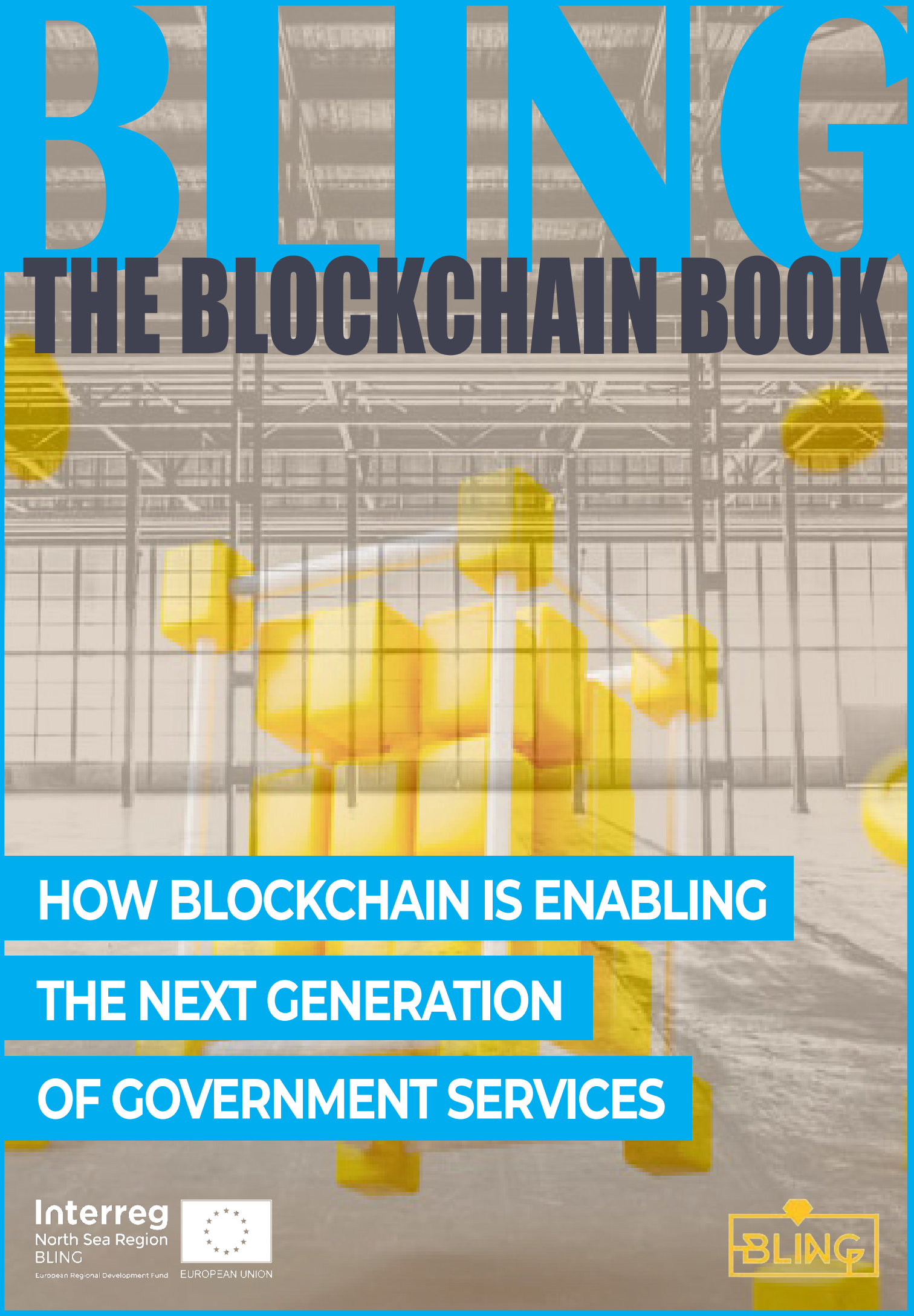
BLING

THE BLOCKCHAIN BOOK



HOW BLOCKCHAIN IS ENABLING THE NEXT GENERATION OF GOVERNMENT SERVICES

Interreg
North Sea Region
BLING
European Regional Development Fund
EUROPEAN UNION

COLOPHON

Blockchain IN Government
(an Interreg Vb North Sea Region project)

LEAD BENEFICIARY
Municipality of Groningen

PRODUCER
Renske Stumpel – renske.stumpel@groningen.nl

AUTHOR/EXTERNAL EXPERT
Dave Fitch – dave@dere-street.com

DESIGNER
Jetta Post – jettapost@gmail.com

BOOK CONTRIBUTORS / BLING PARTNERS
Adri Wischmann, BlockchainLab Drenthe, Netherlands
Ali Amin Rezaei, University of Oldenburg, Germany
Annik Schoutenden, City of Antwerp, Belgium
Astrid Stroobandt, Howest University, Belgium
Daniël du Seuil, District 09 and European Blockchain
Danny Dreves, BlockchainLab Drenthe, Netherlands
Dave Murray Rust, TU Delft, Netherlands
Dewi Eshuis, Groningen Municipality, Netherlands
Ella Tallyn, University of Edinburgh, Scotland
Emmie Osselaere, Gent, Belgium
Evite van Winkoop, Groningen Municipality, Netherlands
Gino Dehullu, City of Roeselare, Belgium
Jan Willem Bos, Emmen Municipality, Netherlands
Jasmien Wellens, City of Roeselare, Belgium
Jelena Zec, County Administrative Board of Skåne, Sweden
Jeroen Wester, BlockchainLab Drenthe, Netherlands
Joe Revans, Edinburgh University, Scotland
John Smalbil, Emmen Municipality, Netherlands
Joke van Gheluwe, Howest University, Belgium
Jolanda Hemmes-Blumers, CJIB (Dutch Central Justitieel Incassobureau), Netherlands
Jörgen Dehlin, County Administrative Board of Skåne, Sweden
Joris Moorthamers, City of Antwerp, Belgium
Josef Gustafsson, County Administrative Board of Skåne, Sweden
Juho Lindman, University of Gothenburg, Sweden
Keith Fisken, SEStran, Scotland
Kimberley Van Luchem, City of Roeselare, Belgium
Kris van Berendoncks, City of Antwerp, Belgium
Kurt Callewaert, Howest University, Belgium
Livia Norström, University of Gothenburg, Sweden
Nele De Clercq, City of Ghent, Belgium
Niels Annema, Province of Drenthe, Netherlands Partnership
Sergey Tsiulin, Aalborg University, Denmark
Shane Deconinck, Howest University, Belgium
Tim van Achte, City of Ghent, Belgium
Timo Wyffels, City of Ghent, Belgium
Tineke Smegen, Province of Drenthe, Netherlands
Wim van Renterghem, Howest University, Belgium

FOLLOW US
BlingNSRproject@groningen.nl
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INTRODUCTION

HOW BLOCKCHAIN IS ENABLING THE NEXT GENERATION OF GOVERNMENT SERVICES

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

This book brings together 24 pilots, proof of concepts, and use cases that show how blockchain-enabled solutions will change how local and regional governments deliver local services and how they work with citizens.

From the largest government blockchain service in the Netherlands, to new ways to help people in financial difficulties, this book provides a range of examples of new ways to design and deliver services for communities and citizens that cross many service areas, including health, energy, and transportation.

We highlight the innovative ways our blockchain-enabled solutions have enabled new ways of supporting people and delivering services to communities, and show new ways that governments can build and deliver privacy-first solutions that help people.

It has been challenging working with a new, exciting but still evolving technology. When governments seek to adopt technologies, these are usually technologies that are ‘new to them’, and not technologies that are still in the midst of periods of rapid development and adoption. In many ways blockchain is still an immature technology: but what BLING has found is that the biggest challenges to blockchain adoption are not technical, but organisational and cultural.

BLING is unique in targeting blockchain capacity development and piloting for local and regional governments.

When BLING began there were relatively few local and regional government blockchain use-cases: BLING has significantly expanded the evidence base, and BLING's pilots, proof of concepts, and use-cases have had an outsized impact.

INTRODUCING BLING: BLOCKCHAIN IN GOVERNMENT

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

BLING – Blockchain in Government – is a €6M project set up in 2018 to help governments in the North Sea Region to accelerate and de-risk the adoption of blockchain-enabled solutions and to help develop the next generation of innovative e-services and e-government.

BLING's partners have delivered real services in real life governmental settings: they have also delivered many new pilots, proof of concepts and use cases that exemplify how this innovative technology can be used in many different ways and in many different domains.

BLING isn't a tech project: BLING uses an innovative three stage explore/enable/deliver approach to accelera-te the adoption and deployment of blockchain-enabled services.

By using this approach BLING has had significant success in enabling the creation and delivery of the next generation of smart services for citizens, governments and SMEs.

Want to find out more about BLING? Contact us.

BLING'S IMPACT

- # PRODUCED 20 NEW USE-CASES FOR BLOCKCHAIN IN LOCAL AND REGIONAL GOVERNMENT
- # ATTRACTED OVER 22.000 PARTICIPANTS TO LOCAL, REGIONAL AND ONLINE EVENTS
- # LED TO 31 ACADEMIC PUBLICATIONS
- # WORKED WITH 90 SMES
- # PUBLISHED REPORTS, INTERVIEWS AND OTHER PUBLICATIONS THAT HAVE BEEN READ OVER 33.000 TIMES
- # PUBLISHED THE 'BLOCKCHAIN IN GOVERNMENT IN EUROPE' MAGAZINE THAT BRINGS TOGETHER LOCAL USE-CASES AND NATIONAL AND TRANSNATIONAL APPROACHES TO ENABLING LOCAL AND REGIONAL BLOCKCHAIN DEVELOPMENTS

BUILDING ON BLING'S IMPACT

In 2021 BLING received an 18-month extension and an additional €1M in funding to accelerate our ground-breaking work to continue the development of innovative new local government use cases for blockchain enabled services. This additional time gave BLING's partners the time and space needed to successfully deliver pilots, proof of concepts and uses cases with this new and still developing technology.

The Gothenburg BlockchainLab – one of BLING's academic partners – identified two significant issues hampering the development of blockchain-enabled services in local and regional government:

- the lack of relevant local and regional government-focused blockchain uses cases, and
- the relatively limited amount of published information and learning about issues identified and lessons learned during local testing, development and piloting of blockchain-enabled services.

With this additional time and funding BLING was able to continue the development and delivery of blockchain-enabled pilots and services in local and regional governments that had been affected by the Coronavirus pandemic, along with the production of a comprehensive and expanded programme of evidence, outputs, and lessons learned.

Our **new website** pulls together all our learning from BLING. It holds information on all our pilots, our proof of concepts, and our use cases, together with our academic outputs, our lessons learned, and the Blockchain Readiness Assessment Tool.

3 themes to focus outcomes and impact

In BLING the partnership focused on accelerating blockchain innovation across key themes – innovation and capacity building, working with communities, and energy and transport. This sharpened focus is a response to the key capacity and support needs which BLING has identified to support the development of blockchain-enabled services in local and regional government – particularly the need to deliver significant numbers of new use cases and lessons learned from local and regional governments.

WHY BLOCKCHAIN?

The adoption of blockchain-enabled services is a key part of a wider transition to the next generation of innovative government services. This once in a generation shift requires more than technology and technological change – it requires policy, legal, and capacity development at local, regional and national levels.

Blockchain is a key enabling technology that will underpin efforts to deliver innovative services under the Digital Agenda for Europe. Blockchain promotes user trust by making it possible to build systems that share information and record transactions in a verifiable, secure, permanent and manageable way. Based on a 'distributed ledger', blocks of information are chained together with cryptography to produce a system that stores, manages, and verifies both information and access to information.

Blockchain-enabled systems will allow governments to deliver a range of new solutions and service designs that have the potential to redefine the relationship between governments, citizens and SMEs.

Blockchain-enabled systems have the potential to transform how citizens, governments, and organisations work together – developing tools to increase transparency, enable trust, and giving citizens, control over how and where their data is used.

When should you 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:

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

Rule 2
These parties can't fully trust each other (e.g. they may use incompatible management systems and can't share information easily)

Rule 3
There may be an incentive for one party to "cheat" (i.e. one party can gain some form of advantage due to gaps in information sharing)

The advantage of a rules based framework

The great strength of these three simple rules is that they provide a framework to quickly identify projects whose needs don't align with the particular strengths of blockchain.

As part of a wider review of internal processes Roeselare identified their Leisure Pass service as one where a blockchain solution might be appropriate. The review of their service identified that it was:

1. delivered by multiple organisations, where
2. individual service providers kept their own records of Leisure Pass usage, and
3. there was no way to confirm Leisure Pass usage information.

So the three rule test indicates that in this case it's worth looking at whether a blockchain-enabled process can address these concerns.

WHAT WE'VE LEARNED ABOUT BLOCKCHAIN: 10 LESSONS FROM THE BLING PARTNERSHIP

Blockchain will enable the next generation of government services

Over the last 5 years BLING and our partners have learned a huge amount about what you have to do to build blockchain-enabled services and the challenges and risks you'll have to deal with on the way.

Here are 10 of the most important lessons we've learned about how blockchain will – and will not – change government services.

1 It is not about the technology. It is about the collaboration that is enabled by the technology – that's what matters

By providing new ways for organisations to collaborate, by providing platforms that build trust between organisations and between organisations and users, by enabling individuals and organisations to share verified information in verifiable ways – it is the new forms of collaboration that blockchain enables that are the real changes that will be delivered by blockchain-enabled services.

Ghent's Energy Loan and CJIB's Red Button projects both show the potential for sometimes quite radical rethinking of how services can work if there is systemic integration across different parts of government(s) to enable better services.

Skåne's work looking at how communities can use blockchain-enabled systems to deliver new forms of community governance shows how blockchain enables organisations to re-think how they work.

2 From co-design and co-production to co-delivery of services

Over the last 20 years we have seen significant changes in how government services are planned, organised and delivered. We have seen the shift from centralised top-down services towards the co-design and co-production of services with citizens and communities. Blockchain enables a further shift to co-delivery of services, where different organisations – even non-governmental ones – can be better integrated into service delivery.

3 Talk about blockchain

Despite the hype around blockchain, there are not enough projects, enough pilots, and enough proof of concepts out there. Because of this, many organisations that want to explore or test blockchain-enabled services don't know where to start.

4 Don't talk about blockchain

More people have *heard* about blockchain than actually *understand* blockchain. The lack of understanding of the technology, and the fear of its environmental costs are significant barriers to acceptance. Focus first on the benefits or the change in services or the collaboration that you want to deliver, rather than on the enabling technology.

Emmen's EnergieKnip and Roeselare's Leisure Pass are examples of projects where local governments work with a range of public and private providers to help deliver government services.

BLING's EnergieKnip is the Netherlands' largest government blockchain service. It has shown new ways to reach users, to work with retailers, and to drive service take-up through a blockchain-enabled platform. At the other end of the spectrum, we have BRAT – the Blockchain Readiness Assessment Tool. Developed by BLING's academic partners, BRAT helps organisations understand how ready they are to work with blockchain and whether they understand the technical, organisational, and legal questions they'll have to answer as they build blockchain-enabled services.

SEStran's work with stakeholders to identify opportunities for blockchain highlighted that technological adoption is rarely a case of replacing one service with another, and that blockchain is just one part of a wave of new disruptive technologies that governments will find challenging.

Ghent, Howest, and Roeselare all found when working with stakeholders that there was considerable uncertainty in the minds of stakeholders about blockchain – mostly due to fear of cryptocurrency. They found it easier to get stakeholders to focus on the project's goals first, rather than on the technology enabling the goals. They then found it easier to address these concerns.

Howest's Mobiliti pilot found that local organisations wanted to participate in the service, but were unable to participate in the blockchain network that underpinned the service. Organisations will have to tailor the design of their blockchain-enabled services to enable partnership working and the range of capabilities that exist in the real world.

Ghent's Energy Loan pilot identified the need to guarantee interoperability between digital wallets and the outsized impact Federal Government participation would have on their pilot.

5

5 It is the strength of your partners that will actually determine the success of your blockchain-enabled service

The organisational and technical abilities of a partnership will determine the scope and success of blockchain-enabled services. Smaller organisations may wish to participate in blockchain projects but may lack the technical ability to do so – in which case you will have to find ways to support them. Larger organisations can have an outsized impact by enabling integration with existing regional/national IT systems/services.

We see this with Roeselare's Leisure Pass, and with GeoPact's tools for local collaborative working, where the blockchain enables auditable data flows across organisations, which enables trust across delivery partnerships and allows for significantly greater understanding of how services are actually being used.

6

6 Rethinking service delivery and enabling decentralised service delivery at scale/volume

A key feature of blockchain is the ability to enable decentralisation. By allowing organisations to create new tools to collaboratively deliver services with clear, auditable records and data flows, blockchain-enabled services can enable new forms of collaboration with other service organisations, with communities, and for people.

Ghent's Energy Loan pilot and Antwerp's Blockchain on the Move pilots show how organisations can re-think how they work, how they share information, and how they work with internal and external partners to deliver better services.

7

7 Delivering efficient partnership working – at scale

Blockchain facilitates new forms of systemic collaboration between organisations and people. The technology collaboration can make complicated services simpler to organise and simpler to deliver.

8 Give citizens control over information sharing and services

By enabling formal ways of sharing information across and between organisations, blockchain can enable new and more efficient services. We can see a future where citizens are automatically given services and support that they are entitled to – without making citizens ask for this first. Tools like self-sovereign-identity will be used to give citizens close control over how and where their personal data is used, and by who.

Both of Oldenburg's proof of concepts explore this in detail, asking how citizens can manage their most personal information in ways that give citizens control while enabling collaboration between organisations and administrations.

8

9 Build re-usable tools

Across government we see many examples of stand-alone, non-integrated service delivery, where different services may use very different approaches and tools – even in the same organisation.

What we've seen through Antwerp's linking of the A-Card and Antwerp's service platforms and through the work Groningen and Emmen are doing around the MultiWallet are ways in which governments simplify and integrate their internal service delivery processes.

9

10 Blockchain will change how services are delivered. Except when it won't

We live in a multi-channel environment where services are delivered in a range of ways that are appropriate to the audience and which should reflect how the audience needs to be served. The need (if not the requirement) to continue providing multi-channel approaches – online, face to face and so on – will affect the speed in which governments adopt new technologies.

While blockchain-enabled solutions can transform some types of service design and delivery they will not remove the need to support different audiences through different service channels.

Across BLING's pilots and projects, we have seen blockchain-enabled services continue to support a range of types of customer engagement – the first EnergieKnip project was delivered entirely online, while EnergyKnip 2.0 will use personalised coaching to support citizens.

10

Blockchain is a very different way of thinking about technology and solutions and how people and organisations work together.

Blockchain projects are usually change projects.

And change projects always take longer than we expect.

Blockchain terminology like “zero-trust”, technological definitions of “public” and “private”, and “cutting out the middlemen” are often very misunderstood in the government sector.

CHANGING HOW WE THINK ABOUT CHANGE – BLOCKCHAIN AND NEW WAYS OF WORKING

Blockchain enables new ways of working, which should change how we think about the ways we change government services.

Shifting the ways organisations work and collaborate

Blockchain enables new forms of collaboration and provides new tools for organisations to work together. But government is not a place where people are used to thinking in a “decentralised” way about how services, workflows and organisations are and could be organised. As with the adoption of all other technologies in the digital transition, there is a need for a cultural shift in our understanding of how we could change how we work. The shift towards decentralised working that is enabled by blockchain should be seen as part of the wider shift from co-designing services to the co-delivery of services – as these new ways of working and collaborating are aligned with the wider transition away from top-down service design and delivery in the public sector.

Public sector organisations and staff often do not understand the place or the value of tools and approaches which are designed to facilitate trust between users and organisations. These collaborative tools have emerged from a very different working/collaboration environment, and there is often a need for the language and approaches of Distributed Ledger Technologies to be ‘translated’ into services and solutions which are better understood by governments.

Moving from potential to solutions

Government organisations are interested in blockchain-enabled solutions – particularly around how the technology can help governments to support people, to deliver services that cross multiple branches/units of government, and to support efforts at transparency – with challenges like e-voting (e.g. polls and local referenda).

While there is a lot of talk about blockchain as a technology that can change organizations and processes, many government organizations are not really confident about what this actually means in practice – what an organisation can do with this technology, what networks of organisations can do collaboratively, what the implications are for existing ways of working in organisations, and what are the technological requirements to be successful.

When governments usually adopt ‘new technology’ they aren’t actually adopting **new** technology – they’re adopting technology that is **‘new to government’**. This makes .the adoption of blockchain-enabled solutions trickier, as it is a new technology that is still evolving (and evolving quickly).

As there are fewer well-developed projects and use cases than might be expected, combined with the rapid evolution and development of the technology, governments are sometimes disappointed when they look to adapt or re-use existing blockchain solutions – particularly if they are looking to adapt published and hopefully open-sourced solutions. In these situations, governments may unexpectedly find themselves in the role of ‘early adopters’, and having to look at developing their own blockchain solution, which will take longer and cost more. This is why it is vital to build on existing networks – like the European Blockchain Partnership, to use transnational frameworks like EBSI (European Blockchain Services Infrastructure), and to build on the work done by innovation networks like BLING and TOKEN.

When governments begin developing blockchain projects they should link up with any existing work/approaches on digitalisation and e-services and innovation within their areas and within their government networks to see how/if they can facilitate what your objectives.

It's not about doing the same things'better' – it's about how you can now do different things, and combine services and information in different ways Shifting the ways organisations work and collaborate.

There is a need to understand that the public-sector is a very different delivery context from the private sector – where quite often they use the same words, but where the same words have very different meanings.

This has highlighted the need for BLING's services, pilots, proof of concepts and use-cases – BLING's work will accelerate the adoption of blockchain technologies by substantially increasing innovation capacity across the public sector.

Adopting new technologies

It is a mistake to think about blockchain as a single/monolithic technology. While users casually talk about putting things 'on the blockchain', in reality there are many different types of blockchain: some of them are public, many more are private, and they are all configured and managed differently. There are a wide range of distributed ledger technologies available, with multiple architectures and multiple supporting/enabling projects. One of the advantages of blockchain-enabled solutions is that they provide ways for multiple organisations/parties to work together and coordinate systems and ways of working. This organisational coordination is often a bigger challenge than the technical work.

As blockchain is an emerging technology, there is often a lack of relevant knowledge and technical capabilities within organisations when they consider adopting blockchain. For the same reasons organisations may have fewer options for external consultancy and support.

There is less technical and operational understanding of blockchain than we might like. As a result, we see some prejudice against blockchain solutions – fears of hacks, of high energy consumption, complexity, etc. – but this is often related to a partial understanding of how the private-sector and fin-tech use blockchain, and not about how government-focused solutions use the technology.

When we talk about "Blockchain", many people immediately link the technology to private uses of blockchain – they hear "Bitcoin" and "crypto". Far too many people think they are synonymous – they are not.

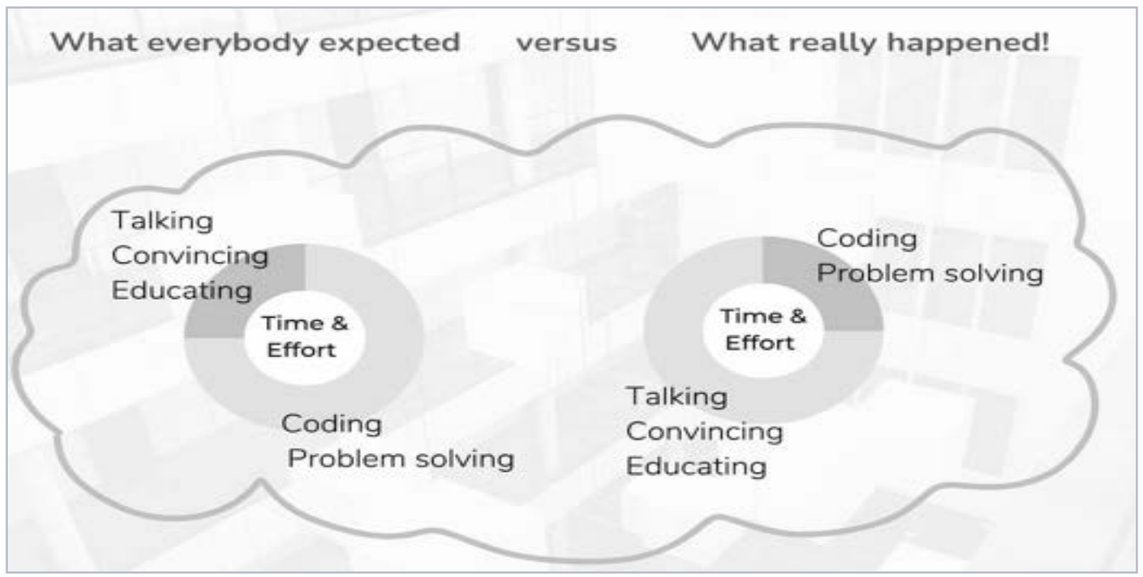
There is still too little knowledge about the technology, what possibilities it creates, and "when to use to use it" (and when not to use it). Like most digital technologies, blockchain suitable for some use cases but not others.

While there are many more blockchain services, pilots, proof of concepts and use cases than there were, we still need more. There are not enough successful examples/deployments in of blockchain-enabled services in government to successfully address the 'fear' of blockchain.

Organisations will need to manage the risk aversion – the fear and prejudgement around blockchain by stakeholders, civil servants, leaders etc. Organisations developing solutions will need active ambassadors in every organisation/department that is participating in the development and delivery of your solution. This can only happen with strong ownership and leadership, who believe in the approach and technological solution. Creating an environment that embraces new solutions and new ways of working (particularly across organisations) can be time-consuming – but this is true of all digital transformation projects.

The expectation vs. the reality of blockchain projects

The reality of blockchain implementation is that most of your time will be spent managing organisational change, rather than managing technical change. This will be even more true if your blockchain solution is linking different organisations and different ways of working.



Source: 'BLING _ Blockstart LL for Government.pdf'

10 BLOCKCHAIN MYTHS

Juho Lindman, University of Gothenburg, Sweden

The early hype around blockchains – including buzzwords and overblown expectations – played a central role in the early innovation activities which legitimized blockchain.

The overblown expectations and hype surrounding blockchain make it tricky to understand what has actually been delivered.

1 (Public) blockchains are disrupting the public sector all around the world

2 It is impossible to build successful blockchain applications for the public sector

3 There is one single obvious way to apply block chain technology in the public sector

4 If you build it, users will come

5 If it uses blockchain, it needs to be big and disruptive

6 Nobody knows how blockchains are implemented

7 Blockchain is a generic technological solution, similar to AI

8 We are not technology people and should not care about detailed design decisions such as blockchain

9 The results of blockchain projects contribute to blockchain knowledge

10 Users want to know that services are based on blockchain

BLOCKCHAIN PROJECT SUCCESS AND RISK FACTORS

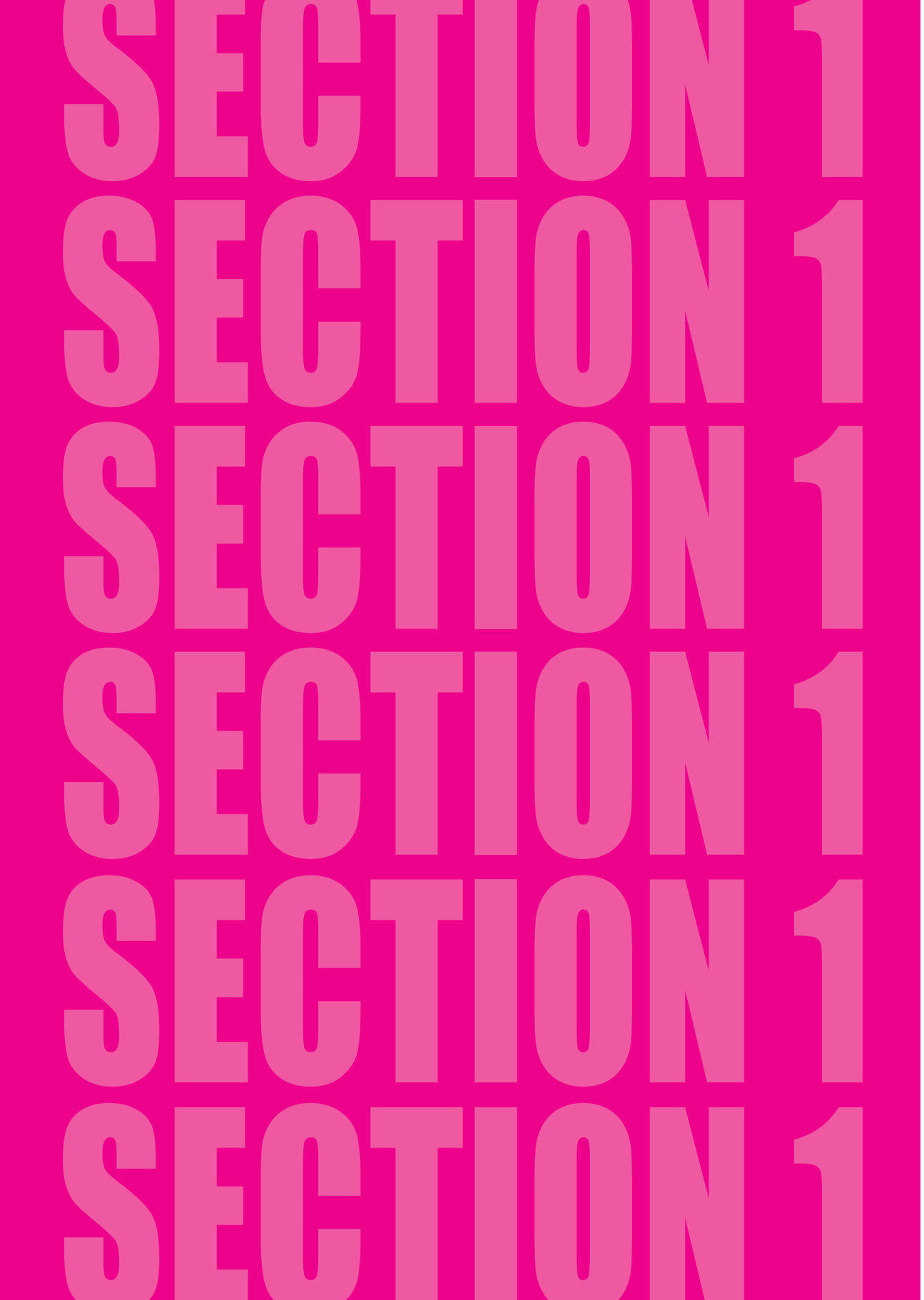
It is a mistake to think about blockchain as 'just' a 'technical' solution. The successful adoption of blockchain-enabled solutions entails overcoming new types of organisational and legal risks and challenges.

SUCCESS FACTORS FOR BLOCKCHAIN SOLUTIONS

CLEAR VALUE PROPOSAL	**The project must address a clear, specific business goal** If you want to build things for fun, organise a hackathon. If you want to change how your organisation works/delivers things, then you need a clear business goal that is supported by stakeholders.
APPROPRIATE TECHNOLOGY	**The project must use appropriate technology** Just because can use blockchain doesn't mean you need to use blockchain. (This is true of all technologies.) Your platform choice and configuration decisions should come after a robust analysis of technological options – not before.
STAKEHOLDER MANAGEMENT	**The project must identify and manage relevant stakeholders** Stakeholder engagement is key to successful blockchain projects – particularly when you are bringing together multiple organisations to link processes and share information. Stakeholder management is arguably the most important *success factor*.
USER FOCUS	**The project must engage end users with the service's design** Just because you've built it doesn't mean people will use it.

RISK FACTORS FOR BLOCKCHAIN SOLUTIONS

DISRUPTIVENESS	**Disruptive projects are generally more complex and difficult to implement** Disruptive projects need significant stakeholder buy-in, clear technology and operational road maps, and significant investment in ongoing stakeholder management if you are to build something that is both a technical and an operational success.
LIMITED SCALABILITY	**Projects that deliver solutions that do not scale might provide learning opportunities, but service deployment will be difficult** As part of your project planning, you should understand whether your solution can be used in other local/organisational contexts. If it's a stand-along project with minimal opportunities for wider adoption you should consider the organisational value of the project. Sometimes a project is just a proof of concept. Sometimes it is just a learning opportunity. Both of these outcomes are ok – but don't present them as something else.
LEGAL UNCERTAINTY	**Lack of clarity regarding the legal or regulative side hinders service deployment** You need clarity that the approach you want to take and the project that you want to build is actually legally deployable. If you are working with personal data, you must be GDPR compliant. If you want to use tokens/coins etc. to manage the allocation of funds to citizens and organisations, you must make sure that this approach is allowed. Collaborate with decision makers to make sure that any legal or regulatory questions are resolved in advance – or as soon as they arise during development. There is no value in building a solution that is a technical success, but which cannot deployed.



SECTION 1 – USING BLOCKCHAIN FOR SERVICE INNOVATION AND CAPACITY BUILDING

This section begins with some of the key lessons from BLING – lessons learned on how to build technical innovation capacity, how to get the most from blockchain technology, and improving how we govern, manage, and implement new blockchain-enabled processes.

We follow these lessons learned with the learning from a series of real-world pilots, proof of concepts and use cases. These explore ways to identify services that could be improved with blockchain-enabled solutions, how blockchain can simplify meeting management, and how to help people move houses. What these examples show are the many situations where blockchain-enabled tools can radically improve local government services.

TURNING BUZZWORDS INTO PUBLIC SERVICES

A Comparative Case Study of European Blockchain adoption... and the fear of missing out

Livia Norström and Juho Lindman – University of Gothenburg, Sweden

> Analyzing buzzwords before – and as – they enter organizations is important for better understanding the early stages of the innovation processes of organizations.

Public sector organizations lack ways to understand and experiment with technology that is not yet fully mature and which is surrounded by high levels of expectations and hype – like blockchain.

As a first step of bridging this knowledge gap, academics from the University of Gothenburg examined the early innovation activities with blockchain technology in local governments in Europe. Cases were selected from the European public sector and research was conducted by the Gothenburg BlockchainLab as part of the BLING project – where academic institutions and public sector organizations collaborate to increase knowledge about public sector blockchains.

Researchers found that the 'organising vision' of local governments who were trying to innovate with blockchain-enabled solutions was made up of three things:

- how the organizations interpreted blockchain technology,
- how they legitimized its use in the public sector context, and
- how they mobilized resources to experiment and implement blockchain technology.

They explain the three processes in detail and explore how this overall vision is shaped by the hype of blockchain technology and the overblown expectations of its benefits.

Interpretation

Organizations' *interpretation* of blockchain technology was mainly based based on secondary sources such as industry press and technology vendors, on private sector experience, and – especially – about Bitcoin. This knowledge helped organizations to try out blockchain in practice. This then led to tensions and contradictions when the technology – created for a private sector context and surrounded by high expectations – was applied in the public sector context. These tensions and contradictions created both technical and organisational learning opportunities for government organizations experimenting with blockchain.

> The hype around blockchain helped organizations and individuals advertise their early blockchain efforts in the media. These efforts likely had positive organizational and career impacts on the proponents.

Legitimacy

Legitimating experimentation with a novel technology in an organization can be tricky. This was especially true in the case of blockchain in the public sector, when there were no best practices and established use cases to rely on.

To legitimize the use of blockchain, buzzwords such as "decentralization" and "revolution of public sector" were heavily used in the organisations the team studied. The media played an important role in spreading both these buzzwords and the organizations' interest in innovating with this new technology. In some cases, the examination of blockchain-enabled solutions was legitimized by technologically driven arguments including the "fear of missing out" and for the need to be the "first to innovate".

INTERPRETATION Understanding of blockchain was based on...	LEGITIMIZATION Blockchain rationales were motivated by...	MOBILIZATION Internal resources were allocated by...
Information from technology vendors and press	Attention in media	Seeking expert knowledge in university students and technology consultants
Influences from private sector and especially Bitcoin with no empirical evidence from public sector cases	Technology driven arguments about “fear of missing out” and being the “first to innovate”	Supporting local entrepreneurs to build a longer-term innovation environment
Learning by experimentation, discontinuities and tensions between conflicting blockchain affordances	Individual managers innovation interests	Advertising blockchain projects in media to get positive organizational and career impacts on proponents
	Conceptualized business needs	

Delivery

The *mobilization* process is about allocating resources and organizing activities to realize the technology’s benefits. Organisations they studied sought expert knowledge by turning to university students and technology consultants and by organizing hackathons where partners can meet and collaborate around blockchain technology. These activities are an important part of building a long-term innovation environment. They make organisations appear attractive to both internal and external/regional actors, and also show a willingness to support local entrepreneurs and innovation ecosystems.

A blockchain hype matrix

The table summarizes local public governments enactment of the hyped blockchain technology through interpretation, legitimization and mobilization:

Summary

Gothenburg’s findings show that the early hype around blockchains – including buzzwords and overblown expectations – played a central role in the early innovation activities which interpreted and legitimized blockchain technology, and when mobilizing local resources to work with the technology in these organizations.

Norstrom, L., Lindman, J., Lindquist, M., Karlsson, J., & Landsten, N. (2022). Turning Buzzword into Public Service: A Case Study of European Blockchain Projects. In Americas Conference on Information Systems, Minneapolis, August 10-14, 2022.

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BRAT – THE BLOCKCHAIN READINESS ASSESSMENT TOOL

A new tool that tests organisational readiness across 6 domains

Juho Lindman and Livia Norström
University of Gothenburg and UGBlab, Sweden

Introducing BRAT

The University of Gothenburg’s BlockchainLab has released the **Blockchain Readiness Assessment Tool**, which is freely available. The BlockchainLab is an initiative to establish a creative environment that allows researchers and students involved with the University of Gothenburg and Swedish Centre for Digital Innovation to work with blockchain solutions in their studies and research.

Organizations can use the tool to better understand their knowledge of blockchain and the success factors affecting successful deployment. Developed with the support of the BLING project, the tool has undergone significant testing within the partnership and with governments and organizations across Europe. The online tool will provide users and organizations with a range of targeted materials to help them develop their capacity to undertake their own blockchain journeys and to develop relevant skills and capacities for success once they’ve undergone the assessment.

BRAT is intended to be used in one organization at a time. A maturity score will be generated for each organization, which can be compared to that of other organizations as a benchmark.

An organisation can also repeat BRAT, and compare results to their earlier scores to see how their capacity is developing over time.

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 will 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 when assessing the technology and making design and architecture decisions.

Against this backdrop, GUBlab and BLING have developed the *Blockchain Readiness Assessment Tool* (BRAT) as a tool for organizations who want to explore the development and design of blockchain-enabled services. The tool is a survey instrument that can be used by organizations to facilitate internal discussions about their readiness to adopt blockchain, and their organization's capacity and capabilities.

Users of BRAT should be able to make their organization more aware of its capacity to explore/adopt blockchain enabled services, and the tool will identify areas where improvements can be made and where organisational capacity can be developed.

BRAT is designed as a set of simple questions that support discussions around the key aspects that make up an organisation's blockchain maturity. It covers six themes for public sector organisations: 1) business need, 2) organization roles and participants, 3) blockchain architecture, 4) legal requirements, 5) data handling, and 6) the more philosophical aspects which we call 'mandate'.

These domains are explored in more detail below, with each theme explained and then followed by a question prompt to lead the organisation's discussions on blockchain exploration/adoption.

The Blockchain Readiness Assessment Tool

BRAT can be used in two ways – as a survey, and as a workshop tool. Organisations can survey employees and stakeholders and collate survey responses to develop a broad organisational view of their relative strengths and weaknesses across the six domains BRAT covers. Alternatively, organisations can complete the tool through workshops with staff and stakeholders – this approach may facilitate greater discussion about relative organisational strengths and experiences and provides an opportunity to bring in external experts and facilitators.

The BRAT tool provides an organisation with a structure to gauge their blockchain readiness by focusing on capacity in six thematic areas. Each theme begins with a statement setting out relevant issues/background, and then gives a question prompt to help the organisation consider their readiness to adopt blockchain technology. The participants score each question on a numeric scale from 1 (Strongly Disagree) to 6 (Strongly Agree).

These six domain scores can then be combined to provide a score for the organisation, which can be used to either benchmark the organisation against peers, or to track the organisation's progress over time. The BRAT tool will also provide tailored recommendations for additional resources, based on the organisation's overall score and on the individual scores in the six domains.

THEME 1 BUSINESS NEED

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

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

THEME 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. This covers the organisations who will participate in delivering the service, the organisations that will fund the service, the organisations that will use the service, the organisations that will provide technical support, and so on.

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

THEME 3 BLOCKCHAIN ARCHITECTURE

When creating a blockchain application, there are a range of technical and architectural design choices that need to be made about the blockchain. These range from determining how open the blockchain should be (i.e. public vs. private), to choosing which consensus mechanism your solutions will use, to deciding on a transaction model. These choices should be made to fit the needs and requirements of the organisation's particular use case.

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

THEME 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.

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

THEME 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:
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.

THEME 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 their working processes, and reduce the need to use or rely on intermediary partners.

Question:
As an organization we are... 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 developing 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 would indicate that an organization might be at the start of their blockchain journey, and should work to develop the capacities that they don't yet have, and to address the self-identified capacity gaps in 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 service development.

SCORING THE BRAT

QUESTIONS FOR BLOCKCHAIN APPLICATIONS. AS AN ORGANIZATION, WE ARE/HAVE...	ANSWER *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 appilcation	1 2 3 4 5 6
2 A clear understanding of the roles required in our application and who should fill those roles	1 2 3 4 5 6
3 A thought-out strategy for making design choices about the architecture of our blockchain solution	1 2 3 4 5 6
4 Identified which area of legislation our blockchain solution must comply with	1 2 3 4 5 6
5 A clear understanding of what kind of data we should store on the blockchain and what to store off-chain	1 2 3 4 5 6
6 Discussing if/how blockchain-based government services can change the role, need and mandate of the public sector	1 2 3 4 5 6
ORGANISATIONAL SCORE:	

HOW GOTHENBURG'S BlockchainLab USES BRAT TO SUPPORT SERVICE CHANGE

Building capacity, identifying risks

Juho Lindman – University of Gothenburg / GUBlab, Sweden

The University of Gothenburg's BlockchainLab has released the Blockchain Readiness Assessment Tool (BRAT). BRAT has been made freely available for groups and organizations to use at blockchainingovernment.eu.

BRAT is a workshop tool developed by researchers that can be used by organizations who want to learn more about blockchain and what it can do and whether they have the skills and capacity they need to assess and develop blockchain-enabled solutions. The purpose of the tool is to help organisations "measure, discuss and follow-up" their blockchain capabilities and to explore how an organisation's aims align with their internal capabilities, skills and competencies.

The GU BlockchainLab has learned through extensive stakeholder and practitioner engagement that while there is a lot of talk about blockchain as a technology that can change organizations and processes, many organizations were not really confident about what this actually means in practice, and how the technology could be used to deliver their objectives. If we could provide these organisations with organised blockchain-related knowledge, this could be used to help these organisations to understand the technology better. So, if an organization is discussing implementing a blockchain solution and has already carried out some piloting with blockchain – but wants to learn more – this is a useful tool that can be used to provide structure to their capacity and technological development.

> While there is a lot of talk about blockchain as a technology that can change organizations and processes, many organizations are not really sure what this means in practice.

> The Blockchain Readiness Assessment Tool was developed by the University of Gothenburg's BlockchainLab in the University's Department of Applied Information Technology as part of the BLING (Blockchain in Government) Interreg NSR project.

> The BlockchainLab is an initiative to establish a creative environment that allows researchers and students involved with the University of Gothenburg and Swedish Centre for Digital Innovation to work with blockchain solutions in their studies and research.

BRAT in practice – a three stage approach
Gothenburg University's BlockchainLab uses BRAT as part of a three-step process to help organisations build capacity and identify gaps and risks in their blockchain knowledge.

Step 1 – initial survey
The initial survey is a short form that is sent to the organization to collect information about their blockchain maturity. The BRAT tool address blockchain understanding and capacity across six domains: business needs, organisational roles and participants, expertise, technical architecture, data management and legislation.

Step 2 – results workshop
The results workshop is an in-person (or online) workshop that offers an opportunity for the organisation and stakeholders to review the BRAT survey results, to rate the own organization's blockchain maturity, and to develop action plans with blockchain experts.

Workshop participants can be selected from survey respondents and relevant stakeholders,

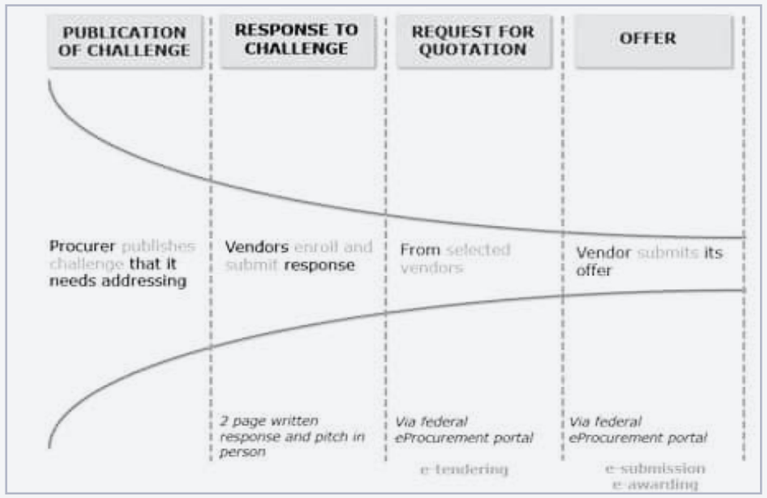
and should represent blockchain-informed stakeholders from the organization. People who have been involved in earlier potential blockchain pilots, and service users should also be included if possible.

Step 3 – reporting
At the end of this process GUBlab provides a status report, which is a short report that summarizes the findings from the survey, and the results workshop. This report gives suggestions on challenges and opportunities that are specific to the organization.

USING BLOCKCHAIN IN THE ‘SMART PROCUREMENT TOOL’

How the city of Antwerp and their IT partner Digipolis re-thought their procurement process

Joris Moorthamers and Kris van Berendoncks,
Stad Antwerpen, Belgium



Buy from Start-ups procurement procedure

Introducing Digipolis

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, 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 Digipolis Antwerp, with the vendor enrolling and submitting their initial response to the challenge on this website, the later stages are not. Thepublication 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’programwanted 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

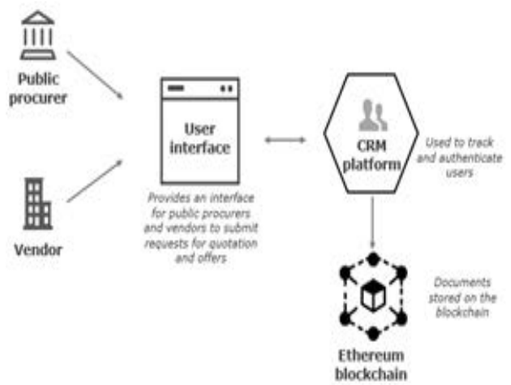
To meet these objectives, Digipolis has developed a blockchain-based smart procurement tool which enables procurers to publish a request for quotations and vendors to submit their offers.

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.



Components of the smart procurement tool

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.

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). We have approached the Port of Antwerp to add an additional node. 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.

In the two years after launch Digipolis has 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.

BLOCKCHAIN AND DIGITAL TRANSFORMATION IN THE PUBLIC SECTOR – THREE KEY THEMES

Understanding the potential transformation of public sector services, and the new value this could create

Livia Norström and Juho Lindman, University of Gothenburg, Sweden

Blockchain technology will facilitate digital transformation in the public sector by offering tamper-resistant storage, a decentralized governance and sharing architecture, and by enabling novel types of services.

Blockchain technology also challenges a number of key assumptions about how the public sector is organised, and about how it changes.

Future possibilities

Every so often, a technology arrives that spurs digital transformation and prompts us to re-think some of the previously taken-for granted assumptions about how public-sector organizations work and how they deliver services. Blockchain is one of these technologies.

Blockchain allows for more reliable record keeping, increased security, and higher quality transactions and data, which are important improvements in public service. Blockchain-enabled solutions will enable organizations and stakeholders to manage and track transactions, data, and services. This opens up possibilities for new ways of organizing service delivery, and could enable new cultures of openness and collaboration in service design and delivery.

Current hype
Gartner's Hype Cycle for 2019 (Gartner, 2019) lists blockchain as one of the most important technologies for digital government. The early hype around blockchains – including buzzwords and overblown expectations – played a central role in the early innovation activities which interpreted and legitimized blockchain technology, and when mobilizing local resources to work with the technology in organizations.

However, the overblown expectations and hype surrounding blockchain make this a tricky area for research and development; it is much easier to find information about project launches and plans than information about blockchain's actual deployment for end users.

Technology and change
With the complex problems it faces, the public sector must organize for change. The importance of understanding digital transformation in the public sector is increasing as novel technologies challenge assumptions about how public organizations organise themselves and how they deliver services.

There is a need to better understand the challenges that public-sector organizations face when they are conceptualizing and designing for change with blockchain technology. More research and theorizing are needed on the transformational effects of blockchain, especially on how the decentralized service architectures implied by blockchain and distributed ledger technology challenge the prevailing organizational paradigm of centralized control and governance.

We can align the attributes of blockchain technology (new service functions and features, e.g., immutability; new *organization forms*, e.g., stakeholder collaboration and a new decentralized way of working, including delivery of new *values* in terms of service outcomes) against the attributes of digital transformation in the public sector (changes in *service*, changes in *organizational structure and culture*, and changes in *value delivered*).

There are three things which we need to explore to better understand the impact of blockchain and similar novel technologies:

1 the transformation of public services,

2 the transformation of organizational structure and culture in public services, and

3 value creation (including the creation of 'non-economic' value).

3 key questions on the impact of blockchain on organisations

First, research is needed to understand government organizations' business needs and how blockchain technology can support improvements in the delivery of public services. We need more evidence of the scale of public-sector blockchain usage through both empirical data and use cases. We also need better knowledge of the legal issues organizations must tackle when using blockchain technology for service delivery.

Second, the decentralized character of blockchain technology implicitly (and sometimes explicitly) challenges our existing beliefs about ways of working/delivering services in the public sector. It particularly challenges beliefs in the traditional paradigm of service design and delivery through centralized/top-down organisations. This decentralised shift poses questions about the prevailing organizational structure and culture in the public sector, and how suitable it is for new emerging service delivery approaches that are increasingly collaborative and decentralised.

We must also better understand the how practitioners are organising blockchain projects to meet service design and delivery challenges. A range of different approaches to experimentation and innovation are currently being used to deliver different types of projects across a range of service domains.

The importance of understanding digital transformation in the public sector is increasing as novel technologies challenge assumptions about how public organizations organise themselves and how they deliver services.

Third, it is clear that decentralized service architectures may lead to entirely new types of service offerings, offering new and different types of values to citizens and other participants in these networks. This transformation requires an in-depth understanding of:

- how blockchain may *disrupt public-sector processes*, and
- what changes in (citizen, organisational) values may result from such disruptions,
- how blockchain can *reconfigure trust* between the public sector and citizens, and
- what the *role of the public and private sectors* will be in these new dynamics

We are only at the beginning
The technology of blockchain enables changes in how organisations work, how they are structured, and how they collaborate with other organisations to deliver new kinds of services. We are only at the beginning of this transition, and work is needed to better understand the real-world implications of this shift and the relationship between digital transformation and new forms of service delivery.

Norstrom, L., Lindman, J., (2023) Digital Transformation in the Public Sector and Blockchain.– A Research Agenda – unpublished manuscript

HOW BLING SUPERCHARGED BLOCKCHAINLAB DRENTHE

From a kitchen table to China – the story of BlockchainLab Drenthe

Adri Wischmann – BlockchainLab Drenthe, Netherlands

Serendipity, hard work and Interreg took 3 entrepreneurs from a kitchen table to build an internationally recognized organisation that has delivered the biggest public service government blockchain project in The Netherlands.

Some history

Satoshi Nakamoto may have invented Bitcoin in 2008, but it was 2016 before the founders of what would become BlockchainLab Drenthe discovered blockchain. In the beginning, a handful of enthusiasts would meet at an office or in someone's living room and they'd give each other homework assignments – "next time you will explain what 'consensus' is, and I will explain what a 'Proof-of-Work' is". From September 2017 there were monthly open meetings, where the community worked to help each other understand the ins and outs of Distributed Ledger Technology.

In February 2018, BlockchainLab Drenthe Foundation was established as a non-profit foundation with the goal “to spread knowledge, experience and insights about Distributed Ledger Technology”. Jeroen Wester, Danny Dreves and Adri Wischmann were the founding members, helping their community to sail off into uncharted territory.

A few months later in July 2018 serendipity struck on a trip to the Interreg Like! conference in Angus, Scotland. A wee chat between Adri Wischmann and Tineke Smegen from the Province of Drenthe during a bus ride between conference venues planted the seed for the long-term collaboration between the Province and the BlockchainLab. It turned out that the Province needed people who knew about blockchain to support Drenthe’s participation in the BLING project, and BlockchainLab Drenthe was in need of a partner/client who could provide projects, funding, and a network. A match made in Blockchain heaven, just in time for BLING’s kick-off in February 2019.

Our first BLING project – the Self Sovereign Attendancy App

It was not easy to set up our first project. A governmental body like the Province of Drenthe is not used to thinking about decentralized ways of working – and a number of ideas were scrapped before we found the inspiration for our first project, the Self Sovereign Attendancy Application. The app is a blockchain based, GDPR compliant alternative to the (hand)written attendance lists which have to be signed at every Interreg event (but which are not compliant with a number of GDPR rules).

Our motto “eat your own dog food” was the driver for BlockchainLab to develop a blockchain based solution that could manage a list of meeting attendees and prove that the meeting hosted X number of people, while preserving the attendee’s privacy. The app gave attendees a way to prove they were present, without needing to ask the organizer to confirm that they were there – the app could do that! It took quite a bit of work to determine what GDPR compliance would look like for this use case, but after building and showing our proof-of-concept the Self Sovereign Attendancy-app was born and field tested at a number of events (e.g. the 2022 North Sea Conference in Bruges). It’s now been proposed that Interreg uses the SSA-app instead of traditional paper attendance lists for all their project and network meetings.

Our Second BLING project: the Netherlands’ largest government blockchain-enabled service

The Municipality of Emmen – another BLING partner – was struggling to develop a use case that allowed them to distribute funding from the Municipality to citizens. In November 2020 Emmen got in touch with BlockchainLab Drenthe: Jan Willem Bos and Adri Wischmann started working with Emmen and over time convinced them that they could build a tool that used blockchain to enable a new type of service to distribute government funding/subsidies.

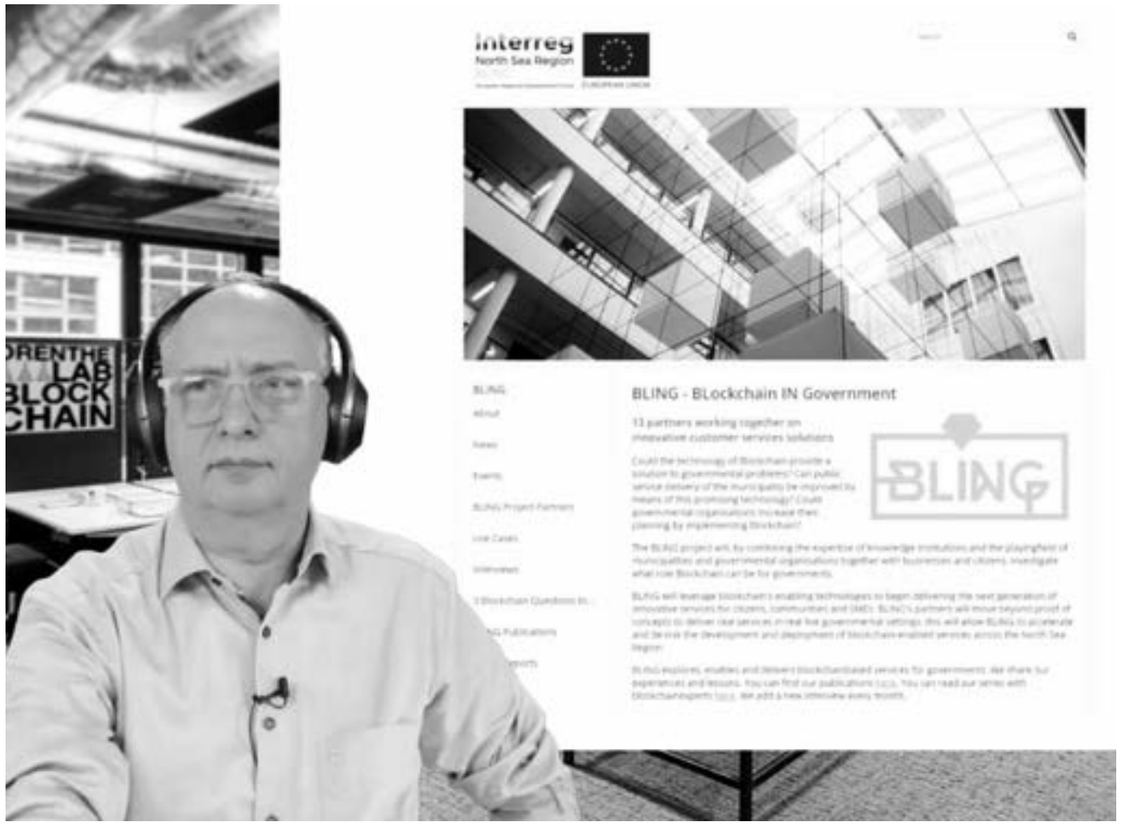
10 months and a feasibility study later, programming started on EnergieKnip (Energy Wallet) – a blockchain application based on the IOTA protocol. EnergieKnip allowed citizens to anonymously submit information about their domestic (home) energy usage, and rewarded them with €50 worth of tokens that could be redeemed for energy saving equipment at hardware stores in Emmen.

EnergieKnip was a win-win-win-win situation for:

- the residents, who received energy efficient devices and gained energy awareness through the app,
- the Municipality, which gained a very efficient way to distribute funding, and which gained a lot of information about how their citizens use energy,
- local retailers, which got a lot of revenue and new clients, and
- the environment, because lots of energy and CO2 were saved.

Emmen had previously used a paper voucher system to deliver energy support, but after 7 months it had only been able to give away 16% of their budget.

EnergieKnip was launched on January 11th 2022 with a budget of €150.000, and only 13 days later (on January 24th) all of the money had been claimed. An additional €150.000 was then released, and it only took 11 more days for all of that to be claimed. Nearly 50.000 wallets were sent out (1 for every home in the Municipality) making EnergieKnip the largest government/public services blockchain project in The Netherlands.



EnergieKnip (and BlockchainLab) received national and international media attention, with articles in China and even Al Jazeera contacting us to learn about our “Blockchain driven energy project”. Then came national and international events where we were able to present EnergieKnip to new audiences.

EnergieKnip 2.0 is currently being developed – it will allow Emmen to distribute energy saving appliances to low-income citizens.

Teaching blockchain

There are many companies which want to jump on the blockchain train and who want to build blockchain solutions. But the number of blockchain programmers and experts is extremely small. BlockchainLab Drenthe wanted to do our bit to change this (as much as any small organization can), and so we convinced NHL Stenden University of Applied Sciences to start delivering two blockchain courses in September 2021, which now trains 40 students per year.

The EnergieKnip spin-off

Russia’s invasion of Ukraine led to the tripling of energy prices in The Netherlands. The Parkstad Region in the South of the Netherlands contacted us if we could help them with distributing €5,000,000 to 20,000 families who were in financial difficulties because of these high energy costs. This resulted in the Parkstad EnergieKnip, which we deployed in a record breaking 6 weeks, so these households would receive targeted financial support to help them pay their energy bills.

IT-Hub

In 2022 the Province of Drenthe started the IT-Hub initiative in the Municipality of Hoogeveen, which was set up to promote IT knowledge among students and to help companies with automation projects. IT-Hub provides a bridge that connect entrepreneurs, schools and government. BlockchainLab Drenthe is providing much needed knowledge and experience about distributed ledger technology to the hub.

So...

Now, don’t think this was all smooth sailing; everywhere you talk about implementing blockchain you are met with prejudice, scepticism and resistance. Persistence and enthusiasm has brought us to where BlockchainLab Drenthe is now but being able to show successful deployments makes it (somewhat) easier!

MAKING MEETINGS MANAGEABLE – THE SELF-SOVEREIGN ATTENDANCY PILOT

BlockchainLab Drenthe brings meeting registration into the 21st century

Niels Annema – Province of Drenthe, Netherlands
Adri Wischmann – BlockchainLab Drenthe, Netherlands

The Province of Drenthe is the lead partner for a wide range of European projects, and a lot of administration is required to successfully deliver them. The Province commissioned BlockchainLab Drenthe to deliver the Self-Sovereign Attendance pilot, which replaces the paper attendance/ registration lists that organisers have historically used to record lists of attendees at meetings and events with an app-based GDPR compliant blockchain solution that uses a 'self-sovereign identity' approach.

> The app has been able to give users control of their own data.

Moving beyond paper lists of people

Despite being in a profoundly digital world, many events still use paper signature lists to prove that someone was present at the event. The use of these paper attendance lists is problematic – paper lists contain large amounts of personally identifiable information (often including names, organisations, addresses and signatures) which can be accessed by other attendees and other parties. By creating a mobile application based on blockchain technology and using self-sovereign identity, the app has been able to give users control of their own data, end inadvertent data sharing, while still being able to prove attendance at events.

What is self-sovereign identity?

Self-sovereign identity (SSI) is an approach that allows a user to provide their own credentials which are used to manage their own digital identity. This gives users control over the information that they use to prove who they are to websites, services, and applications. Traditional approaches to identify verification rely on the use of existing identity providers who verify a user by linking the user to their service – as Google (Google Sign-In) and Facebook (Facebook Connect) do. If a user relies on an identify provider, that provider has control of the information associated with the user's identity and the provider can control how and where a user can verify their own identity. In a self-sovereign identity system, users control the credentials that they hold, and the user's consent is required to use those credentials. This reduces the risk of unintended sharing of users' personal data.

How the SSA app works

The meeting organiser uses the app to register an event on the blockchain, after which the organiser receives the event key in the form of a QR code. Meeting attendees can only scan the meeting key when they are present at the event, and when they scan the meeting key with the SSI app the app registers the user's own unique key and then receives the certificate of attendance for that event. After the event is closed, the attendee will always be able to prove that they were present by showing the event's certificate.

If anyone else needs or wants to verify this attendance (e.g. for control or audit purposes) they will be able to validate the unique key on the blockchain and there will be no need to share the attendee's personal information or the personal information of other attendees. Administrators will still be able to evidence the number of attendees at their event, but they will no longer be forced to inadvertently share attendees' personal information.

It took quite a bit of work to determine what GDPR compliance would look like for this use case, but after building and showing our proof-of-concept the Self Sovereign Attendancy-app was born and field tested at a number of events (e.g. the 2022 North Sea Conference in Bruges). We have now suggested that Interreg uses the SSA-app instead of traditional paper attendance lists to manage attendance and reporting for all of their project and network meetings.

The idea of using self-sovereign identity to verify individual users was central to the creation of this pilot. With the application now in use, we were able to prove that it is possible to change the way organisations currently work and to provide people with more control over their personal data.

Learning from the BLING partnership

In any relatively new field of work it is nearly impossible to keep track of all the developments by yourself. The BLING partnership has shown BlockchainLab Drenthe many other possible uses of blockchain technology. The other pilot projects in BLING are taking many different approaches to solve a wide range of problems. This allows us to share the learnings about the many technical and organisational challenges they have faced. It has been very valuable for BlockchainLab Drenthe to be able to discuss the technological aspect with other developers in the project, as there are still relatively few blockchain developers, so all opportunities to discuss your challenges and learning is useful.

But the feedback so far on the SSA pilot has been great. Everyone that has tested the application for themselves immediately recognized the problem with the paper signature lists, and saw the need to change to a better system. In their showcases the BlockchainLab showed participants a copy of a signature list that they had downloaded from the internet. This really resonated with app testers as they recognised that they

could potentially be on one of these lists, as it's too easy to accidentally publish this information. Having a robust system that gave users control of their own data has definitely helped to highlight the value and usefulness of self-sovereign identity applications.

The SSA app is trying to get rid of a fairly annoying activity, so people are very open to changing that system. It has been interesting to see that when presenting the application, the first thing most people do is trying to find the loopholes and possible problems with it. People will think of very specific scenarios and see if the app will still work properly. Fortunately, pretty much all of these questions were considered and resolved by BlockchainLab Drenthe during the feasibility and design stages of the SSA solution.

Blockchain shouldn't be the story

The biggest lesson for us in using blockchain is that it is not always useful to talk about blockchain. To many people, blockchain has a lot of negative connotations and this makes it more difficult to talk about the possible blockchain use cases in an organisation than is the case with other technologies. Some people link blockchain with cryptocurrencies and volatility and scams. Others are confused about the specific technologies underpinning blockchain, and therefore are not as eager to start a project or research on blockchain.

If we focus on possible solutions or improvements in processes that can be enabled by blockchain, we found we had a lot more enthusiasm from stakeholders. After all, most people are not really interested in the specifics of how solutions are built c they just want them to work. If can avoid the distractions of discursive generalised views on blockchain and focus on the key concepts and aspects of blockchain-enabled solutions, we can still have these conversations and achieve useful projects.

What happens next to the SSA app

Now we are focussed on rolling the app out to the other partners in the BLING project, after which we are aiming to reach out to other Interreg projects to also make sure that they are aware of our solution and the GDPR benefits it brings.

The province of Drenthe has commissioned an external consultancy firm to investigate the legality of the continued use of paper attendance lists and to analyse the pros and cons of replacing these lists with the SSA app.

While our main focus in designing the app has been the Interreg ecosystem, anyone in the world who runs an event is able to use the app to manage attendance.

BlockchainLab Drenthe
BlockchainLab Drenthe on YouTube

Id

BLOCKCHAIN ON THE MOVE – GIVING YOU CONTROL OF YOUR OWN DIGITAL IDENTITY

A Self Sovereign Identity proof of concept between the city of Antwerp, VICTOR, and Information Flanders

Joris Moorthamers and Kris van Berendoncks – City of Antwerp, Belgium

Is blockchain part of the solution to a number of tricky issues around identity, privacy, and online transactions? And if it is part of the solution, what's the best way to make it part of the solution? The City of Antwerp explored this question – in co-creation with Digipolis, Information Flanders, and the Flemish ICT organisation (V-ICT-OR) – in the 'Blockchain on the Move' project. The project's goal was to develop an approach that would give citizens control of their data by giving them a digital identity – on blockchain.

Blockchain on the Move aimed to develop tools and approaches to give citizens control over their own data. In a digital world the protection and management of personal data is becoming increasingly important – and if you are in control of your own personal data, you can decide for yourself how, when, with who, and for how long you share this information.

'Blockchain on the Move' started in March 2018 with support from the Flemish Government's Program for Innovative Public Procurement (PIO).

Using Self Sovereign Identity to manage information

Information about citizens is often stored in multiple databases which are managed by a wide range of different organizations. Citizens are often unable to manage this data, don't understand how and where this data is being used, and usually can't make sure that it is accurate or complete. The project partners wanted to develop innovative solutions that would safely and transparently handle data and transactions between citizens and the government.

With a self-managed identity (Self-Sovereign Identity or SSI that can be provided through blockchain-enabled systems, **Blockchain on the Move** aimed to provide a recognised process to enable citizens to take ownership of both their own data and their digital identity. By using SSI approaches to manage their data, citizens can both validate their own data – ensuring that names and addresses are correct for example – and then easily share this validated data *if they wish to*. SSI approaches should also allow citizens to understand and manage which organisations are able to see and use any data that the citizen chooses to share.

SSI and blockchain

Blockchain technology stores data in a decentralized way. With SSI, the individual is in control of their own data and can decide who to share their data with – and the user can also *withdraw* the right to use their data. Rather than having personal information in many central databases, SSI enables the user to control their own data in one place, and to then decide which third parties are allowed to have limited access to it. SSI solutions remove the need for intermediary or third-party agencies (e.g. Google or Facebook) to provide identify services for users. As permissions to access data is controlled by access to the blockchain, SSI solutions also mean that only those who are given the correct key can open the 'lock' and consult or use certain data that is managed through the blockchain. Blockchain solutions also offer cryptographic mechanisms to confirm that their information has not been accidentally or intentionally modified.

Blockchain on the Move (BotM) was the first attempt by project partners to provide Antwerp's citizens with a Self-Sovereign Identity (managed through a blockchain solution) that they could use with governments, public organisations, or companies.

The project also looked at developing a 'digital vault for citizens'. Citizens would be able to manage and store their own data in the vault, and grant access to this data to third parties. The initial use case for this tool would be for the 'relocation process' – citizens would use their digital vault to share information with the city to streamline the registration of a household move. This seemingly simple process actually triggers a complex set of processes in the city, and the partners were looking for ways to simplify and automate the processes.

The Blockchain on the Move plan

The initial Blockchain on the Move plan had two phases:

Phase 1

Development of the Self-Sovereign Identity (SSI)-building block – a generic ID solution based on Blockchain technology that could be used in service development and testing, and

Phase 2

Development of the 'relocation process' use case.

At the end of Phase 1 Jolocom GmbH delivered a proof of concept (POC) or 'first version' of the SSI building block. This illustrated the potential of SSI, but was not the 'total' SSI building block the partners had envisaged.

The BotM partners then revised plans for Phase 2, and used the SSI proof of concept built in Phase 1 to examine the potential feasibility and added value of SSI-based optimisation of some of the processes used by the City of Antwerp. This envisaged using a central customer profile – based on the citizen's self-managed identity – to improve and simplify service delivery and management.

BoTM Use Case 1: linking the A-card and the A-profile

The A-card is Antwerp's user card, which gives citizens and visitors access to many of the city's services, including libraries, swimming pools, youth and district services, and household waste disposal facilities.

The card plays three different roles in the city:

- it is a loyalty and access card for leisure service users – for both city and private leisure services
- it is a user pass that grants access to various city services, and
- it is a personal discount card for residents receiving financial support or on low-incomes

You can apply for an A card at more than 100 locations in Antwerp: at the city shop, at museums, at libraries and pools, at one of the city's service counters, and so on. More than 750 city employees are trained to deliver this service.

After registration, a unique A-card number can be linked to the citizen. If you receive certain kinds of government support this can also be linked to your A-card.

When the proof of concept was being developed, administrative simplification was a key aim: the rules about services and service access that are delivered through the A-card (e.g. the costs of services, reward criteria for frequent service users) are made in 8 different parts of the organisation. There is also a need to understand how services are being used across the city – which was not particularly straightforward with the information they were collecting through the A-card at the time.

The A-profile concept

Using an A-profile, a citizen can log on to various websites of the city of Antwerp and receive customised information and support. The 'A-profile' would be used when the citizen accessed the city's digital services, such as making requests or requesting documents via the e-desk. Information linked to the citizen's account would be used when applying for or managing service use, so the user would not have to repeatedly provide the same information to the city.

The partners used a series of brainstorming sessions and workshops with city employees to map and structured the end-to-end (E2E) track for the A-map and the link with the A-profile. The process moves through successive phases: applying for an A card, the possible linking of the A card to the A profile, the use of the A card, changing the data relating to the A card and reporting on the use of the A card towards management and the service providers.

The linkage process:

1. **Create A-profile**: If a citizen wishes, they can link their A-profile to their A-card. If they do not have an A profile, they must create one using a verified e-mail address.

2. **Link eID to A-profile**: Before they can link their A-profile to the A-card, they must also link their national eID to their A-profile.

3. **Link A-card to A-profile**: Once the e-ID has been linked to the A-profile, they can link their A-card to their A-profile.

Citizen benefits from having an A-profile:

1. **Self-activation**: citizen could apply for virtual A-cards online

2. **Automatically assign rights**: e.g. the card is linked with various national databases so that citizens who qualify for certain government services or benefits are automatically assigned them

3. **Commercial**: The card/profile combination can enable a 'one-stop shop' approach that links multiple services within the city of Antwerp

Citizens can add to their self-managed identity by adding additional verifiable credentials, including e-mail addresses, telephone numbers, and other forms of electronic identity – and municipal employees would no longer have to manually update this information at the citizen's request. The City of Antwerp can verify these credentials, and these trusted credentials can be shared across city departments and with third parties if the citizen approves.

BoTM Use case #2: Moving to Antwerp/Moving from Antwerp

When a citizen moves to Antwerp – or moves within Antwerp – they are required to update their address with the city within eight working days. The city will then launch a series of internal processes to validate this move and to update associated family records before it is able to formally change its record of the citizen's address. This is a complicated process, particularly if the applicant has moved between municipalities. Antwerp will also perform a residency check for some address changes to make sure the resident has actually moved. Antwerp would like to streamline this set of internal processes.

BoTM partners worked out a number of different scenarios for a revised relocation process based on the use of a self-managed identity (SSI) and predicted that the relocation process could be extensively automated.

Citizen data provided through SSI would serve as input for a '**residence control engine**'. This engine combines and processes the available data into a prediction whether the citizen and their family actually do live at the new address as they claim. If the residence control engine predicts that the move is genuine, it would trigger a smart contract to automatically issue a verifiable credential to the applicant. This credential would be stored in their digital vault, and the citizen could then share it with other organisations as their new proof of address.

Outcomes

The BoTM project and its two use cases provided a considerable amount of information and learning about how Antwerp's internal processes worked and how they could be improved through the use of blockchain-enabled services like Self Sovereign Identity. The two proof of concepts estimated that they could deliver significant time savings and simplified operations for Antwerp and its employees. The SSI proof of concept will not be developed further as the Province of Flanders has decided to explore other identity solutions.

DIGITAL TRANSFORMATION IN LOCAL GOVERNMENT: LEARNING FROM BLOCKCHAIN PROJECTS

Understanding the factors that drive, shape and impede digital transformation

Livia Norström and Juho Lindman – University of Gothenburg and UGBlab, Sweden

Digital transformation is fundamentally a change process.

Local governments are undergoing significant digital transformation, including experimenting with new technological solutions like blockchain. This article summarises the findings of a case study of three municipalities in Western Europe that are exploring the adoption of blockchain-enabled service solutions as part of the BLING project.

Public sector organisations need to make the right decisions in their digital transformation efforts, and use public resources in ways that align with public values: boosting government efficiency, improving citizen services, and boosting democracy and participation whilst staying inclusive and transparent.

Digital transformation is fundamentally a change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities. Local governments find it particularly challenging to cultivate a culture of innovation and to allocate enough time and resources to develop priority innovations. Municipal leaders must resolve trade-offs between i) making informed decisions on implementing modern technologies to avoid overspending and not meeting expectations, and ii) gaining empirical evidence how and where specific technologies bring the best value.

Blockchain is one example of a group of emerging technologies that can be implemented in numerous ways as a part of the digital transformation process. Despite its financial background, Blockchain has become a general-purpose technology with several possible benefits to the public sector, including: to notarise

transactions, to automatically execute transactions, and verify identity. These benefits echo the government's three main functions: managing governmental registries, social transfers and benefits, and providing verified information.

Blockchain is not (yet) a fully mature technology, which causes uncertainty and scepticism around its usage. Most blockchain pilots are in early stages, which reflects governments' lack of capacity to convert pilots into more mature projects.

Blockchain and digital transformation

The public sector is transitioning from the traditional public administration / new public management paradigm, which aims for efficiency and effectiveness. Emerging approaches focus on the adoption of new(er) technologies and stimulating the expansion of internal knowledge resources with external support. While the "old" governance model implies a top-down approach to social and economic activities, new models put interaction (e.g., with citizens and industry) at the heart of their activities.

Digital transformation has become an integral part of this organisational change. Oversimplifying the important and difficult changes associated with digital transformation – by ignoring the public sector's complex institutional environment – will understate the obstacles organisations face as they seek to transform themselves.

Looking at blockchain enabled transformations

The study analysed the digital transformation processes of 3 Northern European municipalities participating in the BLING project. These digital transformation processes include a range of activities that drive, impede, or shape these transformations.

Digital transformation is a continuous process.

Driving transformation

The "driving" characteristic includes the forces and situations that motivate and drive digital transformation. The activities driving the local government exploration of blockchain technologies are: the experimentation with new technology (which is seen as an essential activity if organisations are to be able to adapt to future changes and be proactive in modern service delivery), addressing business/societal needs (where technology is used not only to digitise services but to improve them), improvement of service delivery (where blockchain could make services more flexible and scalable while protecting the privacy of citizens, or making processes more efficient and moving staff from the back-office to front-office), and creation of publicity for the Municipality (where the Municipality is seen to use novel technologies and to be innovative).

Impeding transformation

"Impeding" relates to characteristics that make digital transformation challenging. In a blockchain exploration these include technology limitations (technology didn't deliver theoretical promises), lack of human resources (for example projects are often driven by one person, and so are vulnerable to failure if that person leaves), external attention and the hype (publicity can be distracting, and there can be excessive expectations on the technology), and the difficulty of delivering within a regulated environment (such as GDPR).

Shaping transformation

"Shaping" refers to cultural characteristics that frame the digital transformation process. These characteristics don't drive or impede but rather shape how the digital transformation process takes its form. These are organizational learning (managers are unsure of the outcomes and benefits of blockchain piloting, which impacts future investment/development), legal aspects (for instance "the right to be forgotten"), collaboration with industry (and government stakeholders), and the organization's wider view

"Local governments, often viewed as the most-trusted governmental bodies, are particularly challenged to cultivate a culture of innovation and (to) allocate enough time and resources to the development of priority innovations."

of the role of public organizations (which affects their willingness to use approaches like smart contracts, and to decentralize decision making).

Digital transformation and blockchain in BLING

Governments' innovation ambitions in the three case studies were driven by a range of factors, from the need to address specific business and societal needs, public value creation, publicity, or a general curiosity to test available tools. Those needs included protecting users' privacy, providing better services, and automating bureaucracy. Change can be driven by an ambition to stay adaptive and proactive in public service delivery: conversely it can also be argued that there must be specific business needs driving experiments with new technologies.

Changes in both internal bureaucratic cultures and external relationships are needed if governments are to adapt to new demands and technologies and not be held back by

"Municipal leaders must resolve trade-offs between i) making informed decisions on implementing modern technologies to avoid overspending and unmet expectation, and ii) moving beyond theoretical debate and gaining empirical evidence on where specific technologies bring the best value."

conservative and cautionary approaches. Organisations must be flexible and adaptive if they are to successfully adopt recent technologies. Decisions about the use of blockchain must be taken in light of local policy goals, public values, institutional structures, and social expectations.

During the blockchain's 14-year life span, it has been altered and used in many applications and sectors with varying success. However, it is neither a "one-fits-all" nor a mature technology, as there are still many uncertainties associated with it.

Despite all the surrounding promises, technologies like blockchain need to demonstrate sufficient success before they become mainstream tools for local governments.

Mahula, S., Lindquist, M., Norström, L., and Lindman, J. (2022). Proceeding in DGO.2022: The 23rd Annual International Conference on Digital Government Research, June 15-17, 2022

HOWEST HOSTS THE WORLD'S FIRST DECENTRALISED AUTONOMOUS HACKATHON

Developing blockchain-enabled solutions to tackle the over-use of water

Shane Deconinck – Howest University, Belgium

In April 2022 HOWEST and BLING organized a blockchain hackathon to tackle the over-use of water by developing blockchain-enabled solutions to improve water management.

The hackathon allowed HOWEST's blockchain students to brainstorm and build solutions alongside students from the LUCA School of Arts – with support from 17 external organisations (SMEs, universities etc.). The hackathon was hosted by Snowball, with coaching from Smappee and IntellectEU, sponsorship from the EU S+T+ARTS project, and the main prize was donated by the European Blockchain Conference.

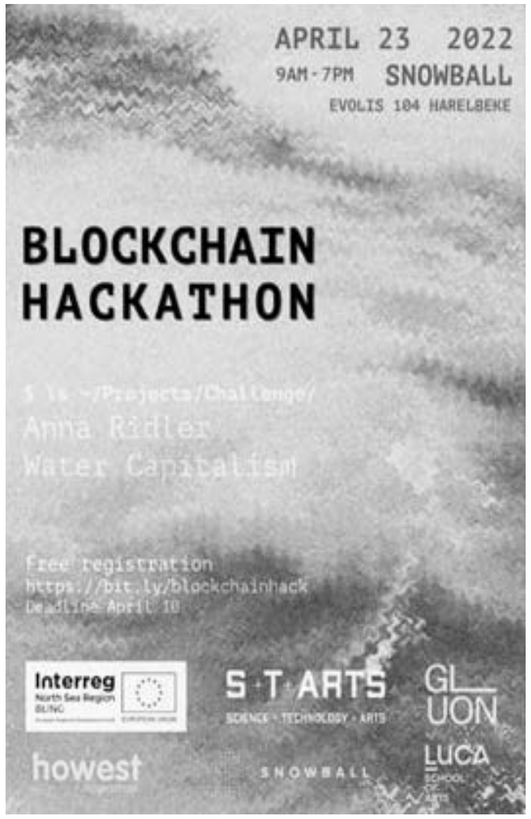
What is a 'decentralised autonomous hackathon'?
This hackathon was a first-of-its-kind 'decentralised autonomous hackathon' (DAH), where the hackathon was organised via (autonomous) smart contracts built on the (decentralised) blockchain. Users registered themselves using a smart contract and created their team.

Once they pitched their idea, the jury was able to use their votes (represented as NFTs) to vote for certain categories (in our case Best Overall, Most Creative and Runner-Up). Once the votes are cast, the hackathon is finished, the votes are recorded and tallied by smart contracts, and a smart contract automatically distributed the winner's NFTs to them.

Water and blockchain
The inspiration for the hackathon was given by Anna Ridler, an artist that makes artworks surrounding blockchain. She challenged the participants to create a project that mimicked nature: Non-Fungible Token (NFTs) that degrade over time, mutate, or grow. As blockchain is usually very static, this change in perspective on blockchain was really interesting and the students really enjoyed this hackathon.

What's a NFT?
NFTs are "one-of-a-kind" digital assets. These digital tokens can be thought of as certificates of ownership for virtual assets.

The collection of NFTs developed for the hackathon have been published. There you can see the team participant NFTs, the vote NFTs used during voting, and the winner's NFTs for each category.

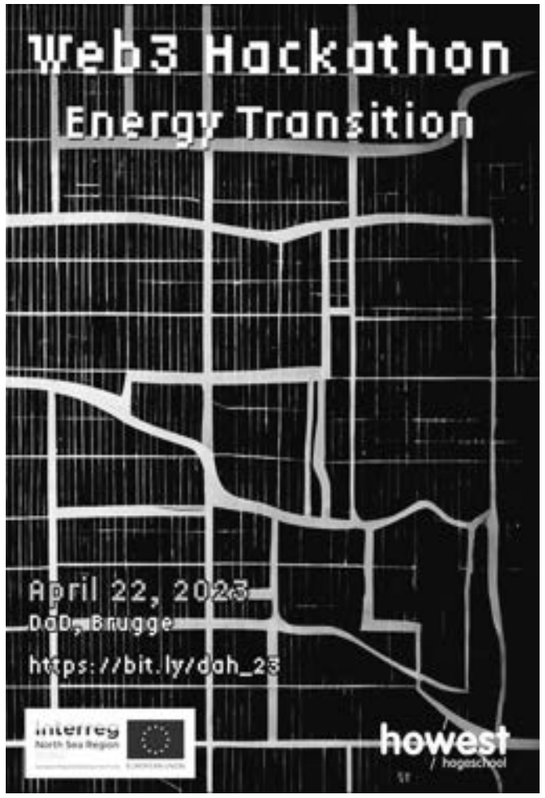


The winner – Kojo!
There were several great projects but there can only be one winner of the DAH. This honour went to Kojo, a project which rewards you for saving water. Water usage is monitored using a tamper-resistant IoT-enabled water meter: when your usage is lower than the average usage of families like yours, you receive tokens that you can use to water virtual flowers. These flowers need to receive water to stay alive, just like real plants. In essence, you use the water that you have not used in real life to virtually water your virtual flower NFTs. Because this project focused on a solution to reducewater usage, included natural elements like the degradation of plants, and was the most viable at the end of the hackathon, it was voted 'Best Overall'.

What happens next?
HOWEST's blockchain students will use the projects from the hackathon as part of their coursework, and will try to turn their ideas in to actual products. HOWEST will use this autonomous platform for their 2023 BLING hackathon.

2023 Hackathon
In April 2023 HOWEST will host a decentralised autonomous hackathon focusing on the 'Energy Transition' for their students and the BLING partnership. The hackathon will be followed by a job fair and networking event.

The Energy Transition is a wicked, complicated, but high-impact problem – and we hope this hackathon will help to generate new blockchain-driven solutions. Our hackathon is governed by a smart contract, which will award participation NFTs as participants move through different event phases (registration, hacking, finished, voting), and trophy/award NFTs.



USING A PROCESS CATALOGUE TO IDENTIFY OPPORTUNITIES FOR BLOCKCHAIN-ENABLED SOLUTIONS

How the city of Roeselare in Belgium reviewed their internal processes to identify opportunities to develop new ways to deliver services

Jasmien Wellens – City of Roeselare, Belgium

The City of Roeselare developed a four-stage process to review their internal catalogue of service processes with the aim of identifying services which might be suitable use cases for the development of future blockchain-enabled services. This approach was designed to be portable, so other organisations could adopt it.

1 Initial internal scan of city processes

2 Review of potential use cases with Cronos, an external specialist

3 More in depth review of processes with Cronos, the process owner in the Municipality, and the city's strategic unit

4 identification of services that were suitable environments to develop new blockchain-enabled proof of concepts

THESE 7 FACTORS WERE ANALYSED FOR EVERY PROCESS:

- **THE MOST IMPORTANT CHALLENGES**
- **THE NUMBER OF PARTIES INVOLVED**
- **INTEGRITY RISK**
- **VERACITY RISK**
- **DUPLICATION RISK**
- **REPUTATIONAL RISK**
- **SCALABILITY**

Stage 1

Initial scan of city processes

The process catalogue of the Belgian City of Roeselare in Flanders was scanned to see which processes could potentially be optimised through the adoption of blockchain-enabled services. The first process scan was done by the policy officers of the City's Strategic Unit, which identified 40 potential use cases.

Stage 2

Review of potential use cases with specialists

The initial long-list of potential services was then reviewed a second time, in collaboration with an external partner – The Value Hub (part of the Cronos Group, an external consultancy and blockchain specialist).

Stage 3

Review of potential use cases with specialists

The short list of four processes that had potential for improvement through the adoption of blockchain-enabled processes/ services were then more extensively analysed with the City's process owner, The Value Hub, and the Strategic Unit.

Identifying potential blockchain success factors

A structured process was used in these workshops to identify when the factors that indicate that a process could potentially be optimised by blockchain-enabled solutions were all present.

When all of these factors were rated as high by the workshop participants, this indicated to everyone that the process might be a suitable candidate for a blockchain-enabled solution. A visualisation of this analysis can be found below:

Understanding processes to improve processes

In these workshops, the process owners of the processes which showed potential for improvement with blockchain solutions did a 'deep dive' into how their process actually worked with the team from The Value Hub. This involved a complete analysis of these processes 'from the first step to the last'. The process owners found this process of examining their processes with other internal and experts was very useful – regardless of whether or not their process was identified as a potential blockchain use case.

Roeselare's goal in this scanning exercise was to identify one process with the potential to be transformed by an blockchain-enabled solution, which could then be optimised by the development of an appropriate solution.

Roeselare has identified the 'Leisure Pass' process as suitable for a blockchain proof of concept – this use case is set out in more detail later in this book.

BLINGathon
a BLockchain IN Government hackathon

THE BLINGATHON INTERNATIONAL HACKATHON

An online hackathon bringing together 12 countries, 34 teams and 140 participants to work on some of BLING's biggest challenges

Adri Wischmann – BlockchainLab Drenthe,
Renske Stumpel – Gemeente Groningen.

BLING's BLINGathon hackathon was held over the weekend of 13 & 14 November 2021. This was the biggest hackathon BLING had organised, with 34 teams and over 140 participants from 12 countries picking their brains for the 30 hour-long event to come up with the best solutions for 4 challenges set by the BLING partnership. There were prizes for Best Overall proposal, Best Design, and Most Impact.

BLINGathon was a "Hybrid Online" hackathon – teams organized a local place to work together, but communicated online with the hackathon organisers via a Discord server. In some locations workspace was provided to the teams by BLING's project partners. BLINGathon live-streamed the hackathon on our YouTube channel.

There were several workshops during the event on topics like "Ideation" and "Pitching" to help the teams develop their ideas and fine tune their presentations. On the Saturday evening in the middle of the event there was a Pubquiz, and during the event there was a serious gaming track where every team could earn points. The winning teams from the Pubquiz and the gaming-track got to choose their preferred position in the pitching list for the international jury.

The BLINGathon Challenges
BLING's partners set the teams 4 challenges – on energy, transport, e-voting and on secure delivery of electronic documents. The hackathon was overseen by an international jury: Nena Dukozov/Slovenian Government, Peter Verkoulen/Dutch Blockchain Coalition, Mr Panizo/Innovation Project Manager at FNMT-RCM, and Adnan Imeri/Technical Lead at Infrachain.

Track 1 – 6 teams – Energy and microgrids
Track 2 – 6 teams – Transportation and logistics
Track 3 – 5 teams – e-Voting
Track 4 – 6 teams – Secure document transfer

Spotlight: the transport challenge

The Problem
Increasing numbers of containers are taken incorrectly – either mistakenly or on purpose

The Challenge
How can ports solve this problem with trailer inventory and security?

BLINGathon Results
The expert jury had a tough job deciding who were the winners in the four prize categories – best overall, best design, most impact, and the audience prize.

Best overall: Team Greasy Monkey from the transport trackGreasy Monkey's 'Harbour assist utility' solves the transport challenge with a website and app which uses blockchain for

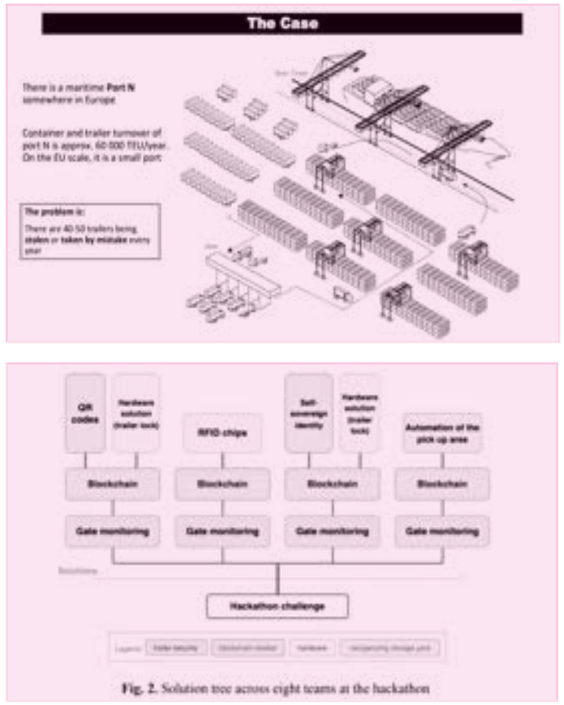


Fig. 2. Solution tree across eight teams at the hackathon

user identification and data storage. Truck drivers request collection slots on the app website, and then identify themselves using self-sovereign identity to gain entry to the harbour. RFID equipped containers are scanned by the truck driver's app, which makes sure that the driver has picked the correct container. A system with QR codes at loading bays is used to manage free spots, and data on bay usage is stored on the blockchain. This means everyone will know when loading slots are available, and everyone who uses the dApp can locate containers. This combination of identity and data collection approaches should prevent drivers from collecting the wrong container and stop thieves from stealing cargo.

Best design: Team Beevoters from the e-voting track
The best design award went to Beevoters, for their passionate presentation that "e-voting is the future" proposing we move from expensive, un-sustainable paper voting to online voting via their 'BeeVoter' app.

Most impact: Team Oldennoobs from the e-voting track
Oldennoobs' mission is to make online elections possible by making them secure, transparent and verifiable.

Oldenboobs proposed a hybrid system of online and in-person voting – building on national e-ID infrastructures – that does not link your ID with your vote. Their IOTA Streams structure is built like the 'real-life' structure of voting districts.

Audience prize: Team Titan X from the secure document track
Titan X proposed a secure electronic document and messaging system, that made it possible for people and organisations to send classified files over the internet and then verify these files through hash comparison using a decentralised system.

Impact
BLINGathon was a high impact event, with substantial interest in the event and our results and participation from teams all around the world – not just in the North Sea Region! More than 500 people watched the final results live, and the BLINGathon videos have been watched or streamed more than 2000 times. There were over 8.000 visits and 16.000 page views at the BLINGathon website.

The event wrap-up video can be seen here.

SECTION 2 – WORKING FOR COMMUNITIES WITH BLOCKCHAIN

This section focuses on the development of new and innovative services for people and communities. These services are all underpinned by blockchain solutions, and show the value of the technology in enabling new and different ways of working and delivering services.

These solutions range from helping people in financial difficulty to examining how we can make voting easier and more accessible – but both are underpinned by the unique opportunities that are opened up through the potential of blockchain-enabled services.

THE RED BUTTON – AN EMERGENCY BRAKE FOR PEOPLE IN FINANCIAL DISTRESS

Almost 8% of Dutch households have debt problems. What's the best way to coordinate help for them? And how did BLING help?

CJIB – Dutch Centraal Justitieel Incassobureau
Dewi Delhoofen – Eindhoven Municipality
Koen Hartog – Dutch Blockchain Coalition

Helping citizens in financial distress

Almost 8% of Dutch households have financial problems of some description. As a result, cities and municipalities across the Netherlands provide services to support citizens with debts or who have trouble managing their finances. The challenges people in financial difficulties face usually involve multiple companies, multiple agencies, and multiple services, all of which need to be co-ordinated to successfully help citizens.

People with debts often do not seek immediate help – for a variety of reasons. As a result, their debt situation can deteriorate and become even more complex. When they do request support, it can take a while for the agencies helping them to get a clear picture of the entire circumstances of their situation. While local services are trying to understand what help is needed, creditors are continuing to request repayment, attempt to recover/collect their debts, or charge penalty fees or collection costs, which causes the citizen further stress and possibly sees their debts increase.

Many local debt assistance services recognised that it would be useful to have some form of 'pause' button for people who cannot pay their financial/debt arrears – some mechanism that would temporarily pause debt collection efforts. This would stabilise the situation for the citizen and create a period of (debt) peace. The citizen and local services could then work on developing a supported solution to the debt problem without the citizen being affected by the continued stress of ongoing debt collection efforts.

Examples of this approach include the City of Amsterdam with the 'Pause Button' and the NVVK (Netherlands Association for Debt Relief Assistance and Social Banking) with the 'Kennisgeving'. In these scenarios once the municipality has been in touch with the citizen's creditors, the creditors 'pause' their efforts to collect debts and arrears while the citizen and local debt services review how the citizen can be best supported to address their financial situation.

Amsterdam's Pause Button and the 'Kennisgeving' from the NVVK used a 'traditional' pause button approach: the citizen with financial challenges seeks help from the municipality, and the municipality then gives some form of signal to 3rd parties (debt collectors, debt owners, other agencies) that the citizen was being supported. The citizen is not actually involved in the information sharing. In this case the citizen has no ability to control their own data (from the municipality) or to manage how their own data is then used.

Can we change this to a situation where citizens are able to get – and then share – their own information from municipalities? If citizens can own their own data and distribute it, then that is a huge change in how governments work with (and help) citizens.

Developing a national approach to innovation

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. 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. CJIB joined the BLING project in order to accelerate their innovation work, with the aim of developing new ways of working and collaborating with other organisation using blockchain-enabled tools.

> The threat that constantly hangs over your head, no longer knowing how to solve it, then sticking your head in the sand because of the stress... this is a common situation for many people with debts. We have to work differently to help. For example, with the Red Button.

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 debtorsand collect debts in a socially responsible manner –this includes government organizations, such as the tax authorities and the CJIB.

For these reasons, it is important to CJIB to be able to make the distinction 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 the 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 to receive a timely signal that the citizen is in debt. CJIB has developed an algorithm call Debt Alert, which tries to 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 about their situations, 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 debt collectors 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 understands 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' (also known as the 'Red Button' or 'Rode Knop').

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 proof of concept for a service for citizens and government organizations that helps support citizens with financial or debt problems. This was in response to calls for a national approach to supporting citizens with financial 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 (and local municipalities) that local services are providing (debt) support.

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.

The proof of concept aimed to use 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).

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 would "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

The blockchain solution for the Financial Emergency Brake was expected to use two key technical approaches: **Self Sovereign Identity** with a **Zero Knowledge Proof.**

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 digitalway 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.

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 their financial situation –perhaps that they are receiving a certain type of financial support – the 'claim'), and is able to prove that their claim to know this is true – without revealing the actual details of the information to the verifier.

Lessons learned during prototype development

CJIB learned two main lessons during the development of their 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 CJIB's 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 quadruple -helix collaboration between the government, the private sector and the knowledge sector.

Testing a proof with real people

2017 saw their first assessment on how to tackle this – and a theoretical/paper model was developed setting out how a system using self-sovereign identity and zero-knowledge proofs might work. Zero knowledge proofs were very much theoretical ideas at the time, so CJIB wanted to test them more thoroughly. CJIB decided to move forward and build a proof of concept, and the University of Delft advised CJIB on the selection of a proposal from the 4 applications they'd received. Ledger Leopard was selected by Delft University to build a prototype, which was then technically assessed by Delft, and then legally assessed by CMS Law to ensure the solution was GDPR compliant.

A key question for CJIB was whether this proposed service provided added value – the test was showing tool to people in financial difficulty and seeing if they could use it, if they liked it, and if they saw it as a potential solution to the challenges they were facing. This was done in late 2021, when CJIB tested this approach with 80 citizens in two Dutch municipalities – Eindhoven and The Hague. The feedback from testers was overwhelmingly positive – testers wanted to use it now or to have access to it if they were in difficulties. This solution allows those in debt troubles to show that they are in the municipal financial aid process, and they can then share this information with other third parties (like the CJIB, or debt agencies) via a federated signal (through the blockchain?).

Next steps

Following the successful testing of the pilots, the Dutch Ministry of Social Affairs and Emplyment was asked to support the building of a single solution for all municipalities and debt organisations in Holland. There was real local support for every local pilot, but there was also a recognition that a universal service was needed where all parties would use the same service.

In February 2022 the Ministry of the Interior gave an enthusiastic go-ahead for a national approach. Sessions with stakeholders confirmed the

great demand for the service and for a national approach. The Ministry has been asked to identify at any legal requirements that are necessary so that all parties (government and private) can be required to use the same solution. Stakeholders are currently looking at delivering an expanded solution that actually has 4 different financial pause buttons – because each different stage of the process needs a different 'signal'.

While the Red Button approach allows citizens to flag that they're actively being supported by their municipality, it would be helpful to have a support stage before this – immediately when citizens realise that they can't pay the bills anymore. In Holland on average it takes 5 years before someone with debt problems asks for help from their municipality. By offering a direct pause when you realise that you cannot pay your debts and are willing to ask for help, we hope to reach a bigger group of citizens in an earlier stage.

Signal 1
The citizen realises they can't pay their bills anymore and are in need of professional help to solve his problem. The citizen can push the first button and gives a signal to all his debt collectors that they have serious financial problems and are going to ask for help at the municipality. By pushing the button immediately, the municipality also gets a signal that this person is having serious financial problems and needs support. The municipality will reach out to this person to start a support plan.

Signal 2
The citizen has been in contact with their municipality and has agreed on some form of support, and the municipality gives the citizen validated attributes/certification that they can share with other parties to prove that they are receiving municipal support with their debt problems (this is the Red Button use case).

Signal 3
This shows that the citizen is getting specialised debt aid from municipality
Signal 4
The citizen has had support and is now in the position to make some different agreements with debt collectors etc.

This solution will be connected to 'het schuldenknooppunt' a Dutch data layer that connects private and public partners for appropriate data sharing for debt problems. For people it is currently possible to share some data within the 'public' world – i.e. from government to government – but success for the Red Button would be helped by being able to share data with the private sector – with the citizen's permission (possibly via self-sovereign identity management).

Stakeholders are exploring working with the Dutch Ministry of the Interior to develop this approach – as the Ministry leads on a lot of the Dutch digital infrastructure, and this will help this to become a country-wide solution. The Ministry thinks the Red Button can be a good Proof of Concept which will facilitate many other use cases in Holland.

Delivering the Red Button – Blockchain and API approaches

The Red Button service will be delivered via a web application. As blockchain is still a new technology and challenging for some organisations, an API (Application Programming Interface) for the service is available for municipalities that don't want to use a blockchain solution.

The success of getting all the municipalities on board will be through giving participating organisations different organisational/technical options for how they participate in the solution – be it by using the central Blockchain, by using a municipal Blockchain, or through the API approach. By giving municipalities different technical options they then don't have to spend a considerable amount of time debating internally about whether they are comfortable or willing to use blockchain – making a standalone solution with API access it makes it easier for municipalities to buy in. No organisation will be forced to use blockchain.

Organisations that choose not to use a blockchain-enabled solutions will still be able to use the Red Button service. It will still be possible to give citizens control of their own data in other ways, and municipalities will still be able to send validated information to debt companies – but in this case it will be government data about the citizen that the municipality is sharing, *not the citizen's data*.

Technical and organisational lessons

CJIB's project was an important application of Self Sovereign Identity. 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.

This pilot did two things governments talk about a lot – using as little data as possible to provide a service to citizens, and allowing people to control their own data and what is shared through the use of self-sovereign identity. This is not the standard way of interacting with a government agency, but this solution with CJIB/Eindhoven/The Hague does both of these things and is a great example of delivering a different type of digital service to citizens.

One of the key lessons from this project is that it developed a shared solution – and in these cases a lot more groundwork needs to be done, when compared to the situation were one entity provides a solution and organisations can decide whether or not to use it.

CJIB and their partners also learned the implications of working with a new and emerging technology. Blockchain is still very young and still needs to mature, and a lot of the issues reflect that it's still at a relatively early stage.

Going forward, solutions like this also raise the question of where services should be designed and delivered – and how decentralised technology leads to wider questions about decentralised services. Should we provide some services centrally, or look for more decentralised solutions?

For the CJIB, the Financial Emergency Brake project was an excellent example of the Quadruple Helix approach – collaboration between the government, the private sector, the knowledge sector and citizens. This project shows that this type of collaboration can deliver sustainable results.

FIT4WORK CHALLENGE 2021

How Roeselare used a private blockchain solution, developed by Howest, to support health coaching for their employees.

Kimberley van Luchem and Jasmien Wellens – City of Roeselare, Belgium
Shane Deconinck – Howest University, Belgium

The 'Fit4Work Challenge 2021' pilot was a partnership between the City of Roeselare and the HOWEST University of Applied Science. The Fit4Work Challenge offered a preventive health program to the employees of the City of Roeselare, with a user-friendly onboarding process and a secure connection between trainer and trainee through blockchain. Roeselare tested this pilot with a group of 20 civil servants.

Why Fit4Work?

The labour market is at a turning point – workloads are increasing and more and more organisations are having to take action to support the physical and mental health of their employees. More than a third of Flemish employees are worried about mental fatigue and work-related stress.

There is an obvious need for an organisational staff health policy.

Sometimes it feels like companies only invest in external services to support their workers to comply with workplace legislation. Research shows that an unhealthy employee lifestyle results in higher absenteeism, lower productivity, lower employability and less employee involvement.

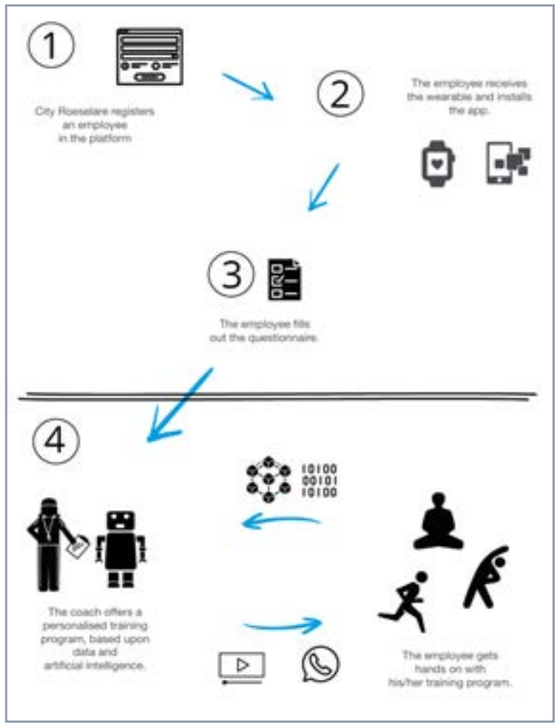
In the City of Roeselare, over 6.5% of staff time was lost due to illness in 2017. In response, the City of Roeselare set up the Fit4Work Programme, a well-received employee health policy. The BLING project gave Roeselare the opportunity to expand the Fit4Work program with the 'Fit4Work Challenge 2021' pilot.

The BLING Fit4Work Challenge Pilot

Offering personal coaching to guide health (both fitness and healthy lifestyle) is economically feasible if it is done digitally. Wearable devices are excellent tools for remote coaches to use to understand if their guidance is effective. Because these wearables also collect personal information about the "bearer", they are a privacy risk if this data is accessed inappropriately. Wearables that use a central database therefore pose a privacy and security risk for organisations and / or third parties that keep all data.

The solution for this pilot used a private blockchain owned by the City of Roeselare.

Each test employee had a wearable whose data was added to the blockchain. The coach could make video training programs, and they could provide individualised feedback – all through the coach's platform. This content was then delivered through the app. The personal coach could access the client data and use it to make sure the clients were given the right programme, but the employer and third parties couldn't



The Fit4Work pilot model

This is one of the pillars of this pilot: trust in blockchain, trust in the data, trust in the privacy.

access the data. This is one of the pillars of this pilot: trust in blockchain, trust in the data, trust in the privacy.

By using blockchain technology, the data is only shared between the client and the coach, and the client owns their data – not the employer. The design of the blockchain component means the pilot is GDPR compliant. Results Matter were hired to train the employees in the pilot and to manage their feedback.

Designing a blockchain solution

Roeselare worked together with HOWEST University of Applied Science to develop this pilot. Hyperledger Fabric Private Data was used to store data, and Chaincode was used to ensure that only authorised users could view and edit their data. When using personal data, there is always the risk of a leak. Howest mitigated this risk by using Hyperledger Fabric's Private Data, where only the hashes of private data are published on the shared ledger, and not the raw data. That meant that only authorised users were able to access the employee's personal data.

Howest provided knowledge of the blockchain ecosystem and platforms, and set-up the Fit4Work Challenge pilot. Roeselare used the pilot to learn how to talk to users and stakeholders about these kinds of innovation projects, tested it, and provided feedback. Roeselare was able to use the pilot as a real-world example of blockchain in use for other city employees.

Understanding the pilot's impact

The aim of the Fit4Work Challenge pilot was to improve the (subjective) health of the participants, which should have an impact on their work and their mental and physical health.

In June 2021 Roeselare surveyed the participants, asking for their views on a range of issues after the three-month testing period (March-May), including questions about doing 10,000 steps a day, the online coaching, using the wearable, the Fit4work app, the Facebook community, blockchain, and so on. Users provided an overall feedback score of 8.05 out of 10, and highlighted the value in increasing their understanding of how much they were moving, identifying how much (or how little) exercise they had, the value of monitoring their activities and emotions, and of the value and importance of exercise.

What happened next

After the pilot ended, a series of governance questions emerged – key questions like 'How can we incorporate this pilot as part of our regular service delivery?', and 'Who/what organisation will maintain the app and blockchain platform?'. These were fundamental questions that must be answered if the pilot was to become a permanent part of the Fit4Work programme.

Roeselare did a thorough analysis about what actions were needed to formalise the programme and determine the costs for this.

Roeselare worked with external parties to determine:

- How much would the online coaching cost?
- How much would it cost to build an Android version of the iOS app?
- How much would it cost to keep the app updated each year (specifications)?
- How much would it cost to keep the app up and running on the blockchain platform each year (technology)?

When these costs were reviewed, they were higher than anticipated. Making an extra Android version of the app was very expensive, but to keep the app up and running on a blockchain platform was very costly. Roeselare has a fixed budget for the total Fit4Work programme per year for all employees. If Roeselare had chosen to make the Fit4Work Challenge a regular part of the programme, it would have taken nearly half of that budget to only support 20-22 participants. Because of this relatively poor ROI, the city decided not to make the pilot permanent, as the blockchain component was too expensive.

It may be possible to find ways to scale up the app so that the development cost could be spread over more users, but that was outside the scope of this pilot. Exploring self-sovereign storage solutions such as Solid – in combination with a blockchain solution – might be the key to reducing the cost of this service.

Fit4Work Challenge was a very successful pilot for Roeselare – they learned a lot, the technical approach was successful, and the pilot resulted in significant cultural change for the pilot testers. While scaling up from a pilot to a full service wasn't possible, the significant interest in the pilot and the learning from the pilot has been extremely valuable for other government organisations working in this area.

EXPLORING THE POTENTIAL FOR BLOCKCHAIN-BASED E-VOTING

Drenthe looks at the practical and political challenges

Adri Wischmann – BlockchainLab Drenthe, Netherlands
Niels Annema – Province of Drenthe, Netherlands

In some way our society 'votes' nearly every day. But these polls differ in importance, security level and auditing. Conventional voting using paper ballots is slow, inefficient, costly and does not treat everyone equally. E-voting could potentially deliver dramatic change, but there are big challenges (and a lot of scepticism) to overcome before it can be used in national elections.

To better understand the issues that were holding back wider acceptance of e-voting, the Province of Drenthe commissioned BlockchainLab Drenthe to review the technological issues and challenges that might be holding back' e-voting in the context of a potential e-voting pilot that used some form of blockchain solution. This analysis of the potential value of blockchain-enabled voting system complements the work done by BLING's Swedish partner Länsstyrelsen Skåne (the County Administrative Board of Skåne) who searched Europe for an open source, GDPR compliant e-voting solution (see 'Can Democracy become Digital?' – page 86).

There have been big changes in how we vote

A big part of our lives is spent online. We make friends online, we communicate online, we pay our bills and taxes online and during the recent pandemic we worked online. But voting still requires a pencil, a piece of paper, traveling to a crowded building, and standing in line. Granted, we have come a long way since the times where ballots were printed in the newspapers, and voting was in public – you had to say the name of your election candidate in public where everybody could hear you – and votes could be bought. But taking the next step to bring voting to the digital realm seems to be a giant leap with many benefits and many potential problems.

Social acceptance of new ways of voting

While most of the technical and organisational challenges to e-voting can eventually be addressed, we will probably not see national elections using blockchain solutions in the next decade.

It is however very important to try and push the boundaries of implementing blockchain in e-voting to local and regional levels if we are to gain traction for the idea of e-voting, and to create the broader social acceptance that would be required to support the transition to national e-voting on some future election day.

Although a 100% perfect e-voting solution might prove to be a utopian ideal, our local goals should be to improve and innovate the voting system to get to a solution that is better, faster, more efficient, cheaper, more accessible and more inclusive than the current paper based or electronic voting systems.

Principles of successful e-voting

BlockchainLab Drenthe identified a common set of principles for e-voting:

- E-voting elections must be verifiable – from end-to-end
- Ideally e-voting elections have a low operational footprint
- E-voting elections should be transparent and 'explainable'
- E-voting elections should increase voter engagement
- E-voting elections might be more frequently held
- E-voting should be secure (and that is hard)
- The goal should be to get to a better voting system, not to an absolutely infallible one

E-voting is more complicated than you might think

Our pilot created a report that thoroughly reviewed the current possibilities for e-voting, the processes and mechanisms that needed to be included, and identified possible problems and solutions. As this is a forward-looking paper, there were a number of people in our organisation who were interested in our results. However we do not expect the Province to be ready to shift towards new e-voting systems, as these systems remain difficult to explain and keeping the trust of voters is a big factor behind the successful delivery of any election. If it becomes too difficult to understand the blockchain technology underpinning e-voting, then there is a real risk that voters' trust will be lost. So, for the near future e-voting will remain an interesting idea.

Looking at platforms

There are literally hundreds of blockchain platforms and protocols which could be used to build an e-Voting system – and each of these has pros and cons. For practical reasons we narrowed this down to look at 2 protocols in greater depth: Ethereum (the most popular and widespread blockchain protocol and the first one to implement smart contracts) and IOTA (a 3rd generation protocol working with a DAG – Directional Acyclic Graph – being one of the most energy efficient, fee-less, miner-less blockchains in the industry).

Ethereum quickly proved to be too inefficient and congested, after which the BlockchainLab explored the IOTA options. BlockchainLab has previously developed solutions on IOTA, and our experience is that IOTA is fast, free and eco-friendly.

Many challenges lie ahead

Our work identified a series of practical challenges that would need to be overcome if we were to seriously consider blockchain-enabled e-voting systems:

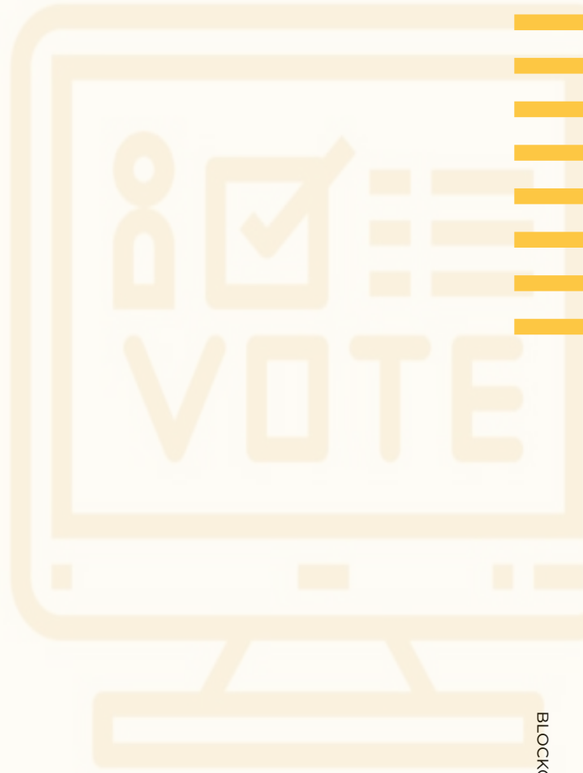
- the (commercially) available solutions are not open source
- the available solutions are not truly End-to-End Verifiable Internet Voting systems (E2E-VIV)
- the risk of DDOS-attacks on voting systems would need to be addressed
- we would need to be sure that there was no prospect of undetectable manipulation of thE system (leading to betrayed trust of voters)

There were particular challenges facing blockchain systems that we identified, included the vulnerability to '51% attacks' in blockchains that are secured by proof-of-work algorithms, the need to bring in adequate privacy controls, the economic and ecological transaction costs, the challenges of scaling blockchain systems, and the need for high transaction speeds.

Taking stock

The lessons learned from our review have been published and disseminated across the organisationand to other governmental bodies in the Netherlands.

If Drenthe decides to move towards e-voting, then we will do this with a much more robust understanding of the advantages and challenges of blockchain-enabled approaches.



BlockchainLab Drenthe
BlockchainLab Drenthe on YouTube

CAN DEMOCRACY BECOME DIGITAL?

Using blockchain to support democracy in Sweden

Jörgen Dehlin and Josef Gustafsson – Länsstyrelsen Skåne, Sweden

Skåne's democratic goal

The County Administrative Board of Skåne in southern Sweden believes that blockchain-solutions can be used to develop the dialogue between the citizen and society. The question Skåne wanted to answer through their participation in the BLING project was how blockchain-enabled solutions could increase citizen participation in government and democracy.

Skåne wished to test a blockchain-enabled governance/voting solution in a community that was looking for tools to implement an innovative approach to community governance (see the article on 'Enabling new approaches to community governance' to learn more about R:ekobyn.) This is the story of why Skåne took this approach and what they learned about what e-voting solutions are available.

How can blockchain strengthen democracy?

The blockchain's most important component in supporting democratic systems is that it should create trust between participants. With systems that use blockchains, trust can be designed and built into the system – because there is no single actor who is in control of the system and able to influence outcomes.

Blockchain combines openness with cryptographic security to give everyone a faster, safer way to verify key information and establish trust. With blockchain distributing copies of records across multiple nodes/computers, data security is enhanced, and it is virtually impossible to tamper with or delete records once they have been created, significantly reducing the risk of fraud. These technical solutions distribute trust, with participants being able to have relatively unfettered access to their records, which enhances transparency and control.

Bringing decisions closer to citizens

Local self-government is important in democratic terms. Swedish municipalities, county councils and regions have wide-ranging responsibilities – particularly when compared with other EU member states. Local self-government means that Swedish municipalities are able to design and adopt solutions that are locally appropriate – be it at municipal, county council or regional level. This also helps to improve the efficiency and effectiveness of service provision.

Citizens' closeness to local decision-making should make it easier for them to gain access to local politicians, and to then hold them accountable for their decisions. This in turn should improve citizens' opportunities to influence local service provision in their Municipality, county council or region, and to affect how their taxes are used.

Unfortunately, it tends to be the citizens' perspective that local authorities know the least about, and where systematic analysis is most lacking. If we are to support citizen dialogue, how do we listen to everyone, not just to lobby groups and those who shout the loudest? How do we make sure that we are not giving those who already have resources yet another way to influence outcomes?

How can the blockchain be used for different forms of elections, polls and referendums?

Digitization can create better conditions for people to meet, to make decisions, and develop the tools, methods, processes and functions of democracy.

You can develop new approaches to dialogue by using new technologies, through outreach activities and through cooperation with organisations across civil society. Democracy is constantly changing and developing. Digitization is one of the strongest driving forces for change in our time, and it creates opportunities as well as challenges for democracy. Digitization can create better conditions for people to meet, to make decisions, and develop the tools, methods, processes, and functions of democracy. But we also need to remember that not everyone is online – at the moment over half a million Swedes don't use the internet.

Blockchain-enabled democratic solutions

In concrete terms, Skåne sees great potential in blockchain-enabled solutions as a way to deliver different types of engagement with citizens – be they referendums, e-petitions, elections, or other approaches that widen or enhance citizen participation. The citizen casts their vote and sees their choices are stored on the blockchain, visible and transparent to anyone who can access the blockchain. While the votes themselves are stored on a blockchain the voter's identity is not saved in the blockchain – it's just ticked off on an electronic voter list – respecting both the voter's privacy and the need to follow data-protection requirements.

By using blockchain-enabled platforms, a system for electronic voting (or any other form of electronic engagement) could be created which makes it possible to vote or "speak" from anywhere. Everyone who is entitled to vote would be registered as users of the blockchain, and every user would be assigned a vote. Users should be able to exercise their vote(s) through an interface that would be accessible via any electronic device with internet connection.

Each user would have their own password, that would give access to a secret key, which is used when the vote is registered. All votes would be saved in the blockchain in the same way that other transactions are. The validity of each voting record would then be verified by other users via public keys. This can deliver a new level of transparency, where the results of elections and other forms of digital citizen engagement are public and verifiable.

Democracy and blockchain in practice

For Skåne, blockchain solutions can definitely be used to enhance democracy, deliver better voting solutions, and to develop digital democracy.

Since the beginning of the 21st century, many countries have considered the introduction of electronic voting over the Internet as a supplement to general elections. Although internet voting is not yet considered secure enough to be implemented in general elections in most countries, there is a wide range of uses for the technology in other forms of elections and polls.

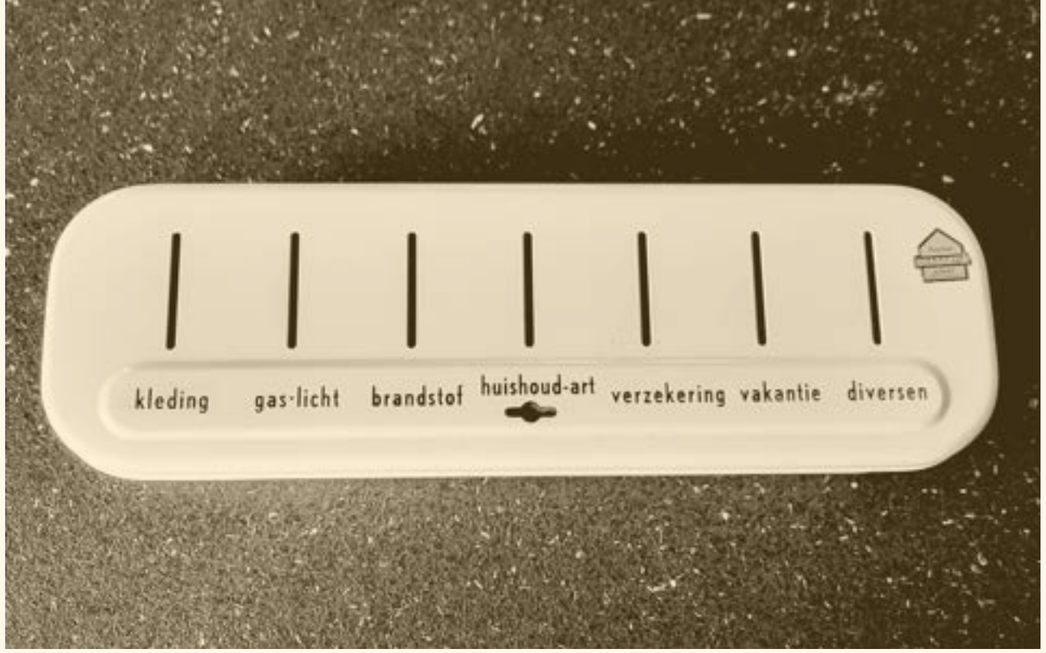
Blockchain has been proposed as a technical solution that has the potential to provide secure electronic voting while preserving the secrecy of individual votes – however there are only a few examples where blockchain technology has been used to enable electronic voting.

Building new solutions

When Skåne started work on the BLING project, they assumed that there were already developed solutions for elections and polls using the blockchain available in open- source; models that they could just 'pick up off the shelf' and use. This turned out to be wrong: there weren't.

Skåne have studied approximately 250 different projects around the world where blockchain has been used by various local authorities and governments for things like polls, and have not yet found a solution that meets their needs. The hunt for an open-source, GDPR compliant blockchain-based citizen-engagement platform continues.

Skåne have not given up though. They have now reached out to academic and governance networks across Scandinavia to identify new partners who will help them define a new solution. Skåne is currently working with students from Copenhagen Business School and Karlstad University to identify new approaches and options to build a GDPR compliant voting and governance solution.



DEVELOPING MULTIWALLET – A CROSS-SERVICE TOOL LEVERAGING BLOCKCHAIN TO DELIVER A RANGE OF LOCAL GOVERNMENT SERVICES

Developing multiwallet– a cross-service tool leveraging blockchain to deliver a range of local government services

Adri Wischmann – BlockchainLab Drenthe, Netherlands
Renske Stumpel – Gemeente Groningen, Netherlands

Local and regional governments in the North-East Netherlands – including Emmen, Groningen and the Province of Drenthe – are looking to build on the success of the EnergyKnip (Energy Wallet) blockchain-enabled service to roll out new ways of delivering a wide range of services in their regions.

EnergieKnip is The Netherlands' largest public service governmental blockchain project, with over 30,000 users and with over 50,000 people having digital wallets on the platform. EnergieKnip is based on the IOTA protocol, a very energy efficient blockchain which can host a digital wallet that can be used in many different ways by different services.

MultiWallet aims to provide a generic platform that works across local governments to enable more targeted and more joined up service delivery. This is a potentially new way of working that could enable the targeting of specific groups with services that they are pre-qualified for – i.e. services which the governments already know that citizens are entitled to receive. MultiWallet will also provide a channel to push information directly to relevant audiences who opt-in to notifications.

Knip is the dutch word for 'wallet'. So 'MultiWallet' translates as 'MultiKnip'

The City of Groningen will initially focus its MultiWallet efforts on helping companies and entrepreneurs to be more sustainable by providing funding that can only be used to buy energy saving measures and services. This will save the companies money and benefit the environment. Groningen is currently reviewing what additional services could be added to the platform and selecting/prioritising them.

Emmen is in the process of selecting 3 use-cases out of a long list of potential candidates: they are looking for uses that focus on residents, visitors, or SMEs. 'Purpose bound' (or 'limited') money is a very powerful tool which can be assigned not only to a person, but also to a building (e.g. providing a maintenance budget), a club (e.g. providing a budget for buying shirts), or a company (e.g. a subsidy for installing LED-lighting), or it might even be used anonymously if that's what the service wants to do.

An example of the integrated services the municipalities would like to offer is a use case that Adri Wischmann from BlockchainLab Drenthe describes as "grandma's personal care budget (GPCB)".

Every Municipality knows how much administration is involved when the Municipality is delivering multiple services to the same person, and how much duplication there is: receipts have to be saved, unspent money has to be returned, and it all has to be supervised so that money will not be spent on other things instead of the goal it was intended for.

"Now suppose that the money from this GPCB is only accepted at three taxi companies, a home care organization, and a physiotherapist. Grandma gets her money every month. When she purchases care from one of those parties, she can transfer the money directly to them

> Nobody has to wait for payments or complicated claim processes anymore – it will save an enormous amount of checking and administration.

> Tying money to a specific purpose can drive changes in consumer behaviour. For instance: eating healthier or doing more exercise at a fitness centre. – Adri Wischmann

by scanning a QR via a single app. It is impossible to spend the money anywhere else than with those 5 organisations, and a reference to this payment is immutably registered in the blockchain. Nobody has to wait for payments or complicated claim processes anymore – it will save an enormous amount of checking and administration."

IoT Nederland and BlockchainLab Drenthe are working to enable MultiWallet to manage a variety of different funding streams and use cases, says Wischmann. "Just like grandma used to have grocery money, clothing money, tax money and holiday money. People will now have an electronic wallet with different kinds of money that can be used for different purposes (or specific goals)".

We often hear that giving out money with strings attached (so users have to follow the "rules of the game") might feel patronizing, and that could be true. But we want to ensure that funds go where they're intended to go, without creating a tremendous administrative burden. "If you want people to use support to buy a school laptop for their child, you also need to make sure that they do spend it on a school laptop for their child". The MultiWallet funds and services can be targeted to stimulate the local economy – as they would usually be redeemed through local organisations and retailers.

GENERATING HEALTH CERTIFICATES IN OLDENBURG, GERMANY

Developing a privacy-first solution to share sensitive health information

Ali Amin Rezaei – University of Oldenburg, Germany

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 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

In many cases we see that organisations are using blockchain when they don't need to.

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?

Blockchain is an obvious suggestion for this use-case – given the privacy and trust implications of data sharing in this area. However, we first needed to make sure that using blockchain was appropriate 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 could add unnecessary complexity to our solution.

For our 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?*

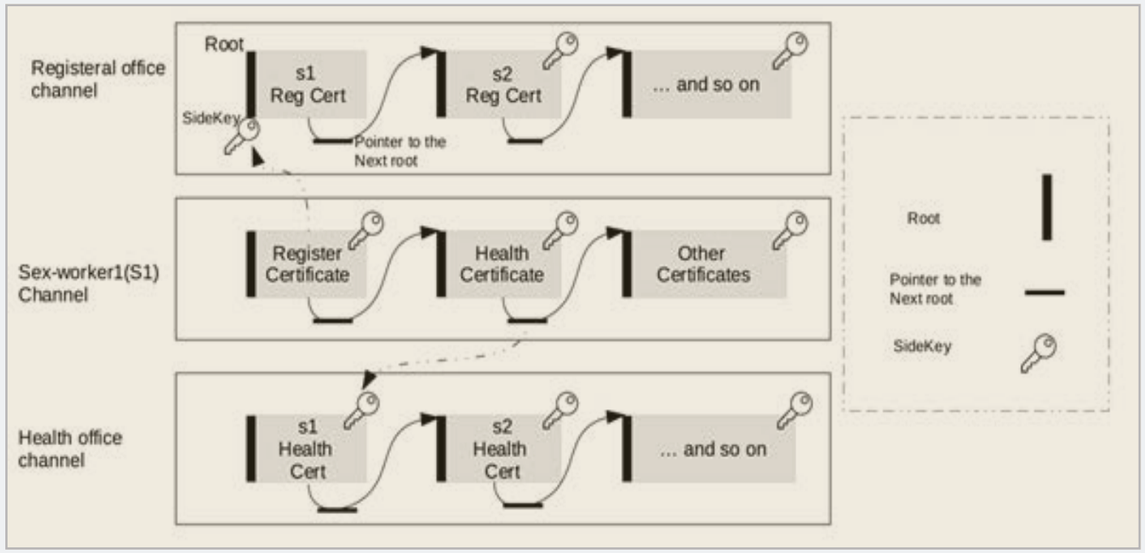
What type of Blockchain – How we chose IOTA

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). But blockchain is just one 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

Every city provides a different form of registration certificate, which makes it difficult to authenticate certificates.



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, fee-less, 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 transaction 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 costs involved 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 have completed the development phase of the pilot and both Android and iOS apps are now available. We expect to test the pilot over a two to three month period in mid 2023, with both 5-10 sex workers, and with the officials issuing registration and health certificates. 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.

Roeselare was looking for services that needed user privacy, a more robust record of service use, and needed trust between organisations delivering services.

MOVING THE LEISURE PASS TO THE BLOCKCHAIN

How Roeselare plans to simplify service operation and delivery through a blockchain-enabled solution

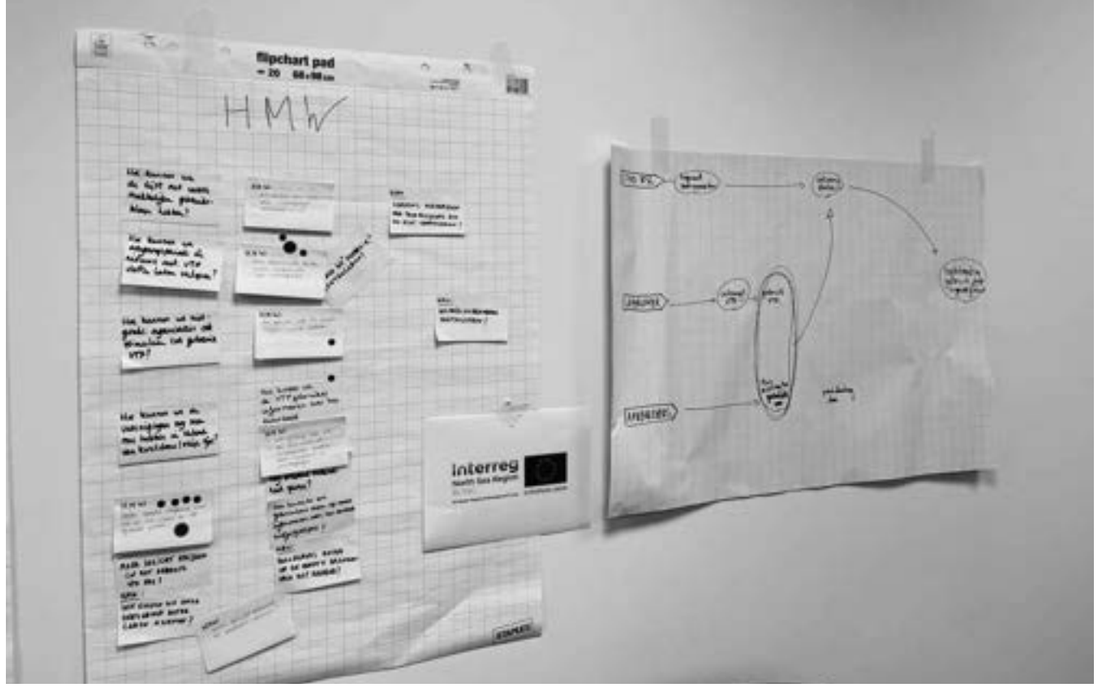
Jasmien Wellens – City of Roeselare, Belgium

In a review of municipal processes in 2022, the City of Roeselare in Belgium identified several processes that could potentially be made more efficient and effective through the adoption of blockchain-enabled tools and processes. Following this review Roeselare decided to develop a proof of concept to see how the management and administration processes of the City's Leisure Pass could be improved by the adoption of a blockchain-enabled solution, such as a personal digital wallet.

Every two years Roeselare issues a Leisure Pass (Vrijetijdspas) to citizens who have limited incomes, as defined by their health insurance fund. This pass provides access to services provided through the city at a significant discount, including some holiday activities, sports, membership fees, tickets, service registration, and discounted courses and activities. This means it is much cheaper to access a range of services if you have a Leisure Pass.

At the moment, the process for service providers to claim back costs for discounted activities is manual and not digitised, and is open to errors and the risk of inaccurate claims. The providers/owners of pools/theatres/youth activities etc. must tell the City what discount they've awarded and to how many people, and then the Roeselare reimburses the providers.

As the process isn't digitised, the city has to trust that the partner organisation is telling them the truth about the number of users.



City staff need to manually check with every participating organisation to get the number of Leisure Pass users, but if it's digitalised then this data collection and payment could become automatic.

The city is not allowed to know who has a pass – addresses are anonymised by the Health Insurance Department of the City – so a policy officer can't see who has low income for example, and they are not allowed to track users. In practice, this means that the city has a very limited understanding of who is using the Leisure Pass service and how effective it is – e.g. whether all age groups and genders are using it, or if certain sections of the population use it more than others.

Roeselare's priority is to be able to understand how the Leisure Pass is being used in practice, and to make sure the right target groups are using it. The Leisure Pass includes a personal identifier that encodes the user's age and gender, and Roeselare aims to be able to work with this anonymised data through a privacy-focused solution to better understand the number of users and their age and gender.

Given the need for user privacy, the need to develop a more robust record of service use, and the need to add trust to the network, Roeselare identified Leisure Pass as an appropriate set of processes that could be significantly improved by a blockchain-enabled solution.

Roeselare's proof of concept development process

In August 2022 Roeselare worked with all the participating stakeholders to finalise a process map for the Leisure Pass, mapping out how the process works and how different parties were involved in service delivery. The City is now running workshops with Policy Officers to identify what their service needs are and to finalise a vision for what the 'best version' of the Leisure Pass would be.

Roeselare's development of a blockchain solution is being supported by Cronos, a specialised blockchain consultancy. When talking to stakeholders and partners and interviewing with citizens Roeselare deliberately didn't highlight the potential use of a blockchain-enabled solution, choosing to focus instead on the challenges they faced and the problems they'd like addressed.

Cronos are developing a prototype of the service for Roeselare, which will be tested with citizen users and partner organisations in mid 2023. Once the prototype is completed Roeselare will be looking to calculate the cost savings of a shift to a blockchain-enabled solution. If the proof of concept is successful, Roeselare's Strategic Unit will propose the adoption of a revisedservice to local politicians after the 2024 local elections.

This is an example of how projects like BLING continue to have direct impacts on service design and on service delivery well the project has finished. The increases in local government skills and capacity resulting from projects like BLING have direct and indirect long-term impacts.

USING BLOCKCHAIN TO REMOTELY MONITOR PATIENT HEALTH

Oldenburg explores how to deliver a GDPR compliant remote patient monitoring solution

Ali Amin Rezaei – University of Oldenburg, Germany

Oldenburg University is developing a proof of concept that explores how blockchain can be used to solve the privacy problems that are endemic to the sharing of remotely collected patient data. The Oldenburg Clinic – the largest acute care hospital in Lower Saxony – is cooperating as a consultant and observer as the solution is developed.

From surveys to smart solutions

Over the last 20 years there have been a wide range of projects looking to formalise ways to collect information from patients about their clinical outcomes (i.e. Patient Reported Outcome Measures – PROMS) and experiences (Patient Reported Experience Measures – PREMS). Most of these have used questionnaire-based approaches that provide a framework for somewhat-regular collection of data from patients – though these questionnaires may be patient, disease, or intervention specific.

The value and challenge of remote patient monitoring

The development of wearable technologies, Bluetooth and the Internet of Things (IoT) has opened up a range of new ways to remotely capture data about patients – broadly described as RPM – Remote Patient Monitoring. Using these devices for RPM could potentially provide new streams of patient information to clinicians and potentially reduce the administrative and technical burdens implicit in data collection from patients.

Oldenburg's Remote Patient Monitoring (RPM) proof of concept was developed as a strategic response to the need to use new tools to monitor patients to reduce the load of hospitals during the pandemic. RPM could be enabled through a range of medical IOT gadgets, such as smart wearable devices and sensors. These sensors could enable medical staff and systems to continuously monitor the symptoms of the patients – even though they are not in the hospital – and medical centres could be able to respond to changes in symptoms and intervene when necessary or in case of emergency.

The most significant practical challenge raised by this however is that these devices often store patient data in the cloud in ways that may not be privacy compliant – or accessible to healthcare providers. RPM data is some of the most personal information imaginable – so solutions that enable data-sharing clearly need to be both ZGDPR compliant and privacy centric. In current practice, data from IoT style devices is usually stored on a proprietary cloud-based platform, and therefore patients have limited ability to manage access to their data – and to share it with healthcare providers.

Distributed storage of RPM data

To address these concerns, Oldenburg is developing a proof of concept for the distributed storage of RPM data using a combination of peer-to-peer storage with access control managed via an IOTA distributed ledger (blockchain).

How do we reduce the legal, administrative, and technical burdens that come with the remote collection of patient data?

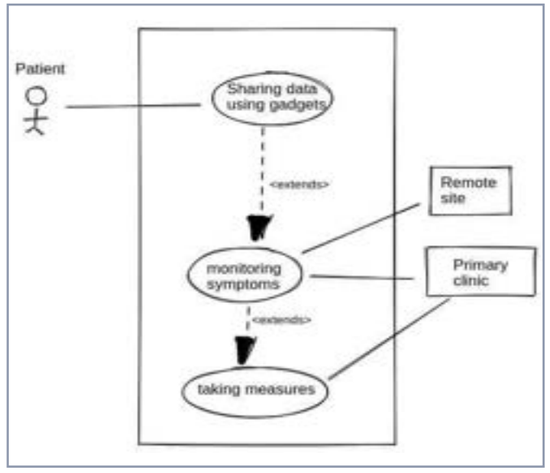
Oldenburg will test using peer to peer local storage based on IPFS. Since IPFS is an open access network, the data should be encrypted first; and the decryption key should be delivered to the authorized peers to see the data – which in our use-case is the Oldenburg Clinic. In this solution architecture Oldenburg will use IOTA Streams to manage access control.

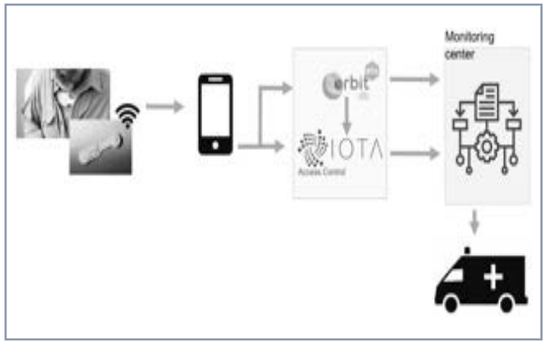
To access patient data, we first need to know where to find the data (in this case the IPFS channel ID) and we need the key to decrypt and read data. These both can be obtained through the IOTA channel. Each patient has a channel and therefore an ID on the IOTA network. Each channel contains many branches. The access data for each sensor will be stored in a branch with an IPFS address and decryption key. Each channel can have many subscribers (e.g. clinicians, clinics, hospitals), and the channel owner (in this case the patient) can grant subscribers access to each branch and thus access to their sensor data. Once branch access is granted, the subscriber can obtain the address where the sensor data is stored, as well as a key to decrypt the data.

This solution provides a flexible privacy compliant approach to store remote patients monitoring (RPM) data, and gives patients control over who accesses their data.

Next steps

University of Oldenburg is going to build a prototype based on this solution in 2023 and will then evaluate how their solution meets their original goals. The prototype will use leading edge technologies like IOTA and Orbitdb (a new serverless, distributed, peer-to-peer database) in our solution, so Oldenburg will really be exploring the art of the possible!





ENABLING NEW APPROACHES TO COMMUNITY GOVERNANCE WITH BLOCKCHAIN

Skåne looks for new governance models to deliver the R:ekobyn community vision

Jörgen Dehlin and Josef Gustafsson – Länsstyrelsen Skåne, Sweden

A combination of the climate crisis and the need to embed sustainability in project design and development means that many communities and development projects now choose to set goals and visions for how common resources should be controlled and managed to ensure that they are used in a sustainable way.

These goals and visions can be quite general – such as incorporating the UN's 17 global development goals or Agenda 2030 – or more specific sustainability goals that are particularly relevant to a Municipality or project.

The R:ekobyn community

R:ekobyn (R = Röstånga, eko=eco, by=village) is a cohousing project in Röstånga in the County of Skåne in southern Sweden. The community of R:ekobyn has a clear vision of the type of ecological, social and economic environment they would like to create for their sustainable community.

The non-profit association that runs R:ekobyn wants to find climate-sustainable technical solutions for the common challenges that face the community – issues like heating, energy, and construction technology They also want to create common spaces and activities – like a common workshop – that supports a more efficient use of resources.

However, there is a lack of framework, based on evidence-based research, for how projects like R:ecobyn should be managed when they need to have shared goals and visions, manage common resources, and involve multiple different parties – including residents, future residents, and other public and private actors.

This proof of concept explores how the community might deliver this rules-based approach to community governance though a blockchain-enabled solution – with a particular emphasis on how to ensure transparency in decision making. This work is part of a wider two part feasibility study on the future of R:ekobyn, consisting of the creation of the R:ekobyn network, and the second being the creation of a steering group with overall responsibility for the project.

Using rules to manage a network

One possible solution is to create a set of formal ways of working – enabled by blockchain technology – that can enable particular forms of collaborative working. Having set ways of working will help the community develop more concrete solutions to the challenges that arise when trying to collaboratively deliver shared visions using shared resources.

The network R:ekobyn is building will be based on Nobel laureate Elinor Ostrom's 'Social- Ecological System' (SES). Ostrom's theory of how the commons (common spaces, common resources) should be governed and of the fundamental importance of trust, is an influential social science theory. The SES system is based on eight guiding principles that increase the likelihood that people should be able to control and manage common resources in a long-term and sustainable way, which are then articulated through seven user rules.

The challenge the R:ekobyn network faces is how to embed these rules in the management platforms they use, and in their day-to-day ways of working.

BLOCKCHAIN BENEFITS

OSTROM'S PRINCIPLES

		Tokenization	Self-enforcement vand formalization of rules	Autonomous automatization	Decentralization of power over infraastructure	Increasing transparancy	Codification of trust
1	Clearly defined bounderies	X					
2	Congruence between rules	X	X		X		
3	Collective choice arrangements	X					
4	Monitoring		X	X	X	X	
5	Granduated sanctions		X	X			
6	Nested enterprises			X			X
7	Conflict resolution mechanisms					X	
8	Minimal recognision of rights to organise				X		X

Using blockchain to enable a new Social-Ecological System

To create transparency and increase participation in the network, and to ensure that the community had a platform to deliver the rules of the SES framework, communication would be driven through a blockchain platform.

The advantage of blockchain technology is that with a private blockchain only those who are invited can participate or write to the blockchain. Content added to a blockchain is cryptographically signed, and cannot be altered or deleted. If someone wants to add text or images, this content becomes a new block in the chain, with that person's unique digital signature.

A R:ekobyn blockchain platform would facilitate internal communication by acting as a logbook for all internal and external communication. It would also provide a single source of truth that enabled members of R:ekobyn to easily get an overview of previous regulations and of ongoing work.

- A network makes it easier for projects to be able to reach their sustainability goals. This should help organisations deliver their goals.
- A network can promote that the sustainable use of shared resources, which reduces the likelihood of the 'tragedy of the commons' resulting from competition for use, from overuse, and from "free riding".
- A network where all parties communicate via a blockchain makes communication secure and traceable, which facilitates accountability.

Delivering a R:ekobyn blockchain platform

This idea sketch sets out how R:ekobyn can create a network based on Ostrom's SES framework – delivered through a blockchain platform. This outline should lead to an implementation project, which aims to deliver the lessons learned by the network and which would also be useful for drawing lessons for future similar networks in other projects in the Öresund-Kattegatt Skagerak region.

What is expected to be included in the project that we want to create?

This proof of concept supports the wider work being done to set up and deliver the R:ekobyn network and its steering group.

The network in R:ekobyn would need to identify where the framework will be most effective, how it will be financed, how R:ekobyn's shared visions and resources should be collectively managed, and which of the SES user rules will be embedded in R:ekobyn's ways of working. User rules that are well anchored in the R:ecovillage's local context will increase the incentives for the participants in the network to try to reach their common goals and to use the common resources in a sustainable way.

The main tasks of the steering group will be to find participants for the network, to embed the SES framework in how the network works, and to find a way to develop and implement the blockchain technology in the network.

Their biggest challenge will be finding an affordable way to develop the blockchain, as this is a technology that is context-specific, and the platform must be developed from the ground up for this purpose.

SECTION 3 – USING BLOCKCHAIN IN ENERGY AND TRANSPORTATION

In this section of the BLING BOOK we focus on pilots, proof of concepts and uses cases from two domains where blockchain-enabled systems have great potential: energy and transportation.

Energy

EnergyKnip (“Energy Wallet” in English) was BLING’s first public service and is the Netherlands’ largest government blockchain project, distributing e-wallets to 50,000 households and €300,000 in funding to increase household energy efficiency. EnergyKnip 2.0 is under development, and this wallet-based approach to managing the distribution of public funds is now being copied widely across the Netherlands and the BLING partnership.

Transportation

Transportation is ripe for disruption, and distributed ledger technologies offer many new ways to disrupt the sector from using smart contracts in the logistics sector, to supporting a privacy compliant Mobility as a Service application, to re-imagining document handling in ports and supply chains.

ENERGYKNIP – DELIVERING ENERGY EFFICIENCY IN EMMEN WITH THE NETHERLANDS' LARGEST BLOCKCHAIN SERVICE

EnergyKnip ('EnergyWallet') delivers energy support to residents in Emmen

Adri Wischmann – BlockchainLab Drenthe, Netherlands

Introducing EnergieKnip

EnergieKnip is a new blockchain-enabled service that went live in 2021. Residents of the Municipality of Emmen – with a population of 100,000 – who used the service could receive an e-voucher worth €50 euros per home if they anonymously completed 27 questions about how they used energy in their home. This €50 could then be spent on energy-saving products at local hardware stores – but only on energy saving products and only at local hardware stores.

Policy and delivery goals

Emmen's goal in supporting EnergieKnip was to deliver a service that helps residents to improve the energy efficiency of their homes and to actively participate in the energy transition by using a personalised energy reduction offer, that didn't rely on direct support to deliver the service from municipal staff, and which supported the local economy.

EnergyKnip's goals are to educate citizens about their household energy use and how they can change their energy use, to encourage users to install energy efficient devices in their homes to reduce their energy consumption, to increase the local demand for energy-saving devices, and to collect anonymous information about household energy use in Emmen (as Emmen didn't understand this very well before the project).

Providing direct support to residents

Funds disbursed by the service came from the Dutch "Reduction of Energy Use Homes Scheme" (RREW), which provided money to local governments to support households to reduce their energy consumption.

The first time the Municipality of Emmen tried to award funding to residents, they sent out paper letters to residents informing them that funds were available to support home energy sustainability and reduce energy consumption. Seven months after the start of the campaign, only 16% of the available funds had been claimed.

The Energy Wallet was Emmen's second try at giving out this funding and used a radically different approach. BlockchainLab Drenthe saw the opportunity to provide a more effective, privacy compliant service as an opportunity, and worked with the Municipality to develop and launch the EnergieKnip ("EnergyWallet"), a service that collected survey information on local energy use habits from app users, and rewarded participants who completed the surveys with tokens that could be exchanged for new energy-efficient equipment at local retailers.

This time the Municipality didn't send out letters to residents: they delivered an unaddressed, cheerfully coloured card to each address. The card had a QR code and a guide to downloading the EnergieKnip app. The Municipality had earmarked up to €300,000 to support for local households: the first funding round launched with €150,000, and that all of that was claimed within 13 days of the EnergieKnip launch. When a second round of funding was launched, an additional €150,000 was snapped up in just 10 days.

EnergieKnip provided Emmen's residents with a personalised energy reduction offer.

Using the IOTA Wallet

An IOTA-powered blockchain wallet was used to deliver the EnergieKnip service. IOTA was chosen as the platform for a token-based local funding program that gave participants a digital wallet to hold their tokens. The IOTA service reduces the administrative cost of organizing a local service, facilitates transactions, and, thanks to the transparent and immutable record of transactions on the blockchain, prevents fraud. On registration, the app automatically created a wallet for the user's wallet reward tokens.

When participants filled out a survey in the EnergieKnip app on how they used energy in their home and on their energy consumption patterns, each answered question was rewarded with tokens that could then be redeemed for energy-saving equipment.

What users got

Participants who used the app and filled out the energy use survey were rewarded with tokens worth €50 per home, which were recorded in their IOTA wallet on the blockchain. These tokens could then be exchanged at local retailers for new energy saving devices – like energy efficient LED bulbs.

During the coronavirus lockdown, people could pick up a "Savings Box" with their EnergieKnip tokens – these boxes contained LED lamps, draft strips, and radiator foil. Once lockdown measures eased, app users were able to chose how to allocate their tokens on a set range of energy-efficient goods and tools.

Participating retailers were then able to exchange the tokens with the Municipality for Euros. "This is the power of earmarked money," says Adri Wischmann from the BlockchainLab in Drenthe. "Because people can only spend the money in set ways for particular purposes, the (local) government has a very powerful tool to easily ensure funds are spent appropriately."

Collecting energy data, not people's data

The EnergieKnip app has provided a mechanism for citizens to anonymously share their energy consumption data with local authorities. Emmen was able to quickly and cost-effectively collect a large amount of data about the energy uses and habits of 9,000 households, which the Municipality will use to improve their energy policies in future.

By design the process didn't collect any personal data – so there was no information about individual residents or participants or their address data. EnergieKnip only collected energy-related data that was submitted by users – such as the age of their central heating systems, and whether residents left their curtains open at night.

BlockchainLab and Emmen recognised that they would have to be very clear about how EnergieKnip was GDPR compliant and met all and data-privacy requirements, so that potential users wouldn't reject the program because of privacy concerns.

To make sure that the data that was collected was anonymous and not traceable to individual households, randomised QR codes were sent out across the Municipality for users to use to activate the app.

Other best practices were that participants had to understand all the steps of the set-up, and that the collected data lead to a direct benefit for energy consumers and the Municipality via an easy to use platform.

The developers felt that it was important to provide an incentive for users to submit information about their energy use – as not everyone is interested in being more energy efficient or needs financial support. But to do all of this anonymously led to the need to use distributed ledger technology to create the wallet for the incentive reward token.

A high profile success

EnergieKnip (and BlockchainLab) received extensive national and international media attention, with articles in China and even Al Jazeera contacting us to learn about our “Blockchain driven energy project”. Then came a series of invitations to national and international events where we were able to present EnergieKnip to new audiences.

ENERGYKNIP 2.0 – DELIVERING MORE ENERGY EFFICIENT APPLIANCES TO THE RESIDENTS OF EMMEN

New approaches and new partners build on the success of EnergyKnip

John Smalbil – Emmen, Netherlands

Following up the very successful EnergyKnip project, the Municipality of Emmen and BlockchainLab Drenthe are developing a new version of the EnergyKnip service with a new energy support offering that looks to provide more energy efficient appliances to households living in energy poverty.

What was EnergyKnip and how did it work?

In the first version of the EnergyKnip, households could earn tokens to be redeemed at a set of identified local stores. In this first version of the service EnergyKnip linked a ‘seller’ of energy efficient products (the local retailer) and a ‘buyer’– the local household. Users would fill out a survey on their household energy use and receive tokens that could be exchanged for €50 of energy efficient light bulbs and so on.

The Goal of EnergyKnip 2.0

EnergyKnip 2.0 builds on the success of the first EnergyKnip and uses the same blockchain-enabled technology to pay for the supply of energy-efficient appliances or energy-efficient home improvements (such as insulation or window replacement). The goal of EnergyKnip 2.0 is to help a target group of residents/households in energy poverty to become more energy efficient, and to actively participate in the energy transition by accessing a personalised energy reduction offer, facilitated by the Municipality, while also supporting the local economy.

In EnergyKnip 2.0, the plan is that 320 residents who live in energy poverty and who live in a rental home will be able to exchange an energy-guzzling refrigerator or freezer for an

> The challengefor EnergyKnip 2.0 will be to connect suppliers,products, installers,and buyers.

energy-efficient one. Funds will also be made available to help 200 households with the installation of glass and insulation material by local companies. These activities will help to make their homes more energy efficient.

Local companies in the Municipality (about 12 companies) that sell kitchen appliances have been approached to participate and a tendering process is underway to set up the replacement/ installation service. As with the first EnergyKnip project, residents and households will be financially supported but they will not directly receive any cash. These households will however be able to see the result of this investment reflected in changes in their energy bills.

The challenge for EnergyKnip 2.0 will be to connect suppliers, products, installers, and buyers, while keeping track of both the waste stream and the proof of delivery of the services to provide evidence of the support activity to the subsidy to the Dutch Ministry of the Interior and Kingdom Relations (BZK). To do this the Municipality of Emmen has developed a new EnergieCoach platform which manages the workflow of the appliance swap (request, claim approval, identification of the resident, marketplace, and delivery). Payment of claims to suppliers is still managed via a blockchain-enabled solution, as in the first EnergieKnip. Appliances that are to be replaced under this programme are given a sticker with a unique QR code, which is scanned by the supplier when the appliance is replaced. This 'transaction' is then saved to the blockchain, and this starts the automated payment process to the retailer/installer.

While the project is still being designed, it's already been a success, as other organisations including a Dutch housing association have approached Emmen to participate in the programme. These new partners will provide additional funds for energy efficient interventions that will be targeted at the people living in the accommodation provided by the housing association.

Emmen hopes to launch EnergieKnip 2.0 in April/May 2023, once tendering for suppliers is complete.

The delivery approach

No money is provided to the residents in this project. All measures are supplied and installed at the homes of residents by local companies.

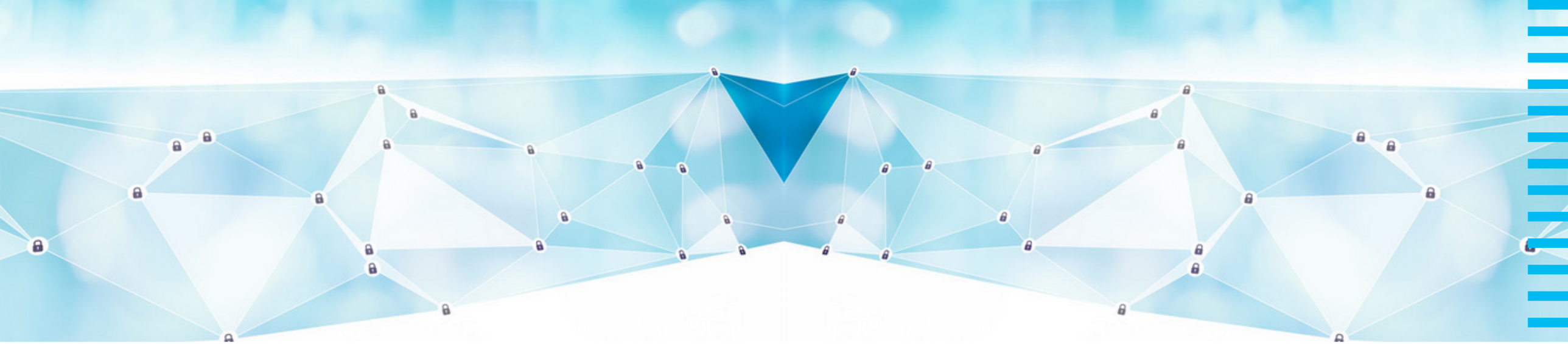
Emmen has a large group of approximately 80 volunteer energy coaches who have been trained and certified by the Energy Coach course at Drenthe College. Residents who have questions about how to make their houses sustainable can book a home visit from an energy coach. The coach will use their knowledge of housing structure and measuring

equipment to write energy reports for each household. The coach will check the efficiency of their household appliances, and if the resident has an energy guzzling appliance the coach will then begin the EnergyKnip 2.0 appliance replacement process.

The first version of the EnergyKnip project connected households and retailers who sold energy-efficient devices. The challenge for EnergyKnip 2.0 is to connect buyers, suppliers, installers and products, while keeping track of appliance swaps, the disposal of old systems, and the proof of delivery that is required by the funder – the Dutch Ministry of the Interior and Kingdom Relations (BZK)

With the new EnergyKnip functionality, the energy coach will identify a suitable energy saving measure for residents that best fits their personal situation. Where energy guzzling devices are to be swapped, a QR sticker is placed on the device. This opportunity will then be listed on the EnergyKnip 2.0 marketplace where local companies can claim it, contact the resident, and make an appointment for installation. After scanning the old appliance and taking it away for recycling, the Municipality will automatically pay the company via EnergyKnip.

EnergyKnip 2.0's revised approach of providing support to targeted individuals in energy poverty may be revised and extended in future to allow the platform to support other groups who need assistance, or to deliver different funding streams. It is hoped that the platform can be developed to provide sufficient flexibility to support a range of communities, services and interventions.



GEOPACT – CONNECTING VIRTUAL BLOCKCHAINS WITH REAL PLACES

A blockchain-enabled location verification system which collects location data from smart objects with security and certainty

Dr Dave Murray-Rust (now TU Delft) and Dr Ella Tallyn, Edinburgh College of Art & Design Informatics, University of Edinburgh, Scotland

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 in the media. This lack of awareness and understanding of these 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 – jus by walking around the city. Roleplay and participation are effective tools to explain smart contracts.

Introducing GeoPact

GeoPact is a blockchain-backed l**ocation 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.

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.

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 verification from 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.

We 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 by 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'

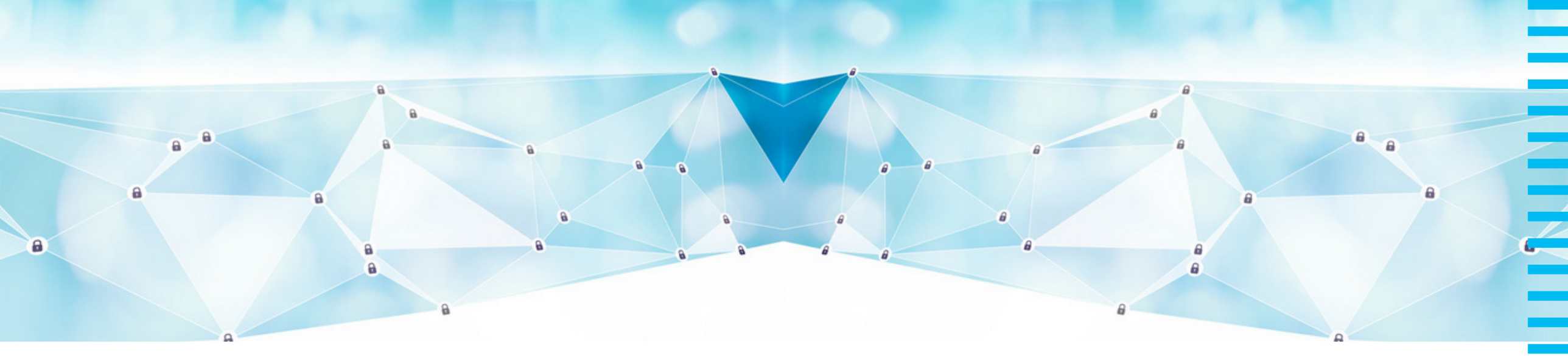
'Location aware' smart contracts connect real-life actions – identified by sensors connected to the Internet of Things – to blockchain technologies, tying events together to ensure things happen in a specified way. This provides contractual certainty around the events that should take place as part of a process. Yet much of their value lies in the security provided by their 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.

Smart contracts often do not match the public's existing mental or legal models of how contracts work.

GeoPact at work

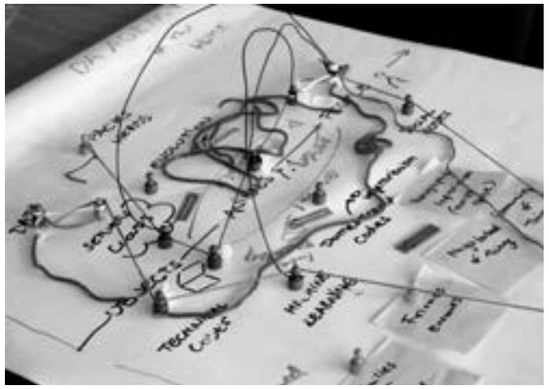
The technological architecture of GeoPact integrates IoT technologies (LoRa, Bluetooth) with an Ethereum blockchain. Bluetooth beacons communicate across local networks using location data to confirm the identity



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 these concepts 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 provide 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 contract to complete. A dashboard displays an entire, active smart 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 technology that was driving it. 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 we 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 the 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 in 2020 with a revised GeoPact test suite that now uses a GeoPact phone app, and a new more robust, smart lockbox These developments make the GeoPact proof of concept 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. To further support this work Design Informatics has produced GeoBlocly – a platform to write location-aware smart contracts for blockchain applications. You can read more about GeoBlockly elsewhere in this book.

IDENTIFYING THE KEY CHALLENGES OF BLOCKCHAIN IMPLEMENTATION IN THE MARITIME SECTOR

Aalborg University finds that the challenges of adopting blockchain in a complex existing system are not unique to port systems.

Sergey Tsiulin – Aalborg University, Denmark

The idea of transforming the maritime shipping industry into a digital platform with real-time communication has become a hot topic in the industry. A key question is the potential role of blockchain technology, which due to its decentralized architecture could potentially simplify some of the complexity of the supply chain network and provide a new way to connect supply chain participants.

Despite this, only a few studies have investigated the feasibility of blockchain-enabled approaches in detail, and without addressing the limitations of blockchain in a systemic way. Aalborg's work identified and systematised the challenges of blockchain implementation in the maritime industry, and within the maritime port environment. From a review of the relevant literature and building on previous research findings, they identified 18 challenges to blockchain implementation. These were then categorized into four dimensions: *human factor, operational, organizational, and technological*.

Aalborg's findings show that different priorities among ports, low levels of digitalization, the scalability of blockchain systems, and unwillingness to change business practices are important challenges to the adoption of blockchain-enabled solutions in this context.

Key issues

Organizational barriers reflect the port development strategies, where infrastructural development is prioritized over IT solutions. So, maritime ports (at the moment) are looking forward firstly to expand and improve connectivity with different types of transport (rail, road, sea). The complexity of **integrating all parties** (e.g., customs, cargo senders, port of origin, port of destination, etc.) **into one network will be a significant obstacle to blockchain adoption.**

Another difficulty is the challenge in **embedding and integrating new software solutions into already working IT systems**. This challenge is likely to be exacerbated by the unwillingness of some company employees to support changes in their business routines.

There are also a great number of **technical challenges**. For the port industry, it is not clear how to identify the appropriate blockchain consensus mechanism if the mechanism **has to work at different scales** (for example, when sharing information between different networks or within different parts of the supply chains). This process is particularly complicated in the case of projects that imply that they are able to evidence the provenance of goods – i.e. tracking them as they are transported across a wide supply chain network. Other practical challenges include problems with running and supporting shared servers, educating personnel and managing stakeholders, and so on.

The potential transition to blockchain-enabled solutions is not so much dependent on the development of blockchain technology, as it is of the ability of all of the participating actors to reach a common level of digital capability. Government organizations and frameworks can facilitate a faster transition to digitalization, which could contribute to interest in decentralized systems.

This lesson about the importance of organisational capacity across a partnership to their ability to innovate and to develop is not unique to port systems.

Tsiulin, S., Hilmola, O.P., Reinau, K. H. (2022) The key challenges of blockchain implementation in maritime sector: summary from literature and previous research findings. Proceedings of ISM – International Conference on Industry 4.0 and Smart Manufacturing (in press)

Different priorities among ports, low levels of digitalization, the scalability of blockchain systems, and unwillingness to change business practices are important challenges to the adoption of blockchain-enabled solutions.

18 barriers to blockchain implementation
Our results found 18 barriers towards blockchain implementation, which we have split into organizational, operational, human factors, and technological categories.

ORGANIZATIONAL CHALLENGES

1 Ports prioritize land expansion

2 Customs, landside integration and final customer

3 One-party ownership/development interferes with blockchain decentralization

4 Legal uncertainty

OPERATIONAL CHALLENGES

5 Ports have poor level of digitalization

6 If blockchain is about tracking, then the industry is already doing that

7 Unclear costs/benefits

8 Similarity to Port Community System

HUMAN FACTORS

9 Dependency on manual input

10 Reluctance to change business processes

11 The level of trust is sufficient

TECHNOLOGICAL CHALLENGES

12 Scalability of blockchain-based systems

13 Distributed database is confused with limited responsibility

14 Parties are likely to not run their own servers

15 Low maturity of long-term projects

16 Participating mechanism is unclear

17 Distributed systems are often attached to centralized platforms

18 Big part of applications is attached to cryptocurrency

ENERGIELENING – GHENT'S ENERGY LOAN PILOT

A proof of concept for a blockchain-enabled solution that makes applying for energy support easier, quicker, and more efficient

Emmie Osselaere – Stad Ghent,
Shane Deconinck – Howest,
Daniël Du Seuil – District 09/European Blockchain Partnership

Becoming a climate neutral city

Ghent wants to be climate neutral by 2050. To make this possible, the city needs to develop new ways of working that can help accelerate the energy transition, and to speed up the program of energy efficient home renovations. The city provides an 'Energyloan' ('Energielening') to households to help them afford energy-saving upgrades for their properties. The current application process involves many parties and is too cumbersome for citizens.

Ghent wants to drastically reduce the time and administrative burden of the application procedure by developing a system that uses blockchain technology to manage user identity and enable the rapid, electronic transfer of authenticated data about applicants between partners – without transferring the applicant's personal details.

In the current process, a lot of communication is required between the applicant and the energy consultant who is supporting their application and gathering all the documents that are required – and the applicant often has to deliver more information than is strictly necessary. Once this is done, an administrative assistant needs to check each document, which is a time-consuming procedure.

Ghent's proof of concept focuses on reducing the burden on both the administrative assistant and the applicant. We are testing an approach based on the use of a "self- sovereign identity", where the applicant can choose which data may be shared and with whom via a blockchain-enabled service.

Proof of Concept Goals

Our pilot will have a positive impact on the people who are using the service by simplifying the process of applying for an energy loan. The combination of a Self-Sovereign Identity (SSI) framework and Verifiable Credentials (VC) technology enables safe, secure, and efficient sharing of identity and loan application information among the various parties involved in the process.

Citizens (credential holders) will be able to request valid electronic copies of their data from data providers via an e-wallet- system. This will replace the paper copies of information that applicants currently provide. The data providers will send the requested data in the form of a Verifiable Credential (VC) whose authenticity can be confirmed via the blockchain. The citizen will then be able to decide if they wish to present these credentials to the wallet of the City of Ghent (the verifier) for processing.

The use of Verified Credentials will provide a method to prove electronically that the citizen meets the different criteria required to be eligible for the Energy Loan without having to give any personal information to the City of Ghent (e.g. the system can verify that the applicant is a Belgian taxpayer without needing to provide their unique taxpayer reference). The length of time it takes to process applications will be drastically reduced, because the citizen can ask for the

data to be provided directly from the authentic source and this authenticity can be verified via the blockchain solution. This will ensure that only the correct documents/credentials can be supplied and eliminates the need to validate and cross-check the applicant's paperwork.

Collaborators
The proof of concept is being delivered through a large partnership with many external organisations, including the City of Ghent, Howest (as technical/academic partner), District09 (IT-partner for the City of Ghent), the Social Welfare department, BOSA (the Belgian Digital Transformation Office), the Belgian Ministry of the Economy, the Belgian Ministry of Finance, EBSI (the European Blockchain Services Infrastructure), and ValidatedID and Walt.id as SSI wallet technology providers.

Using Self Sovereign Identity
The Energy Loan proof of concept is built upon the concept of 'self-sovereign identity' that is enabled by a blockchain solution. The interaction between users/citizens and organizations is managed via an identity wallet, which stores verifiable credentials for the users. Citizens choose which wallet provider they wish to use. The credentials are issued by organisations via trusted issuer registries, so that the credentials can be cryptographically verified. No personal data is stored on the blockchain, but the blockchain solution enables an individual's credentials to be verified in a privacy-friendly way. The pilot is using the European Blockchain Services Infrastructure (EBSI), in which the decentralised identifiers (DIDs) of the issuers are stored on a blockchain. They are listed in a Trusted Registry, so that verifiers can verify the signature on the Verifiable Credentials of the citizens.

The EnergyLoan solution
EnergyLoan involves the integration and coordination of multiple parties. This includes:

- A portal for the citizen by City of Ghent to apply for a loan
- A portal for BOSA to issue the citizen with a VerifiableID and verifiable credentials (from the Ministry of Finance and the Ministry of the Economy)
- A ValidatedID credentials studio by Social Welfare service to issue their verifiable credentials
- A back-end for City of Ghent to verify the credentials which are presented during the application for the Energy Loan, and then issue energy loan credentials

The role of blockchain
In this proof of concept the use of blockchain is actually quite minimal – but the success of the whole process relies on the use of Self Sovereign Identity, which is delivered through the blockchain.

For an SSI-pilot to be set up successfully, it's important to get as many certification issuers as possible to support the ecosystem. But to achieve this, these organisations need to be educated on what SSI is, on how it will benefit them, and on how they can get it set up.

When choosing a blockchain solution for our service, Ghent faced several technical and organizational issues. One of the main considerations was ensuring regulatory compliance for a government service. This required careful consideration of the nodes involved in the network, as well as their hosting location. Ultimately, this led us to consider the use of the public permissioned network of the European Blockchain Services Infrastructure (EBSI) as a viable solution that would meet our requirements for security and regulatory compliance.

Responses to the proof of concept
User feedback and experience with our plans for a blockchain-enabled demonstrator service has been mixed, with many stakeholders having misconceptions and prejudices about the technology. Through our public engagement sessions, we have found it necessary to emphasize the key features of our Self-Sovereign Identity (SSI) implementation, that no personal data was stored on the blockchain, that EBSI is a regulated environment, and that the ecological impact of our blockchain was minimal.

As users become more familiar with the technology and its capabilities, they tend to have a more positive perception of our blockchain-enabled service.

What happens next

Now that the pilot is complete, it will be available to stakeholders for review and evaluation and can be 'tested' with a set of dummy accounts. It will be up to the regional and national stakeholders whether this demonstrator project moves towards deployment. Ghent feels that the wallet solutions tested in this pilot are promising, and they will work with their partners to explore how wallets can help other projects that are aiming to accelerate the energy transition.

For the staff of the City of Ghent, it has been an inspiring and educational experience, providing valuable insights into the potential benefits of blockchain technology.

Although the citizens do not have access to the service yet, the pilot has been a real eye-opener, demonstrating the potential for increased efficiency, security, and accessibility in government services.

The proof of concept has shifted how Ghent thinks about the relationships between technology, strategy, and services. This has enabled more service-first thinking, and is enabling more bottom-up approaches.

LESSONS LEARNED – working with stakeholders

Stakeholders often aren't familiar with Blockchain technology, which causes them to be initially hesitant. Blockchain is often seen as a more experimental and risky technology, and this results in a lot of prejudice. Once stakeholders were better informed of our solution, they were more open to engaging with the project and saw it as an opportunity to learn more about this innovative technology. Opinions within our organisation on our proof of concept were mixed:

- The operational side was sceptical about the changes to the application for the Energy Loan and the value of blockchain-enabled services to their process.
- The technical side was very supportive and willing to help us during the project.
- At a strategic level, the idea of an internal blockchain project was a shift, as projects like this are usually outsourced.

Ghent realised that it was very important to work to bring knowledge into the organisation: people are often more resistant to new things when they don't understand how they work.

LESSONS LEARNED – technical issues

- The choice of a wallet provider was a key challenge, as one of our stakeholders uses a wallet that didn't meet EBSI standards, which meant there was no interoperability between wallets in the system. It is important to find a wallet provider that does guarantee interoperability.
- Our proof of concept integrated many differing systems, but only some parts of the process used blockchain.
- Not every process/system is ready for a digital process flow. One element can block the digitalisation/optimalisation of the process.

Working with EBSI – the European Blockchain Services Infrastructure

By relying on the European Blockchain Services Infrastructure (**EBSI**), we benefitted from their experience and their platform to quickly build our use case. Setting up a separate or dedicated blockchain network just for this use case was not realistic or achievable, while integrating EBSI in this solution added an additional layer of security and transparency.

Onboarding on the EBSI platform did require some exploration and alignment between partners and processes. EBSI is a relatively young and evolving platform, which makes it challenging for the Self-Sovereign Identity (SSI) wallet providers to ensure interoperability.

A bigger challenge in building the proof of concept was choosing the other components which were needed to interact with the blockchain layers and with partners' legacy systems.

User wallets and enterprise wallets are an essential part of the use case, and we relied on platforms using EBSI conformant wallets. But this choice also impacts our stakeholders, and as an entirely open-source wallet is not yet available, we needed to collaborate with commercial wallet providers.
Howest gained valuable experience and knowledge in implementing Self-Sovereign Identity (SSI) with the European Blockchain Services Infrastructure (EBSI) in a government setting. Through the pilot, they have learned a lot of practical lessons about the technical and organizational challenges involved in implementing this technology.

The value of wallets

The concept of the wallet-systems, which we researched through this Proof of Concept, offers a lot of potential for the future.
Existing service initiatives can easily be connected to a wallet system, creating a complementary and decentralized system. A single wallet could potentially offer different applications and services that citizens can use. The wider SSI approach gives the citizens of Ghent ownership of their own data and insights into how and where it is being used.

The service architecture that has been developed is relevant to the other subsidy and loan applications services provided by Ghent, as the data needed to apply for an energy loan is similar to the data needed to apply for other loans and grants. It is possible that once a service like the Energy Loan is deployed, that other similar services will then be easily built using the same (shared) platform.

GEOBLOCKLY – A SMART CONTRACT BUILDER

Edinburgh College of Art tests a new tool that allows users to write their own smart contracts

Dr Dave Murray-Rust (now TU Delft) and Dr Ella Tallyn – Edinburgh College of Art, Scotland

A key advantage of blockchain-enabled processes is the ability to embed and automatically execute smart contracts in blockchain systems. Edinburgh College of Art built GeoBlockly as an exploratory tool that would enable new users to learn how to write these contracts and to get them to think about the possibilities for process management and automation that are opened up by Smart Contracts.

What is a Smart Contract?

A Smart Contract is a simple computer program (often but not always on a blockchain) that automatically runs when a set of predetermined conditions are met. Smart Contracts on blockchains are usually used to automate the execution of an agreement a soon as the requirements for the contract are met, without having to wait for someone to manually trigger or approve the execution of the agreement or contract.

Smart Contracts can also be used in the automation of workflows that manage information on blockchains.

What is GeoBlockly?

GeoBlockly is a graphical tool that enables users to collaboratively build location based Smart Contracts. It is based on Google's Blockly service. Blockly is a library that adds a visual code editor to web and mobile apps. Blockly provides an easy to use, visual code editor that uses interlocking, graphical blocks to represent coding concepts like loops, variables, and logical expressions. GeoBlockly adapts this to enable the user to write Smart Contracts.

What happens next?

After the development of the GeoBlockly tool, Design Informatics ran several workshops to test the tool with users and to capture feedback. The team is now exploring how the logistics and transport sectors could use the tool. The initial development of the GeoBLockly tool was part-funded by the BLING project. Development of the GeoPact Smart Contract Builder is now being funded by DECaDE: Centre for the Decentralised Digital Economy, a UK Research Centre exploring how emerging technologies such as Distributed Ledger Technology (blockchain) and Artificial Intelligence (AI) could transform the digital economy through the use of decentralised platforms.

MOBILITI – BUILDING A 'MOBILITY AS A SERVICE' SOLUTION ON THE BLOCKCHAIN

A ride sharing solution for industrial parks

Shane Deconinck – Howest University, Belgium

In an ideal world everywhere would be well served by public transportation. The team at Howest knew that the public transportation links to many out-of-town industrial parks in Flanders were not great, and so their employees were heavily reliant on using cars to get to work. But what if you don't have a car, or can't drive? How do companies attract workers if the workers they want don't have cars? How do companies collaborate if workers aren't able to move between sites if they don't have cars?

To help solve this problem Howest worked with local employers to build a proof of concept or a privacy-first ridesharing app that used blockchain to connect businesses, commuters, and potential passengers – and thus reduce automobile use and the need to own cars.

One of the unique aspects of the Mobiliti app is that by design it's cross-organisational. Rather than trying to match rides for workers in just one company, it provides a platform where any company can join with others in the same location so their workers can share rides. This way people can find rides even with other workers who are not in their organisation.

Because the app works with separate organisations that may or may not trust each other, and who may not wish to share information about themselves or their employees with other firms, Howest decided to use a blockchain as part of their app solution. Through the blockchain, data on usage can be recorded and analysed in a privacy-compliant way, ensuring a shared understanding about which rides happened, the numbers of people involved, and when.

Howest has needed to educate the organisations and municipalities that they wanted to do the pilot with about the opportunities and risks of these approaches. They have learned from their partners' questions and challenges and have tailored the Mobiliti solution in response to their needs and concerns.

A 3-part solution

The Mobiliti service is based upon a three-part solution. There is a **ride-sharing app**, which matches passengers and drivers – even if they're not part of the same organisation or employer. Secondly, Mobiliti uses a **Hyperledger Fabric blockchain** to store information about ride events – what is offered, what is accepted, and so on. The tamper-proof registration of activities and events increases trust across the participating organisation, as they know the data is an accurate reflection of participants' activities. Thirdly, there is an **Administrative Platform**, which participating organisations use to enrol their employees in the blockchain network, and which reports aggregated on platform use. This data allows employers to reward / incentivize employees who use the service.

Blockchain systems are really ecosystems involving multiple organisations.

MOBILITI IN USE

BEFORE THE RIDE

- The employer enrols their worker in the system via the administrative platform
- The employee is able to either post a ride or respond to a posted ride.

THE RIDE

- Driver shows the QR code for the ride
- Passenger scans the QR code, and starts the ride
- The ride start event is registered to the blockchain
- The ride stop event is registered to the blockchain

At the end of the journey the blockchain now holds irrefutable evidence that ride was started or stopped.

Ensuring user privacy

Mobiliti was designed with privacy in mind. The service was designed to be GDPR compliant – so users have the right to be 'forgotten'. Ride data should also not be public, but only visible for users of participating organizations. HOWEST used a Hyperledger Fabric blockchain to ensure privacy and immutability without having to disclose all of the participant's details. Hyperledger Fabric has a Private Data Store that keeps data private, while ensuring immutability by only making the hash of the private data public.

HOWEST used Hyperledger Fabric's Private Data functionality to store the participant details of a ride in a private information channel, while storing the general ride information in a 'public' channel. (It should be noted that this does not mean that the information is public – it only means that authorised nodes can see the information.) This blockchain configuration is known as a "private permissioned blockchain" and means that only authorised users can see ride information. Smart contracts are used to manage the flows of user data.

Testing, 1,2,3 testing...

Howest will begin testing the Mobiliti service in April 2023, where the initial partners will be De Lovie (a social organization providing support to youth and adults with disabilities) and the City of Poperinge in West Flanders. In this phase they are focusing on accessibility, and will launch the "Mobiliti, Makes my day complete" campaign which will focusing on supporting the daytime activities of De Lovie's residents. As the residents don't all have smartphones, HOWEST has printed cards with a QR code on them for users to hand to drivers to scan. Howest has learned that blockchain systems are really ecosystems involving multiple organisations. Bootstrapping a new ecosystem has coordination challenges and is risky. By making sure that the Mobiliti piloting phase also delivers social value, Howest feels it has reduced this launch risk.

Key learning in building privacy-focused blockchain solutions

Building this pilot has significantly increased HOWEST's understanding of how to handle private data in blockchain systems.

When creating a mobile app, it is not always easy to find a matching Software Development Kit. We couldn't find one for our iOS app, so we had to use an API that translated REST-calls into transactions on the Hyperledger Fabric blockchain.

We also found a powerful way to use Hyperledger Fabric Private Data in a trustless and privacy-oriented way: placing the private data in the Private Data Collection of each organisation and then performing transactions with the node of that organisation. Each node can then validate if the asking user has the correct rights and return the requested data if allowed. In that way, private data does not need to be shared with every organisation in a private data collection. However, to do this, we needed to have the ability to create transactions on the apps themselves, which was not possible with the time and resources we had.

When HOWEST designed the Mobiliti pilot, they assumed that all participating organisations would host their own node on the solution's blockchain. Nodes are effectively 'stakeholders' on the blockchain network, and are able to verify transactions on the blockchain. It turned

out that hosting their own node would be too expensive or cumbersome for many organisations – even if they used a third-party service. So Howest had to add a facility where organisations could join as organisations on 'neutral' nodes, such as one offered by Howest.

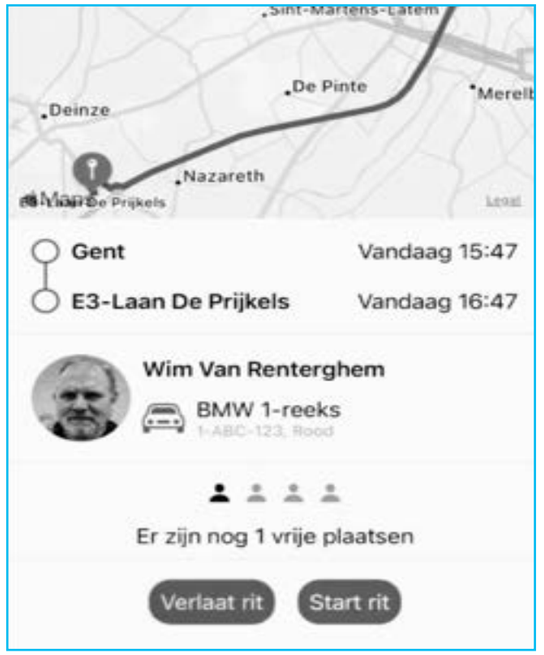
Four lessons in Mobiliti:

1 No personal/or private data should be recorded on a blockchain – this is important if you are to be GDPR compliant. This is why Howest used Hyperledger Fabric's Private Data functionality, as it allowed us to store personal information safely.

2 Education on blockchain is important to prevent prejudices – many people have strong views on blockchain,but they may be misinformed or only have a superficial understanding of the issues involved. Blockchain is a complicated topic, so this is quite challenging.

3 We needed to set up a consortium to deliver this solution. We worked with an external company – IntellectEU – that offers consortium building as a service. This is a viable way for municipalities to build working consortia.

4 The sensitive data that the app generates needs to remain private within participating organisations, and we need to make sure that only organisations in the consortium can participate in the service. To deliver this meant we had to make decisions about the blockchain architecture that we used – so in this case we chose to create a private permissioned blockchain.



The Mobiliti app provides a mobility solution for geographical areas that are poorly served by public transport. By facilitating ride sharing through a blockchain-driven app, employees, students, and seasonal workers can find rides, register ride events (ride offers), and get rewarded by employers for using the service.

BLOCKCHAIN IN MARITIME PORT MANAGEMENT: DEFINING A CONCEPTUAL FRAMEWORK

A review of the use of blockchain in supply chain and port management publications – and what it means for the adoption of blockchain in other sectors

Sergey Tsiulin – Aalborg University, Denmark

Aalborg University did a systematic review of scientific and grey literature published in journals and conference proceedings in the past decade to build a conceptual framework of the aims of blockchain-based applications in the shipping industry and supply chain. They also explored whether blockchain can be adopted into existing maritime shipping and port document workflow management. This framework enabled a review how blockchain can affect communication between stakeholders, information flow, data confidentiality concerns, and other relevant processes in shipping and port management.

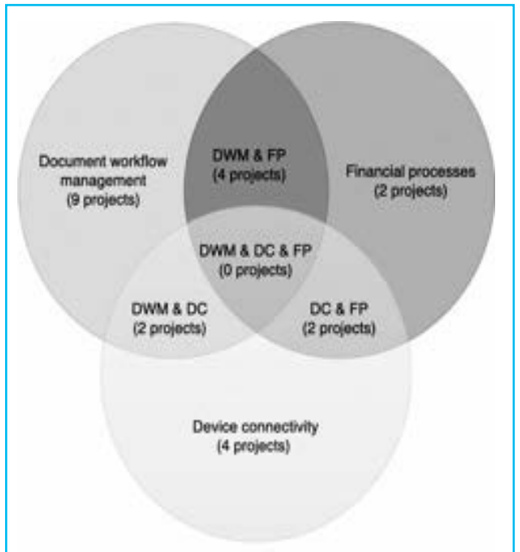
Aalborg's study provides a framework for understanding the use of blockchain applications within maritime port environments, an under-studied part of blockchain implementation in the wider supply chain field. This work is the first to identify conceptual intersections and correlations between existing blockchain implementation projects in this area. This study also looked at whether blockchain can be adopted into existing maritime shipping and port document workflow management.

We have seen the implementation of an extensive range of blockchain applications across many disciplines and fields. The academic literature however lacks an analysis of such applications – particularly if we're looking at the state-of-the-art in supply chain and maritime logistics. Aalborg's paper addresses this by examining the use of blockchain technology in the supply chain and maritime industries. The overview was carried out during 2019 and has been subsequently updated as further relevant projects are identified.

The results grouped the 56 projects that were reviewed into three main areas: document workflow management, financial processes, and device connectivity. However, despite having clear interlinkages between the three themes, none of the projects Aalborg reviewed considered all three areas at once. They also noticed in their project review that blockchain projects unintentionally had similar goals to those set out in other port-management scientific projects – which were underway well before the development of blockchain technology.

The majority of blockchain projects for the supply chain and maritime industry emphasize tracking the provenance of goods, seeking to establish end-to-end monitoring and reporting of cargo. Tracking starts from the place of origin (e.g. the farmer or manufacturer) through international shipping and on to the final destination. Being able to document this logistical process gains credibility from the final customer and provides a mechanism to enable better transparency throughout transportation, being able to monitor the status of the cargo (damage, delays, document-related disputes, etc).

It was clear from the 56 projects that we reviewed that there have been considerable shifts towards the digitalization of document flow in maritime shipping, and the integration of both blockchain and Internet of Things technologies into current data management systems.



Notes: DWM: Document workflow management; FP: Financial processes; DC: Device connectivity

Our findings also found current blockchain initiatives have similar objectives to many pre-blockchain projects – such as those exploring the idea of the 'Port Community System'. The difference with blockchain though is that there was no technical solution available within the Port Community System that could implement its objectives of transactions' transparency, auditability, and real-time functional equity.

Tsiulin, S., Reinau, K. H., Hilmola, O-P., Goryaev, N.K., Mostafa, A. K. A. (2020) Blockchain in Maritime Port Management: Defining Key Conceptual Framework. Review of International Business and Strategy. Special issue: "Blockchain and the Multinational Enterprise", Volume 30, Issue 2, pp 201-224

BLOCKCHAIN IN SCOTLAND – IN TRANSPORT, AND IN GOVERNMENT

Stakeholder views on blockchain, technology adoption, organisational capacity, and change.

Keith Fisken – SEStran, Scotland

As part of the BLING project SEStran undertook a review of the blockchain environment in Scotland/the UK. The work reviewed the use of blockchain in the UK with a particular focus on blockchain in transport and blockchain in the public sector (especially local government).

PUBLIC SECTOR/ LOCAL GOVERNMENT APPLICATIONS	TRANSPORT APPLICATIONS
Identity	Freight & Logistics
Voting	Identity Management
Title & Asset Registration	Mobility as a Service (MaaS)
Digital Certification	Smart Mobility
Public Accounting, Contracts & Taxes	Aviation
Law & Legal Systems	Autonomous Vehicles
	Automotive
	Rail

Blockchain in the public sector in the UK – key findings

2019 Scottish Government forecasts on future impacts of different technologies on Scottish infrastructure estimated that it would be 15+ years before blockchain had a significant impact – although that estimate was given with a high degree of uncertainty. While the landscape review of blockchain use across the UK uncovered a range of blockchain applications within local government and the wider public sector, there were relatively few Scottish use cases.

Research undertaken by the Big Innovation Centre in 2021 found that GovTech – which encompasses technologies and solutions that aim to digitise public administrations – accounted for only 2.3% of companies using blockchain technology in the UK and was 13th out of the 18 industries on the list.

The work undertaken by SEStran found that the blockchain space in Scotland and the UK confirmed that 'transport' and 'government' have experienced less blockchain adoption than other sectors (such as financial services, digital/software, healthcare etc.).

While there are a number of blockchain use cases in the public sector, there is limited evidence of implementation. Blockchain adoption within the transport sector is limited, with 'supply chain & logistics' representing roughly 11% of companies identified as working in this area.

Scottish stakeholder views on DLT adoption

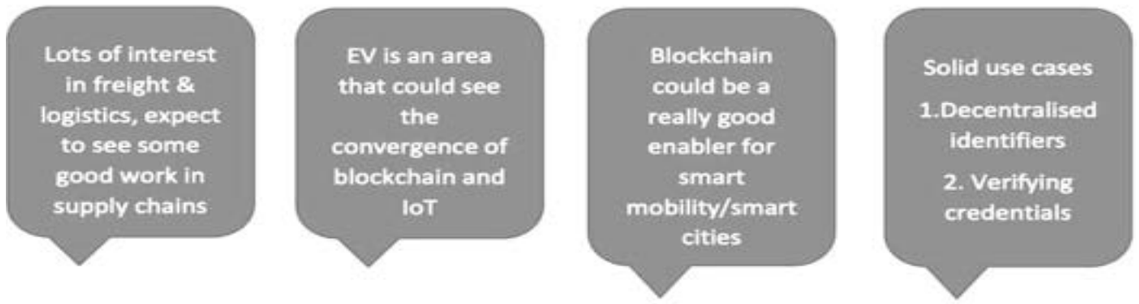
A wide range of stakeholders were consulted as part of the work to ascertain their views on the potential roles of blockchain in transport and government in Scotland. There was a wide range of experience within the Scottish transport context, with interviewees being familiar with a range of other disruptive technologies including, for example, Internet of Things (IoT), Big Data, Artificial Intelligence (AI), Machine Learning (ML), Automation and Robotics. The stakeholders tended to be more familiar with other disruptive technologies than with blockchain – and many noted that these other technologies were generally viewed as being further along the adoption curve than blockchain. The view of stakeholders was that automation and data projects were viewed as requiring less of a 'technology leap' than the adoption of blockchain and smart contracts – so these interventions were more readily accepted by organisations.

Stakeholders felt that while government will adopt proven technologies it is generally risk averse. This means that governments are felt to be less likely to push for the adoption relatively new technologies – such as blockchain.

Much of the discussions around blockchain and its relationship with other technologies indicated that innovation is improved by the simultaneous implementation of these technologies as opposed to competition between them.

Blockchain and transport in Scotland

Potential transport specific areas that stakeholders identified as future opportunities for blockchain-enabled services included MaaS (Mobility as a Service), smart ticketing systems, EV charging, autonomous vehicles, asset tracking and last mile logistics, and smart mobility / smart cities. These stakeholder views were strongly aligned with the findings from Optimat's desk research.



A small number of interviewees mentioned Scottish projects that initially intended to us blockchain, but which had selected more 'traditional' technologies for implementation as projects were finalised. Cost, ease of implementation and appropriateness were suggested as factors.

Blockchain and local government in Scotland – Findings and Next Steps

The work found that Government will a) adopt proven technologies but b) is generally risk averse. This means that governments are felt to be less likely to push for the adoption relatively new technologies – such as blockchain. This risk aversion is present at both the organisational and individual level: this is also affected by the need to increase digital literacy skills across governments.

Government services must be designed to reach all citizens, which includes providing for those who are not digital natives to ensure provision for all. This means governments often have multiple ways to complete processes and deliver services, and while these older solutions need to be retained, this often means that there is less of an incentive to adopt new technologies. The impact of this lack of incentive is that the length of time it takes the public sector to adopt new technologies can be rather higher than it is in the private sector.

'GovTech' represents approximately 2% of the companies using blockchain in the UK.

Different business models and new ways of working will be required to get the best from the blockchain technology, which is both an opportunity for change, and a challenge for achieving interest and buy-in. The challenges of working with and managing stakeholders were highlighted, with more than half of the interviewees highlighting the challenges faced in determining the right stakeholders, and then ensuring that the right people within these companies/organisations were incorporated in project development and then delivery. The distributed nature of blockchain-enabled systems also raises questions about how the costs of implementation and operation are shared amongst stakeholders – particularly if there are large variations in the digital capabilities of stakeholders.

Key finding: A supportive environment for innovation is key to enabling large scale blockchain projects.

THE ROLE OF THE PORT AUTHORITY IN NEW BLOCKCHAIN SCENARIOS – LEARNING FROM DENMARK

Understanding the factors that affect blockchain adoption

Sergey Tsiulin – Aalborg University, Denmark

This research by Aalborg University examines to what extent various blockchain-use scenarios for the shipping industry are actually relevant to maritime port operators, and whether these blockchain use scenarios are aligned with ports' long-term development strategies – particularly in Denmark. Aalborg used qualitative interviews with representatives of the biggest maritime ports of Denmark, covering a range of locations, volumes, operations, and cargo types to answer these questions.

Aalborg's results identified uncertainties in the long-term investment strategies of the ports we analysed. While they were focused on land expansion and operation development, port authorities lack 'inner-port' coordination with related enterprises (logistics, customs, data handling etc.), which consequently affects their overall efficiency. While their development strategies appear to be identical, there is significant variance in their strategies for short-term port optimisation which has implications for different blockchain use/adoption scenarios.

Unlike typical blockchain 'compatibility' studies, our research highlights the impact of core business uncertainties within port area development and communication, reflecting tensions between port owners and terminal operators, the use of outdated IT, and the impact of non-digital workflows.

After defining the main scenarios for blockchain applications for maritime sector, we interviewed stakeholders to examine the likelihood of these scenarios being implemented, and how digitalization aligns with the port development agenda, particularly within maritime ports in Denmark.

The study used semi-structured interviews with representatives of the six largest maritime ports in Denmark: Aarhus, Copenhagen-Malmö, Esbjerg, Aalborg, Fredericia and Hirtshals. The discussion was structured around the current state of the maritime industry in Denmark, long-term development strategies, practical challenges and blockchain scenarios for the maritime industry.

Development, but perhaps not digital development

Long-term development strategies in these ports prioritized land expansion – containership and bulk cargo infrastructure upgrades, and connectivity for land distribution via rail or road transport. There is a low level of digitalization at port authorities, while it varies considerably for terminal operators. For port authorities, the opportunity of working with data is seen from strategic perspective – to get closer contact with terminal operator as an advisor and to better predict and fulfil demand. In this case, existing software applications show potential, including blockchain projects. Generally good working relationships between Authorities and operators mean there is less of a demand for platforms that build trust. It is not clear how the market preference for turnkey solutions for operators would work with decentralised systems. There was however some interest in blockchain-enabled solutions around security and access. A challenge for blockchain projects is incorporating the many different port actors into a single network. Interviewees felt it was unclear whether customs, despite an interest in joining a networked system, would (or would not) contribute to database transaction processing or whether they would only provide read-only data. This emphasises the need for active Government participation to enable the development of new solutions and platforms.

Tsiulin, S., Reinau, K.H. (2021) The Role of Port Authority in New Blockchain Scenarios for Maritime Port Management: The Case of Denmark. Transportation Research Procedia. Proceedings of 23rd EURO Working Group on Transportation Meeting, EWGT 2020, Paphos, Cyprus, Volume 52, pp 388-395

Science direct

The role of port authority in new blockchain scenarios for maritime port management

JASMIEN WELLENS

GINODEHULLU

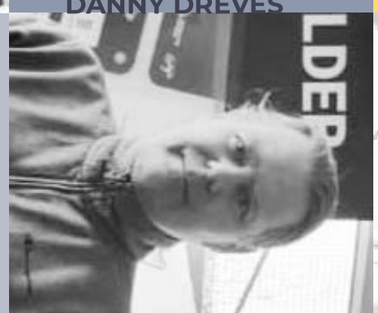
TINEKE SMEGEN

PETER JACKSON

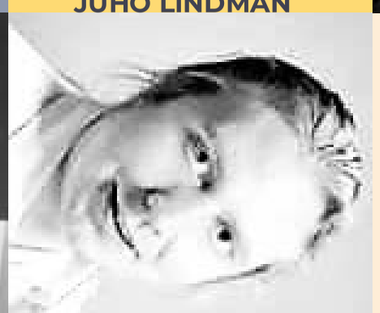
KEITH FISKEN

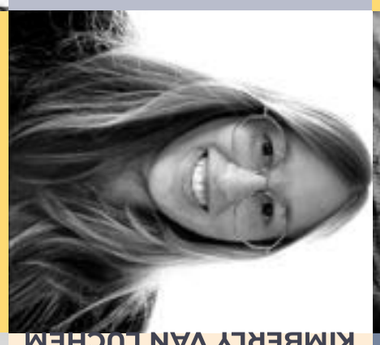
LIVIA NORSTRÖM

DANNY DREVES



JUHO LINDMAN





KIMBERLY VAN LUCHEM

JEROEN WESTER

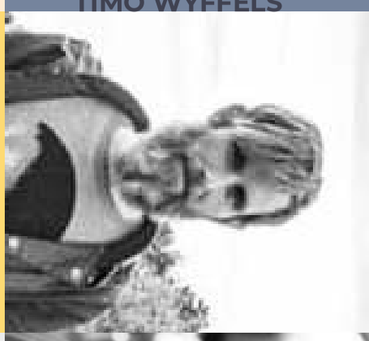
DANIËL DU SEUIL

ADRI WISCHMANN

VAN RENTERGHEM WIM

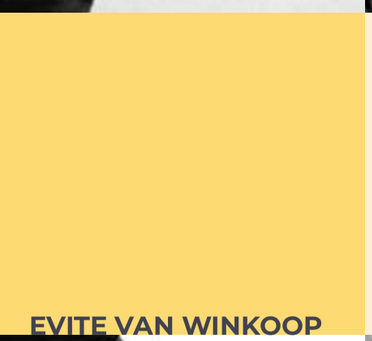
JÖRGEN DEHLIN

RENSKE STUMPEL



TIMO WYFFELS

EVITE VAN WINKOOP

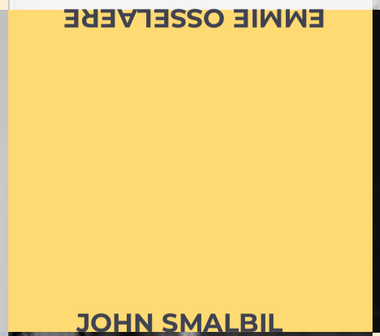


EMMIE OSSELAERE

NIELS ANNEMA

DEWI ESHUIS

JOHN SMALBIL



SHANE DECONINCK

JOLANDA HEMMES

KURT CALLEWAERT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