finnish cross-border data sharing Testbed so they could be used in the real-world business register APIs and other integrated data sources in the following data sharing stage of the experimentation.

The first data products identified in the experimentation were as follows

Non-listed company establishment
The intial and structured data set for registering a company in the trade registers in the Nordics.

Company basic infomation (”Agent” model)
A data set for sharing the basic information about a registerd company.

Company Beneficial owners
A data set for listing of beneficial owners of a company. The shareholders exceeding 25 % voting rights.

Company Signatory rights
A data set for listing the representation rights of a company.

These data products were defined with different requirements in terms of authentication and consent. *Company basic information* data product represents fully open data in terms of any company and thus not require authentication or consent. *Non-listed company establishment* is a data set that must be submitted to the trade registry APIs by an authenticated user but no consent is required. However, *Beneficial owners* and *Signatory rights* data products represent more confidential information, e.g. Signatory rights data product contains personal information which cannot be fully openly available and thus requesting these data requires both authenticated user and a consent for using the data and were implemented in the experiment accordingly.

Quick service prototypes on top of the Virtual Finland testbed

Using the dataspace developer tooling the real business register APIs from the Patentti- ja Rekisterihallitus (PRH) in Finland, Brønnøysundregistrene (Breg) in Norway and Bolagsverket in Sweden was connected to the Virtual Finland dataspace as data sources. New cloud APIs were built to model the company establishment APIs for each country based on the live APIs already available in Norway and Sweden. All data sources were integrated only once and made to offer semantically structured data based on the commonly defined data products for any application willing to use it on the dataspace. Two web applications were used to showcase the data sharing from the company founders' perspective. One built for the company founders as a private company application and one using a Finnish governmental web service in the making that would allow foreigners to establish companies in Finland. The dataspace's authentication and consenting capabilities were used to demonstrate how also the sensitive beneficial ownership and signatory rights data could be shared with the foreign company representative's consent.

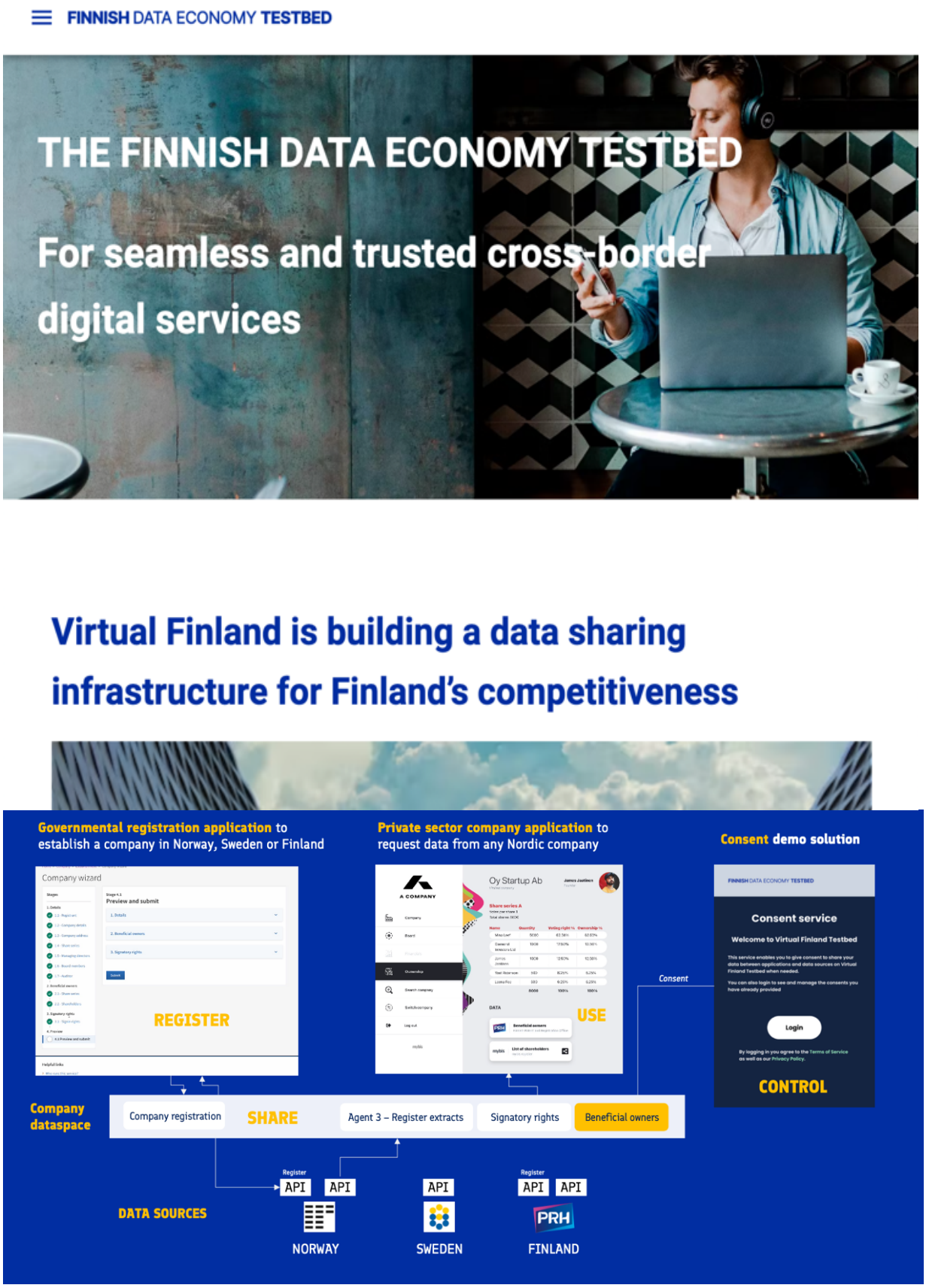


Figure 15. *Demo architecture on the Virtual Finland Testbed dataspace*

The prototype applications and test data services built during the experimentation demonstrate the both two use cases how a citizen from any country could establish a non-listed company in the Nordic market region in an easy and harmonized manner as well as share the company key data in different business operations. The integrations regarding the Company Basic information data product were built against live trade registry APIs in Finland, Sweden and Norway whereas the company establishment, beneficial owners and signatory rights data source integrations use test APIs according to the data product definitions.

The Virtual Finland testbed running on the IOXIO Dataspace SaaS service was used as the enabler of the trusted data exchange experimentation and the dataspace capabilities in the company exchange use cases.

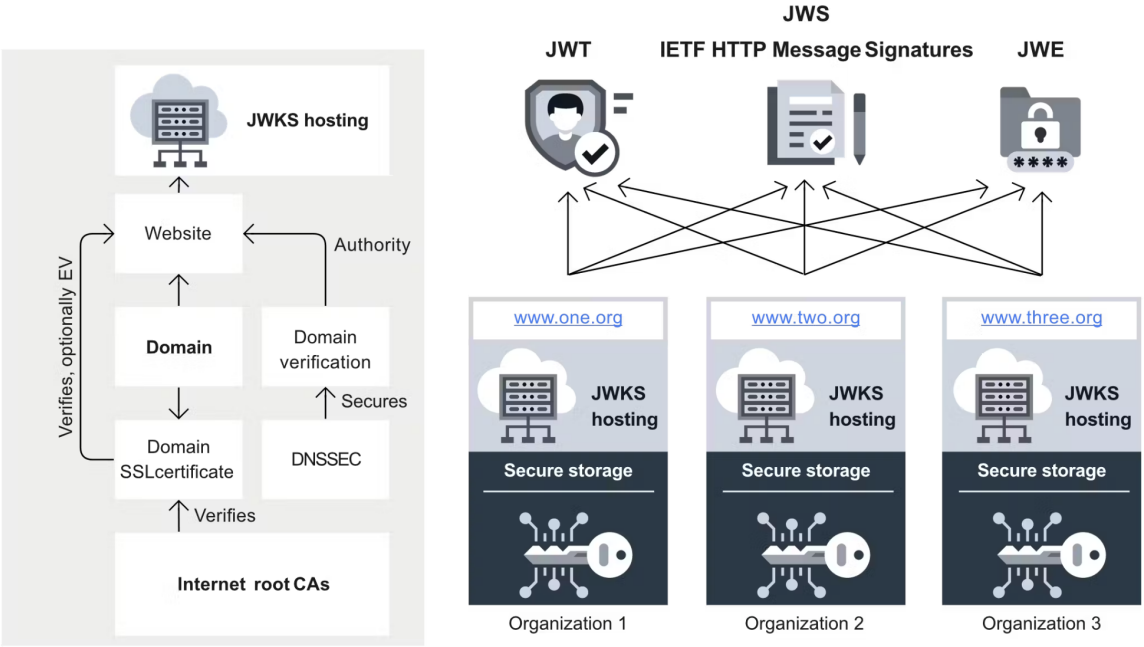


Figure 16. *The trust mechanisms used on the Virtual Finland Testbed's open architecture are built on a decentralized model based on internet best practices currently in widespread use (image by IOXIO)*

Open standards and architecture mixed with industry standards with comprehensive ecosystems of implementations and tools.

The dataspace architecture used in the experimentation promotes the use of following components to ensure the secure exchange of data:

- Data product transfers
- Data product signatures
- Authentication
- Data product encryption and confidentiality
- Group (organization) verification
- Consent protocol
- Rulebook for fair governance and use

Virtual Finland project
https://thevirtualfinland.fi/en/

The Virtual Finland testbed is an environment for testing any cross-border data exchange use cases that would enable more seamless and automated processes between public and private sector organizations in the future. You can read more about the Virtual Finland project here and the cross-border dataspace testbed following these links. It providers easy to use developer guides and tools for integrating any application and/or data source for much improved data sharing purposes.

Cross-border dataspace testbed

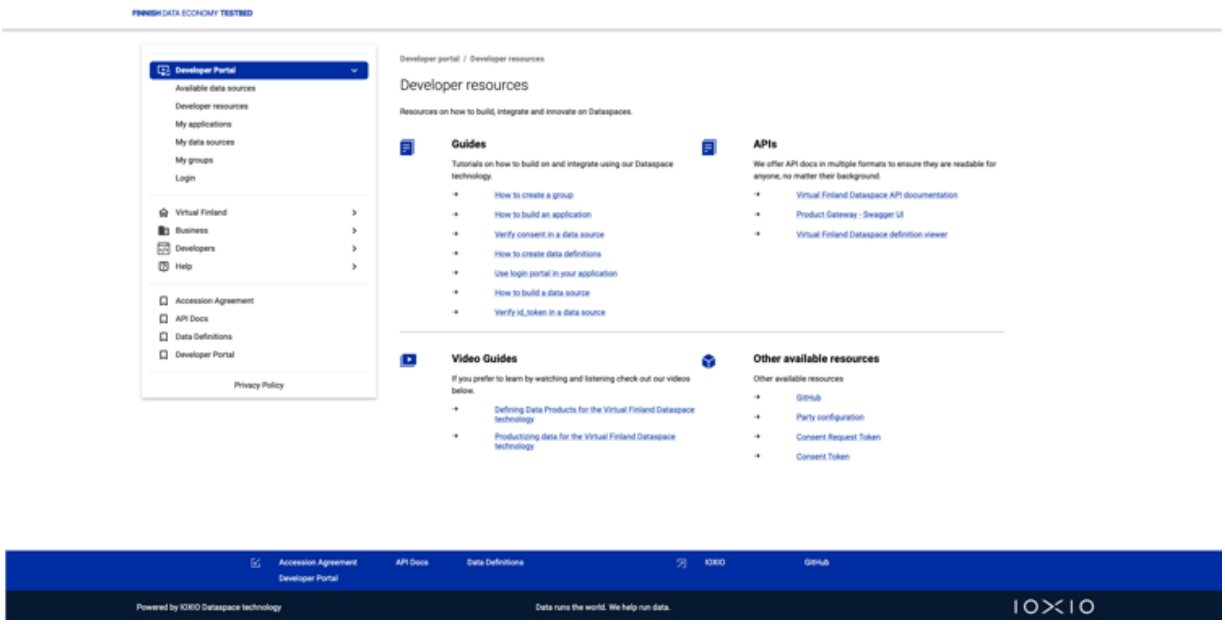


Figure 17. *Virtual Finland Testbed provides easy to use developer tools to share and use data on the cross-border data space*

https://testbed.fi/
https://developer.testbed.fi/resources

Key results and value from the data exchange experimentation

The quick implementation test lasting three months during the Spring 2023 resulted in an end-to-end working prototype for trusted company data exchange and four key results to proof the business value for the future:

1. **The key company data can be structured and standardized between Nordic countries**
   Open data definitions for the trusted company data exchange use cases were defined and made available on the Virtual Finland dataspace testbed
   - Non-listed company establishment
   - Agent Basic information
   - Beneficial owners
   - Signatory rights

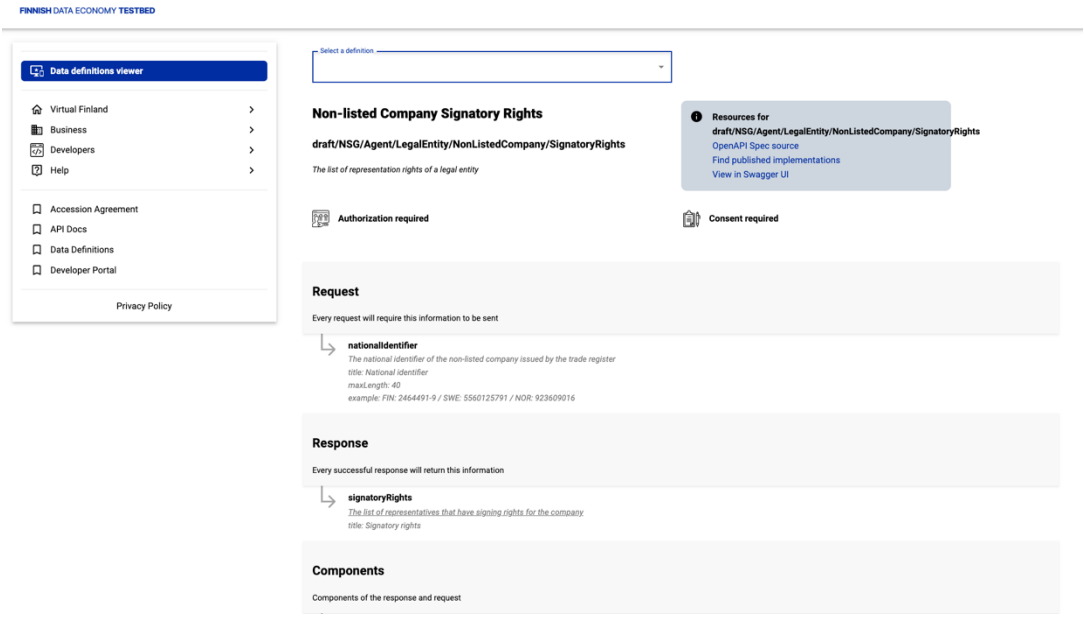


Figure 18. *Data definition viewer showing the descriptions for all four data products defined in the experimentation on the dataspace.*

2. **Dataspace can be used for easily interconnecting several company and public sector services and data sources in the Nordic for better access to data and atomization**
   A test cross-border dataspace was set up and maintained for building and testing easy integrations towards applications and data sources for exchanging data in a trusted manner. The self-service tools and guides of the dataspace serve both public and private sector stakeholders. The Virtual Finland testbed rulebook applied from Sitra's data economy rulebook exists and works as an example to agree and contract the governance framework for stakeholders setting up and accessing a dataspace with agreed rules and procedures.

3. **The standardized data can be shared with consent between stakeholders in the Internet**
   The data sharing through the dataspace can be controlled via consent self-service tooling and standard interfaces built around it. With authenticated users and consent required

in the data product definitions fulfills the data source in the dataspace to verify whether the user requesting the data has consent to the data.

4. **Value for the users both in public and private sector can be demonstrated**
   As part of the two test applications, one representing the public sector registration services as well as a company founder application, the use cases for creating the company digitally and sharing key data with the company founders consent in the business processes can significantly help both the founders as well as public sector officials to automate their processes and reduce manual work.

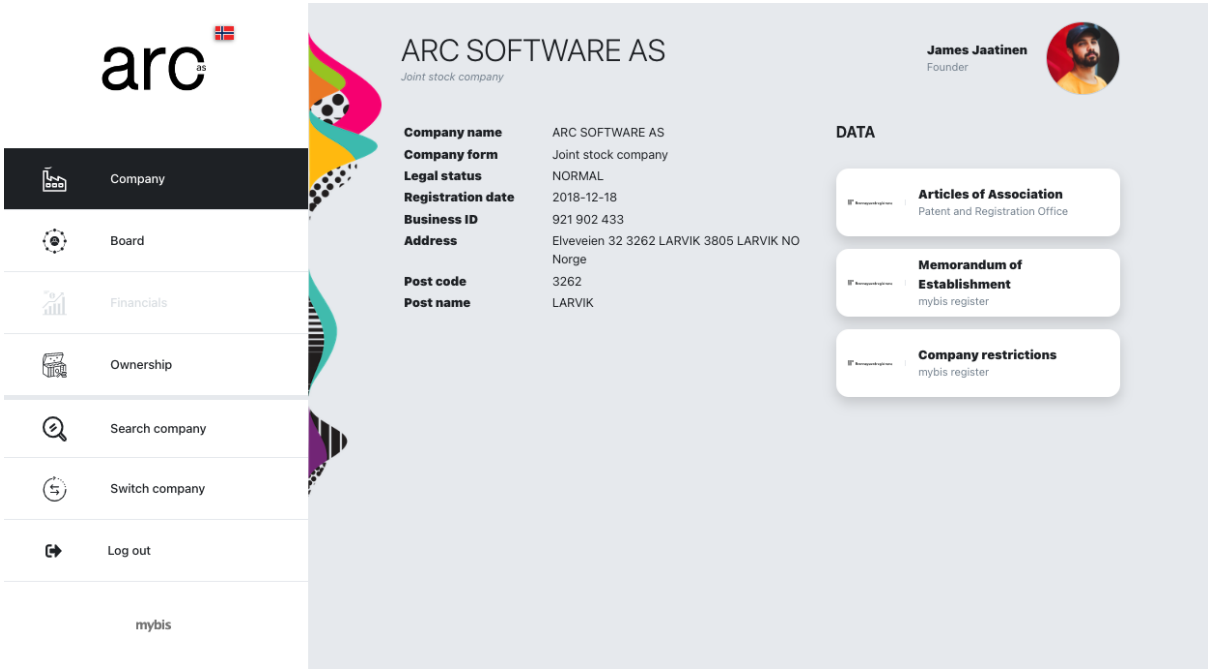
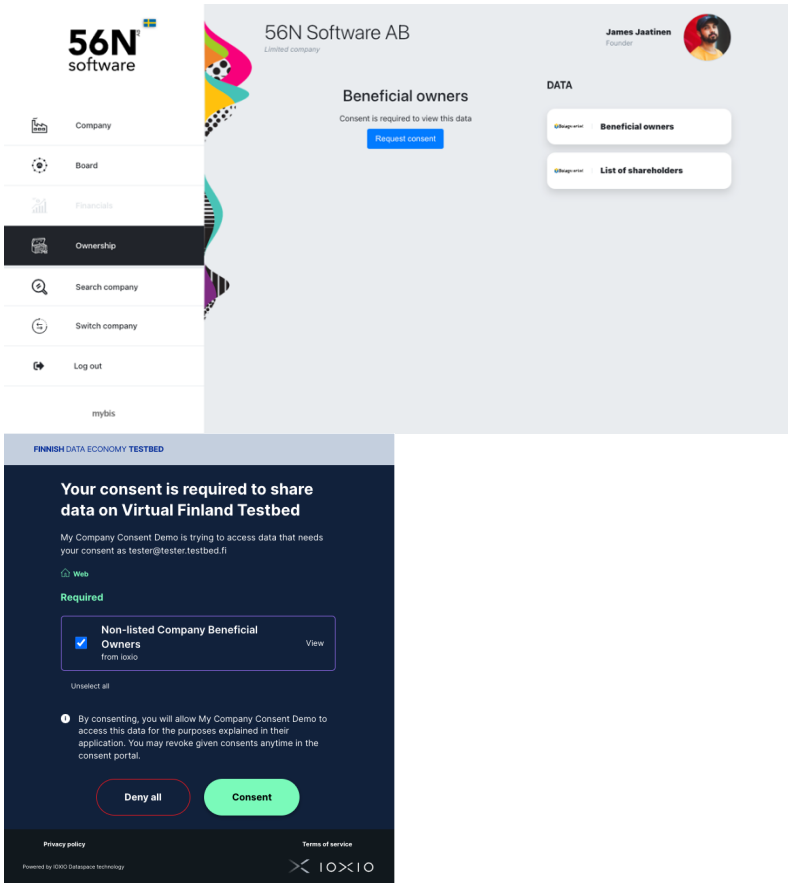


Figure 19. *A demo grade MyCompany application demonstrating the data sharing features from the company perspective. The open company data shown comes from the live Norwegian business register The Brønnøysund Register Centre.*



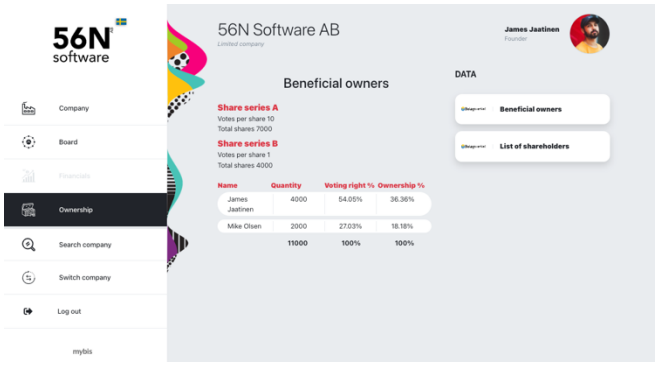


Figure 20. *The data consenting feature demonstrated via the MyCompany application as well the consent self-service demo on the Virtual Finland testbed.*

Conclusions and recommendations

Results promote quick actions to build the digital single markets in the Nordics

The experimentation proved in practice that using public and private web applications and standardized data sharing the companies could be established remotely and safely cross the borders in another Nordic country in the web. To achieve this, the common digital capabilities for data interoperability and digital trust could be commonly built as shown together in the experiment. The governments could provide these components as a

common infrastructure for the Nordic digital economy using the European dataspace architectures and models for data sharing. Although the digital readiness is high among the nations, common efforts and investments are necessary to quickly materialize the NSG&B and the Nordic Council vision towards 2030.

From company end user perspective, the results offer a way to make the companies' life much easier and enabling them to use services and get daily business done much faster, with a lower cost and more securely in another country than today where most of the processes are manual and the digital services are not available for the foreigners.
By using dataspaces, governmental data can be shared and combined with other industry data sources such as accounting, logistics, trade, and banking. This means Nordic companies can have a growing number of digital services that work seamlessly and consistently for any business event they participate in. This will lead to more automation and efficiency in company operations, resulting in significant improvements both in public and private business services. As company service providers the public and private sector could develop interoperable web services faster that would allow to reach much wider audience in the Nordic scale. This would widen the customer base for the businesses, expand the reach for resources from other countries and also help authorities to digitalize the processes between their borders.

From the technical perspective, the decentralized business registers and other web data sources could be made semantically interoperable without changing their existing APIs or how they are implemented today. This would mean significant savings in digital infrastructure as the existing systems could be used today. The governmental registers could provide up to date and trusted foundations for the digital economy without having to take responsibility of the other data outside of their jurisdiction. It would be up to private services to use the data and merge it with any other industry data they offer and to build the actual digital services for the companies. The interoperable cross-sectoral semantic data definitions, common standards and open data sharing architectures would help clarify the responsibilities and provide rapid expansion for digital company solutions. This would require new cross-governmental organization structure to be considered that would take the lead in defining and developing the now missing digital infrastructure for the digital markets based on the work already ongoing in the NSG&B program. It should be next considered how the concrete company data market infrastructure should be operated and built based on the European dataspace and the work Virtual Finland has been leading. By investing in the common Nordic dataspace would provide the needed framework for organizations and their developers to easily get the data moving and would offer concrete ways to build the most integrated region in the world.

Ways forward towards single digital markets in the Nordics

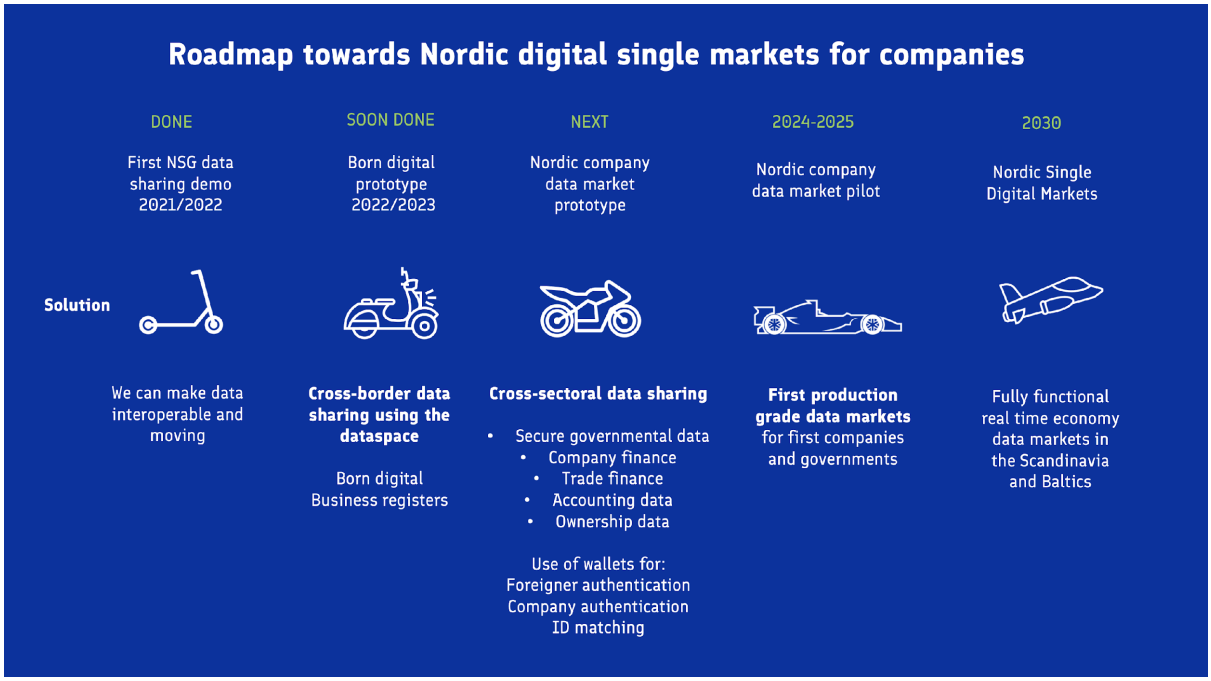


Figure 21. *The vision for the roadmap towards creating the digital single market for the Nordics*

In practice the project encourages to continue the successful work during the ongoing NSG&B and Virtual Finland programs and to expand the already built cross-border company data sharing ecosystem with new use cases and experimentation steps. This would require further steps under the Nordic Smart Government & Business umbrella to next include the private sector to test and validate the results of the first stage of the experimentation in practice and to gain more understanding on how to deliver the interoperable digital trust capabilities with organizational authentication and the use of digital organization wallets.