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Blockchain and Government in Europe

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Forward: Blockchain and Government in Europe

How blockchain is enabling the next generation of government services

Welcome to the magazine for the 2021 BLING Conference.

BLING – Blockchain in Government – was set up in 2018 to accelerate and de-risk the deployment of blockchain-enabled services in government.

This magazine brings together interviews from blockchain practitioners, developers, and policy makers from across Europe to identify the key lessons learned so far from officials, policy makers and developers as they enable the adoption of blockchain in government. This learning is complemented by the introduction of 8 use cases from BLING, highlighting how BLING partners are innovating, designing and building blockchain-enabled services.

BLING's 2021 online conference will provide an opportunity for practitioners and governments to review the state of play for Blockchain in Government, with contributions from key EU stakeholders and government partners from across Europe and the chance to discuss BLING's pilots with our innovators.

About The BLING Project

13 government and academic partners working together to develop innovative blockchain-enabled service solutions

Can government services be improved by using this technology?
BLING – Blockchain in Government – is a €5M project set up in 2018 to help governments in the North Sea Region accelerate the adoption of blockchain in government, as part of a wider move towards the development of the next generation of e-services and e-government.

BLING isn't a tech project: it uses an explore/enable/deliver approach to accelerate the adoption and deployment of blockchain to enable the creation and delivery of the next generation of smart services for citizens, governments and SMEs.

BLING's partners are moving beyond proof of concepts to deliver real services in real live governmental settings: this will allow BLING to accelerate and de-risk the development and deployment of blockchain-enabled services across the North Sea Region of Europe – and beyond.

BLING brings together domain specific expertise; leading academic institutions; local blockchain groups; local, regional and national government authorities; and SMEs to develop and deploy blockchain-enabled public services. BLING builds upon the substantial investments by the EU, national governments, academic institutions, corporations, SMEs and wider networks in blockchain to provide one of the first dedicated platforms to bring these tools and approaches into local and regional services. BLING is currently scheduled to finish at the end of 2022.

Want to find out more about BLING? You can contact us at:
https://northsearegion.eu/bling/contact/

"Can blockchain technology help provide a solution to governmental problems?"

Blockchain and Government in Europe: The BLING Conference

How blockchain enables the next generation of government services

BLING's 2021 online conference will provide an opportunity for practitioners and governments to review the state of play for Blockchain in Government and hear speakers from BLING, from the *EU Blockchain Partnership and from European Blockchain Service Infrastructure* (EBSI) to review where we are and chart the future direction of blockchain in government.

This will be followed by a pair of online sessions introducing BLING's 8 new pilots which are working to deliver blockchain in government and showing the wide range of sectors and approaches where blockchain-enabled services can help to deliver the next generation of e-services and e-government.

BLING's Blockchain in Government Pilots:

1. **BRAT – The Blockchain Readiness Assessment Tool**
   University of Gothenburg, Sweden

2. **GeoPact – Connecting virtual blockchains with real places**
   University of Edinburgh, Scotland

3. **Using blockchain to manage health certificates**
   University of Oldenburg, Germany

4. **Healthy on the blockchain**
   City of Roeselare/HOWEST

5. **Using Blockchain in the 'Smart Procurement Tool'**
   City of Antwerp/Digipolis Antwerp, Belgium

6. **The financial emergency brake**
   CJIB (Dutch Centraal Justitieel Incassobureau)

7. **Blockchain for maritime ports: How can document handling be improved?**
   Aalborg University, Denmark

8. **Using Self-Sovereign Identity to Record Event Attendance**
   BlockchainLab Drenthe, Netherlands

BLOCKCHAIN BASICS

Modern life relies on the exchange of information. We have seen widespread digitisation of local, regional and national government services, but in many cases we have not significantly progressed from the deployment of electronic versions of paper processes.

Blockchain is a combination of existing technologies that are integrated and deployed across a network. Blockchain uses a distributed ledger to record transactions in a verifiable, secure and permanent way that can be shared with other systems and services. This enables new forms of service integration and provides the foundations for services that allow new types of interactions – these have the potential to redefine the relationship between governments, citizens and SMEs in terms of transparency, trust and data-sharing.

How blockchain works

Blockchain is a form of 'distributed ledger technology' (DLT). A blockchain is a chain of cryptographically linked blocks of data, which are stored in a distributed database. Individual pieces of data are combined into blocks of information: each block keeps a history of finished transactions or changes, and all transactions are time-stamped and verified by the participants in the system. Once a block is completed, it is cryptographically 'chained' to the previous one, and algorithms can identify unauthorised changes to data in the chain, minimising the risk of tampering or unauthorised changes. Data in the blocks are permanently synchronised across decentralized storage systems, which can be public or private.

Introducing
the BLING Partnership

Municipality of Groningen – The Netherlands
Groningen is at the forefront of open data, innovation and the digital delivery of services. The city is an innovation centre, and runner up in the 2014 European Smart Cities Competition. Groningen's ICT companies are among the leading blockchain pioneers in the Netherlands, and Groningen has a healthy blockchain eco-system for BLING to build upon. Our ambition is to use the BLING project to create the right enabling environment for blockchain in the North Sea Region.

Groningen is co-initiator of this project and Lead Beneficiary. Groningen is one of the few local governments in the Netherlands which has experience developing and deploying blockchain-enabled services. Groningen seeks to learn what the potential impact of blockchain technology will be for the organization, its citizens, and SMEs. We expect that BLING will provide us with the knowledge, the networks and the experience to deliver blockchain-enabled services and to deploy innovative new services that leverage this technology.

Aalborg University – Denmark
Aalborg University's Department of the Built Environment is leading research on intelligent transport, tracking data analysis, big data analysis, and freight transport studies - from transport, business and logistics perspectives. The University's Freight Transport Research Group focuses on analyzing business models behind new technological solutions in transportation, and studying the potential impact of new technologies in transport and logistics.

Aalborg will contribute to the identification and development of the new ways of using blockchain to optimize freight transport through better service provision from 'Government to Businesses', which will help create better government services for maritime ports in the freight industry. This is an important complement to the other BLING pilots which focus on 'Government to Citizen' (G2C) services.

City of Antwerp – Belgium
Antwerp has already developed 4 proof of concepts (POCs) that use blockchain technology to support service delivery. In BLING, Antwerp will develop services that utilize 'self-sovereign identity', which provides a platform for users to create a verifiable identity – that they control – which services can use in transactions.

Antwerp wants its citizens to take ownership of their personal data in a GDPR compliant way, including giving them autonomy in deciding which personal data to share. Antwerp is working with the Flemish agency Informatie Vlaanderen and the Flemish ICT organization for local governments.

Central Judicial Collection Agency (CJIB) – Netherlands
The Central Judicial Collection Agency is part of the Ministry of Justice and Safety in the Netherlands. It is responsible for collecting a range of fines and penalties, and is the designated authority for the EU's Cross Border Enforcement Directive in the Netherlands. CJIB provides the national coordination service for custodial sentences, arrest warrants, community service orders, and probation services – it also provides a Victims Information Service.

CJIB will build a system using blockchain technology and a 'zero knowledge proof' to allow citizens to directly flag to the CJIB if they are unable to pay fines while maintaining their privacy, and to link this declaration with certification from local services that they are providing debt support. Through participation in BLING, CJIB can transfer knowledge about this multi-stakeholder approach and can pilot with other beneficiaries and work together on joint solutions.

Design Informatics, University of Edinburgh – Scotland
Design Informatics at the University of Edinburgh has significant expertise in the development of blockchain and blockchain-related systems, including linking fintech and distributed ledgers with the Internet of Things via the PETRAS IoT Hub. Design Informatics (DI) is closely linked with the University's Informatics Department, which is Europe's largest computer science department and a world-class research centre.

Design Informatics is developing a proof of concept blockchain based location system, that allows 1) decentralised storage of verified locations and 2) smart contracts to be written based on location information. The team will move our academic tools and proof of concepts into local government environments. We will leverage our existing work on blockchain and location to support Sestran's pilot on logistics and delivery.

Province of Drenthe – Netherlands
The Province of Drenthe is a regional authority in the north-east of the Netherlands. Our aim is to develop our region by utilizing technological advances and cutting-edge research, leveraging the Province's innovative businesses, knowledge institutes, and public authorities to create smarter services and an innovative business environment.

Drenthe will create a Blockchain Lab that will support the blockchain ecosystem in the Northern Netherlands, bringing together commercial and non-commercial networks and organising regular meetups. Drenthe will deliver a pilot that leverages blockchain technologies as part of a solution to administer the Province's Waste Management programme and reduce fraud and the need for inspections.

Municipality of Emmen – The Netherlands

Emmen is the fourth largest municipality in the Netherlands, and is in the Province of Drenthe. Emmen wants to promote the uptake of blockchain and is very interested in platform development. We will appoint a technology evangelist who is ready to explain the possibilities of blockchain technology, and to respond to feedback from both project partners and potential users. Trust in government and local democracy are important areas; in 2016, Emmen ran several projects that resulted in a proof of concept for voting in general elections, which could possibly also be used for opinion gathering on local issues.

Gothenburg University (GU-Blab) – Sweden

The Gothenburg University Blockchain Lab (GU-Blab, www.scdi.se/initiatives/blab) is a part of the Swedish Center for Digital Innovation (SCDI, www.scdi.se) located at the department of Applied Information Technology (www.ait.gu.se), University of Gothenburg. GU-Blab brings extensive knowledge about the use of Distributed Ledger Technologies (DLT) in public services.

GU-Blab will lead work to review progress in delivery and local capacity for blockchain-enabled services, and will enable BLING to bring together knowledge of activities across relevant domains in the NSR, mapping deployment and skills, and producing a blockchain readiness assessment scorecard.


Howest University of Applied Science – Belgium

The Security and Privacy Research Group of the Applied Computer Science Department at Howest, University College West Flanders has a long history of collaboration with large international corporations and local SMEs, and works on cybersecurity, blockchain, innovative web platforms and artificial intelligence. Thanks to current and previous research projects and collaborations with companies and institutions inside and outside Flanders, the Security and Privacy Research Group has established a wide international network of practitioners, institutions and enterprises.

Our role is to explore through 3 or 4 pilots (initially with Roeselare, and then with other partners) how blockchain technologies can be used by local governments. We can define the functional and technical analysis of pilots and develop proof of concepts. We will transfer these competences to other BLING partners through workshops and training.

Oldenburg University (UOL) – Germany

The University of Oldenburg brings experience in data analysis, data processing and blockchain technology; combined with extensive experience with management information systems in our Very Large Business Applications Department (VLBA). UOL has the skills to build blockchain-based solutions.

Through BLING, UOL will build additional capacity in blockchain technology research, researching heterogenous blockchain technology approaches to assess their applicability for government processes. The University will develop use cases for the application of blockchain in local government, as well as supporting the implementation of a local blockchain lab in Oldenburg. UOL will develop a blockchain pilot based on our collaborative work with the City of Oldenburg.
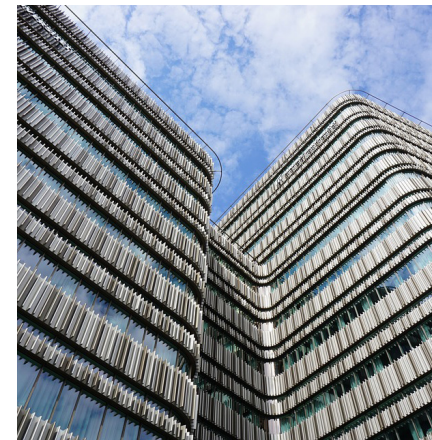
City of Roeselare – Belgium

Roeselare is a municipality in West Flanders in Belgium. The development and improvement of public services has been a strategic priority for the city since 2013 – the city has created a new organizational structure, merged departments, and has worked hard to develop new concepts for services. The city wants to focus even more on technologies that ensure that employees can focus on the quality of their engagement with customers, and on providing innovative ways for the city to function.

Roeselare is at the start of our Blockchain journey, and will use learning from BLING to develop a vision and strategy for new blockchain-enabled services. Starting from our earlier work on e-government, we will increase awareness of the possibilities of blockchain in government, and prototype new blockchain-enabled services for staff and citizens.

The County Administrative Board of Skåne – Sweden

The County Administrative Board is a government authority that links the people and the municipal authorities with the Swedish national government, Parliament, and central authorities. We are a knowledge-based organization which works on many different cross-sectoral issues, from rural development and biodiversity to integration and the protection of cultural environments.

One of The County Administrative Board's tasks is to coordinate public elections and to work to support the development of democracy and dialogue with citizens. We are one of the authorities that ensures that the elections are held properly, and that voting is done correctly. In BLING we intend to run local democracy pilot that is enabled by blockchain-enabled identity services.

South East of Scotland Transport Partnership (SEStran) – Scotland

SEStran is a Regional Transport Partnership comprised of eight local councils in south-east Scotland. SEStran's Regional Transport Strategy focuses on sustainability and reducing greenhouse gas emissions, and seeks to develop a comprehensive, sustainable transportation system for the region.

SEStran is interested in looking at the potential of blockchain in the logistics space. We see the challenge to understand and manage the (open) sharing of freight information (flows, amounts, value) and to enable SMEs to improve their logistics management (and costs) whilst reducing the number of light goods vehicles on the roads as key to the development of the next stage of our transport strategy. We will be working with a local council and with Design Informatics at the University of Edinburgh to develop this pilot.

Developing and implementing blockchain technologies for governments

David Magård, Swedish Ministry of Infrastructure

David Magård works for the Swedish Ministry of Infrastructure, and focuses on the digitisation of the public sector. He gives us his thoughts on developing and implementing blockchain technologies for governments.

What is your current job and what kind of work does it entail?
Currently I work as an adviser for the Swedish Ministry of Infrastructure – I'm a lawyer. My focus is on the digitisation of the public sector – so that covers issues such as AI, datafication, open data, open source in the public sector, and new technologies. One of these technologies is blockchain, and Sweden is part of the EU Blockchain Partnership. In this case, we are trying to help the Swedish public sector understand the possibilities of these technologies: helping them with fieldwork, getting them in touch with relevant partners, and looking at the (im)possibilities of existing laws. It also means we are looking at the laws that are being written right now, and how they can affect the use of these technologies.

I'm also involved with blockchain in a different way, through the EU Blockchain Observatory and Forum. This is separate from my work for the Ministry of Infrastructure, but it has a nice synergy. It is different from the Blockchain Partnership: the Blockchain Partnership is focussed on advancing blockchain within the EU and seeing how the public sector can benefit from blockchain. The Blockchain Observatory and Forum is more of an expert forum and keeps track of the developments around blockchain technology.

What kind of use cases do you see for blockchain on an EU level?
Currently, there are four that the Blockchain Partnership is looking at through the European Blockchain Services Infrastructure. The first is looking for a way to audit bills and spending. A second one is for diplomas and educational qualifications. Self-Sovereign Identity is an important third. We are also looking into data sharing: how can we share data between different customs agencies.

In June 2019 you were one of the speakers at 'The Future of Blockchain in the Public Sector' conference. You were fairly critical of many blockchain applications. What kind of opportunities do you see for blockchain?
I'm not critical of the technology itself, I actually see a lot of possibilities. But I do think it's important, especially on these kinds of conferences, to ask the difficult questions. I'm not critical about the technology, but I am critical about people who think that it is easy to implement.

I also often see that they don't ask the difficult questions when they start – and then the project often fails, because there is no (structural) funding, or because there are legal issues, or governance issues.

You hit the difficult questions sooner or later.
Governance is an especially important but difficult issue – particularly from a public sector perspective – and particularly for open blockchain. Because we need to ask who will 'manage' the blockchain services we are going to use? Who will fund it, and who will feel – or be – legally responsible for it? For example, who will decide what technology will be required to host the blockchain, and who will do any ongoing maintenance that's required to keep the blockchain system online, etc? In Sweden we tested a blockchain application for the Land Registry. This project took almost three years, in part because we got stuck in the legal issues and it is still not 'live' – as it was an innovation 'proof of concept' project.

When you're developing these services it is probably easier to work on a national level, because you can have some influence on the law writing process and on the wider things that can enable this type of innovation. This is a lot harder on the EU level. So you need to know the legal side of things when you start.

So I'm still optimistic about the tech. Implementing it is just going to take a lot of time. But that is the case with all digital changes.

> "I'm not critical about the technology, but I am critical about people who think that it is easy to implement."

Do you have any advice for civil servants that are experimenting or working with blockchain?
Blockchain is hard for a government – especially open blockchain – because government is usually in completely in control of all of the processes. That's the job of government.

I personally think that if technology is available to help you work better or more efficiently, then we should try it. Of course there is still the question of trust: if we trust the blockchain, who do you really trust? Blockchain is written by humans – at the end of the day there are people writing the code. And from that understanding we need to have a quite big discussion about accountability. I think that sometimes people forget that when something goes wrong in a big way, then there are going to be repercussions and the people affected and the government are going to be looking for people to hold accountable.

It is good to try these sorts of technologies and innovations. But not all use cases will succeed, and I don't think every proof of concept should be taken into production. I see many use cases that are basically database solutions. Blockchain is redundant in those cases, usually. But it is good to learn from them.

We talk about the Stadjerspas, a blockchain use case from the city of Groningen. Low income citizens get a pass which they can scan at certain places, such as a swimming pool – or they can buy tickets at a discount at the web portal. Transactions are saved to a blockchain. At the end of the month, the municipality receives a bill with all the transactions and pays them. David responds:
It's an interesting application for blockchain. But I don't think you necessarily need blockchain for this, you could do this with a different solution as well. In Finland they are experimenting with something similar. I think they also looked at the use case from Groningen when they designed their pilot. There they do it a bit differently: they use digital money, which is programmed to valid in certain places, so you don't need to send any bills afterwards.

What do you think blockchain is going to do in the future?
I think blockchain is going to change many things – but not in the way we think. You have to look through the hype and then look for the interesting parts.

Great! Any last advice?
Yes. When you start a blockchain experiment, you need to have a diverse team. You need to think about the governance questions, the legal questions, those kinds of things.

Don't call it an IT development project, because then it is going to fail.

Understanding Innovation in Blockchain in Government

Juho Lindman and Livia Norström, University of Gothenburg, Sweden

Juho Lindman is an Associate Professor of Informatics at the University of Gothenburg in Sweden, and the Director of the University of Gothenburg's Blockchain Lab. Livia Norström is a post-doctoral scholar at the Department of Applied IT at University of Gothenburg. They are both working in close collaboration with European municipalities that are exploring blockchain through the Blockchain Lab. In this interview they tell us about some of the work the Blockchain Lab has done to understand the challenges facing governments as they work on blockchain-enabled services, and some of the factors which are driving this change.

Hello Juho and Livia! Let's start with the big question – where do you see blockchain in government right now in the EU?

Juho: Blockchain in government at the EU level is very much arranged around the *European Blockchain Service Infrastructure* (EBSI), which is a joint initiative of the European Commission and the member states (who are operating collectively as the *European Blockchain Partnership*). The aim is to deliver EU-wide cross-border public services that leverage blockchain technology. EBSI is fully compliant with EU law in terms of privacy, cybersecurity, interoperability, and energy efficiency.

EBSI is organized into a network of distributed nodes, with applications focused on specific use cases. ESBI selected their first four blockchain in government use cases in 2019 – notarization, diplomas, self-sovereign identity, and data sharing – and different prototypes were built to address each case.

#1   The **Notarization use case** is focused on creating audit trails, automatic compliance checks and proving data integrity.

#2   The **Diplomas use case** is about consent management for to access to educational credentials, cost reduction for document verification, and increasing diploma credibility.

#3   The **European self-sovereign identity use** case gives users the ability to create and control their own identity credentials.

#4   The **Trusted Data sharing use case** provides a means for secure data sharing among customs and tax authorities (esp. related to VAT identification and imports).

Livia: Three further three use cases were selected in 2020 – a European Social identification Number, SME Financing, and Asylum Process management.

You're both from Sweden – so what's been happening with blockchain in government in Sweden?

Juho: We have some early pilots in Sweden – most notably Lantmäteriet – Land Registry digital asset transfer, and a pilot from the Swedish Unemployment Agency. The Lantmäteriet land registry is an example of using blockchain to enable a relatively 'disruptive' public service change. Lantmäteriet trialled a new electronic system built on a private blockchain that used smart contracts and digital signatures to automate the processing and recording of land transactions.

Many of this novel system's benefits and efficiencies came from digitizing the existing analogue processes that recorded the transfer of land ownership, resulting in increased transaction speed which should lead to cost savings. The benefits of using a blockchain-based system included the fact that the actors running the network could share the cost of running the service, and increased transparency of the transfer process, which increased the technical trust in the recording of transactions on the chain. However, the 'disruptive' nature of the new service was likely one of the reasons the project encountered obstacles and scaling difficulties, as it required new ways of working – like legally enforceable digital signatures.

Livia: Another real-world example in Sweden that has users is the digitizing of the unemployment certificate process. AXA – the insurance company - wanted to digitize the payments of employment insurance. One of the prerequisites is that the person needs to be registered as an unemployed jobseeker with the State Employment Agency. The transaction process is very simple, but the legal framework is bureaucratic. In the pre-digital process, a person needed to visit the employment office to get their unemployment certificate (after an identity check), and the paper certificate that is produced can then be sent to the insurance company. The current legal framework prevents the State Employment Agency from sharing a jobseeker's status with a third party. So the system requires an in-person visit to the employment agency every month – which is not an efficient process.

Can you give us a quick comparison between the EU approach and how blockchain in government is developing in the rest of the world?

Juho: We can see differences in approaches across the world – for example China and US have their own models – the US with a private-sector model, while China is focused on building a blockchain infrastructure. The US relies more on innovation from private companies than EU does, and most of the large international platform companies are from the US. This platform position allows US companies to explore interesting innovation opportunities that leverage blockchains – for example the Facebook Diem (formerly Libra) cryptocurrency that is now facing opposition in Europe.

Globally, there are several infrastructural projects that aim to build capacity, connect relevant stakeholders and ultimately support public services. These initiatives include, for example, the Chinese Beijing Municipal Blockchain Blueprint initiative (https://link.medium.com/hMYZHDgnR8) which aims to improve

government processes and services by assembling previously scattered expertise in the relevant areas on how to provide services and produce portions of the distributed core infrastructure.

Where is government in terms of blockchain adoption, vs. the private sector?

Juho: The government is behind the private sector, but the use cases are also different, so they're not necessarily comparable in that sense.

We have a technology that clearly has disruptive potential, a series of proven use cases which are mainly from the private sector (many of which are linked to cryptocurrencies, fintech and other financial services, areas in which blockchain's benefits seem different from most potential public sector use cases), and anecdotal evidence from a number of early technology projects showing that blockchain can be used in interesting new approaches or services that match public sector requirements.

Livia: As the use of digital technologies evolves in the private sector, citizens' service expectations have changed, and they are calling on governments to follow suit. In the context of increased dissatisfaction with traditional public institutions, governments may find using digital technologies and data provides an opportunity to transform internal processes, policies and services, which will allow them to better respond to the real needs of citizens.

Based on your work in the Blockchain Lab, what do you think are the main drivers for the adoption of blockchain by governments?

Juho: We can identify a couple of early themes that seem to be driving adoption, but it's still early in the process to be definitive about this. I can speculate though – here are 5 of the things that I think are driving blockchain adoption.

#1 Value

You can identify a range of potential benefits that blockchain-enabled services might bring to the public sector, including improved transparency, fraud avoidance, reducedcorruption, increased trust, auditability, resilience, better data quality, and security. Current blockchain proposals are often linked to aims such as decreasing transaction costs, disintermediating trusted third parties, increasing transaction transparency, and mitigating processing risk using an irrevocable shared account of earlier transactions.

The most critical part of setting blockchain project goals is clearly identifying the business benefit the project is expected to deliver.

Gartner Insight has suggested that 90% of blockchain projects are either driven by a fear of missing out, do not actually need blockchain to meet their requirements, or result in solutions that are unsuitable for the organisation's current IT infrastructure.

#2 Technology

The second success factor is the project's appropriateness. Specific technology benefits that come from blockchain deployments include increased trust, auditability, and information security. (The earlier use cases we analysed for this include land title registration, immigration-related registrations, and banking fraud reduction.) On a more technical level, researchers have found that blockchain can be deployed in different ways using various methods and configurations. Therefore, the relevant design space and design trade-offs in developing a blockchain solution are not trivial, and should not be underestimated.

#3 Stakeholders

Identifying and engaging relevant stakeholders is important for any development project, but especially so for a blockchain project due to its technical novelty and the frequent need to onboard whole networks of stakeholders. Usually, there is a public sector customer and one or more blockchain start-ups or other companies that provide the technology.

#4 Users

Most current software approaches highlight the importance of customers and users as active participants in the design and development process. Many early blockchain projects began as technology processes aimed at implementing a specific idea for a service. However, putting the customer in control and acquiring end-user input are very important for service design.
When the technology has matured, blockchain services should not be primarily seen as technology-driven projects, and therefore user focus is going to be a critical success factor.

#5 Willingness to experiment

Studies have highlighted the need for blockchain experimentation. The purpose of this experimentation is to build in some flexibility and variation for a specific innovation process, so that various attributes of the technology can be tested to learn about their potential real-world outcomes. This means testing various potential approaches/concepts during the pilot/project, and learning about their constraints.

This can also be done in a blockchain-agnostic way – it might not be necessary to decide before a project or pilot begins that the implementation must incorporate blockchain. Instead, blockchain can be one of the potential technologies the project investigates as part of a service design or redesign.

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FUTURE OF BLOCKCHAIN IN THE PUBLIC SECTOR

This one day Conference in Gothenburg (Sweden) brings together learnings from across six countries in Europe on Blockchain technology for government. Engage in networking with colleagues from North Sea Region Countries.

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That's quite a varied set of drivers! Why do you think that is?
Juho: The reasons why public sector agents want to use blockchain to digitally transform services and organization combine external and internal drivers and outside and inside factors. Studies of public sector managers' views on digital transformation show that more than 80% felt there were external pressures for service transformation. These outside factors could include pressure from citizens, from businesses, and from political actors. External agents are used to – and inspired by – the effects of digital transformation in the private sector and expect public institutions to also be efficient and innovative in their service delivery. External drivers reflect technological change in society as a whole.

Livia: Blockchain has been widely hyped for the last few years, which has definitely affected design decisions on the use of blockchain (for good and for bad) in the public sector. Internal drivers of change are often managerial, through business processes renewal and business/service model updates.

What are the main barriers for blockchain adoption in government?
Juho: We can't give a definitive answer yet – as we are still in the early stages of adoption. But we can highlight three types of challenges pilots seem to face – disruptiveness, limited scalability, and legal uncertainty.

#1 Disruptiveness
The more a development project has the potential to disrupt current public services (i.e. by significantly changing how it is designed or delivered), or to affect existing markets, the more complex it will be to implement. Our review of the field revealed hundreds of inactive projects that were previously self-marketed and/or reported in other publications, but of course, many were small-scale proofs of concept or pilots that were aimed at testing the technology and learning. There was no lack of project ambition, and the high number of inactive projects is not surprising. What is a bit more surprising is that successes in this space seemed relatively rare.

#2 Limited scalability
Many early blockchain projects were small-scale pilots intended to facilitate learning about the technology and then to potentially scale up. Some design decisions made during these early pilots did not scale well, such as the number of nodes or load in the network or the number of transactions. Projects like this can deliver learning through experimentation, but they will probably not deliver new services.

#3 Legal uncertainty
In what is sometimes referred to as a "reality feed", there are legal points when a blockchain and the physical world intersect. This is a potential risk if the project is looking to change a service and there is legal uncertainty or ongoing regulatory developments. One example of these legal issues in Europe is the question of GDPR compliance. Different countries are now building legal sandboxes to test what would be legally possible for their blockchain services.

What have you learned from looking at BLING's blockchain pilots?
Juho: While we don't have many blockchain applications in the public sector that we can refer to or study to identify and understand barriers to the adoption of blockchain, however we do have access to several pilots and proof of concepts within the BLING project that we have been able to study.

Livia: In our analyses of BLING's blockchain work we are looking at how the design processes of these pilots worked out, how different actors involved in planning and development reflect over the design decisions they made (both from a technological and organizational point of view), and why they think some things worked out and some things didn't.

"To understand blockchain implementation in the public sector we think that it is important to see digital transformation (change through technology) as a process of constant revision of outcomes, and not as a series of projects or pilots with clear ends. Identifying barriers (to adoption) is part of the process."

Juho: Early results from our reviews show that the hype and the pressure to jump on the 'blockchain bandwagon' could have hampered the possibility of scaling of some pilots. Often pilot engagement was restricted to one or a few enthusiasts in the organization, with no long-term plans for scaling and user involvement, and with little experience of digital innovation transformation projects. Project leaders did also put quite a lot of trust in external developers to develop blockchain solutions quite independently from the host public organization. The complexity, jurisdiction and culture of public sector organizations were thus not fully taken into account. The pilots and concepts were primarily *technology driven* rather than need and *context driven*. However, even though these efforts at a first glance may seem to be naive or technologically led, they also create knowledge and legitimize blockchain innovation both internally and externally – by extending the network of the public organization beyond organizational borders, by supporting local tech start-ups, and through getting knowledge about their activities out to a wider audience.

If we take a broader view of the pilots and look beyond the start and end of a specific project, then their efforts and the lessons learnt could be seen as the beginning of blockchain implementation in the public sector. We see that most of the development and implementation barriers were only identified when organisations started experimenting with blockchain – so they weren't factors that were already known or to be expected or predicted. These pilots should never be seen as failures, since the knowledge they gained is immensely valuable for future blockchain efforts.

Another barrier to adoption is the tension between *technological promises* and *organizational culture* – it is important to make the distinction between technological functionality (what is potentially possible) and how the technology actually 'plays out' when it is used in an unique organizational context. We think this is especially important for blockchain implementation, due to the hype surrounding this technology. It is also important for public sector organizations since they differ from private organizations – where most of the literature and discussions of blockchain usually take place.

While the private sector is primarily driven by economic advantages and competition – which may restrict the sharing of good ideas – the public sector is more motivated by the need to build organisational and delivery capacity and to increase service effectiveness – so the public sector may be a better place for innovation. On the other hand, the public sector is less flexible than the private sector. Legislation, policy and services are usually designed to help business innovate – *but not necessarily to help the government innovate* – which means laws are sometimes contradictory and may hinder public sector innovation.

Have you identified any common approaches to innovation as governments look to adopt blockchain?
Livia: Early results from our research on blockchain in the public sector have identified three approaches to collaboration/innovation as part of wider public sector digital transformation efforts. In some of these blockchain's technological promises and public sector logic align, and sometimes they may not.

A key argument for using blockchain is to decrease costs by increasing efficiency – as blockchain is believed to spur process re-design which reduces service delivery costs. This view of blockchain's transformative capacity aligns with a new public management (NPM) paradigm of making internal operations more efficient and measuring performance. However, we doubt how innovative this rationale is in practice, since NPM is not believed to drive innovation.

Blockchain technology is also thought to provide a path to better service delivery to citizens, providing an improved way to support approaches like providing economic support to fragile groups, increasing the transparency of democratic processes, and decentralizing services to neighborhoods and communities. These efforts to use blockchain for transformation towards more transparent, accountable and secure services are a promising approach to delivering innovation.

A third dimension of blockchain engagement is collaboration between municipalities and industry – with firms and entrepreneurs. In this approach one reason for introducing blockchain in a municipality is to support local entrepreneurs by offering collaboration opportunities. A lack of internal technological skills is also an argument for external collaboration. Opening up an organization for collaboration and innovation is part of a participatory public sector logic of co-production. In this dimension blockchain is engaged to collaborate beyond organizational boundaries, inspired by an open innovation paradigm and entrepreneurial organization.

To really understand how adoption is going, more research is needed on what happens after pilots finish. How were the barriers of misalignment tackled? Even if a blockchain pilot was not scaled up or deployed, did the work to setup and deliver the pilot lead to a transformation of ideas and thoughts and perspectives (leading to a changed organizational culture)? And what lessons do managers and staff bring with them about innovation and barriers from the pilots to future innovation projects?

PILOT

BLING use-case:
BRAT – Introducing the Blockchain
Readiness Assessment Tool

Juho Lindman is an Associate Professor of Informatics at the University of Gothenburg in Sweden, and the Director of the University of Gothenburg's Blockchain Lab. Livia Norström is a post-doctoral scholar at the Department of Applied IT at the University of Gothenburg.

Measuring blockchain readiness in public sector organizations

Despite the public sector interest in blockchain technology, few blockchain projects have gone beyond a concept or pilot stage. This means we have limited knowledge of how the particular characteristics and properties of blockchain play out when implemented in public sector services at scale. Organizations which are starting to engage with blockchain technology thus have less evidence to draw from than they might like.

Against this backdrop, BLING is developing a tool for organizations who want to explore the development and use of blockchain-enabled services - even at this early stage of the technology. The Blockchain Readiness Assessment Tool (BRAT) is a survey instrument that can be used by organizations to facilitate discussions about their readiness to adopt blockchain and their organization's capacity and capability. BRAT should make the target organization more aware of their capacity to explore/adopt blockchain enabled services, and will identify areas where improvements can be made and where capacity can be developed.

The tool is designed as a set of simple questions that supports discussions around the key aspects that make up an organisation's blockchain maturity. It covers the six main domains for public sector actors: business need, organization roles and participants, blockchain architecture, legal requirements, data handling, and the more philosophical aspects which we call 'mandate'. These characteristics are

explored in more detail below, and each discussion is followed by a question prompt, which should lead the organisation's internal discussions on blockchain exploration/adoption.

The Blockchain Readiness Assessment Tool

1. Business need

Using blockchain to store and manage data can be slower and less private than conventional solutions, but it removes the need for trust between parties, and is tamper- and censor-proof in ways that conventional solutions may not be. Before spending a lot of money and effort to create a blockchain solution, the organisation considering this approach should determine whether there is an actual need for a blockchain solution – that their problem cannot be solved by other approaches, and whether the adoption of blockchain fits into their overall strategy.

Question 1: As an organization we have identified/captured a need that can only be effectively addressed by using a blockchain application

2. Organizational roles and participants

Before building a blockchain application, you should have an understanding of who the participants of the blockchain solution will be, and what the trust relationships are between these participants.

Question 2: As an organizahon we have a clear understanding of the roles required in our application and who should fill those roles.

3. Blockchain Architecture

When creating a blockchain application, there are a range of architectural design choices that need to be made about the blockchain. These range from determining how open the blockchain should be, to choosing a consensus mechanism, to deciding on a transaction model. These choices should be made to fit the particular needs and requirements of the particular use case.

Question 3: As an organization we have a thought-out strategy for making design choices about the architecture of our blockchain solution.

4. Legal requirements

There will be legal 'entry points' at the intersection of the blockchain and the physical world, and it follows that the blockchain solution which organisations develop will have to comply with relevant national legislation if it is going to be useful in the physical world. Public sector organizations often have specific sets of legislation regulating their activities, as well as more general regulations such as the GDPR. Public sector organizations are representatives of the state, and therefore must be careful to create systems that comply with applicable laws.

Question 4: As an organization we have identified which area of legislation our blockchain solution must comply with.

5. Data handling

When considering what data an organisation's solution needs to store, and where it will store this data, it is important to consider the regulatory restrictions or possibilities of the blockchain application, and how this aligns with the architecture that the organisation has proposed for their blockchain solution. For example, some data may be better suited for storage off-chain, due to legal requirements (such as GDPR compliance) or scalability, whereas other types of data should be stored on-chain or for purposes of transparency and immutability/permanence.

Question 5: As an organization we have a clear understanding of what kind of data we should store on the blockchain and what to store off-chain.

6. Mandate

One of the fundamental ideas motivating the adoption of blockchain is to replace intermediaries and third parties in processes where possible – in finance, in organizations, in governance, etc. – through the use of approaches like self-sovereign identity. These technologies allow organisations to work directly with clients/citizens without requiring other organisations (such as identity providers, certificate providers) to participate in or support the exchange or service. An organization considering a blockchain solution should think about how their operating model and their offer may be shaped by the ways in which blockchain can be used as way to disintermediate processes and reduce the need for intermediary partners.

Question 6: As an organization we have discussing if/how blockchain-based government services can change the role, need and mandate of the public sector.

High scores from the BRAT indicate that an organization can feel confident about moving forward and implementing blockchain based applications in their organization – these scores would indicate that the organization is 'mature' enough to use and take advantage of the technology and has a good understanding of the particular challenges and risks involved.

Low scores indicate that the organization should work to develop the capacities that they don't yet have, and to address the self-identified capacity gaps in the domains where their scores were low. Organisations with relatively low scores should develop their capacity in these areas and then re-take the assessment before beginning a program of blockchain application development.

The Blockchain Readiness Asessment Tool has already been tested as part of a research project with high-level blockchain expert stakeholder groups. The Blockchain Research Group in Gothenburg is continuously developing the tool and will implement the tooling and development of a maturity assessment model in 2021. The BRG will continue to iterate the questions in the BRAT, and work with different stakeholders and carry out individual follow-up interviews with municipal stakeholders to gain a better understanding of how the public sector is engaging with blockchain technology.

The research group will also monitor successful cases and pilots that are able to garner user acceptance. At the moment public sector blockchain pilots are relatively small and struggling to attract any users. However, several promising public sector deployments offer potential for dramatic change, so it will be interesting to monitor their success. Finding some "killer applications" for the public sector will also make it easier to discuss blockchain benefits and readiness.

SCORING THE BRAT

QUESTIONS	ANSWER
for blockchain applications. As an organization, we are/have…	On a numeric scale of: 1 Strongly Disagree – 6 Strongly Agree
1 identified/captured a need that can be effectively solved by using a blockchain application.	
2 a clear understanding of the roles required in our application and who should fill those roles.	
3 a thought-out strategy for making design choices about the architecture of our blockchain solution.	
4 identified which area of legislation our blockchain solution must comply with.	
5 a clear understanding of what kind of data we should store on the blockchain and what to store off-chain.	
6 discussing if/how blockchain-based government services can change the role, need and mandate of the public sector.	

Delivering Germany's Blockchain Strategy

Andreas Hartl, German Federal Ministry for Economic Affairs and Energy

Andreas Hartl is Head of the AI1 Division of the German Federal Ministry for Economic Affairs and Energy. He is responsible for AI strategy, blockchain strategy, and data policy.

You're working on AI/blockchain/open-data – these are a lot of inter-related hot topics! How did you end up working in this area?
I'm a legal specialist, I started in telecommunications and radio regulation, and recently oversaw the production of a Green Paper on online platforms – which was a bridge to move on to digital issues and to the division I'm now heading.

If we look at the priorities of the current EU commission, it's sustainability and climate, fighting the pandemic, and digital issues – the issues of digital policies have in essence transformed into discussions about data, and access to data. The use of data is very important, particularly for the use of technologies like artificial intelligence (AI) and blockchain. Blockchain has many features which can help us support and establish a data economy. And data is very relevant for AI – machine learning (ML) isn't possible without data – it's like having an engine with no fuel.

In previous years we had very technology-oriented discussions – talking about things like the Internet of Things (IoT), AI, blockchain, and so on. What we weren't discussing is what these technologies actually mean for the economy, and for society. The 'data economy' is the thing that brings all these things together in my division: there's AI, there's blockchain, and in the middle is the data economy. The Ministry is very keen to facilitate the establishment of a data economy – but what this data economy will mean for economic processes, for services and goods, for transactions, is still rather unknown territory.

Can you tell us about the German Federal Government's Blockchain Strategy?
Our blockchain strategy was adopted in September 2019, based on responses from a very broad online consultation process that started in 2017/18 when we followed discussions about ICOs – initial coin offerings – in Berlin's blockchain community. We ran a series of workshops to collect information and then got political approval for the development of a blockchain strategy. We had responses from more than 150 companies, organisations and individuals. We've agreed to have a learning strategy – we need to keep in contact with the community, and have set up an expert dialog to do deep dives on key questions – like studying the 'token economy', which is one of the goals of the strategy.

This is an example of focusing on what the technologies mean for the economy. In a token economy – with blockchain or with tokens in a blockchain – you can represent almost anything – you can represent values, you can represent buildings, contracts, new forms of investments. Everything can be represented by a token. This means that you can trade physical goods more easily, because they're represented by tokens.

Commentators described the first wave of the internet as the 'Internet of humans', followed by a second wave which was the 'Internet of Things'. The third wave will be the internet of values, and these values will be represented by tokens, and these tokens will be based on a blockchain. With tokens you can facilitate economic processes, information gathering, transactions, the allocation of goods. Blockchain can facilitate all of this.
We are also looking at privacy issues – particularly GDPR compliance and blockchain. We've brought together industry and State and Federal privacy watchdogs to identify and focus on specific problems/pain points when developing blockchains.

Where is blockchain in government in Germany right now?
It's hard to say whether we're ahead of the curve or behind the curve – it's hard to determine as there are no metrics we can use! In a way we are spearheading global development in Germany, as our Federal Government was the first government to set up a comprehensive blockchain strategy, however there are a lot of opportunities that aren't being explored at the moment – both by companies and by government administrations.

In terms of policy making I think we're quite good, and I can say that as I have a good benchmark as I represent Germany on international forums like the OECD Blockchain Expert Policy Advisory Board (BEPAB) and the European Blockchain Partnership (EBP). So I think in terms of policy we have done the homework, and are implementing it, but where we can get better is in the uptake – by administrations and in the wider economy.
The division I'm heading is co-ordinating the delivery of our blockchain strategy – but we're not implementing everything ourselves – for example the German Ministry of the Interior is doing a lot of work. A recent BearingPoint study on use of blockchain technologies across all levels of German government – federal, state, municipal – identified 50 blockchain projects. But even the most 'mature' of these projects aren't really as mature as other IT projects.

I'd highlight 3 projects, run by the Federal Government:

- Asylum use case – this is now also an EBP use-case – based on the 2015 refugee situation, where there was no database for Federal, state and local authorities to capture the state of play for individual asylum claims

- TruBudget – this is our most mature pilot according to BearingPoint. TruBudget aims to give more transparency/control to the management of budgets for overseas projects delivered on behalf of the Federal Ministry of Economic Cooperation and Development

"AII, blockchain and open data aren't the next big thing, they are the big thing already!"

- Federal Ministry of Transportation and Digital Infrastructure is looking at how Bills of Lading – used for maritime shipping, air-freight shipping, logistics etc. – can be digitised

When you listen to the Blockchain community it's often supply-led, meaning that the suggestions are oriented to systems that are already in place, e.g. with proposals suggesting that we transform land registries, or other existing working registries. I would say that if we want to show the efficiency of the technology, and how to show that blockchain is the best technology for specific solutions, then let's go greenfield. Do not try and replace a running system that already works - what I'd call a brownfield, but find a greenfield – a problem that's not been solved. There the acceptance will be bigger, because you don't have to convince relevant stakeholders of the benefits of blockchain against existing and functional solutions. At the end of the day we are spending taxpayers' money – we need to be efficient. And unless there is a clear benefit to doing something, we're not going to do it. It is easier to demonstrate the advantages and benefits of blockchain when you don't have to oust a working system.

I am always advocating for a level playing field – for technology-neutral systems and to articulate the clear benefits of technologies. And this works in both directions. Let's give

blockchain a real opportunity, a real chance, but let's not do blockchain just because it's the new thing – that would not be responsible government.

How does this compare to governments elsewhere in the North Sea Region and across the EU?
I really wouldn't like to compare our government with other governments. I'd highlight the European Blockchain Partnership – all EU members states are partners, plus Norway, Liechtenstein, and Switzerland. We have an excellent partnership with a common commitment to set up the European blockchain services infrastructure. What we have accomplished in the first two years with the Partnership is remarkable. I think it's important to have built this at the European level, as none of the member states have the size and relevance on a global scale.

The EBP was established in 2018, the main purpose being building the European Blockchain Service Infrastructure, which has nodes in every member state. These will form the basis for a set of blockchain use-cases – starting with self-sovereign identity, and notarisation services. We have extended this to include use-cases on asylum seekers and for financing start-ups. We want to build an infrastructure for public bodies to use. We're just starting to prototype – we're not conceptualising, we're testing things and building mature use cases.

An example is a French student who wants to study in the Netherlands – they can use a blockchain service to authenticate their diploma. And if they then want to work in Italy, they have an identity they can use to start-up a company or apply for a job.

What are the main drivers for your interest in adopting blockchain in the Federal Government?
I would say that cost efficiency is a requirement, not an incentive. If you're looking for a solution, for a new service, and it turns out that blockchain is the best way to do it, the incentive is to build a solution that works for the people in the administration, to have suitable processes, a straightforward database, a nice front end, it needs to be easy for clients - for citizens and companies – to use, and for the staff of the public administration. We have to remember that blockchain isn't a front-end technology, you don't notice it on your wallet, or on your smartphone. It's a back-end solution – you don't feel it. It's somewhat different from AI, where some things are identifiable as AI (like recommendations), blockchain is hidden (from the user).

The main feature of blockchain for me is that blockchain can provide an origin of truth, an origin of trust. So whenever you have a system with multiple actors, participants who don't know each other – or who know each other but don't necessarily trust each other – blockchain can be the solution. In previous years we've seen intermediaries and platforms as solutions addressing this – for example we trust banks to transfer money – but you could also use blockchain for this – e.g. bitcoin.

So, what I mean with trust is not a lack of trust in democratic institutions and processes, but the assurance that information and transactions are recorded accurately. Blockchain can facilitate this So, what I mean with trust is not a lack of trust in democratic institutions and processes, but the assurance that information and transactions are recorded accurately. Blockchain can facilitate this - especially in multi-lateral, multi-polar transaction systems. especially in multi-lateral, multi-polar transaction systems.

You could either have a centralised system of origin of trust, or a decentralised system – where you don't necessarily trust an authority but you trust the protocol. This is a decisive advantage in multipolar relationships– this feature of blockchain provides real benefits.

As a practical example, I don't own a car, but I use local car-sharing services. And I have to prove to each service that I have a driver's license – I have to show the clerk my physical license. But with a blockchain services you can do this automatically – there is a multi-polar relationship between myself, the licensing agency, and the car company.

When it comes to identity, blockchain is going to be important for identity services – and will complement the systems we already have. I think we'll have physical drivers licenses for years – but electronic systems will be useful too.

What are the big challenges facing blockchain in government?
Education. Education is the thing. There is a lot of disinformation - or not enough information - on blockchain. The success of Bitcoin is in a way detrimental to the development of other blockchain services – people think blockchain and bitcoin are the same thing or linked, they associate bitcoin with the darknet,

and with high energy use and with energy waste. There are man- negative connotations with bitcoin, which frames the blockchain discussion in unhelpful ways. So we need education that there are sustainable blockchain solutions, that there are consensus mechanisms that don't use 'proof of work' and which use large amounts of energy, and that we can use permissioned systems – like private blockchains – to ensure security and manage risk. Private blockchains will gain momentum, and at some point some private blockchains may become public - but not permission less – once they are mature.

One of the four objectives of our Federal Blockchain Strategy is information and networking – providing information and educating people. We're not saying they need to go back to school – but we just have to provide them with the proper information so they can make informed decisions.

To be frank our government use cases are not as mature as I would like them to be, as shown by BearingPoint, and we can be better. At the Federal level we have the three use-cases I described previously – but they're pilots, and not real use-cases – yet. I see lots of opportunities around IDs – self-sovereign identities and blockchain can be one of the technologies. We are looking forward to the results of the expert dialogue on this which we will start soon.

Do you have a strong legal infrastructure to allow use of blockchain?
Our national and EU legislative frameworks are technology neutral, so blockchain systems are not prohibited. But one of the objectives of our approach has been to ensure that our regulatory frameworks are also technologically neutral. As an example a bond – an investment security – has to be a paper document – but is that right in the 21st century? Why not digital? So we are changing our securities assets law to allow this – so the law is technology neutral, and (blockchain) digital assets would be covered, not just paper assets.

We work with the Blockchain Association in Germany – they identify issues, regulatory provisions that may hinder blockchain, and we also liaise with other German ministries to see how we can resolve issues like this.

PILOT

BLING Blockchain use-case: GeoPact – connecting virtual blockchains with real places

Data driven innovation is transforming society and the economy. The Institute for Design Informatics at the University of Edinburgh designs systems for better human/data interaction, in diverse sectors including health, culture, mobility and finance. Design Informatics explores design from, with, and by data: focusing on the design of flows of data which sustain and enhance human values. Design Informatics are investigating the internet of things, blockchains, robotics, speech recognition, data visualisation, interaction design, and social computing.

Dr Dave Murray-Rust (now at TU Delft) is a Lecturer whose research focuses on the "interesting messy bits" between people and computational systems, from large scale Social Machines through the Internet of Things, to personal data and privacy. **Dr Ella Tallyn** is a Research Associate focusing on human/computer interfaces and understanding interactions between humans and autonomous systems.

Making technology accessible

New technologies such as blockchain and smart contracts are becoming increasingly widespread, running in the background and supporting finance and distribution transactions. As these technologies remain in the background, and people have little obvious interaction with them, our awareness of them is often provided through technological narratives and stories – such as those in the media. This lack of awareness and understanding those technologies prevents a more informed conversation around the implications and potential of these tools, particularly when organisations attempt to involve people in the design process as they create/improve services. This makes involving non-specialists in the design of applications that employ these technologies challenging. In order to understand the effects these technologies may have on everyday lives, researchers are looking into ways to make them more accessible and understandable for non-specialist audiences.

Human-computer interaction (HCI) and design projects that collaborate with stakeholders and users to explore blockchain have worked with abstracted and simplified versions of their structures and applications using symbols – like Lego or cards. These methods allow researchers to focus on specific aspects/ attributes of blockchains, without overloading people with technological concepts. Design Informatics' previous GeoCoin

pilot gave users a real-world experience of location-based smart contracts supported by a mobile application – just by walking around the city. Roleplay and participation are effective tools to explain smart contracts.

Introducing GeoPact

GeoPact is a blockchain-backed location verification system which collects and confirms location data from smart objects with certainty and security. Users and organisations can then leverage this data through 'smart contracts' – self-executing computer protocols that run on a blockchain. Smart contracts are enabled by blockchains, as blockchain systems now include a programming language that can be used to create smart contracts. These smart contracts are agreements between two or more parties that can be automatically enacted by the blockchain's programming when a set of pre-agreed conditions are met – such as to transfer money, or to open a lock. GeoPact

is both a proof of concept – illustrating how to link virtual and physical systems – and a real-world demonstration tool, which participants use to help them understand the potential of this technology and which helps make these virtual systems 'real'.

Design Informatics developed GeoPact as a platform to allow researchers and designers to work with people to help them understand and design location based smart contracts. Location-based smart contracts – computer code on a blockchain that allows the correct location of smart objects to trigger useful actions - provide a mechanism to exemplify the use of these new technologies in regular, everyday situations.

Enabling transport innovation

Designing for change in transport and logistics infrastructures is challenging. With more people than ever on the move, and the impact of growing volumes of home deliveries on urban

logistics, this is an area that urgently needs design innovation. Through trusted distributed structures and cryptographic data processing, distributed ledger technologies such as blockchain present opportunities to develop new systems and services locally and on a smaller scale. Smart contracts have the potential to provide a secure, programmatic method to enable people, objects and spaces to interact without the need for trusted third parties.

Using a fusion of location-based Internet of Things and blockchain technology to verify and secure location data, the GeoPact pilots explored how people, organisations and existing services could collaborate in developing new services that use location data as part of their transactions. Delivering this vision however needs tools and approaches which 'open up' these technologies – and their impact on transportation and logistics to society.

Blockchain and smart objects

GeoPact uses blockchain – digital ledger technology – to verify and secure location data used by 'smart objects' in the transport and delivery sector. Blockchains are systems that can computationally verify and store information in a decentralised network. Blockchains allow consensus to be achieved in a distributed system without requiring a central authority – this is important for applications that verify and permanently record transactions and data.

Design Informatics can see a future where the vehicles, street signs, and systems that manage traffic flow may all be 'smart', as part of an effort to create new systems and services that improve transport efficiency and ease congestion. Tools like GeoPact will underpin these services, ensuring that smart objects are where they say they are, managing this using approaches that make sure that location tracking and monitoring don't invade user privacy. GeoPact uses a minimal disclosure approach, in which only the necessary information is disclosed in order to perform a transaction. This is a different approach from many other platforms – such

as social media and Google in particular – that offer services which harvest user data that is not needed for service delivery. There are already numerous ways of detecting the location of smart objects, for example through the location data provided by mobile phone networks. However, location reporting that uses these technologies can easily be faked, so they cannot be relied on in situations that may present risks to safety, have legal implications, or have larger financial consequences. Having certainty around recorded location and journeys – through the use of blockchain – unlocks verified location data for use in a number of applications. This certainty is particularly useful for delivery services, where these sorts of systems could provide certainty in knowing that an important package has actually been delivered to your home.

From 'smart contracts' to 'location-aware smart contracts'

'Location aware' smart contracts connect real-life actions – identified by sensors connected to the Internet of Things – to blockchain technologies, tying events together to ensure things happen in a specified way. This provides contractual certainty around the events that should take place as part of a process. Yet much of the value of smart contracts lies in the security provided by technological structures that are not apparent at surface level.

The main challenge of communicating the potential of smart contracts is a combination of the complexity of the underlying technology, and the lack of general understanding of some of the underlying concepts. Smart contracts often do not match the public's existing mental or legal models of how contracts work. It is not obvious to many how trust can be built up by distributed systems, or why blockchain transactions would become more trustable over time. Having a 'community' of nodes working together to validate transactions and decisions is a change from how existing legal/dispute systems work. With GeoPact, organisations can create different smart contracts specifying a wide range of terms and models of operation using location data.

GeoPact at work

The technological architecture of GeoPact integrates IoT technologies (LoRa, Bluetooth) with an Ethereum blockchain. Bluetooth beacons communicate across local networks using location data to confirm the identity and location of smart objects, then encrypt the data and resulting processing, storing it on the tamperproof Ethereum blockchain. The stored data can then be verified and accessed by distributed networks, and then used within smart contracts. In the face-to face GeoPact demonstrations participants work with both the infrastructure – IoT beacons, smart contracts and blockchain data – and the smart objects that participants interact with. The GeoPact pilot enables people and things to transact and interact through secure, location-aware smart contracts. It provides a view into the concepts of a smart contract system, using transportation and logistics examples as a way to link them to real-life experiences. GeoPact participants go step by step through examples of functioning location-aware smart contracts, enabling them to experience some of the possible transactions a user might have while using the system, and in the process demystifying these technologies.

The GeoPact testbed combines smart lockboxes (used to securely transport items), electric scooters (which help us start to think about how future intelligent transport systems might work), Bluetooth beacons (providing location detection), and a Geoserver/Ethereum blockchain network providing the backend. A set of pre-coded location-aware smart contracts, which allow simple logic statements to be chained together (such as: 'if this box and this person are in the same place, the box will unlock'), govern events that must take place for the smart contract to complete. A dashboard displays an entire smart active contract broken down into its constituent steps, along with a view of the data being written to the blockchain.

The GeoPact demonstration suite was exhibited at three different locations in the spring of 2019. When Design Informatics delivered the GeoPact pilots they found that participants needed a clearly described scenario in order to grasp the complexity of the underlying technology. Building

the pilot around a relatable scenario helped to show how the tools and concepts might transfer to real-life activities, and demystified the abstract concepts underlying these technologies. While getting participants to follow a pre-defined, guided set of interactions may sound like a counter-intuitive way to support creative thinking; Design Informatics found that it enabled participants to focus on the interactions and the resulting reactions (or non-reaction!) of the location-based smart contracts.

It was particularly helpful to provide two different views into the system: an overview via the dashboard that enabled participants to spectate and get a sense of the experience as a whole, plus the physical process of the delivery task with the boxes, interacting directly with the smart contracts. By providing a working example of how these innovative technologies might be used in practice, GeoPact provided participants with confidence to comment on the potential real-world impact of the new types of applications that are enabled by blockchain.

GeoPact on the go

Following this trial, Design Informatics has now completed a second pilot trial with a revised GeoPact test suite that now uses a GeoPact phone app, and a new more robust, smart lockbox. These developments make GeoPact a more durable and accessible system - the phone app enabled GeoPact to work over mobile networks and over longer distances. This pilot explored the potential impact of GeoPact on last mile logistics and on courier work in particular. Initial analysis of the results from the trial look positive and suggest that there may be a feasible use case for location-aware smart contracts in last mile logistics. The results also show many possible directions for further developments.

Bringing design, blockchain, and computer science together

Dave Murray Rust, TU Delft, Netherlands

Dave Murray Rust is a researcher at TU Delft, working on human-algorithm interaction – and exploring the messy terrain between people, data and things!

Hello Dave! Would you like to introduce yourself?
I'm Dave Murray-Rust, and I'm a researcher and lecturer at TU Delft in Rotterdam in the Netherlands. I started with the BLING project when I was at Design Informatics at the University of Edinburgh. I'm interested in all the messy bits between humans and technology. I started out looking at AI and music, and how people can interact with intelligent systems to do 'creative stuff'. I spent a long time working on models on how people interact with their environment, looking at land use and climate change, and I've spent the last couple of years looking at how design and computer science come together and how we can understand the new technologies that are coming into the world and trying to create the kinds of futures that we want to live in. It's important to always create spaces in which people can be humans – and not letting technology dictate the way things are going to be. So that can be looking at AI, and how it sees the world, and how it classifies people – and recognising that this doesn't always line up with how people see themselves. It can mean designing systems that go wrong in useful ways – where machines do the boring bits and let humans do the interesting bits.

How did you get involved in BLING?
We got involved in BLING through taking with Keith Fisken at SEStran (the South East of Scotland Transport Partnership). We had been experimenting with location based smart contracts, and this aligned with some of the things SEStran were trying to do around transport infrastructure, and we then looked for a way to bring this work into the BLING project.

Tell us about 'GeoPact' - what problems is it trying to solve, and how does it work?
GeoPact is looking at what happens when you bring location into smart contracts. Smart contracts are part of blockchain systems – they're programs that people write.

One of the funny things about blockchain systems is that connecting them with the physical world is always tricky, because blockchain is very formal and rules driven, while stuff in the real world is messy and interesting. So GeoPact grew out of the question of what can you do when you know where people and things are. There were ideas we played with in Edinburgh about geo-located currencies – things you could only spend in certain places, or money that would flow depending on how you moved around the world.

GeoPact grew out of this, asking how we could use the location of things in blockchain systems. There are a lot of blockchains that focus on the ownership of things – like houses. Houses are

easy because they (mostly) stay in the same place, but there are other areas like logistics where you are moving expensive things around the world, and it would be very useful to adapt some blockchain approaches to help enable that.

How does blockchain enable this? Could you do something like this with other technologies?
In most cases you don't really need a blockchain to do things, but we think there are some properties of blockchain that make them very useful to deliver approaches like this. A key thing when you're working with location is that location is a very personal and private thing – ideally you don't want to be sharing your location with everyone in the world!

But it's also very useful to be able to prove some facts about where you were – so we saw that working with blockchain systems in this way means we can create systems that notarise where we were without revealing this to the whole world, and you can then say 'I definitely was in this place at this time' and here's a blockchain proof that that is true. So the goal is that we can build a secure way to deal with location without sharing all of it.

The other thing that's very useful with blockchain is that it can give objects autonomy – you can give objects on the blockchain a wallet, and they can then start spending money and being a part of financial transactions through smart contracts. By connecting together smart objects with smart contracts – and in the case of our GeoPact pilots we're dealing with physical lock boxes – they can decide when they lock and when they unlock, and they can decide when the courier gets paid for moving them from one place to another. So the physical object has control over money – and that can support a slightly different way of thinking about the world.

What's a smart contract? Can you explain how smart contracts work with blockchain?
A smart contract is just a computer program – albeit one that runs in a blockchain environment. Smart contracts do have some special properties though: because they're running in a blockchain context they're things that can move money around and carry out financial transactions, and they're run by lots of people at the same time - so they can be checked to see that they're running correctly.

Most of the time when we explain this to people in workshops, we say smart contracts can be understood as a set of conditions and actions – if this thing happens, then do that – for example if a package arrives in a certain place, then pay the courier some

money. It's like IFTTT (If This Then That – an online automation platform) on steroids – and those are some of the ideas we've been bringing into our workshops to help people write smart contracts using tools like Scratch, which are used by kids to learn programming.

What are the challenges of adding location to blockchain?
Location's interesting because there's no completely perfect and secure and private way to manage location all at once across all the different platforms you might use. Sometimes we work with mobile phones that have their own location methods, and sometimes we work with IoT hardware – like LORA – where the network as a whole can start to identify where things are. This gets fed into the GeoPact system and it comes into the smart contracts as some of the contract conditions we mentioned earlier, and this means that we can write a smart contract that says 'if this thing is in this place, then do something'. And we can do some more interesting things like 'if these two things are together then do something' – but without necessarily having to know where the two things actually are – just knowing that they're together.

Ideally people could 'pile up' these smart contracts – this thing needs to get from here to there, and that thing needs to get from there to there, and it's then up to couriers to look at them and put this one together with that one or to subcontract bits of these tasks. The hope with smart contracts is that lots of people can write them – they don't all have to be written in a single way. They could be written by the couriers themselves rather than by a delivery agent (like Deliveroo) telling everyone how they have to do a task.

So you could have someone putting out a contract for delivery with a smart contract attached to it, and couriers deciding if they want to accept that, or the other way round and couriers can have standardised contracts and smart contracts and people select couriers based on the contracts that they offer.

There are lots of interesting things and structures that come up when you talk to people about how they do things at the moment – so law firms have very fast deliveries from one office to another, and to make that work they have secure boxes in their offices where people drop off documents and at a specified time a courier picks that up and transports it to another place where it's opened in their secure environment. So there are lots of structures that people would like to be able to write (smart) contracts for, where at the moment it's a complex negotiation.

This is really an enabling technology – so the hope is that people will be able to use these tools to come up with interesting things that we haven't thought of.

Where can GeoPact-type approaches be used?
Recently we've been working a lot with logistics and in particular with couriers, and particularly looking at ways to come up with smart hardware and systems that will change the way in which they do their work. The original impetus came from looking at active travel (moving around without using cars – bicycles, scooters, walking, running – where you are providing the energy for travel) and for ways to for people to verify that they've done active travel journeys, and then to be able to prove that to the government as a way to talk about carbon reduction targets and to enable things like participatory budgeting – so if you can prove that everyone in your building is really cycling a lot then maybe the council will fund bike racks outside your flats. Or if you commuted to work on your bike 10 times in a month you might get a free bike service. And you could write all of that in a location-aware smart contract that you participate in.

Can you tell us more about the potential for using blockchain in transportation and logistics?
One of the exciting ideas is how can all the different transport and mobility systems we use connect – so could you get a ticket that lets you pick up a scooter, go to a station, take a train, and then get an e-bike at the end to do the last mile of your journey – all one one ticket? Another one of the ideas that keeps coming up our GeoPact workshops is about using location-aware smart contracts to manage train ticket refunds. In the UK, if I get a ticket from a train company, the contract says I will arrive in this place at this time, and if I don't I'll get a portion of my money back and if I'm more than 5 hours late then I get a different refund. You can bring some of these terms and conditions into a smart contract, and then you wouldn't have to fill out a form and convince someone that this delay happened, you could have a system that handled refunds in an automatic and transparent way.

There is potential wherever you are connecting the computational world with the physical one. That's a place where we'd look to work with other systems, e.g. on blockchain interoperability, so you know about the provenance of this thing and we'll help figure out how it moves around.

Some of our work has been influenced by a courier firm that we've worked with called Zedify, and they do their deliveries by bike, and if someone wants something to go from Glasgow to Edinburgh, they'll have a courier pick it up in Glasgow, load it on the train there, and then the package goes to Edinburgh and another bike courier picks it up and takes it where it's supposed to be going. So the hope is that location-based smart contracts help make those kinds of things easy. Because you have more a chain of assurance of what's happening. You could leave a package in an autonomous hub or in a special compartment on a train with the security of the smart contract saying we know

where it is and what's happened to it. So you can create a slightly physical (location-aware) audit trail.

Do you see any barriers to adopting these technologies?
The barrier to adoption we're most interested in at the moment is 'how do we get people to write smart contracts?' It's kind of a social barrier as much as a technical one – people aren't used to thinking that they're allowed to structure the interactions they take part in. So that's what our next stream of work is going to be – about ways to demystify smart contracts and get people to design and create their own smart contracts. And that hopefully moves them on to being able to more easily make prototype systems.

We're working on a workshop that takes people through some guided thinking that uses traditional design tools of Post-its and discussion and collaboration, and gradually moves them to writing stories about how interactions should work that can be translated into smart contracts. The interesting thing then here is you can get a bunch of people around a table to talk about how a contact should work, because you have a very different discussion if you have not just the people who want to move parcels around but the couriers and the logistics managers and the people who receive them. We're looking at workshops that bring all these different stakeholders together to then collaboratively design the type of contract they would like to have happen.

You always find out with design that people don't know all the things that bother them until they happen, or you help them think about all the issues.

What are your plans to develop GeoPact – what happens next?
The other direction we're starting to look in is co-creating smart contracts, and how this would work in creative industries for example, in places where people have to do lots of shared work. Can they start to write smart contracts that help them make sure that that is done in a way they're all happy with? So were're starting to look into IP and asset management things.
We're looking to work with the Surflogh project (Sustainable URban Frieght LOGistics Hubs), as they have some of the slightly smart transport infrastructure that would be a very natural fit with GeoPact in terms of connecting to smart contracts in the background and they have some shared partners with BLING.

We're very keen to find people who'd like to go through our workshop and see if there are location-based smart contracts they would like to build. So there is a nice path from coming in with an idea to doing a workshop to develop their ideas to implementing a functional prototype.

The Token Project – Using Decentralized Ledger Technologies to create a more open, transparent, trusted and efficient government

Tom Kettels, Infrachain

Infrachain has been a partner in the 'Token' Horizon 2020 project since January 2020. The Token project aims to ease the adoption of Decentralized Ledger Technologies (DLT) to create a more open, transparent, trusted and efficient government. BLING and Token share common goals and BLING interviewed Tom Kettels, Project Lead at Infrachain, to discuss our shared challenges and possibilities.

Hi Tom, can you tell a bit about your company Infrachain?
Infrachain is a Luxembourg based non-profit organization. We are a blockchain community and we provide community-driven governance for operational blockchain use. This means that we are a network of different blockchain-interested companies and institutions from the legal, business, technical and academic sectors who aim to bridge the gap between public and private Blockchain.

Why is governance important for blockchain?
Governance is fundamental as it creates trust in the blockchain. Good governance ensures optimal participation in decision making by all relevant parties. Bad governance destroys trust by creating imbalances and opening the door to manipulation. There's a social and a technical or network dimension to governance, with the former initially preceding the latter. At the social governance level, participants agree on what type of blockchain they will use, which architecture, public or private, permissioned or non-permissioned, voting rules, the rules for adding nodes, and so on. For a consortium blockchain this also includes the need for decisions about legal structures, business models, IP management etc. Once these decisions are taken, those related to the network are then translated into code, i.e. into the 'consensus mechanism' that validates data on the blockchain. That is the network dimension. Depending on decisions taken at the social level, some rules may be hard coded into the blockchain's consensus mechanism algorithm, which means they cannot be changed at a later stage.

Getting back to what I said earlier about trust, good governance rules should, for instance, prevent a minority from taking decisions against a majority, and make sure that good decisions are being made even with limited participation.

Can you tell us a bit about the difference between 'public' and 'private' blockchains?
A public blockchain can be considered the 'purest' form of blockchain. 'Public' means that it is open to anyone to join that blockchain. Thus, it is truly decentralized. Some would even say that if it isn't public, then you shouldn't use a blockchain, as you forego its most distinctive feature and advantage - decentralisation.

By contrast, in a private blockchain there are rules that determine who can join, and who cannot. As there are some barriers – or at least conditions – to entry, there is some kind of control over the blockchain. A private blockchain may be distributed, but it is not fully decentralized.

What is your personal interest in blockchain?
Blockchain and Distributed Leger Technologies in general are interesting because there is a high degree of automation and it links different technologies such as big data, Artificial Intelligence, and the Internet of Things together. Other technologies are able to share huge amounts of data, but the parties that share the data need to trust each other. With blockchain, parties do not need to trust each other as the trust is provided through the blockchain – thanks to its immutability.

What is immutability? Why is it important?
Immutability means that once data is recorded in a blockchain it cannot be changed or tampered with, and it will stay there forever. In other words, the data on a blockchain is permanent and unalterable, but it is also traceable. This, in turn, allows us to perform very efficient (and on the fly) audits of data. And thanks to blockchain's transparency, this validation can be done by anyone with access to the blockchain. This is particularly important in situations where parties don't trust each other, or for example in places where the authority of governments cannot be fully trusted.

So, a blockchain's immutability – together with its transparency – create trust. And that is fundamental for Blockchain adoption, especially in an untrusted environment.

Blockchain can kick off new processes and keep an immutable record of what happened. For example, AI based systems use data as input and produce outputs that can trigger actions coded in a smart contract - basically a small script that executes action 'X' if situation 'Y' occurs. A blockchain is a ledger. Besides

> "Blockchain's status now is similar to the Internet in the 70s."

providing the execution environment for these smart contracts, blockchain has a notary function. It provides an immutable record of anything that is registered onto it. Blockchain is thus more than just sharing data.

What is the value of blockchain for governments?
The decentralized structure of blockchain creates an environment in which data needs to be entered only once. This reduces the risk of human errors. By decentralizing the information, all organizations linked to the blockchain can use the same input, and are not duplicating the data in their own storage silos. This improves efficiency and transparency. For example, when applying for a building permit, all municipal departments can have access to the same data and this data could also be made available to the public in case a public consultation is required, or to third parties, like the construction company you selected.

Blockchain can be of real added value to governments due to its efficiency and transparency, but there are also still some challenges to overcome. A common concern is blockchain compliance with GDPR. Since data on the blockchain is immutable, personal data that would have been registered in a blockchain cannot be changed or deleted. This is in conflict with GDPR's right to be forgotten. I am optimistic however, that one day blockchain and GDPR will be compatible as technology evolves and legislation changes. So far, we are missing jurisprudence on this issue.

Is this a blockchain issue, or a service/information design issue?
Immutability is a core feature of a blockchain, so I wouldn't call it a blockchain issue. I would prefer to say it's a regulatory issue. The General Data Protection Regulation was adopted before blockchain became widely popular and before the benefits of blockchain for making our economies more efficient were understood.

Today, the general recommendation is to not register any personal data directly on a blockchain, but rather to keep it 'off-chain'. If you really want to register personal data on a blockchain, a common technique is to only register a 'salted hash' of personal data on-chain. In other words, what is stored on the blockchain is data that has been cryptographically transformed in a way which makes it even more difficult to establish a link between what is stored on a blockchain and the original source data. At the moment, in the absence of any firm statement from the EU legislators or regulators and with no

relevant jurisprudence (legal decisions), we cannot definitively say whether these techniques are GDPR compliant.

What legal support/frameworks will we need to adopt blockchain more widely in government?
The legal aspects of blockchain are often uncertain, such as the legal recognition of data notarized in a blockchain, and such questions need to be clarified before governments can integrate blockchain in their services. Legislators could for instance recognise blockchain the legal value of data registered in a distributed ledger. In Luxembourg we saw that the legislator specifically included the use of distributed ledger technologies for making some financial transactions. This is essential for legal certainty.

Another example of legal issues we need to consider is where data is stored in a blockchain. In a public blockchain, this data can be anywhere in the world, including in countries with very different rules regarding access to data, private or not, than those we have in the EU. Thus, the natural choice for governments is often a private blockchain where they can define the rules regarding who can join the network, and on what terms.

What is the goal of the TOKEN project?
Token is a Horizon 2020 project in which 11 partners from 8 member states work together to create a transformative impact in public services with DLTs. We will set up an experimental ecosystem in the public sector in which blockchain can serve as a service for specific use cases. We will investigate four use cases: grant distributions via competitive open calls, mobility, smart city, and public procurement. Together with knowledge institutions, technical partners and local governments we are developing these use cases, but we are also building a community. Our DLT4Gov community is open to everyone interested in blockchain and together we connect and share knowledge on how DLT can impact public organizations. You can join the community via this link: https://fundingbox.com/c/dlt4gov and you can find more information on the TOKEN project via this link: https://token-project.eu/

Can you tell us a bit about these four blockchain use cases?
Sure. The first use case is about improving the process for distributing public funding. Today, this is often a lengthy and cumbersome process with lots of red-tape and little transparency. In the Token use case implemented by Fundingbox, a decentralised and self-sovereign identity (SSI)

is created for companies to make their grant application process more efficient, more transparent and more trusted. With the SSI, applicants can seek certification of their data from different authorities and the information provided to open calls can be automatically validated.

The mobility use case is being implemented in the city of Leuven in Belgium, and it seeks to promote 'last mile' deliveries and the local economy. Local farmers are granted privileged access to the city and to parking services based on their sustainable practices. This is done by combining multiple metrics such as sustainability, green mobility and real-time traffic information. Thanks to the Token platform's transparency and distributed traceability, all parties can share data on a trusted platform while making sure that each participant can control which data is shared and can only access the information that is needed for each single step of each process.

The city of Santander in Spain has become a leading 'smart city'. Smart cities collect vast amounts of data from various data sources – like IoT networks – in order to improve their services. Santander makes this data available to third parties through the SmartSantander marketplace. To better understand how this data is used, the marketplace is integrated with the Token platform, thereby benefitting from blockchain's transparency which allows full traceability.

The fourth use case is deployed in Greece in the Municipality of Katerini. The main goal is to increase transparency of public accounts though a blockchain-based platform. Thanks to the Token solution, processes will become faster and more transparent and this will not only save time and money but also increase citizen's trust and participation and allow real-time tracking of expenditures and audit trails.

What are the similarities between BLING! and TOKEN?
Both projects address the same issue: how can blockchain contribute to the services governments provide. Since BLING is already up and running, TOKEN could learn from their approaches. On the other hand, TOKEN focusses on four use cases which are highly replicable. This could possibly help BLING to further develop their current use cases. And of course, both projects have established an interesting field of stakeholders of which we can both benefit.

BLING Blockchain use-case:
Generating health certificates
in Oldenburg, Germany.

Oldenburg is a city of 170,000 in north-west Germany, and is the cultural and administrative hub of the area. It is the region's centre of education, with the Carl von Ossietzky University, the Jade University of Applied Sciences, the Private University of Applied Sciences for Business and Engineering, and more than 70 schools, vocational colleges, and technical colleges. Oldenburg was Germany's City of Science 2009. The local government is keen to build a 'digital future' for the city.

BLING and the development of local blockchain use-cases

New technologies usually present new ways to develop and deliver services that benefit the local community and government. However, we can't find out how practical these new technologies are until we try them out. As deploying those technologies at scale can sometimes have unintended consequences, piloting use-cases makes sense.

In the BLING project, partners – both academic partners and municipal partners – from six different Northern-European countries are assessing how they can improve processes in their Governments or municipalities by applying the unique properties of blockchain technology to either improve existing services or to develop innovative new services that lever the technology's unique properties. Every partner has chosen at least one use-case to design a blockchain-enabled service solution which can be tested in a local pilot study.

Supporting delivery of the 'Prostitutes Protection Act' in Oldenburg

Like other Cities in Germany, Oldenburg has to register local sex-workers as required by the 'Prostitutes Protection Act' (Prostituiertenschutzgesetz) – a German Federal Law that came into force in July 2017. Sex workers are required to register and receive a registration certificate, and are required to have to have regular health tests.

It is estimated that there are more than 400k sex-workers in Germany, but government data suggests that only approximately 40k were registered by the end of 2019. Sex workers have voiced considerable concern about the privacy implications of registering, and that their personal information will become public.

One of the problems that health organizations in Oldenburg are dealing with is of fake or invalid registration certificates. At the moment, every city provides a different form of registration certificate, which makes it difficult for other regions etc. to authenticate certificates and determine if certificates are valid or spoofed.

The municipality shared this problem with the University of Oldenburg, and asked them to design and develop a solution. They were looking for a solution where a user could verify or validate a registration certificate, and ensure the integrity and source of the registration certificate. Our initial thought was to digitize the registration certificate, and then cryptographically sign it so it could not be modified or tampered with, and then store it on a decentralized public ledger.

Why a blockchain-based solution?

The aim of the BLING project is to develop and assess blockchain solutions, and naturally we tend to use blockchain in this use-case as well – given the privacy and trust implications of data sharing in this area. However we first needed to make sure that using blockchain was an appropriate solution and would add value to our solution. In many cases we see that organisations are using blockchain when they don't need to – and this would add unnecessary complexity to our solution.

For this solution evaluation, we began by answering the question of what our solution would have looked like before distributed ledger technologies became available. In a traditional solution – before the invention of

blockchain – we would have had to design a centralized database that was manged by either the local Registration Office or the Health Organization that provided health checks for the sex-workers. Neither of these approaches were desirable, since these two organizations should not necessarily be forced to 'trust' each other – by making them share their information between the organisations.

An additional concern we had to address in the design of the system was preserving the privacy of the sex worker. We had to address questions like: 'should the City's Ordnungsamt – public order office - have access to the sex worker's health data?', and 'should the Gesundheitsamt – the Public Health Department – have access to the sex worker's identity details'? This convinced us that using blockchain technology would add value to our solution. In a blockchain network, we can ensure that the trust relationship is based on the network itself, without the need for any third parties reviewing/validating data etc. By using blockchain, we could ensure the source and the integrity of the certificate, as well as protecting the privacy of the sex-worker.

Blockchain gives us real solutions
Because this approach uses blockchain, this solution has some real strengths that make it valuable for both sex-workers and the organisations that register and support them:

- This solution ensures the accuracy, integrity, and source of the certificates, while also maintaining the sex-worker's privacy – particularly if they want to use an alias
- It provides a way to prove that the sex-worker's health certificate is up to date

- The sex-worker is the owner of the certificate – they are the only person that holds the cryptographic key which points to the certificate. They cannot change

the content of the certificates, but as the owner of the certificate they can revoke the access to it when they want to – which supports their right to be forgotten

- The sex-worker can decide what information is stored in their record, and can decide who is able to access the certificate, and what information is shared and with who it is shared with.

This system should make certificates more portable and easier to authenticate, and could be expanded to support other cities and other relevant information and certificates. But the next question we had to answer after deciding to prototype a blockchain-enabled system, was *what platform/infrastructure would we use to store the electronic certificate?*

What type of Blockchain - How we chose IOTA
Now that we had decided to pilot a blockchain-enabled solution, it was the time to think about implementation details – like *what type of blockchain technology would be appropriate?* There are a range of different blockchain technologies – such as private blockchains or public blockchains for example. Blockchain is a distributed ledger, in which the ledger itself is designed to be the source of trust (through its cryptographic design). However, blockchain is just a type of distributed technology, and not the only one. Blockchain is more popular than other distributed ledger technologies because of the popularity of bitcoin, and all the hype around bitcoin.

However, blockchain technology has always had to work within the trilemma of security, scalability and decentralization. In a Public blockchain (e.g. Ethereum, bitcoin), the amount of transactions per second are limited since the validation of transactions depends on "miners" – work done by other computers that use their computing power to validate transactions – these receive a fee in cryptocurrency for their validation work. So in a public blockchain every transaction is charged a transaction fee.

To avoid this limitation, there are private blockchains, in which transactions are validated by consensus among participating members. Transactions on these private blockchains do not incur a validation/transaction fee. However, as the name suggests, private blockchains are not open to the public, and so are not truly decentralized. Other types of distributed ledger have been developed to address these underlying questions of security, scalability and decentralization - like IOTA. IOTA is an open, feeless, data and value transfer protocol for blockchain that is designed so that every transaction in an IOTA distributed ledger will validate two other transactions in the ledger when it is recorded. This allows IOTA to overcome the cost and scalability constraints of public blockchains This means the ledger does not need miners or pay transactions fees. The unique design of the IOTA network means that as the number of transactions increases the speed and the capacity for transactions also increases.

For the Oldenburg use-case, the blockchain solution should be publicly accessible, so the registration certificates are accessible by different organisations and users . As sex-workers are move from place to place, the solution should be expandable as well so that other registrars and health workers outside of Oldenburg can use it.

Scalability, no transaction fees, and security makes IOTA a very attractive solution for our use-case. By using IOTA, we can have the advantages of both public and private blockchain. We can have a public secure decentralized ledger, in which there is no cost for writing new records on the ledger.

How IOTA controls access to private information
In our pilot, every party in the system (sex worker, Health Office, or Registration Office) would create their own restricted channel in our IOTA network - this is similar to a publisher/ subscriber model. The Registration Office R1 issues an anonymous certificate for sex-worker S1 (based on S1's unique ID) and puts it on R1's own channel. S1 has his/her own channel as well - in this channel when they claim

the registration certificate created by R1, the system creates a pointer to the relevant certificate in the authorities' channel. In this design, since the certificate is hosted by the Registration Office, S1 can remove access/link to that certificate at any time they wish, and the Registration Office – as the certificate issuer, also has the right to revoke the certificate – e.g. when it has expired.

Certificate viewers have to install a smartphone app, and to register an ID on IOTA network – this ID will be anonymous. (A username and password are required to login to the app). Once they have an anonymous ID, they can scan a QR code generated by the sex-worker's app and will receive one-time access to the certificates the sex-worker wants to share with the user – the worker will decide what certificates they share.

Pilot delivery and additional use-cases
We are currently in the development phase of the pilot and will deliver the initial prototype in March 2021. We expect to test the pilot with 5-10 sex workers, along with officials issuing registration and health certificates for a two to three-month period. As it's not compulsory to use the pilot system, we'll need to be able to convince users of the benefits of using the system we've developed so they'll help by testing it.

The broad approach we have taken is transferrable to other situations/use-cases where a user needs to verify that they have received a certificate from another source – e.g. the approach we have designed can also be applied to situations where a user needs to provide evidence that they have had a recent Covid test, for example, or that the user does not have any convictions or criminal records. Changing the focus to add these additional capabilities will require the development of relationships with additional organisations to ensure we meet their needs and requirements. Discussions about expanding our pilot to additional geographical areas and of potential additional uses for our approach to registration/certificate verification are ongoing and will be developed once the pilot is live.

Introducing the European Blockchain Partnership

Daniël du Seuil, European Blockchain Partnership

Daniël du Seuil is involved with a number of European blockchain initiatives. He is an active member of the EU Blockchain Partnership (EBP), and is convenor of the 'European Self Sovereign Identity Framework' for the European Blockchain Services Infrastructure (EBSI). In this interview he shares some insights on the projects he is working on, on EBSI, his thoughts on the future of blockchain, and on the role government should play in supporting innovation.

Tell us about the blockchain projects that you're working on

I'm involved in the *European Blockchain Partnership (EBP)*, an initiative of the European Union. I also participate in the *EU Blockchain Observatory and Forum*, the European expert forum that does research on the trends and developments that are happening around blockchain.

I used to be the Blockchain program manager for the Flemish Government, and now I've moved from the national level to the European level. Which is good, as I think we need to work on a lot of these challenges at the European level. And I work with a lot of different organisations – for example I'm working with Antwerp on some of their blockchain challenges, such as '*Blockchain on the Move*' (a blockchain pilot to give Flemish citizens more control over their identity data).

The European Blockchain Partnership is working on a European technical infrastructure. Can you tell us a little bit more about that?

The European Blockchain Partnership is an initiative of the European Commission and the different partners/member states to bring several blockchain initiatives together. For example, we see that many interesting use cases get stuck on technical issues. And because there is no centralised technical infrastructure for Blockchain, it is hard to bring certain use cases into production. So we thought it is was important to build a European blockchain infrastructure that can used by all member states. This is called the *European Blockchain Services Infrastructure*.

What does this European blockchain infrastructure look like?

The European Blockchain Services Infrastructure (EBSI) aims to enable cross-border public services using blockchain technology. EBSI will deploy a network of distributed blockchain nodes across Europe, initially supporting applications focused on four broad use-cases – Notarisation, Diplomas, Self-Sovereign Identity, and Trusted Data Sharing. EBSI is now working on additional use cases on a European Social identification Number, SME Financing, and Asylum Process management.

How can blockchain enable interoperability?

Building a common infrastructure will significantly help with the interoperability side of the technology: if we have one infrastructure for Europe than it will be easier to solve cross-border use cases. Ideally, of course, you'd have a global standard for each use case because a lot of use cases actually have a global scale – they're helping address shared international problems or issues.

This is quite complicated because it takes a lot of time to investigate, a lot of deliberation between countries and so on. But we think it is the way forward. So we are working on a pan-European blockchain infrastructure. Of course, this should not discourage national initiatives - quite the contrary! We really want to help the use cases that need a (cross-border) technical infrastructure so we can facilitate the development and delivery of cross-border use cases.

Blockchain and governance

Because blockchain is a new technology that works in a decentralised way, you quickly get to the difficult question of governance. Who takes the lead in designing or specifying systems or standards? For example, when you realise that for some use cases you need to look at a European or even global scale, it can be a bit intimidating for a municipality or even a national organisation to take the lead on a solution that's going to be used at European or global level. Is appropriate for a city like Antwerp to take the lead on

developing a reference standard for a regional or international use case, for example?

So there is the risk that organisations will start to wait on each other. To prevent this from happening, the European Union is investing quite a lot so that we can take the lead and take the initiative in supporting these use cases. Organisations such as the *European Blockchain Observatory and Forum* and the *International Association for Trusted Blockchain Applications* (INATBA.org) are examples of this.

In a sense, blockchain is very intuitive for Europe, because Europe is already quite decentralised. Especially compared to China, for example. Decentralisation is in our DNA. Of course, that has its own challenges. For a local government or city some use cases are too big or too complex to solve – but they can be an important partner in a larger ecosystem and sometimes a catalyst for the development and adoption of regional use cases.

What are the use cases that the EBP are looking into right now?

There are several. Verification of diplomas and academic qualifications is an important use case, since a lot of fraud is being committed in this area. We saw that organisations in many different places were already building their own custom solutions. That kind of innovation is very good, but everyone involved also quickly realised that having many different solutions is not going to help in this case. So a European – or even worldwide – infrastructure would be very helpful.

Other use cases the EBP are working on involve self-sovereign identity and the authorisation of documents and bills using the European self-sovereign identity framework (ESSIF). Self-Sovereign Identity (SSI) allows individuals to control their own digital identity, without having to use third party "identity providers" – blockchain has a key role in enabling the adoption of SSI. The technical infrastructure that we are building should really help to take these kinds of use cases into production.

"innovation is a marathon."

What is your personal interest in blockchain?

Well, in the beginning I was fascinated by blockchain because of the bitcoin and the crypto side of things. I was very interested in the question of how you can organize money in a decentralised way. I was already working on innovation in government, and I figured that the decentralised way that blockchain is organised might be interesting as well for other processes and services, and I started to wonder how we could connect these things.

Many problems in government are caused in part because government is organised in a very centralised way. I got an opportunity to work on these kinds of questions at the Flemish government. My focus now is mostly on self-sovereign identity, as I think that is one of the most interesting and relevant use cases. A lot is going on in that field. And I quickly saw that this goes further than just the national level, this really is an international issue.

What kind of opportunities do you see for blockchain in government?

Well, transparency would be one. And tokenization (a process of representing an asset or securities ownership as a digital 'token' stored on a blockchain which can be transferred or sold).

Used together transparency and tokenisation have a lot of potential to be used in systems to show how the government is managing/delivering certain things – like processes and services. You can make things easier to oversee and be more transparent. For example, you might tokenize a subsidy. That would make it easier to give insights into how much subsidy the government has given to certain parties. But you could also tokenize infrastructure in roads, for example. So many different departments and governments work on infrastructure that nobody knows where what is anymore. If you would treat it as an asset or token, it would help you to create more overview of what is happening and who is doing what. This has enormous potential. However implementation of new approaches like this will require an enormous amount of coordination across organisations. So often the classical solutions are chosen, because they are faster.

For government public services, it is important that you are able to fix errors. Part of the promise of blockchain is that you have a ledger that cannot be altered. How can blockchain-enabled services solve this dilemma?

Well, you can implement blockchain in a very strict way and say it's not possible to fix something. I think that is too dogmatic. Of course, you cannot overwrite a transaction once it has been written (saved) to the blockchain, so you cannot delete or hide an error. But it is possible to update the blockchain, so then then you change a value and make it correct. The older transaction is still there, so you do have an audit trail. You're going to need some form of revocation.

You can implement a blockchain system in a very decentralised way, which gives you less ability to fix mistakes. But you can also add a little bit more control. That's a question of implementation and configuration - and most importantly of governance – even in a decentralized system.

Can you tell us a little bit about 'Blockchain on the move'?

Yes. This was a project that started about two years ago in Antwerp. It originated with a classic use case: people move house, and how do they then share this updated information across the city and all of its services. We thought we could use blockchain to develop a better and easier solution. Now there are a lot of departments that all have citizen data - it would make more organisational sense if that data was shared once across departments.

And it should be easier for users and citizens to see who is holding what data. While we were exploring how to make this process easier, we came across the concept of self-sovereign identity – which seemed to be a key part of the solution that could allow citizens to manage their own data. So we asked the market to help us build the building blocks for this, since not much existed at the time. We wanted to explore what self-sovereign identity-based solutions could bring us.

After we had developed the initial technical approach, we quickly realised that the biggest challenge was not the tech, but the organisation and how it managed data, and how the various systems and departments worked together. In practice, the way this sort of data is handled is really quite complex. So we took a critical look at the available public sector / government blockchain use cases, and also tried to see which ones were also private sector use cases – with the aim of bringing all of this together. Because we also realised that citizens don't want to have all sorts of different digital wallets and identity systems. So we need to look at tackling this from a national and European level. But that also complicates things, of course.

Do you have any final thoughts you would like to share?

Oof! Well, my final thought is that you should remember that innovation is a marathon – it is about the long term. Usually, there are not a lot of quick wins, if any. You need a lot of partners, a lot of coalition building. But it is very important that the government takes on this role and supports innovation. It may sound a bit contradictory, to have government help to create a decentralised network. But we see that in countries where governments don't take on this role it is a lot harder to get momentum and to deliver services and use-cases. So you really need it, you need innovative government that leads, helps and facilitates, and will work to help pave the way for your use-cases and solutions.

BLING Blockchain use-case:
Healthy on the blockchain (HoB) –
How using blockchain enables citizens to stay in control of their health and their health data

HoB application on the smartphone and wearable to track heart rate and steps (pexels.com)

Look and feel for the pilot's communications plan for the City of Roeselare (Shutterstock)

Healthy on the Blockchain' (HoB) is a partnership between the City of Roeselare and the Howest University of Applied Science and Arts. Healthy on the Blockchain (HoB) offers a preventive health program to organizations, with a user-friendly on-boarding process and a secure connection between trainer and trainee. Roeselare will be the first pilot organisation to test HoB.

Why a workplace health pilot?

The labour market is at a turning point. Workloads and stress levels are increasing, and it's not surprising that more and more organisations are taking action to try and improve their employees' physical and mental health. More than a third of Flemish workers struggle with stress or mental fatigue, and fewer and fewer employees think they'll be able to stay in their job until retirement.

There is an obvious need for employers to take this seriously and develop physical and mental health policies. A 2015 survey by the Flemish Institute of Healthy Living showed that employers generally performed poorly in this area, with smaller companies particularly underperforming. In fact, companies seemed to be doing even less to support exercise than they did in 2012, and important lifestyle issues such as a healthy diets, sufficient exercise, or limiting sedentary behaviour were rarely prioritised. It seems that companies only invest in services when they are forced to by workplace legislation. Extensive research shows though that unhealthy employee lifestyles result in higher levels of absenteeism, lower productivity, lower employability, and less employee involvement.
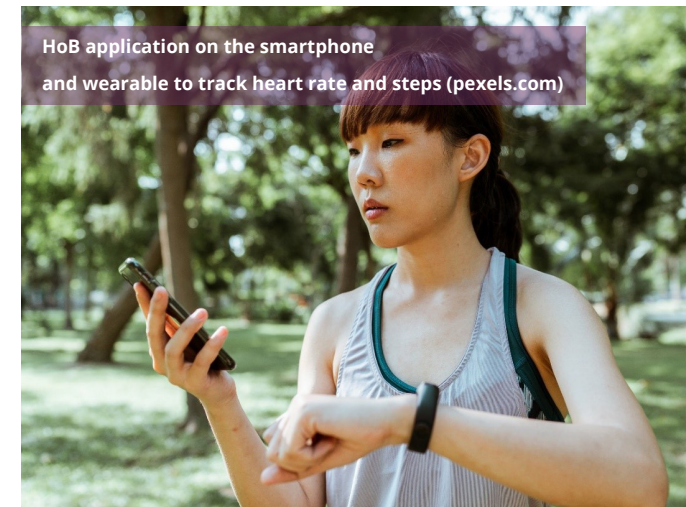
In Roeselare in 2017 the level of absence due to illness was 6.55%. In response the City has drawn up a health policy and started the Fit4Work Programme, which has been appreciated by employees. Roeselare's participation in the BLING project and the 'Healthy on the Blockchain' pilot will give the city's Fit4Work project an extra boost.

Introducing Fit4Work

Roeselare has a dynamic local government – but in order to deliver this, it's not only important to have the right people and skills, but the right environment as well. If people have a good work-life balance (i.e. they feel happy and healthy), then absence through illness goes down and workplace stability goes up. In order to support their staff the city of Roeselare set up the Fit4Workprogram. This focuses on delivering a good work-life balance, flexible and appropriate workplace procedures, and the Fit4Work project.

Fit4Work is a program to help employees become more active. Each semester, a calendar is populated with different types of activities: active sports (tennis, start to run), sports to get into balance (yoga), and some activities supporting healthy eating. Everyone who works in the local government of Roeselare can register for these activities.

Roeselare will add 20 new users (city employees) onto the HoB platform. The employee will be sent an email with practical information about the program, about the HoB application, and about the wearable device the program uses. The employee will install an application on their smartphone, and receives the wearable device. The employee creates a user profile with information like their name, weight, and height; and also maps their current fitness level by answering some questions that analyse their fitness at work, their lifestyle, and their stress levels. Based on this information, a training program will be generated and linked to the various activity profiles according to the employee's fitness level. The employee can then get started with the wearable and the training program, managing them via the application on their smartphone.

The programme's activities include walking, running, at home fitness exercises, and relaxation. The wearable tracks the users' steps and heart rate. The activity data goes to a coach, Ken, who can follow up and support the pilot users via a dashboard. The coach is supported by a virtual trainer, as feedback is automatically generated by the system. This feedback includes encouraging people to take more steps, rewarding them with badges for achieving particular goals, and inviting them to do meditation and relaxation exercises.

The trainer's dashboard

Activities in fit4work
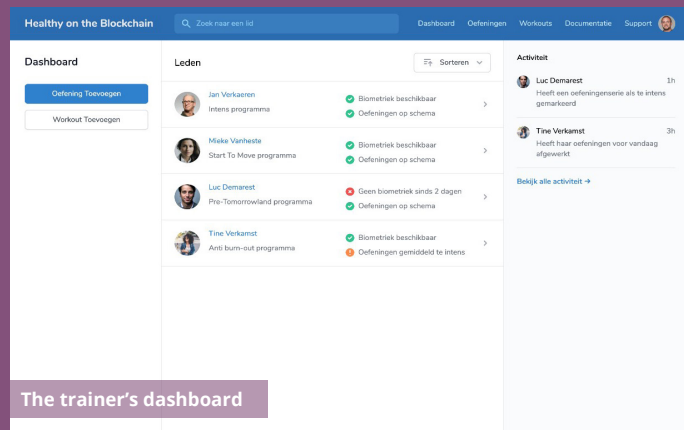
Why use blockchain? Blockchain brings data security and ownership to sensitive data

Preventive health care is important, and it will become even more important over the next few years. As employees will have to work longer, it is in every organization's best interests to improve the well-being of their employees. Offering personal coaching to guide health (covering both fitness and healthy lifestyles) is only economically feasible when the coaching can take place remotely and via digital means. Wearables are a hip and handy tool to help a coach to deliver a personalised service. But because these wearables also collect personal information about the "user", they are an interesting target for cyber criminals or for organizations that sell customer data. Wearables that use a central database pose a security risk for organisations and/or third parties with centralised storage solutions.

The solution to this is to of set up an inherently secure private blockchain within an organization, where each pilot user has a wearable whose data is added to the blockchain in a form that can be analysed, and which can be used for personalised feedback. The remote e-health coach has access to the client's data and can provide the user with digital guidance and feedback. The solution is designed so that the client does not have to worry that their activity data will end up in the hands of the HR department or in an external database. This gives employees peace of mind that they will not be monitored or managed on the basis of their exercise data.

This is one of the pillars of this pilot: trust in blockchain, trust in their own data, and trust in their own privacy. By using blockchain, the data between the client and the coach remains in a self-contained loop in which the client owns their data but the coach is able to provide one-on-one communication

and feedback based on the data. The system will also generate notifications and activity suggestions – if for example the user reports feeling down for 3 days in a row, the user will get a notification suggesting they go for a walk outside. Being able to do this digitally is more relevant than ever, as it meets users' expectations for how services should work.

Who will benefit from this pilot?

#1 Knowledge institutions doing blockchain research and implementation

Howest will expand their knowledge and experience developing blockchain-enabled solutions for health applications. Their work began with comparisons of different wearable devices, moving on to creating a blockchain for data from clients and coaches, translating raw data into aggregated data for analysis, and ultimately leading to client feedback via a coach/client platform. The project has produced a proof of concept for a business model that delivers preventive health care within organizations, offering a coherent and structured approach that stimulates a healthy lifestyle for employees. They will also produce an e-coaching manual for the business' coaches.

#2 Employers – linking wellbeing & innovation

The City of Roeselare has two objectives for this pilot. By connecting sport with digital tools they can introduce new technologies like Blockchain into their organization in a fun way. Secondly, this provides an extra boost to Roeselare's ongoing work to help the staff with their physical and mental wellbeing. Without using these digital tools, the City would not be able to afford to provide personal coaching - even to test as part of a pilot.
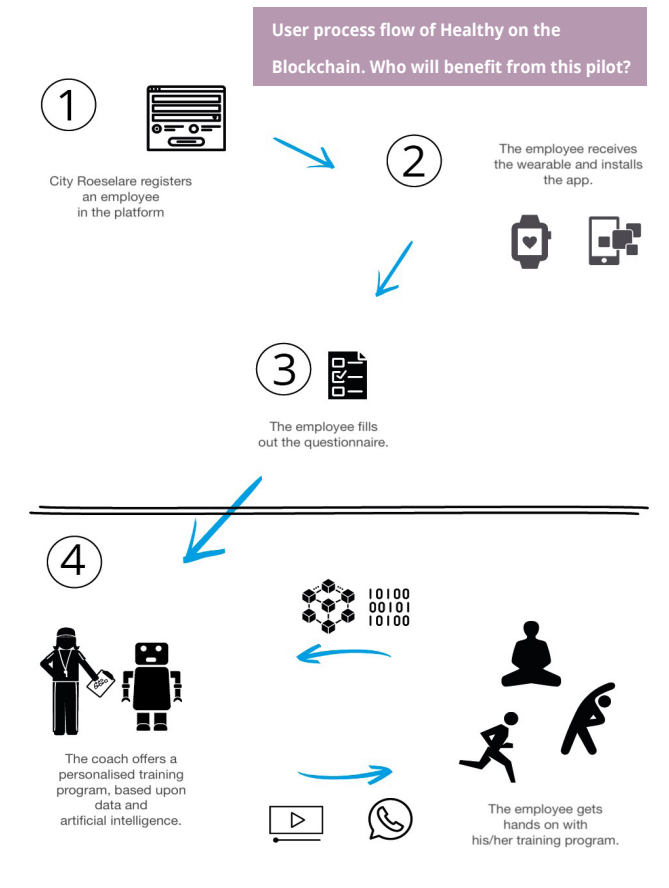
#3 Employees

Participating employees will be supported in their efforts to adopt healthy and happy lifestyles, while remaining in control of their own health and fitness data. The test group of Roeselare employees will receive personalised guidance from their personal coach via remote feedback after analysis of aggregated data. Employees will handle their own health data, and be able to track their own progress, while being supported and motivated by their coach.

Communicating and learning from the pilot

The pilot's test period will begin in March 2021. User tests with the pilot group and with the coaches will teach us a lot about the UX, about using blockchain in practice, about what makes a successful health application, about wearable devices, and about how we can best manage and develop the connections between all of the components parts of the system.
Roeselare is now setting up a communication program to promote this innovation project as part of their 'Fit4Work' programme. The fact that this initiative is linked to an existing and well-known programme makes communication and awareness raising easier as they introduce new technologies to the Fit4Work program.

Preliminary work has shown that it's not that easy to explain the use of blockchain to the target audience with brochures and flyers. As a result Roeselare has decided not to explicitly mention that they are using blockchain in the publicity materials for the 'recruiting phase' of the pilot. They will host information sessions for potential users which will explain the underlying technology, and which will give users an opportunity to ask questions.

Because of the COVID-19 outbreak, Roeselare will highlight the 'Corona proof' nature of this service. While the regular Fit4Work activities have had to be put on hold as they are unable to provide group sports activities for adults and teenagers, this new HoB platform is a welcome alternative which offers support and a more tailor-made approach than the previous Fit4Work@home approach.

User process flow of Healthy on the Blockchain. Who will benefit from this pilot?

1 — City Roeselare registers an employee in the platform
2 — The employee receives the wearable and installs the app.
3 — The employee fills out the questionnaire.
4 — The coach offers a personalised training program, based upon data and artificial intelligence.
The employee gets hands on with his/her training program.

A wearable has been tailor made by IMEC to avoid third party dependency

Diplomas and Credentials – Building a European Blockchain Use-Case

Hennie Bulstra, European Blockchain Partnership

Hennie Bulstra is a blockchain realist. He is the convenor of the Diplomas and Credentials User group of the European Blockchain Partnership, is a member of the Blockchain Expert Policy Advisory Board (BEPAB) of the OECD, and is a business consultant and policy advisor for DUO, the Executive Agency of the Ministry of Education, Culture and Science in the Netherlands.

Hennie, what's your view on blockchain?
Blockchain is a new technology that we can use to develop great innovative solutions for problems we have. But blockchain requires a new way of thinking, and a new way of designing governance and the relationships between the players and participants in the field.

There are two ways to do innovation. Firstly, you can innovate on top of an existing way of thinking – such as *digitizing* paperwork and paper-based processes. But when it comes to blockchain and AI, you have to adopt a new way of designing and innovating and you have to think outside the box.

This is where *digitalization* takes place. Self sovereign identity, blockchain and other technologies are key to a new digital society. This is different from a digitized society – it's a new way of thinking. Albert Einstein said "We cannot solve our problems with the same thinking we used when creating them" and this is how I think about blockchain. It is definitely not a goal in itself and it will not solve poverty, but it can be an enabler to make life easier. We are looking at complex challenges which cannot be solved by a single organization - you need to work together. You have to create an ecosystem in which all partners are involved.

You are convenor of the 'Diplomas and Credentials' user group of the European Blockchain Partnership. What's a convenor?
A convenor is a sort of liaison between the member states of the European Union, and the European Commission's Directorate General for Communications Networks, Content and Technology. This DG is responsible for building the infrastructure to boost the digital single market, to enable more growth and jobs in an environment where citizens, businesses, and public administrations can seamlessly and fairly access and provide digital goods, content and services. I connect member states and the DG on blockchain related topics – like the Diplomas and Credentials use case.

What sort of pilots are the 'Diplomas and Credentials' user group working on?
Europe has policy goals to enable student mobility and employment between companies. This means that students and workers should be able to easily move across borders and have 'freedom of movement'. This sounds like a great goal, but how do you achieve this? One of the enablers of this free movement is blockchain – as we can use blockchain solutions

to allow students to 'take' their qualifications with them – electronically. The real key advantage of blockchain is that it can enhance and enable mobility in a much broader sense, in a cheaper way than current systems, more secure, and with less administrative burden on the students and the institutions they attended.

For example, the Dutch government holds a diploma register and we have some 6 or 7 million records in it. It is kept by the Dutch government, so it is authentic (i.e. we know the information in it is true) and we can trust it. When a Dutch student wants to continue studying in Germany, the register should be able to provide proof to the Germany educational institute that the student's Dutch qualification is real. However, Germany is organized in a different way, with State and Federal governments and different administrative agencies.

This creates a large administrative burden when evidence of qualifications – like certificates – needs to be sent (and sometimes even physical copies of certificates are required) to the foreign university and they then need to check and accept that these documents are real. This costs extra time and money and extra administrative overhead for both students AND Higher Education institutions.

Another example, imagine a refugee from Syria has graduated from University in Syria and would like to continue studying at another European educational institute or apply for a job. How can they prove that they have a real high-school diploma if the school they attended in Syria does not exist anymore? Besides, the opportunities for fraud and mis-representation are increasing because institutions are sending copies of authentic documents. The use of blockchain technology in a dedicated qualification e-service can resolve these issues by building a service around citizens and allowing them to manage who has access to their academic credentials - this creates a new way of sharing and authenticating information across borders, next to existing ones.

How does this work on a European level?
A good system that is built on blockchain infrastructure makes it possible to build a system to share authenticated diplomas and certificates. This enables student mobility and mobility across sectors and regions. Enter the European Blockchain Service Infrastructure (EBSI) – a network of distributed nodes across Europe that will enable the development and deliver of cross-border public services. EBSI is a program supported by all the EU member states in which they agree to work together to

build a blockchain infrastructure based on initially four use cases: notarization, diplomas, self-sovereign identity and trusted data sharing. Together we are building a standard approach to diploma authentication based on blockchain that works in all the signatory states – we have been working on this for 1.5 years and the first version is planned to go live in the first quarter of 2021. Then the member states can pilot some of the important business elements and we will further develop this idea. It will be up to member states to do further trials on the platform and to roll out this as a service to their citizens. The private sector will also be able to build services on top of the EBSI.

What are the challenges of building a blockchain-enabled service?

Of course there are challenges. Not all educational credentials are digital, and in some countries diplomas and qualifications are still paper based. So we initially need to develop a digitized way of working. Secondly, it is very difficult to reach a standard system that works across all Member States, as some member states and some institutions are less digital than others and each Member State controls how their educational systems is organised.

This project can help them to take a big step forward, but it will also take time to get everyone at the same level. In addition, there are the legal issues such as the GDPR and the right to be forgotten which need to be considered as part of the design of these services. And there is the issue of governance. How will this influence the role of executive organizations such as DUO or accreditation bodies in the Netherlands? The wider ecosystem in which they work will shift, and we will need a new level playing field between governance, market, regulators and citizens.

What are you doing with blockchain at DUO?

Dienst Uitvoering Onderwijs (DUO) is an Executive Agency for the Dutch Ministry of Education, Culture and Science and is the holder of the diploma register in the Netherlands – this has more than 6 million records! DUO is exploring new technologies and we are curious what role these technologies can play for our organization. We have set up an innovation lab at DUO where we are experimenting with blockchain and digital identity to see what opportunities this new technology can potentially bring to us.

Blockchain is all about recreating trust. And the first set of questions we encountered when thinking about how to deploy blockchain-enabled solutions is how the governance should be organized and how to exchange value (in terms of skills, credentials) between an issuer, the recipient and the supplier.

Making a 'Career Wallet' real

You can now think about things in a different way. Education and employment have been organized in silos in member states and within member states. We will not recreate this – we'll put the citizen at the center of this. The citizen can say "This is my wallet and I have qualifications and skills and credentials from my career, and I can now share these on my terms with the people and organizations I want to". This is huge – citizens can define themselves and describe themselves in terms that are based on what they think they're worth and what their value is. These tools will provide an efficient, effective and authentic way for citizens to show what their value is.

So you can take this further: a 'Career Wallet' can also contain skills and experiences, which makes it really valuable to the citizen. This 'Career Wallet' is an application where users can manage information around their employment and qualifications. The wallet will be able to hold your diplomas and other credentials, and you'll be able to share this information with employers and educational institutes using a process called 'self-sovereign identity'. The Wallet will give a standard way that users can share their information in a reliable way .

This innovation was developed by a Dutch consortium who are now working on the prototype – Rabobank for example took the initiative and is leading this consortium, which includes the Dutch Blockchain Coalition.

At DUO our mission is to make education and development possible. That's the reason why we modestly contributed to the development of a prototype of a wallet with dummy test data from DUO. The opportunity is bringing this idea together with what already has/will be brought by EBSI.

The EU and EBSI will bring a framework to the market with clear standards and requirements, and it is up to the market to actually build services and user interfaces that individuals will use to create and manage a wallet. The European digital credentials infrastructure will provide a standard way to describe to the content of your CV – the format and templates and so on. It is up to the private sector to build services that leverage the wallet idea, and a lot of companies are developing business models that use these wallets.

Blockchain

PILOT

BLING Blockchain use-case:
Using Blockchain in the
'Smart Procurement Tool' –
City of Antwerp/Digipolis Antwerp

PUBLICATION OF CHALLENGE	RESPONSE TO CHALLENGE	REQUEST FOR QUOTATION	OFFER
Procurer **publishes challenge** that it needs addressing	Vendors **enroll and submit** response	From **selected vendors**	Vendor **submits** its offer
	2 page written response and pitch in person	Via federal eProcurement portal	Via federal eProcurement portal
		e-tendering	e-submission e-awarding

**Buy from Start-ups procurement procedure**

Digipolis is responsible for IT systems and services for the Belgian City of Antwerp. Digipolis' 2015 'Buy from Start-ups' project aimed to stimulate the procurement of innovative IT solutions and services from smaller, creative entrepreneurs. The project aimed to combine supporting innovation with the development of a 'lean and mean' procurement process. Although the project has been successful, it was hampered by the program's reliance on the Belgian Federal eProcurement portal as the place where requests for quotations and supplier offers had to be submitted.

With the Smart Procurement Tool project, Digipolis wanted the e-submission and e-awarding part of the innovative procurement process – the part that is currently managed in the eProcurement portal – to be replaced by an innovative, more user-friendly, more intuitive, and future-oriented application that better matched the needs and nature of our target group of suppliers and which provided a one-stop solution for applicants.

Digipolis developed a blockchain-based application which combined the publication of requests for proposals and the submissions of tenders from vendors. The publication and submission of offers is done via a dedicated user interface (https://antwerpen.digipolis.be/nl), which connects to the Smart Procurement Tool. The metadata of the submissions – including timestamps – are uploaded to our private blockchain, providing assurance that they have not been tampered with.

Simplifying eProcurement
In order to encourage the participation of smaller companies in tenders, Digipolis' "Buy from Start-ups" programme aimed to provide a 'lean and mean' and straightforward procurement procedure for smaller-scale and start-up companies. This program covers contracts worth less than €144,000 (contracts not requiring publication in the OJEU).
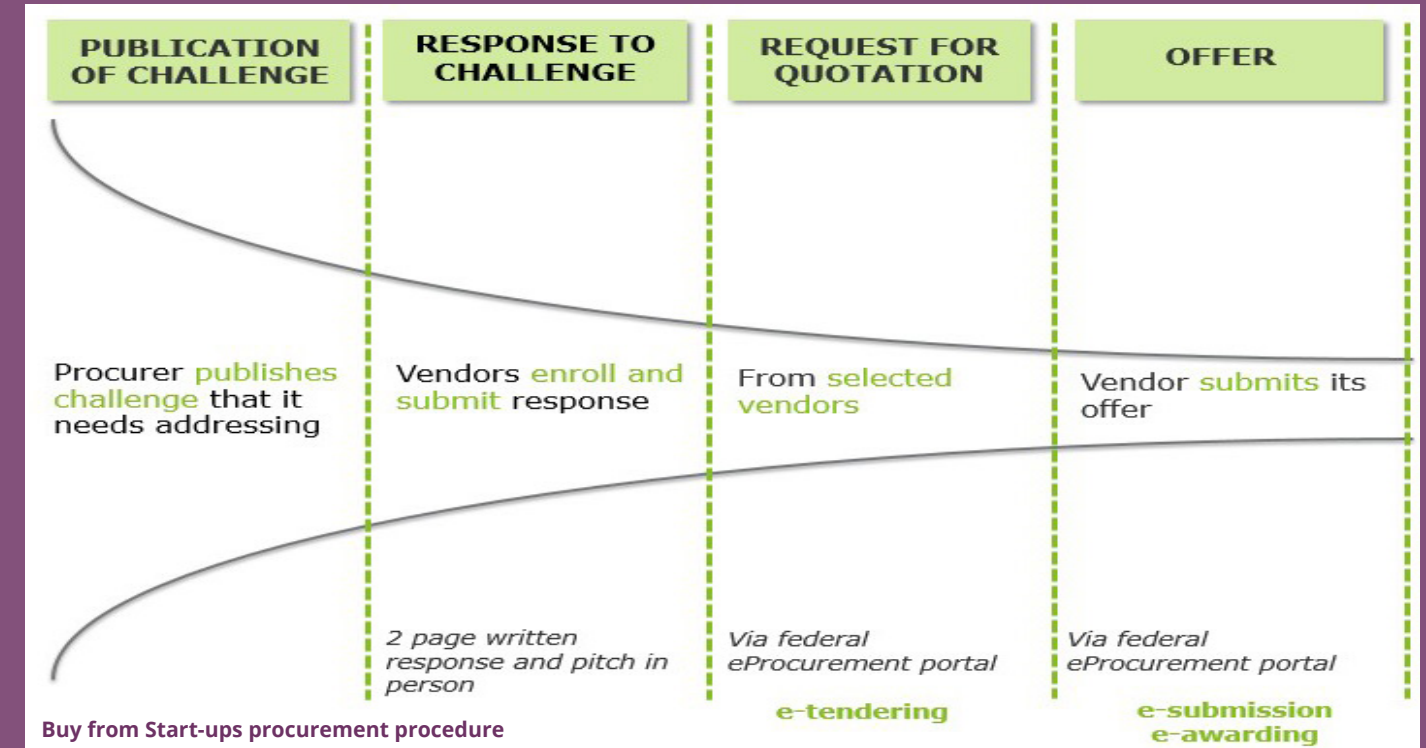
We have a four-stage procurement process:

- **Publication of challenge** – The procurer publishes a "challenge" that it wants addressed, rather than a list of detailed specifications, and requests potential solutions from vendors

- **Response to challenge** – Interested vendors enroll on antwerpen.digipolis.be. They submit a concise proposal outlining how they would approach the challenge, and pitch their approach in a 30-minute face-to-face meeting

- **Selection and request for quotation** – The procurer selects a limited number of vendors and requests a quotation from them

- **Offer submission** – The vendor submits their complete offer

While the first stage of this process is conducted on the Digipolis Antwerp website (https://antwerpen.digipolis. be/nl), with the vendor enrolling and submitting their initial response to the challenge on this website, the later stages are not. The publication of the request for quotation and the offers from the vendor were both done via the federal government eProcurement portal.

Switching between two platforms in one eProcurement tool is not very user-friendly for the applicants, and was putting-off the small companies that the 'Buy from Startups' program wanted to attract.

Digipolis wanted to create its own eProcurement portal that would publish requests for quotations and receive submissions from companies applying under the Buy from Startups procurement procedure. We had three objectives for this portal:

- Provide a **user-friendly experience**: with a simple and intuitive workflow

- Be **fraud-proof**, providing a secure and transparent method for the submission of offers

- Be compatible with the **ACPaaS principles** (i.e. using modular, reusable components)

Our blockchain-enabled service
To meet these objectives, Digipolis has **developed a blockchain-based smart procurement tool** which enables procurers to publish a request for quotations and vendors to submit their offers.

The smart component tool consists of:

- A user interface – which the procurer uses to publish the request for quotations and the vendor uses to submit their proposals. User authentication is enabled via our CRM solution

- Customer Relationship Management (CRM) solution – enabling user authentication (for potential suppliers)

- Blockchain component – the posted requests and the offers we receive are added to the blockchain, providing guarantees that the documents have not been tampered with

The revised process has eight steps that move from the publication of requests for quotations, through the submission of vendor offers, to the contract award:

1. The procurer publishes a request for quotation via the user interface

2. A smart contract with this request is uploaded on the blockchain

3. Vendors submit their offers via the user interface

4. The offers are uploaded to the blockchain

5. The procurer closes the process

6. The procurer assesses the offers and awards a contract

7. A trigger is sent to the smart contract which generates an event recording the result

8. The procurer enters the result of the award in the Digipolis CRM system, which automatically sends award and non-award letters to the respective vendors by email.

Components of the smart procurement tool
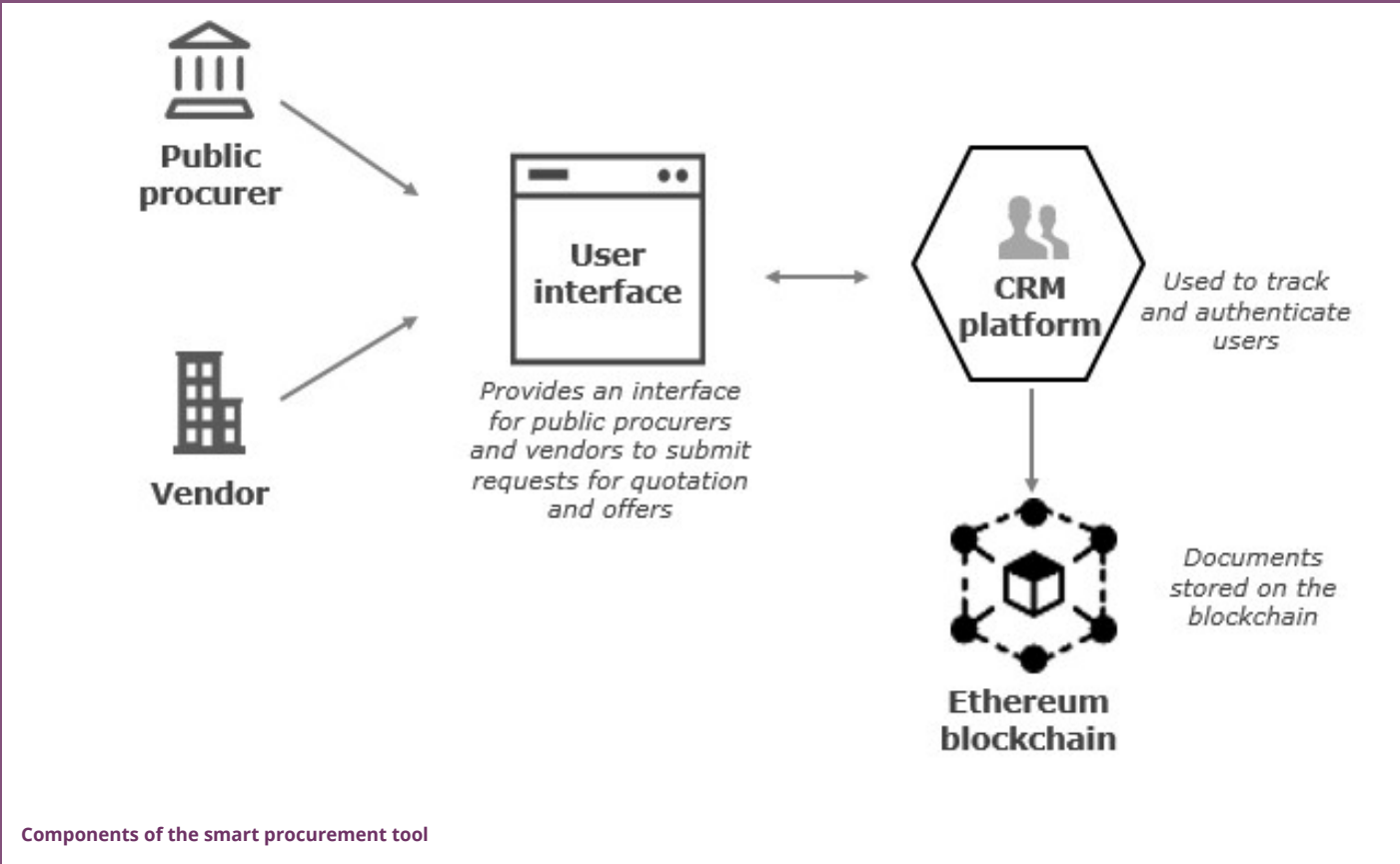
The smart procurement tool has been designed with a combination of both blockchain-based and non-blockchain-based components. This was done to ensure compliance with public procurement rules. Vendors do not directly write their offers onto the blockchain, but instead submit their offers to a Digipolis file server. Only metadata, including – a time stamp – is added to the blockchain. Vendors do not have direct access to the blockchain, which ensures that they cannot see any details of any other submissions from other vendors (including how many submissions have been received). In accordance with public procurement law, the final outcome of the procurement (the contract award) is communicated to all participating vendors once the review procedure is completed.

The use of blockchain as one of the technological components of the solution adds a significant level of reliability and transparency to the process. The documents submitted by both the procurer and the vendor are added to the blockchain, together with their time stamps, providing system-level assurance that they have not been – and cannot be – tampered with.

Blockchain configuration
Ethereum is the blockchain technology we used, and we created a private, permissioned blockchain – this means that only a limited number of users are able to write or read the data on the blockchain. This configuration choice makes it possible to switch to a public Ethereum blockchain in the future, if that is required or stakeholders feel it is desirable. The blockchain operates using a proof of authority to validate the data once it is added. At this point there are only two nodes to the blockchain hosted by Digipolis, and one node hosted by BOSA (the Belgian Federal Government Procurement Organization). Talks with the Port of Antwerp to add a node are currently being finalized. A blockchain with more nodes expands the value proposition of blockchain technology: there is increased

trust, as nodes are no longer hosted by a single partner; there is increased transparency; increased vigilance; and there is increased security and increased availability (as we have eliminated the risk of a single-point-of-failure).

Managing risks when adopting new technologies
Digipolis felt that the overall risks for the project were quite limited, and the team was confident that it could drive it to a successful conclusion. That said, there were some risks associated with the use of a new technology that the in-house team did not have experience with.

While the team were aware of the potential of the revised Smart Procurement Tool to improve their procurement process, when an emerging technology is being adopted by an operational system there is always some fear, doubt or reluctance. Will it be stable as expected? Will it be as safe/secure as promised? Will it be flexible? Luckily it became clear very quickly that the new system was solid enough to support our procurement process. These risks were also reduced by the relatively small, exploratory nature of the project. The team had a fallback solution – reverting to the federal eProcurement portal (the solution they were previously using) – if the Smart Procurement Tool project did not turn out to be a success.

Since launch Digipolis have used the system for 52 calls for proposals, receiving 130 submissions, and 34 contracts have been awarded. Overall, the project was relatively technically straightforward, and one that could be easily implemented by many other public authorities around Europe. A key lesson of the pilot project for us was that public authorities should not be put off by the unfamiliarity of emerging technologies such as blockchain – in some cases these technologies can actually be implemented quite easily. An important success factor when adopting these technologies is that user input must be gathered to ensure that the tool is properly tailored to their needs.

How the Triple Helix supports Blockchain in Government

Peter Verkoulen, Dutch Blockchain Coalition

Peter Verkoulen has been the coalition manager of the Dutch Blockchain Coalition since September 2019. BLING had the opportunity to interview the new CEO and hear his vision of creating a Blockchain ecosystem in the Netherlands.

What is the Dutch Blockchain coalition?

The Dutch Blockchain Coalition (DBC) is a triple helix organization, in which governments, knowledge institutions, and industry work together to boost the ecosystem for distributed ledger technologies. We do this by working together with our partners to develop Blockchain use cases, to develop Blockchain-talent in the Netherlands, to investigate the possibilities for Blockchain-based technologies, and to assess the impact of legislation on these use cases.

DBC's #BlockchainForGood mission is to advance reliable, robust and socially accepted blockchain applications; to create the best possible conditions to allow blockchain applications to arise; and to utilise blockchain as a source of trust, welfare, prosperity and security for citizens, companies, institutions and government bodies. For this mission, the DBC is mainly a catalyst and facilitator that activates and connects within a broad public-private network, with connections to the international blockchain ecosystem. Talent development is a very important specific activity, as part of DBC's Human Capital agenda.

What is your interest in Blockchain?

I'm attracted to the idea behind blockchain: because blockchain is based on the decentralization of trust, it enables self-determination. It is all about digital ecosystems and subcultures which act in socially responsible ways. This makes Blockchain relevant: it promises to provide real added value to our society in a tech-savvy way. Besides the ideology, the blockchain technology is interesting: it is able to efficiently share sensitive data in a safe, privacy-preserving and decentralized way. This creates many possibilities for great new use cases.

An example of a DBC use case like this is an international blockchain-based system to register diploma's and other HR credentials. Students who would like to study abroad often face the challenge of proving they have obtained particular certificates or qualifications. Employees often have to prove that they have obtained certain diploma's and certificates before they can start in a new job, inside or outside their current employer. Together with the Dutch department in charge of education (DUO), part of the Dutch Ministry of Education, and an open consortium of large employers led by Rabobank, the DBC initiated a Blockchain based solution in which diploma's and micro-credentials are registered and linked to students and employees. The individual themselves can decide (through using self-sovereign identity) who may have access to their information and can easily share this (efficiency) with the relevant organisations. This use case has been piloted extensively and is now ready to be implemented.

In contrast to what we sometimes see in other parts of the world, the DBC focusses on "Blockchain for Good": applying Blockchain-technology to resolve certain societal and economic challenges. We are not particularly interested in developing Blockchain use-cases "for money" or "for control".

What is the current status of Blockchain?

The Blockchain-hype is over, but that does not mean that Blockchain as a technology has failed. On the contrary, we see more and more practical applications of the technology in business and society. No longer do we see Blockchain as a hammer and we are looking around for a project that can use the hammer, but the hammer has been incorporated in our digital toolbox.

Blockchain is becoming business as usual, and is now one of our standard solutions to deal with problems. This is where the DBC is working: it is time to show what role Blockchain can play as a tool in an organisation's toolboxes. Also the sense of urgency for developing and deploying use-cases is increasing due to the COVID-19 crisis – which is forcing us to think about non-centralized ways to deal with crucial processes in our society.

The blockchain ideas we are seeing now are no longer just experiments or proof of concepts, but blockchain is on the verge of being implemented in large use cases. For example, subsidies (economic aid) are important to develop certain sections of our societies.

Unfortunately the associated application procedures are complicated, and there is some potential for fraud. The use case DBC is developing with the Dutch Ministry of Finance (amongst others) in this context is called 'Compliance by Design', and it shows how this process can be organized in a much more efficient and effective way. In the use-case the grant is programmed in such a way (compliance by design) that it can only be used for certain pre-set goals. This initiative will be further developed in other related use cases because this idea can be implemented for many other products and processes as well. For example it is now being used to support the application process of various COVID-19 support grants in the Netherlands.More examples of the Dutch Blockchain Coalition's use cases can be found on the DBC's website.

Is Blockchain of added value for government?

The role government plays in the DBC triple helix setting is unique. Often, authorities function as the central or controlling party. Blockchain demands the decentralization of data of the central party and puts this into the hands of the users. Blockchain also requires cooperation between different parties. In many of our cooperation-chains we see governmental organizations in crucial positions – such as the owners of data. Therefore it is so great to see that the Dutch government organizations are playing an active role in the development of Blockchain-networks, because they then become an active part of the chain – instead of staying passively outside. Examples in which governments are part of these blockchains are Compliance by Design in regulating subsidies, diploma's or pensions. These examples are already tested or implemented in the Netherlands, and governments play different roles - such as a participant or as initiator. The Dutch Blockchain Coalition and I hope to see many more of these initiatives.

For more information on the Dutch Blockchain Coalition visit:
https://dutchblockchaincoalition.org/en/

> "Blockchain is a hammer which we can now add to our toolbox"

BLING Blockchain use-case:
The financial emergency brake –
CJIB – Dutch Centraal Justitieel
Incassobureau

The CJIB (Centraal Justitieel Incassobureau/ Central Judicial Collection Agency) is part of the Dutch Ministry of Justice and Security. It is responsible for collecting a range of fines and penalties in the Netherlands, and is the designated Dutch authority for the EU's Cross Border Enforcement Directive. The CJIB is the national coordination service for custodial sentences, arrest warrants, community service orders, and probation services.

In 2017 the CJIB founded an Innovation Lab to find solutions for complex issues – like 'how can government agencies exchange information that will help vulnerable citizens, whilst still complying with GDPR?' - using a combination of data and new technologies – like blockchain.

Introducing the 'Financial Emergency Brake'
With funding of two parts of the Ministry of Justice (Innovation-team J&V and DGSenB) , BLING, the Cyber Security Group of the Delft University of Technology (TU Delft), Ledger Leopard, and Blockchainprojects.nl were able to develop the 'Financial Emergency Brake', a sustainable new service for citizens and government organizations that helps support citizens with financial or debt problems.

The Financial Emergency Brake allows citizens to directly flag to the CJIB when they are unable to pay government fines. The system allows citizens to maintain their privacy, while linking this declaration with certification from local services that they are providing debt support. The

service uses blockchain's identity- and information-management tools, together with a zero-knowledge proof (a system
where one party can prove to another that they know a piece of information, without conveying any other information apart from the fact that they know the information).

Addressing personal debt and finance problems
Nearly 1.4 million Dutch households have financial problems. The impact of financial problems and having debts on people is worrying; this is why the Dutch government wants to help people to avoid – and get out of – debt. The Dutch government aims to balance the interests of the debtor and those of the creditor, and not to overlook the social causes of debt. All creditors should be more aware of the circumstances of debtors and collect debts in a socially responsible manner – this includes government organizations, such as the tax authorities and the CJIB.

For these reasons, the CJIB distinguishes between those people who want to pay their debts but can't, and those people in debt who are able to pay but won't. People who cannot pay a claim can now come to an agreement as to how to the debt can be paid, which helps prevent debt problems from worsening. To identify people who want to pay their fines to the CJIB, but can't, and to provide them with services and time to fulfil their obligations, the CJIB needs a timely signal that the citizen is in debt. The CJIB has developed an algorithm call Debt Alert, which can predict whether someone is at risk of either going into debt or being in debt.

The problem the CJIB faces is that many citizens with debt problems do not tell the CJIB, and letters to them are often left unopened. The gravity of their debt problems often only becomes apparent very late in the debt collection process – when it reaches bailiffs or the courts. If the CJIB had known the scale of the individual's debt problem earlier a lot of time, money, and stress could be saved, and the debt issue could be better managed. However, CJIB have found out that

these citizens are often in contact with their municipalities and using local debt help/debt relief services. Knowing this, CJIB developed the idea of the 'Financial Emergency Brake'. The Financial Emergency Brake can help with timely identification of debt problems. In addition, it can potentially prevent someone's debts from worsening. As such, this application contributes towards the Dutch government's wider debt reduction strategy. In 2019 the prototype was developed using blockchain technology, based on the principles of privacy and citizen-centred sharing.

Why blockchain?
For the CJIB, technology is a means to an end, and not and end in itself – so they investigate how different technologies can help them achieve their objectives. For the Financial Emergency Break-pilot, the CJIB looked for a suitable technological alternative to using centralized or siloed data stores. Any solution needed to allow participating organisations to easily exchange information in a safe and legal manner, whilst maximising citizen's control over their data. These two requirements "GDPR-proof" the solution.

The CJIB decided to use blockchain as part of our solution for three main reasons:

1. It was important that no single partner should have control over all of the data – a decentralized chain of trust is required

2. Blockchain-enabled solutions can provide citizens with tools to control their own data in a private and secure way

3. The solution would be more stable because it uses a distributed approach, so there would not be a single point of failure

Our blockchain solution for the Financial Emergency Brake used two key features of blockchain: it is based on a combination of Self Sovereign Identity with a Zero Knowledge Proof.

Lessons learned during prototype development

CJIB learned two main lessons during the development of this pilot:

Firstly, that there are multiple blockchain technology stacks, each with different structural/design/architectural properties. Which one to use is a matter of deciding what stack is most 'fit for purpose' – i.e. which meets most of the pilot's requirements. Unfortunately, there was no single technology stack that covered all of our different requirements: authentication, access control, secure communication, confidentiality related mechanisms, and so on.

CJIB thus had to choose between two options:

- wait until there is a complete blockchain stack/solution is developed that meets all of the pilot's requirements (this might take some time), *or*

- adopt one specific blockchain technology stack, and then customize it by adding the desired components.

CJIB chose to do the latter.

Secondly, CJIB learned that the privacy related tools that they wanted to use – such as Zero Knowledge Proofs – proved to not to be as mature as hoped, and that existing implementations were very limited and not 'ready-to-use' off the shelf. What was required to deliver practical solutions for private data sharing in a distributed network was joint work between researchers and software developers, particularly focusing on:

- Development of a more complete blockchain technology with needed components,

- Development of secure and properly implemented, computationally efficient cryptographic protocols, including Zero-Knowledge Proofs.

This is what the CJIB did in a triple-helix collaboration between the government, the private sector and the knowledge sector.

Zero knowledge proof (ZKP). Any information claim or credential can be proven using a zero-knowledge proof – a computer-based algorithmic solution. This means that a computer 'game' can be designed between a prover and a verifier where the prover has knowledge of some information (e.g. in this situation particular details about a client's financial situation – perhaps that they are receiving a certain type of financial support – the 'claim'), and is able to prove that the prover's claim to know this is true – without revealing the actual details of the information to the verifier.

Next steps

For the final part of our project CJIB has started a plot with two Dutch municipalities – Eindhoven and The Hague, with 80 testers. This pilot will learn whether – and how – this solution works in reality, moving from a controlled design and testing environment into complex real-world settings. CJIB hopes to finish the pilots before the end of the summer in 2021, and will plan to go live after that, if the pilot results are positive.

With the support of these municipalities, this pilot will give their citizens control over the sharing of their debt information and make a contribution to tackling an important an important social problem.

CJIB's project is a first – important – application of Self Sovereign Identity and zero-knowledge proofs by the Dutch government. Using the same methodology and building blocks (no pun intended), organisations can create a wide range of privacy-preserving governmental services. Any situation where information sharing between organizations can benefit vulnerable citizens would be a good candidate for this type of solution.

Over the next few months and years our challenge will be deploying a fully operational application which is scalable and embedded in a collaboration or consortium that can continue to expand the ecosystem. At the same time, CHIB will need to make the approach and technology available for other applications that benefit citizens and governments.

For the CJIB, the Financial Emergency Brake project was an excellent example of the Triple Helix approach – collaboration between the government, the private sector and the knowledge sector. They've shown that this type of collaboration can deliver rapid results.

Self Sovereign Identity (SSI) is an approach where people and businesses can store, manage and share their attributes or credentials on a blockchain. These credentials can be efficiently shared with other parties that can then validate these credentials, without having to rely on a central repository of user or system data. SSI is a digital way of doing what people do today when they hand over their paper-based driver's licence or passport as part of a verification/identification process.

Data security and blockchain solutions – lessons from Estonia

Henry Rõigas, Guardtime*

Henry Rõigas works for the Estonian company Guardtime and is leading their research, development and innovation work to develop advanced data security solutions based on its KSI Blockchain technology.

Can you tell us a little bit about your current job?
I work for Guardtime, where I'm leading our research, development and innovation cooperation. Guardtime – established in Estonia in 2007 – is developing advanced data security solutions based on its KSI Blockchain technology. KSI provides massive-scale data authentication without reliance on centralized trust authorities.

I've been at the company for about two and a half years and it has been a great experience as the company is rather unique in the blockchain space. When the company was created in 2007, the term "blockchain" did not exist. Once blockchain became "the next big thing" and well known, Guardtime was ahead of the curve as we had already deployed solutions based on our KSI blockchain in production with many governmental, military, and enterprise clients. My team's objective is to boost research, development and innovation cooperation with the EU, European Space Agency and other European research organisations.

*Since this interview Henry has become the Chief Strategy Officer at thesentinel.ai

I'm also a member of the board of directors of INATBA: The International Association for Trusted Blockchain Applications. INATBA is a multistakeholder organisation based in Brussels, bringing together all the relevant players in the distributed ledger technologies (DLT) community. INATBA has really grown to be one of the main organisations in the blockchain ecosystem with close to 200 companies that are developing or are interested in DLT and with very representative Governmental and Academic Advisory Bodies. My focus as a Board member is to enable and stimulate INATBA's collaboration with research organisations.

2007 is quite some time ago! Why did Guardtime start then, and why in Estonia?
It is indeed! Guardtime's core technology – the KSI blockchain – has its roots in the research of a few brilliant Estonian data scientists who were working on cryptographic problems (particularly on linked timestamping) before the creation of the company. And in 2007, as you may know, Estonia was faced with one of the world's first politically motivated large-scale cyber-attack. This functioned as a wakeup call to Estonia and, actually, to the world. It was clear that novel technologies were needed to mitigate the growing risks that come with raising dependencies on information technologies. So, a combination of the academic research, living in the world's most advanced digital society and the looming cyberthreat – these are the factors behind the creation of the company.

And as I said, back then, the term "blockchain" didn't exist. Guardtime was initially created to solve a quite specific cyber security issue: ensuring data integrity. Our focus was on how

> "Since we were in the business of 'blockchain' in 2007, there are even some highly creative people who claim that the founder of Bitcoin – the mysterious Satoshi Nakamoto – also is probably from Guardtime."
>
> *J Chuckles*

to make tampering with data impossible and being able to prove the integrity of data without depending on any third parties or central authorities. In a country like Estonia, and in our modern digital world as a whole, data has essentially become the "fuel" of the 21st century – and ensuring its authenticity and integrity is a basic need. So Guardtime has taken a very pragmatic, problem-oriented approach to solve very fundamental data-security related issues.

Can you give us some examples of blockchain or distributed ledger technology being used by governments?
I can speak about what we have achieved with Guardtime in Estonia, which, in 2012 deployed a blockchain solution as part of the national Succession Registry (a registry of wills), becoming the world's first nation state to deploy a blockchain-backed solution in production. Today, several national (Estonian) registries are backed by Guardtime's KSI blockchain technology. For example, we have integrations with the Healthcare Registry, Property Registry, Business Registry, Succession Registry, the Digital Court System and the State Gazette. Estonia uses the KSI blockchain to enforce the integrity of government data and systems. The solution – integrated with the existing government infrastructure and ensuring privacy by not storing any data on the blockchain – makes it impossible for malicious insider (e.g. officials abusing their powers) or hackers to make changes to the highly sensitive data stored in these registries. It essentially provides blockchain-grade trust for the citizens about the processing of data, renders data immutable and allows for independently verification of the integrity of that data. This means that if there's a question about trust or malicious actions, organisations hosting, and processing data can mathematically prove who has accessed a certain piece of data and when.

Take electronic medical records for example. Citizens need to be absolutely sure that, first, their medical data – such as their blood type – is not changed somehow, and, second, that the data is accessed, viewed and processed only by those who have the authority to do so. Every health record – and its access logs – is protected in this way in Estonia.

How does KSI's massive-scale data authentication work?
Unlike traditional approaches that depend on asymmetric key cryptography, KSI uses only hash-function cryptography, allowing verification to rely only on the security of hash functions and the availability of a public ledger. With this Guardtime guarantees data integrity without the need to keep secrets. Instead of putting all of the data up in the blockchain, we ensure privacy by operating only with the so-called cryptographical fingerprints of the data.

How did you get involved in blockchain? And why are you excited about blockchain?

Henry thinks for a bit.

Well, I guess part of it was by chance, as it usually is the case with many things in life. Before Guardtime and getting involved in distributed ledger technologies, I worked as a researcher for the NATO Cooperative Cyber Defence Centre of Excellence – a NATO-affiliated think-tank and competence centre where I did policy research on cyber defence and security. At some point, I wanted to move away from research to more practical things – I wanted to be involved in the development of innovative and potentially breakthrough technologies that have a more direct impact. And this is what really excites me: new technologies, solutions that solve serious, fundamental problems.

I see that there are some legitimate, and potentially high-impact use cases for blockchain, e.g. for cryptocurrencies, for self-sovereign identity, or for specific cyber security solutions. But there has also been a lot of hype and ideas that really do not appear to be realistic or useful. In some cases – during the peak of the blockchain hype – it almost felt as if people and organisations were more interested in asking themselves what they could do for blockchain. But people and organisations investing in blockchain should actually be focusing on asking what blockchain can do for us.

On the other hand, looking at today's developments, it is also clear that we have moved past the hype. In 2019, the commercial investments into blockchain dropped drastically and with the current pandemic, this overall trend is bound to continue. Public funds are usually a bit slower to follow, due to the more complex decision-making and longer-term budgetary processes. So public investments are still relatively high, and sometimes rising. That being said I don't always see a clear end goal in terms of the use-cases that are targeted by these public programmes... but this is how innovation works... you take risks, and then you find out what works and what does not. But organisations need to find a balance between unquestionable optimism and realistic pessimism. Easy to say, difficult to execute.

> "Although I am not a so-called 'religious' believer in blockchain, the technology holds real promise."

Do you have any advice for government officials and policy makers who are considering blockchain-enabled solutions?

My main recommendation to governments is on the methodology or approach they use when they want to develop or invest into blockchain technologies. As the very basic first step, you should define the problem that needs attention and can possibly be solved with a DLT-based solution. And then – only after this step – you need to analyse whether a blockchain-based solution is the most reasonable approach, in comparison to other "non-blockchain" alternatives. This point is really important – you need to conduct a thorough comparative analysis of all different technological solutions before creating some pre-set technological dependencies in your solution or service that have a long-term impact on how it will be designed, managed and used.

Another issue to keep in mind is the skills and knowledge gap – the lack of sufficient relevant technical competencies within public institutions. Blockchain-related technologies are quite complex, but this is a more general issue. In the labour market, the public sector – with its inflexibilities and particularities – often cannot compete to hire the high-level technical specialists who are bombarded with lucrative and interesting opportunities in the private sector, especially in the field of IT.

Being a non-techie by training myself, I find it best to acknowledge the limitations of my own knowledge, and to try to learn how to ask the right questions, and then to establish access to a pool of experts who can answer those questions. At the government level, this requires acknowledging individual or organisational limitations and establishing cooperation mechanisms with the private sector and academia.

We talk about blockchain in general and the remarkable enthusiasm it has generated in the last few years. Is it blockchain that got people excited, or is it the philosophy and ideal of a decentralised world?

Oh, yes, discussions about blockchain can get confusing. There are different definitions, but also very different general understandings among the stakeholders. Indeed, blockchain sometimes does carry a 'power to the people' message to some. This sometimes generates a useful enthusiasm, and allows individuals and institutions to ask questions about existing business and governance models. Opening oneself up to such fundamental questions is the most useful, I think, for policymakers and governments.

In addition, there is this interesting dichotomy when it comes to the vision of decentralization in the context of governments who aim to develop and integrate blockchain technologies. To put it very simply, blockchain often adds value only when there are trust issues. How should governments position themselves here? Aren't governments actually the main trusted "middle-men" in our societies? Should governments then

rather look at the specific technological benefits that may be provided by the solutions? Such as increased security? Or should the focus be on ensuring more take-up through increased trust by the users, criticizes? These are broad and simplified questions, but I just wanted to highlight that there is a tension between the promise of decentralization and public, state-provided services.

So far, it seems there are not a lot of blockchain use cases up and running in government. Why do you think that is?

As I have not been involved in many government-backed blockchain use-case developments, I can only make some guesses on the possible reasons. It may be that some blockchain-backed services are just too expensive to integrate and/or comparatively inefficient compared to existing or alternative solutions. Also, implementing and putting blockchain-based tech into actual use can simply be a very costly or a lengthy process. We also might be in a point where the technology is simply not mature enough.

A lot of investments by public institutions have gone to research and development, and we can hope that these yield results in a few years. There are also specific technical complexities around scalability, privacy and governance. In addition, the issues I mentioned in my previous answers are still relevant: the lack of experts involved in the technological decision-making, the lack of a brutally honest and comprehensive analysis of reasonable use-cases for the technology, and the decentralization versus control question. But – this is just to point out the possible reasons, and these are certainly not universally applicable. There are always problems when it comes to complex processes and issues. Time will tell.

What role do you see for the International Association for Trusted Blockchain Applications (INATBA) in the future?

I see a very important role for INATBA. The association has the potential to become the key player in bringing together the blockchain community to present a necessary unified voice for the industry and the community at large, be it for involvement in policymaking, agreeing on definitions, providing input to standardisation activities, or fostering collaboration with governments and the academia.

As many questions about how we can best use blockchain remain unanswered or open, INATBA acts as a collaboration hub and is becoming very useful for all the stakeholders in the blockchain ecosystem. Governments who have blockchain-related projects or are planning to invest more in the technology, should certainly contact the organisation and get involved. INATBA is one of the tools to address the questions and issues that I identified that governments face when trying to innovate.
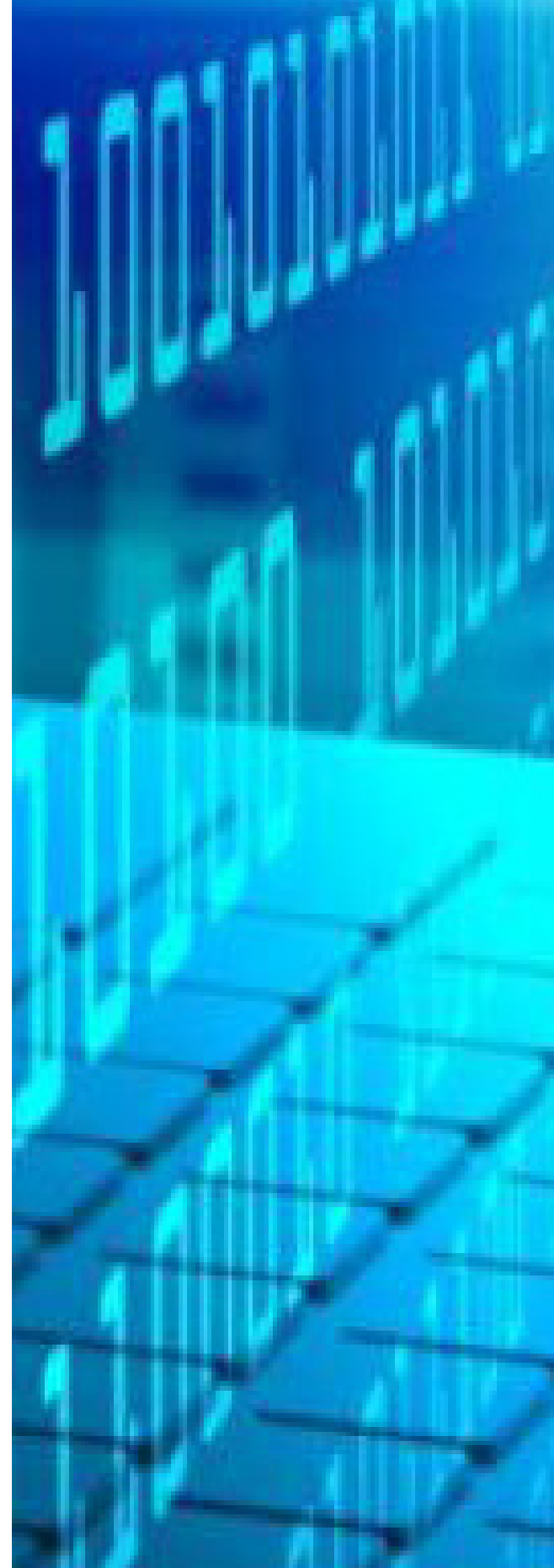
PILOT

BLING Blockchain use-case: Blockchain for maritime ports – How can document handling be improved?

Aalborg University's Department of the Built Environment is leading research on intelligent transport, tracking data analysis, big data analysis, and freight transport studies – from transport, business and logistics perspectives. The University's Freight Transport Research Group focuses on analyzing business models behind new technological solutions in transportation, and studying the potential impact of new technologies in transport and logistics.

Aalborg University's role in BLING is to explore how blockchain technologies can be used to increase the quality of services provided from 'Government to Businesses' (G2B) for freight transport in ports and cities. This is an important complement to the other BLING pilots which focus on 'Government to Citizen' (G2C) services.

Aalborg will contribute to the identification and development of the new ways of using blockchain to optimize freight transport through better service provision from public authorities, which will help create better government services for maritime ports in the freight industry.

Logistics, ports and document handling
Maritime ports and logistic hubs have constantly been an efficiency driver for the global economy. With today's market of new and innovative technologies, the maritime industry is overdue for communication upgrades.

The primary issue the sector faces is in inefficient cargo document handling throughout the supply chain. Shipping cargo via ships involves dozens of parties – terminal operators, customs, shipping agents, port authorities, freight forwarders etc. – having rounds of interactions and confirmations as goods are moved/consigned/consolidated and so on. Most of the parties involved in these interactions are not aware of upcoming transportation activities, and often do not know the place of origin, goods type, corresponding documentation and

other relevant information for customs and receivers. This lack of information especially complicates work for customs and their container checks, which brings additional time delays before goods can be collected for onward shipping.

For the BLING project, Aalborg University is creating a model showing how blockchain can be used for document coordination in a sea port, working with the Port of Alborg to capture real-life experiences and situations to build a robust real-world foundation for a blockchain-enabled business model.

Why a blockchain solution?
Blockchain could potentially transform the maritime industry's existing document handling schemes. If blockchain tools are integrated into existing accounting, database and ERP systems, it will be possible to potentially standardize documentation and move document flows online, replacing physical processes with digital approval processes. When saved to a blockchain, these approvals would also serve as timestamps, enabling tracking and real-time monitoring of goods as they move through administrative processes.

A key aspect of implementing blockchain is the transparency and auditability of all transactions – which is a key for such a widespread distributed network as shipping. Establishing connectivity between all parties in a supply chain is the next step for time-efficient, secured deliveries. Blockchain upends established rules of data ownership, centralization and access. Instead of conventional workflows, blockchain-enabled systems can bring new approaches to collaboration, and link multiple parties with equality of ownership.

To support this vision, Aalborg University is developing a knowledgebase that identifies the actors in the logistics/port network for mid-sized maritime ports in Denmark. The pilot identifies what are the document handling challenges these actors face, and how various blockchain use-scenarios and technologies can help tackle these challenges. To reality-check their results, Aalborg is working within the port network for the Port of Aalborg, who are a project partner in this work.

This work will inform industry specialists, maritime agents and agencies, municipalities and blockchain enthusiasts about the potential of the technology for a middle-size maritime port. Aalborg University's research will identify conceptual intersections and links between existing projects, mapping current approaches and potentially increasing knowledge in this area.

From Port Community Systems to Blockchain-enabled systems
Aalborg initially identified and analysed all existing blockchain projects and applications in the maritime industry that had been covered in the media and in academia. We classified all of the maritime blockchain projects we found into three scenarios: blockchain for document communication, blockchain for financial transactions, and blockchain for product trackability. Aalborg focused on the first scenario – document communication.

In general, the document workflow in maritime logistics has not been changed for decades, and this pushed Aalborg to search for other initiatives that had been proposed before the development of blockchain. This allowed Aalborg to compare blockchain concepts and earlier maritime innovation proposals. We found close interrelations between blockchain concepts and 'Port Community Systems' (PCS) from 90s and 00s as. PCS was an attempt to address many of the challenges that current blockchain-enabled solutions are looking at. PCSs had similar goals to digitize port document handling and speed up port communication - however, many PCS initiatives failed because of data ownership concerns and partners' unwillingness to change business routines and organizational structures. A combination of the two approaches could be key for industry adoption.

To better understand where the industry – particularly medium-sized ports – is heading, Aalborg conducted inter-views with six major maritime ports in Denmark. The goal was to understand the feasibility of different blockchain use scena-rios from both practical and business viewpoints. The results showed uncertainties in communication between port actors: the port authority, terminal operators, customs. Addressing that is crucial for building a decentralized communication like blockchain. It appears that medium-sized ports are generally not focused on IT innovation, prioritizing physical expansion and equipment optimization. Aalborg found big communication gaps between port authorities and terminal operators, mainly in optimization and data handling.

Connectivity across a port's network is important if we are to help the industry shift into the digital space. Aalborg are currently looking at the influence of SMEs that are based at the port site, and port authorities and customs agents, and exploring whether these actors can be brought together as part of a digital network.

Groninger Stadjerspas, a blockchain-based service for low income citizens

Paul Spoelstra and Bram Scholtens, Gemeente Groningen

The Stadjerspas is a blockchain based service for low income citizens from the city of Groningen, the Netherlands. BLING interviewed Paul Spoelstra and Bram Scholtens about their experiences working with this blockchain-based service. Paul is project manager for the Stadjerspas for the municipality of Groningen. Bram has also been involved on behalf of Virtueel Groningen (a strategic programme to drive innovation in public service delivery).

What is the Stadjerspas? What does it do, and how did it come about?

Paul: "The *Stadjerspas* is basically a combination discount card and voucher system for citizens and families with low incomes in the municipality of Groningen. It has been around in different forms since the 90s, and we have had the system in its current form since 2016. Stadjerspas gives card holders access to social and cultural activities for free, or at a discount. The system subsidizes private services that low-income citizens would otherwise not be able to access, thereby promoting inclusivity. For example, you can go to the swimming pool, or get a discounted cinema ticket. It has a physical pass with a QR code that can be scanned, and it also has an online component - a web shop that citizens can use to buy tickets. At the moment it is only for citizens with low incomes – we are exploring the options to make it available to all citizens. This is already technically possible."

The Stadjerspas runs on a blockchain application. Why did you choose a blockchain solution?

Bram: "At the end of 2013, the Stadjerspas was supposed to be withdrawn because of budget cutbacks. After discussions in the Municipal Council, it was decided to continue the Stadjerspas – but only for people with low incomes. We needed to produce an updated application in a very, very short time."

Paul was required to get a working solution up and running within a few weeks, and he successfully managed to get the online web shop up and running. However, in part because of the time constraints, it initially had a lot of errors. "We were mostly able to fix those, but after a while we decided to look for a new solution", Paul tells. "So we wrote a tender for a new solution, after we agreed on a program of requirements that we designed together with Stadjerspas users."

What was the programme looking for? (in terms of transactions, authentication etc.)

The Dutchchain company offered us a solution that used blockchain. At the time it was a very new technology, and it looked promising because we could do secure transactions. We started using this solution in 2016, and after it was implemented the blockchain hype really started building – so we were suddenly invited to be on national television and to go to lots of conferences to speak about it." Bram adds: "That was a nice side effect – it helped put Groningen on the map as a digital and innovative city."

Can you tell us a little bit about how blockchain is used in the Stadjerspas?

Paul explains: "every user gets a personal wallet which is updated with credit once a year, and when new or temporary offers are added. For example, a citizen gets three tickets to the swimming pool in his or her wallet. When you go to the swimming pool, the QR-code is scanned. This transaction is stored in the blockchain. At the same time, an amount of money is made ready by the municipality to transfer to the swimming pool. The payment to the service provider is done in the usual way – it's only the overview of the transactions that is put into the blockchain. At the end of each month, we receive an overview with all the transactions, and with that the invoices for all the service providers."

Paul: "the system is hosted externally. Externally, we only have an email address and the QR-code. Apart from that, there is no personal information. This was done for security and privacy reasons - so if the system gets hacked, you'll only have a bunch of email addresses. That is bad enough, but it is 'less bad' than being able to take a lot of personal information. The personal information we have about users is stored and managed by the municipality's systems. So there is a connection between the external system and our own system."

Can you give us an idea of how many people have used this service since it was started?

Over 20,000 citizens and service providers are registered in the program – there are around 4,000 smart voucher transactions every month.

Are there any downsides of working with blockchain?

Bram and Paul agree that the current solution has a few problems. Paul: "currently, we cannot undo transactions or delete accounts. This does not align very well with the right to be forgotten. So that is a problem. On a practical level, it is difficult when an error has been made. For example, sometimes people accidentally enter a wrong number, so they might buy three tickets instead of one. So sometimes we get emails from users who complain that they only have used the swimming pool once, but they have lost all their credit for the rest of the year. Our system is built in such a way that you cannot restore this per individual. In theory, we could have built it so you could update the existing ledger with a new transaction, so that the total is correct again. However that would have been very costly, so for the moment we have decided to take a different approach to solving these kinds of issues."

What opportunities do you see for blockchain in the municipality in the future?

Bram: "well, as it is now, it is a nice to have, and it's good to learn from it. But in this case blockchain doesn't add a lot of added value. On the other hand, it doesn't hinder us either. We can deliver a version of the Stadjerspas without using blockchain: there are other technologies that achieve the same results that don't use blockchain. Of course, the technology and the range of solutions on the market has improved a lot since we started using this system three and a half years ago. Even so, there still is the matter of principle – if you can and should be a partner in an equal playing field as a government. A decentralised network can be challenging to use in our case.

Personally I don't think a public blockchain is very suitable for most use cases for government, you'll probably use a permissioned blockchain in some form instead. As a government, you are often responsible for many processes. So if we want to use blockchain for public services, you should be able to fix mistakes, for example. If that is not possible, then it is very hard to use."

What do you think are the main issues organisations should think about when they are considering whether or not to choose a blockchain solution?

Both: "The solution just needs to work, and it must be easy to use. If the solution uses blockchain, that is fine, but if the solution can be delivered with just a regular database, then that's ok as well. For us, blockchain is not an end in itself. If a solution uses blockchain we are open to that, but for us, the most important thing is that the solution has to work well."

PILOT

BLING Blockchain use-case: Using Self-Sovereign Identity to Record Event Attendance – BlockchainLab Drenthe

At many conferences, events and classes attendees are required to sign in via some form of attendance list. They often end up putting their name and signature on a public list, which many people can see or access. These attendance lists usually have two functions – for the host organization to see who attended, and for attendees to prove that they were present. However, the typical registration sheet – usually a paper list open for everybody to see, is outdated and is often not GDPR compliant, as anybody with access to the list can copy the information on it. If an attendee had to prove their presence, they would usually have to contact the host organization and hope they had kept the list(s).

If any of the organizations involved had an incentive to manipulate the attendance numbers, a paper attendee list is very susceptible to fraud. Blockchain technology can offer a solution to this problem with the development of the Self Sovereign Attendance App. With this app, based on IOTA, people can check in on a decentralized blockchain, which is immutable, transparent and cryptographically protected, so that only the authorized parties can access and see attendee data. This app gives complete control of the personal data to the attendee, while ensuring that the host organization can prove its attendance numbers in a safe and GDPR complaint manner.

Why use Blockchain?
BlockchainLab Drenthe uses three ground rules in order to determine if a problem could be solved using Blockchain and/or Distributed Ledger technology:

Principle 1
Multiple organisations/parties must be working with each other

Pilot context
Many events have multiple additional stakeholders in addition to the organizers and attendees. Organizations that provide subsidies or grants to host an event for example. Many organizations pay their employees or members to attend certain kinds of events. Plus, for many professions it is mandatory to attend certain number of conferences or courses in order to be eligible for a professional license/certification/membership.

Principle 2
These parties can't fully trust each other

Pilot context
At many big organizations/associations/events it is impossible to know everybody, and this is invariably the case with international organizations. Exchanging data about attendees can be problematic, since event organizers may not know client organizations very well and vice versa. Parties also can't be sure what other organisations will do with the data that has been collected.

Principle 3
There may be an incentive for one party to "cheat" (i.e. one party can gain some form of advantage – perhaps by claiming they had attended an event when they did not actually attend it)

Pilot context
There can be several incentives for a party to manipulate attendance figures. An event organization can inflate the numbers in order to collect more money from sponsors of grants. An attendee can falsely claim they were present to get a compensation or gain permanent education points for their profession. Also, an ill-willed attendee can steal information from the attendance lists, since it's open for everyone to access.

You can see that the problem we've identified meets all three criteria.

The only way to make sure all parties can access the information they need for their particular situation, but won't be able to alter, misrepresent, or misuse the data is to set up system where the data is immutable – i.e. it can't be changed – and all involved are only able to access the information on a "need to know" basis. These requirements match the properties of blockchain, as it is decentralized, immutable, transparent and cryptographically protected.

Self-Sovereign Attendance at work
Self-Sovereign Attendance is the solution to these problems! In BlockchainLab's pilot, the user/attendee is the owner of their attendance credentials and any associated personal information. As their identity is 'self-sovereign' the user is able to create and manage their own identification credentials, without requiring support from other organisations or third parties. The event organizer can create an event, where they give the attendee the possibility to "check in" to the event through a QR-code or Bluetooth-signal on their phone. The event/check-in data is encrypted and stored on the blockchain. This solution means:

- Only the event organizer knows how many attendees checked in into the event: and they can choose to share this information

- The attendee has control over the proof that they attended a particular event: and they can choose to share this information without asking the organise

This solution provides the user (in this case the event attendee) many ways in which they can control the use of their personal information:

- The user collects their own data (the event host facilitates this by creating the event record which the user can attach their data to)

- Their data is stored in a decentralized ledger that uses a combination of encrypted data and offline-storage, so the information is safe

- The user can access their information 24/7

- The user can choose to share this information with other organisations in a safe and verifiable way, with or without sharing their personal information

- The user can choose to "forget" all events connected to an account by deleting the information

Building the proof of concept

For this proof of concept, BlockchainLab stored an event on a Blockchain (they used IOTA's 'Tangle' distributed ledger) and at a BLING-meeting they gave participants 2 QR-codes: one which loaded the proof-of-concept app on their phone, and one with the link to the Event. Attendees were able to use their smartphones to register their attendance on the Tangle. BlockchainLab were able to see how many people registered: their next step will be developing the app. Because this approach uses QR-codes, this registration method can be used for online-events. When event organisers use Bluetooth to broadcast the event key they will have a way to register a large number of people at the same time – if they are within 10-15 meters of the beacon. After the event the organiser will be able to attach extra information to the event (slides, presentations, documents) which the attendees can retrieve anonymously - since the organiser does not have their personal information and can't link attendees and downloads.

The attendee will have a wallet on their phone with details of all the events they attended, and the organiser will have a wallet on the blockchain, with information about the events they organised – without holding any personal information from the attendees. This approach also ensures GDPR compliance, as no personal information is stored on the blockchain.

Pilot next steps

The proof of concept was successful, and BlockchainLab are continuing to develop the pilot - they are now building prototypes for the production app. With this solution they have shown how a blockchain-enabled solution can improve the safety, trust and fairness for different groups of users and organisations. The basic idea – of giving a user fine grained control of how they share information with different organisations - isn't limited to just managing attendance at an event. With some imagination you can use the 'Self Sovereign Attendance' approach for a wide range of uses:

- Many professionals – medical specialist, physiotherapists, accountants, etc. need to prove they have undertaken continuous professional development or personal education activities to keep their professional registration. This app could provide the proof they need that they attended conferences, courses, meetings, etc.

- Students who need to prove they attended lectures, visited companies, etc.

This promises a lot more applications that use this concept in the future, and the Blockchain Lab Drenthe will most certainly continue to explore them.

Slovenia's bottom-up approach to blockchain innovation

Nena Dokuzov, Slovenian Government

Nena Dokuzov works for the Slovenian government and is involved in several international blockchain projects. Here she shares some of her thoughts about the possibilities for blockchain in government, and about the uniquely effective approach of the Slovenian government in facilitating innovation.

What is your current role?

I am head of the 'New Economy and Blockchain' project group which was established by the Slovenian Ministry of Economic & Technical development. We are working on implementing blockchain based technologies and integrating them into technical and sociological solutions. I'm also a member of the 'Blockchain Expert Policy Advisory Body' (BEPAB), which was set up by the Organisation for Economic Cooperation and Development (OECD), on their Blockchain Expert Advisory Body. We have prepared a white paper on blockchain use cases that can support the OECD's Sustainable Development Goals.

Slovenia is one of the countries in Europe that is on the forefront of work to adopt blockchain. Can you tell us a little bit about how that happened?

Yes! It started in 2017. This was when the hype surrounding blockchain was at its highest. In June 2017 we organised a huge meet-up with representatives of companies, academia, civil society and government.

A few months later we did a follow-up event, but this time also included members of the international community. We had been working on a Slovenian declaration on blockchain, which was adopted then. This happened about the time when the European Commission established the Blockchain Observatory and Forum. Then in 2018 I became a member of the European Blockchain Partnership, which is a collaboration between member states and the European Commission.

We adopted a *national blockchain action plan*. This was a strategy with some very concrete goals. First, we would identify relevant areas to be covered by blockchain technologies and do research on where these applications could be useful. Secondly, we tried to identify if legislation should be changed in order to allow the adoption of these technologies, and if so, in what way should the laws be updated. Thirdly we tried to define the different roles of specific stakeholders: government, companies, NGO's, etc.

Then we had a call for projects, funded by €73 million from the Slovenian government. Most of these projects involved new technologies like Blockchain, Artificial Intelligence (AI) and the Internet of Things, and a lot of the projects focussed on smart cities and smart factories. About 60% of these projects expected to use blockchain. Another important technology that is related to blockchain is Artificial Intelligence - it turns out it can be very useful to combine AI with blockchain. And then in 2019 Slovenia launched SiChain – the world's first national blockchain test infrastructure.

What made the Slovenian approach so successful?

I think what was special and effective about the Slovenian approach was the fact that it was really bottom-up. We organised a lot of meetings with stakeholders and asked them what ideas they had, but also what kind of support they needed, or what problems they faced. We really got to know the blockchain community, and this

gave us a good sense of direction and what to do. We saw a lot of use cases that were very focused, in really niche markets. We saw a lot of solutions that were not possible before.

Because of this approach, Slovenia was selected as a role model by the United Nations: our strong cooperation between government and the private sector in the development of blockchain solutions is seen as an example for other countries.

Of course, these kinds of things depend on people, not just methods. People need to be personally engaged with these ideas. We were able to work with a very strong community of companies in Slovenia that were developing use cases for blockchain and developing projects, and we successfully connected that community with other more traditional companies.

What kind of use cases do you see right now for blockchain?

In Slovenia we see a lot of different (potential) use cases. A lot of things are happening around energy, especially the sharing of sustainable energy. And traceability of materials is a very important one too. Data and health are other domains with blockchain use cases.

What will Slovenia do next?

Currently we are working on new legislation to facilitate the use of blockchain solutions. But we're not rushing this, since the European Commission is also working on recommendations in this area. The most important blockchain use case for us is digital identity. When we have a solid legal framework for using digital identity (in public services and in commercial transactions), we can more easily define how that framework should work and look at the specific workings of the law.

A second step is defining a regulatory sandbox. Not only for the technical sector, but for all relevant industries that want to explore this technology. We want to respect the existing regulations, but also make them suitable for new technologies such as blockchain. Another important thing for us is interoperability and standardization. Since a lot of use cases can be applied on an international level, it will be very important to make sure the technology has the same standards. So I'm happy to see that a lot of international collaboration is being done in this area.

Blockchain In Government – additional resources

1. European Blockchain Partnership – EUBP
The European Blockchain Partnership (EBP) was created in April 2018 and includes all EU Member States and members of the European Economic Area. Partners are working together to support the development of blockchain-based services for the benefit of citizens, society and the economy. As part of this, the Partnership is building a European Blockchain Services Infrastructure (EBSI), which will deliver EU-wide cross-border public services using blockchain technology.
https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership

2. European Blockchain Service Infrastructure – EBSI
The European Blockchain Services Infrastructure (EBSI) is building EU-wide cross-border public services using blockchain technology. In 2020, EBSI will deploy a network of distributed blockchain nodes across Europe, supporting applications focused on four broad use-cases – Notarisation, Diplomas, Self-Sovereign Identity, Trusted Data Sharing. EBSI has now chosen to support additional use cases on a European Social identification Number, SME Financing, and Asylum Process management.
https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/ebsi

3. EU Blockchain Observatory and Forum – EUBO
The EU Blockchain Observatory is a European Commission initiative to accelerate blockchain innovation and the development of the blockchain ecosystem within the EU. EUBO will monitor blockchain initiatives across Europe, produce a comprehensive source of blockchain knowledge, act as a forum for sharing information and opinion, and make recommendations on the role the EU could play to support the adoption of blockchain. EUBO has two working groups – one on Blockchain Policy and Framework Conditions, and a second on Use Cases and Transition Scenarios.
https://www.eublockchainforum.eu

4. International Association for Trusted Blockchain Applications (INATBA)
Launched by the European Commission in 2018, INATBA is the leading convener in the global blockchain ecosystem, offering developers, companies, and users of blockchain/distributed ledger technology a forum to interact with regulators and policymakers and bring blockchain technology to its next stage. The mission of INATBA is to develop transparent and inclusive governance and cooperation models for blockchain applications, to inform policy and regulatory measures that may contribute to harnessing the many opportunities of blockchain through a close dialogue with policy-makers and regulators, and to promote regulatory convergence that drives potential impacts for society and the economy from these technologies.
https://inatba.org

5. OECD blockchain resources
The OECD's Going Digital portal has a wide range of accessible information about blockchain – covering technology, policy, and use-cases.
http://www.oecd.org/going-digital/topics/blockchain/

6. BLING
The BLING website brings together information about the BLING project – project outputs, blockchain tools, stakeholder interviews, meeting information, pilot information, and partner profiles.
https://northsearegion.eu/bling/

7. GU-BLAB
Blockchain LAB (BLAB) is an initiative for creating a creative environment that allows researchers and students involved with the Swedish Center for Digital Innovation to work with blockchain solutions in their studies and research.
https://scdi.se/initiatives/blab/