

# EU BLOCKCHAIN OBSERVATORY AND FORUM 2018-2020 CONCLUSIONS AND REFLECTIONS

a thematic report prepared by  
THE EUROPEAN UNION BLOCKCHAIN  
OBSERVATORY AND FORUM

# About this report

The European Union Blockchain Observatory and Forum has set as one of its objectives the analysis of and reporting on a wide range of important blockchain themes, driven by the priorities of the European Commission and based on input from its Working Groups and other stakeholders. As part of this it has published a series of thematic reports on selected blockchain-related topics. The objective of these thematic reports is to provide a concise, easily readable overview and exploration of each theme suitable for the general public. This report represents a consolidation of the work of the Observatory between February, 2017 and May, 2020.

## CREDITS

This report has been produced by ConsenSys AG on behalf of the European Union Blockchain Observatory and Forum.

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## NOTE

While we have done our best to incorporate the comments and suggestions of our contributors where appropriate and feasible, all mistakes and omissions are the sole responsibility of the authors of this paper.

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# Foreword by the European Commission

Back in 2017 when we released the first call for tender to launch the European Union Blockchain Observatory and Forum, we had already recognised blockchain as one of the most important technological breakthroughs of the decade. It seemed to us on the one hand that this ‘technology of trust’ could play a key role in supporting a more fair, inclusive, secure and democratic digital economy; on the other, that as a key component of the next generation Internet it was likely to become a significant industry in its own right, helping drive innovation and economic growth.

If Europe was going to take a leading role in blockchain, then we as policy makers needed a deep understanding of both the technology as well as the ecosystem in order to make the best decisions. Luckily, we had an excellent source of information in the vibrant European blockchain scene: a deep well of thought leaders, academics, researchers, technologists, entrepreneurs and enthusiasts spread out across the European Union. The Observatory has been designed to mine that wealth of knowledge for the benefit of policy makers and the community. Its dual mission is to be both a watchtower, analysing the ecosystem, and a lighthouse, providing the ecosystem a means to offer its wisdom and guidance for the benefit of policy makers, and to express its concerns, needs and desires to them.

Since then the Observatory has built a strong community with a great deal of credibility through its events, reports and thematic papers, and has established itself as a resource on the European and global scene. Along with the European Blockchain Services Infrastructure (EBSI) and the International Association of Trusted Blockchain Applications (INATBA), it is one of the main pillars upon which we base our blockchain policy.

In May 2020, after 27 months of dedicated work, the first edition of the Observatory will conclude its activities. The road however does not end here. Having profited greatly from the first edition of the Observatory, we have renewed the mandate. In June, a new team will be taking over and the Observatory will be embarking on another multi-year journey. The handover from one team to the next is a good time to reflect on our accomplishments so far. In this book we provide an overview of the Observatory’s activities and learnings in a comprehensive but hopefully

## FOREWORD BY THE EUROPEAN COMMISSION

easily digestible way. We hope it will prove a profitable read and source of knowledge.

With that we would like to thank all those who have contributed to the journey so far. This includes the 60 European thought leaders in our two working groups, all the speakers, panelists and participants in the Observatory's workshops, and everyone from the community who contributed to the online forum and the blockchain map. Last but of course not least, we would like to express our heartfelt thanks to the Observatory team. Both ConsenSys, as the lead partner, and its Academic Partners have worked tirelessly to make this initial version of the Observatory a success, not only meeting our expectations, but exceeding them. They have laid a strong foundation from which we have already profited greatly, and upon which we can continue to build.

### **For the European Commission:**

Pēteris Zilgalvis, Head of Unit, Digital Innovation and Blockchain, Digital Single Market, DG CONNECT and Co-Chair of the EC's FinTech Task Force

Pierre Marro, DG CONNECT

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Maiko Meguro, DG CONNECT

Lukas Repa, DG CONNECT

# Foreword by the EU Blockchain Observatory and Forum

For our team, comprising ConsenSys as the lead partner along with academic partners the University of Southampton, the Knowledge Media Institute at the Open University and the Lucerne University of Applied Sciences and Arts, it has been an honor and a privilege to run the EU Blockchain Observatory and Forum during its first two years of life. Over that time our main tasks have been to develop the platform, including the website, blockchain map, online forum and social media channels, to organise the workshops, to establish our working groups and collaborate with them and the wider community on our thought leadership, and to contribute meaningfully to the blockchain community and dialogue in Europe.

It has been a time of intense but we hope fruitful activity. On the quantitative side of the ledger, we can look back on 18 workshops, 13 thematic reports and nine academic papers on a wide range of blockchain subjects of interest to the community. Our crowdsourced blockchain map, which began with the launch of the website in April 2018, now counts over 700 initiatives in Europe and globally. Since its launch the website has attracted over 91,000 visitors and 310,000 page views. The over 800 tweets from our Twitter account have attracted more than 9,500 followers, and our YouTube channel more than 8,500 views. The Online Forum, with its 2,200 members, has been a place of lively debate and community information, while our monthly newsletter has kept its 2,600 subscribers continuously informed of our progress.

From the outset we have seen the Observatory as a journey for the whole blockchain community in Europe. We have tried to build it to be a conduit for that community to be heard. And once this expertise has been gathered, we have tried our best to make the collective wisdom of the Observatory as useful as possible for both policy makers and the wider public. This has been challenging but also we believe important work. The team, comprised of practitioners and researchers in blockchain, appreciate the potential of this new technology. As active participants in the European blockchain community, we clearly understand the potential for Europe to be a leader in blockchain. We are also well aware of the key role that government has to play in ensuring this - including the European Commission, the European Parliament, Europe's Member States and governments in the wider European region.



## FOREWORD BY THE EU BLOCKCHAIN OBSERVATORY AND FORUM

There has been much progress over the past two years. When we started, there were hardly any large blockchain projects or platforms in production. Two years later, we can count several that are already live, and many more that are very close to production. At the same time, the political and regulatory narrative about the role of blockchain technology in our society has radically changed. Where there was once mild or intense suspicion, there is now mainstream acceptance that this new domain is a vibrant and meaningful field of innovation, with the potential to positively change our relationship to identity, financial services and government, among many other things.

That said, there is still much to do. When we started the Observatory, it was apparent that there was significant hope from the community that a bridge would emerge organically to provide an overarching solution to some of the most intellectually challenging questions raised by blockchain technology – including the legal standing of decentralised governance structures, the legal validity of smart contracts or the development of interoperable standards across all blockchain technologies. While many interesting frameworks, interpretations and proposals have emerged to address these and other issues, it remains to be seen if, or how soon, the vibrant innovation that continues at a rapid pace in our community will fit neatly (or at all) into frameworks that can be applied globally and across the board.

So as the Observatory moves on to its next iteration, there will be no shortage of work for the new team. We look forward to following its progress, and of course, each in our own way, to continue to actively contribute as members of this community to what we all hope will be the steady realisation of blockchain's potential. With that, we would like to express our heartfelt thanks to all our stakeholders and partners, including our Working Group members, the members of our online community and everyone who contributed to the workshops. Above all we would like to thank our partners from the DG CONNECT team and the European Commission. We doubt any contractor could have hoped for a more engaged, collaborative, and supportive partner.

**For the ConsenSys Team:** Ken Timsit, Member of the Executive Committee; Ludovic Courcelas, Project Manager; Tom Lyons, Report Manager.

**For the Academic Partners:** Alexander Denzler, Lucerne University of Applied Sciences and Arts; John Domingue, Knowledge Media Institute at the Open University; Luis-Daniel Ibanez, University of Southampton; Elena Simperl, University of Southampton.



# Introduction: Blockchain in Europe – yesterday, today and tomorrow

In this section we provide a short overview of the Observatory's work over its first two years, take stock of its achievements, as well as look at how the blockchain ecosystem in Europe has evolved since the Observatory began work in February, 2018. Much of this chapter is based on the presentations and discussions during our Conclusion Workshop on 6 May, 2020, which interested readers may consult as well.<sup>1</sup>

## HOW IT ALL BEGAN

The roots of the Observatory date back to a call for tender to build a “European expertise hub on blockchain and distributed ledger technologies” published by the European Commission in July 2017.<sup>2</sup> After the conclusion of the competitive bid, a team was chosen consisting of ConsenSys, a leading blockchain venture studio with a strong European presence, as the lead contractor, and the University of Southampton, the Knowledge Media Institute at the Open University, University College London, and the Lucerne University of Applied Sciences as members of the consortium.

Our work began in earnest in February, 2018 when we held our kickoff meeting with the

EC. The mandate we had been given, stated in the public call for tender, was clear:

- **Identify and monitor** blockchain initiatives and trends in Europe and globally.
- **Produce** a comprehensive, publicly available source of **blockchain knowledge**.
- **Create an attractive and transparent forum** to share experiences, debate issues, and reflect on the future of this new technology.
- **Make recommendations** on the role the EU could play in accelerating blockchain innovation and adoption while also protecting investors and consumers.

The environment at the time was however different than today in many respects. While the EU and the EC had recognised blockchain as one of the major technological breakthroughs of the past decade, and a potentially important new industry, 2017 was the height of the ICO bubble and public debate about cryptocurrencies and money laundering. There was also a fair amount of skepticism among many policy makers and the general public. The idea of creating a framework around blockchain in Europe was, as Eva Kaili, MEP said in our Conclusion Workshop on 6 May, an act of “political entrepreneurship”.<sup>3</sup> For this reason our main focus has been on use cases, whether transversal, fundamental ones like identity, legal frameworks or governance, or more industry-specific ones including supply chain, healthcare or financial services. The hope was

<sup>1</sup> [Conclusion Workshop Report - Online 6 May, 2020](#), EU Blockchain Observatory and Forum, 26 May, 2020.

<sup>2</sup> [CALL FOR TENDERS 21 July 2017 to 25 September 2017 EU Blockchain Observatory and Forum](#), Shaping Europe's Digital Future, European Commission.

<sup>3</sup> [Op. Cit.](#), Conclusion Workshop.

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to provide a narrative for blockchain that went beyond cryptocurrencies and ICOs to show the potential value of decentralised trust for business, the economy and individual citizens. As such, we hoped to provide the intellectual and academic underpinnings for what at the time was a nascent but evolving European blockchain policy and regulatory landscape.

### THE STARTING POINT

Before we could embark on our journey, we had to establish where we were. For that reason our first workshop<sup>4</sup> and first thematic report<sup>5</sup> were dedicated to evaluating the European blockchain ecosystem as it was then. It can be instructive to look back at this starting point in light of how things have developed.

Europe, we found, had many strengths when it came to blockchain. There was strong interest from multiple stakeholders both in the private and public sector. The ecosystem was also already quite vibrant, with over 500 startups, a handful of flagship European projects, and an active developer community. Also encouraging was the growing blockchain-based academic curriculum at a number of European universities, as well as the fact that Europe was very strong in fields of research intimately related to blockchain, such as cryptography.

But we found weaknesses too. Chief of these, not surprisingly, was the lack of regulatory certainty and legal and

regulatory fragmentation, which many of our stakeholders feared was holding back innovation. At the time the most pressing need was clarification around blockchain and the GDPR, but issues around digital asset tax accounting, bank accounts for blockchain companies (which at the time were hard to get), and how blockchain would interact with industry-specific regulatory regimes (for instance in financial services or supply chain), were also already top of mind. We noted too that, while there was much activity, most of it was still in the early phases. We were seeing many proofs-of-concept, but hardly any large-scale projects in production (though many were close to going live). Entrepreneurs faced multiple hurdles, such as a scarcity of blockchain talent. It has also traditionally been more difficult to raise early stage funding in Europe than in other regions.

In light of this, our recommendations at the time were clear:

- Europe needs to clarify the legal and regulatory framework, and support common standards where they make sense.
- Europe needs to continue to focus on education and research.
- Europe should support blockchain skills training.
- Europe needs to support startups through funding initiatives.
- Europe should continue to drive the adoption of blockchain technology by the public and private sectors, including by launching flagship projects.
- Europe should continue to promote collaboration in the blockchain space,

<sup>4</sup> [Workshop report - Blockchain Innovation in Europe - Vienna, May 22 2018](#), EU Blockchain Observatory and Forum, 13 June, 2018.

<sup>5</sup> [Blockchain innovation in Europe](#), EU Blockchain Observatory and Forum, 27 July, 2017.

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including through public/private partnerships.

### THE REGULATORY AND POLICY LANDSCAPE HAS EVOLVED RAPIDLY

Since then, the European regulatory and policy landscape with regard to blockchain has evolved significantly. As Pēteris Zilgalvis said at our Conclusion Workshop, while the Observatory “is an essential part of the EU’s blockchain strategy, part of an overall vision for blockchain, that vision contains many other elements”.<sup>6</sup> One of the most important is the European Blockchain Services Infrastructure (EBSI), an initiative of all 27 Member States, Norway and Liechtenstein to build a blockchain infrastructure for cross-border government services. EBSI is starting with four use cases this year – European Self-Sovereign Identity (SSI); Trusted Data Sharing (for cross-border regulatory reporting); Notarisation (audit documentation and certification); and Diplomas (letting citizens manage their educational credentials). As Zilgalvis tells us in our interview for this book (see [page 31](#)), EBSI will be expanding both in terms of use cases but also scope, eventually connecting both outside of Europe and with the private sector. EBSI, he has said, is also significant not just as a major blockchain initiative, but as a way for the European Commission to “learn by doing” and so be in a position to make informed decisions about blockchain-related regulatory initiatives.

There have also been significant developments in terms of public/private blockchain partnerships. The most significant

of these is the International Association of Trusted Blockchain Applications (INATBA), a public/private partnership designed to bring the Member States of Europe together with the private sector as well as other stakeholders like academia to further the blockchain ecosystem in Europe. Europe has been moving on the funding and startup support front as well. Besides its research funding through Horizon 2020, the European Commission also created an AI/Blockchain Investment Fund so that public money can help make up for the historical European gap by investing in up-and-coming startups. The EC has also been cooperating with bodies like ISO, CEN/CENELEC and ETSI on interoperable standards, and there are several initiatives focused on skills development coming to ensure the availability of the necessary high level skills.

Perhaps most importantly, we are now witnessing a great deal of movement – if still in the early stages – on the blockchain-related regulatory front. The EU has been promoting and enabling blockchain as part of the Digital Single Market legal framework, for example through the recently closed public consultation on digital assets. It is also looking at the Digital Services Act, which focuses on e-commerce, to see what can be done to support the mutual recognition of smart contracts and avoid fragmentation of smart contract regulation between Member States.

We can expect this momentum to continue as the European blockchain strategy becomes increasingly well defined. The EC, Zilgalvis said, will soon be publishing its first dedicated Blockchain Strategy, a communication from the Commission to the European Parliament and Council on how to take blockchain further under the next budget. The EU Data

<sup>6</sup> [Op. Cit.](#), Conclusion Workshop.

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Strategy underlines the possibility of using decentralised technologies like blockchain to support self-determination by citizens for managing their own data, while the Standardisation Strategy coming out this year will address the standardisation of emerging technologies like blockchain.

All of these things are key. As Roberto Viola, Director-General of DG Communications Networks, Content and Technology, tells us in the interview on [page 26](#), “blockchain technologies are an important enabler of technological innovation in our data-driven economy”. As a technology of trust, blockchain can support the Digital Single Market, the European Green Deal, the overall European Data Strategy, and even play a significant role in the fight against COVID-19. For this reason, Viola adds, Europe wants to “lead by example to set a ‘gold standard’ for blockchain technologies worldwide”.

## THE BLOCKCHAIN ECOSYSTEM HAS MATURED TO A GREAT DEGREE

Over these two years we have watched the ecosystem grow and mature as well.

When we began our work there were few large blockchain projects or platforms that people could actually use. Today there are many significant live platforms and many more set to be launched. As we discuss in more detail in the next section, there has also been a significant rise in the number of companies joining blockchain consortia in Europe. We take this as a sign of maturity, as the ecosystem focuses on clear value-add, enterprise type implementations.

The perception of blockchain has improved as well. Compared to two years ago, we think it fair to say that more people are aware of blockchain’s potential. The perception of blockchain technology among journalists, executives, policy makers and the general public has become more granular, with more people in the mainstream familiar with, and even excited about, the potential of blockchain for innovation.

Taking a look back at the thematic work of the Observatory we also find a great deal of progress and maturation in several of the specific areas that we examined. (For a detailed overview of our work on blockchain use cases and topics, see the “Thematic Overview” starting on [page 35](#).) To take a few examples: In supply chain and trade finance, one of the most important and far-reaching blockchain use cases, we can now point to a number of major projects and consortia in areas such as food, pharmaceuticals, energy, luxury goods or commodities trade finance that are delivering services and creating value, and in some cases introducing innovative new business models. We have also seen a great deal of interest, as well as several significant live projects and consortia, in the areas of blockchain for healthcare and social impact.

When it comes to digital assets, while we have yet to achieve full clarity, great progress has been made on the regulatory front. Almost every significant jurisdiction has published an opinion on the subject of digital assets by now. In Europe, the aforementioned regulatory review, including the recent consultation on digital assets, indicates a strong desire on the part of policy makers for a regional framework if possible. Last year we also saw tremendous interest and growth in the area of stablecoins.

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More recently – catalysed to a great degree by Facebook’s Libra stablecoin project – there has been a remarkable amount of movement in central bank digital currencies (CBDCs), including those based on blockchain, with an increasing number of central banks considering a CBDC and several close to issuance.<sup>7</sup>

We think that EBSI represents a very significant advance for the use of blockchain in government services, and will position the EU as a pioneer in this area. We are also excited to see live projects combining blockchain with IoT to provide trusted data from sensors, as well as projects to use blockchain with AI, for example in broad-based data and AI model markets. As we looked at in some detail in our Convergence report,<sup>8</sup> these three technologies in particular can complement each other, helping unlock their respective potential and enable large-scale, high-impact use cases like smart cities.

We have seen movement in several transversal issues as well. Blockchain technology itself continues to mature. While it still needs development in areas like scalability and usability, there has been much progress made, and the pathway to highly performant, user-friendly blockchain-based platforms seems relatively clear. The blockchain community has also become very excited about a number of new privacy-preserving technologies, like zero-knowledge proofs or secure multi-party computation that – while not blockchain itself – can be used to increase the security and privacy of data on blockchains in significant

ways, and can also contribute to better performance.<sup>9</sup>

For many, the most important transversal theme in blockchain is digital identity, another topic upon which we have written in detail.<sup>10</sup> Here too we are encouraged by developments. Over the past two years there has been a marked increase in awareness of decentralised identity concepts in general, as well as growing interest in Self-Sovereign Identity (SSI) approaches. We have also seen progress in the development of decentralised identity standards. That the EC has made SSI a core part of EBSI, and has otherwise committed to supporting SSI principles, is in our opinion highly significant. Giving users more control over their identity and personal data will play a significant role in fostering decentralisation in general.

All of these developments point to an increasingly solid foundation for blockchain in Europe. Yet the edifice is far from complete. As we survey the landscape, we also find many unanswered questions. Because we have not achieved full regulatory clarity, regulatory uncertainty continues to hinder innovation. While we have also learned a great deal about blockchain governance – for example, in terms of best practice for blockchain consortia – the field remains largely unexplored, and we have yet to see broad-based consensus on best practice. As working in a decentralised environment can take some getting used to, clear and broadly communicated guidelines based on empirical evidence are needed. There are also security issues with blockchain, particularly with regard to smart contract

<sup>7</sup> See [Proceeding with caution – a survey on central bank digital currency](#), Bank for International Settlements, January 2019, as well as the Observatory Conclusion Workshop, [Op. Cit.](#)

<sup>8</sup> [Convergence of Blockchain, AI and IoT](#), EU Blockchain Observatory and Forum, 21 April, 2020.

<sup>9</sup> See [Blockchain and cyber security](#), EU Blockchain Observatory and Forum, 22 May, 2020 and [Workshop report - Cyber security - Brussels 29 Oct, 2019](#), EU Blockchain Observatory and Forum, 3 April, 2020.

<sup>10</sup> [Blockchain and Digital Identity](#), EU Blockchain Observatory and Forum, 2 May, 2019.



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technology. Here too, the best defense lies in research and the communication of best practice within the community.

None of these issues are insurmountable. And while progress may seem too slow to some, it can be argued equally that – as is often the case when an exciting technology appears on the horizon – expectations in terms of how quickly change will come have been too high. As one participant in our Conclusion Workshop pointed out, if you believe in the promise of decentralisation, you also have to understand that it could take up to 10 years for that promise to be realised. What seems clear to us looking back over the past two years is that the momentum is growing, and shows no sign of letting up.

## THE MAKEUP OF THE ECOSYSTEM HAS ALSO CHANGED

Maturation implies change, and certainly as it has grown, the blockchain ecosystem has also changed. To get a sense of this, for our Conclusion Workshop we decided to take a quantitative look at the European blockchain ecosystem. This is no easy task: as a nascent industry with a high degree of fluctuation, comprehensive data for blockchain companies and funding is not always readily available. To do our analysis, we started with our own database of 700 initiatives from our crowd-sourced blockchain map. To enhance our data with a global view, we were generously assisted by the blockchain-focused market research firm Blockdata.<sup>11</sup> Combining our data with theirs resulted in a data set

<sup>11</sup> [blockdata.tech](https://blockdata.tech)

comprising publicly available information on over 5,000 companies, of which 3,000 are pure blockchain projects (other companies are service providers, investors, etc.). Below we summarise the findings (see also charts starting on [page 17](#)).

### ***Drop in project creation reflects (expected) post-hype consolidation***

While the number of new blockchain projects created was in the 150-300 per year range between 2013 and 2016, and exploded in 2017 and 2018 to reach above 750 per year, the number is now back to approximately 150. The recent decrease is, however, partly compensated by the fact that many projects now involve multiple companies working together: since 2017, there have been 2,125 companies joining consortia. (For more see Chart 1 on [page 17](#).)

### ***Funding through token sales has peaked***

We have seen significant variation in the total amount of funding raised by blockchain projects each year, with our numbers indicating EUR 775 million (USD 844 million) raised in 2015, EUR 1,035 million (USD 1,092 million) in 2016, EUR 4,249 (USD 5,097) in 2017, EUR 11,285 million (USD 12,921 million) in 2018 and EUR 2,854 million (USD 3,195 million) in 2019. While we have seen a precipitous fall since 2018, it is encouraging to see that total funding in 2019 is still three times the value in 2016. When it comes to geographic breakdown, data shows that North America represents 60% of security token raises, whereas Europe (as a region) represents around 15-20%. (For more see Chart 2 on [page 17](#).)

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### ***Use cases dominated by finance***

Next we looked at the distribution of use cases in and outside of Europe. Unsurprisingly, the lion's share of blockchain projects are dedicated to a financial use case of some kind, whether in the capital markets or financial infrastructure. This reflects a focus on asset tokenisation, investment management and exchanges, as well as growing interest in decentralised finance (DeFi). Here Europe and the rest of the world are generally aligned, although we did find that Europe had slightly more focus on identity and reputation use cases, while the region outside of Europe seems somewhat more tech focused. (For more see Chart 3 on [page 18](#).)

### ***Smart contract ecosystem is growing steadily***

Another encouraging metric for the European blockchain ecosystem is smart contract creation, where we have seen a steady and significant increase in the number of deployments on Ethereum since 2017. (As our data shows, Ethereum is currently the most popular smart contract platform by a wide margin.) This points to steadily increasing experimentation, use and familiarity with this technology. That said, we found that 80% of the transactions on Ethereum were being generated by only 0.05% of the deployed smart contracts, indicating that the vast majority of smart contracts are not for production purposes. The increasing number of deployments does imply a growing smart contract developer base and by extension a maturing ecosystem: today's test or practice smart contract is tomorrow's live one. We also looked at digital assets. Here too we found

that Ethereum was the most popular platform, hosting the majority of digital assets thanks to the ERC-20 standard. Within the Ethereum ecosystem, slightly more than half of the close to 40 billion euro of value is accounted for by the ether cryptocurrency. Of the rest, nine billion euro are Ethereum-based utility tokens, and seven billion are stablecoins. (For more see Chart 4 on [page 18](#).)

## OUTLOOK

So where do we go from here? Considering the robust health of the blockchain ecosystem in Europe today, we believe the future for blockchain in the region is generally quite bright. Over the near to mid term we should see continued progress in many of the areas we have been discussing.

We think the European blockchain ecosystem will continue to consolidate and mature. In particular, we expect more and larger consortia to be formed to address industry-specific needs, and additional projects and platforms to go live. We believe EBSI has the potential to boost blockchain adoption by providing a broad-based, cross-border blockchain platform, by giving policy makers a chance to experience and therefore better understand the technology, and eventually, as EU citizens increasingly make use of this platform, to foster adoption among the general public. Finally, we expect that global public blockchain networks will continue to play the role of bridges between proliferating permissioned networks, and be key enablers of global trade, global financial markets and global communication.



We also expect digital assets to continue to increase in importance. If the first movers in digital assets were tied to the ecosystem (for example cryptocurrencies and ICOs), we are now seeing more institutions getting involved. CBDCs in particular, if and when they come online, should catalyse tremendous growth in the digital assets ecosystem. We also expect increasing clarity and harmonisation on the legal and regulatory framework side. As mentioned, almost every country in the world has published at least an opinion on digital assets. That means policy makers are now familiar with them. The EU has expressed a clear desire for harmonisation of the framework among Member States. This can only benefit the blockchain ecosystem.

### ***One final word***

We have had a poignant reminder of the potential of blockchain and the broader rationale behind decentralisation as a result of some of the debates around the response to the COVID-19 pandemic (during which this paper has been written). As we discuss in our Healthcare report released in May 2020,<sup>12</sup> while no one doubts the critical role that big data – for example in the form of population health monitoring or contact tracing – plays in the fight against the virus, many are concerned that the centralised approaches commonly being deployed can pose security risks or set dangerous precedents for mass state surveillance. In the course of our work, we have repeatedly pointed out the potential for decentralised approaches to data based on blockchain and related technologies to allow simultaneously for data transparency and

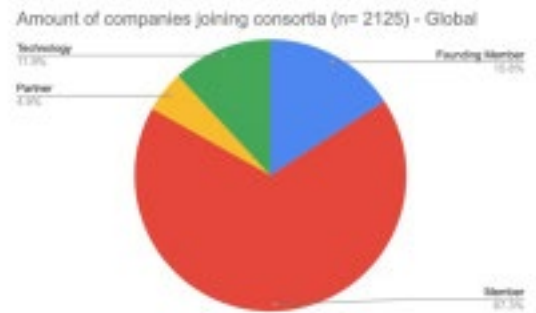
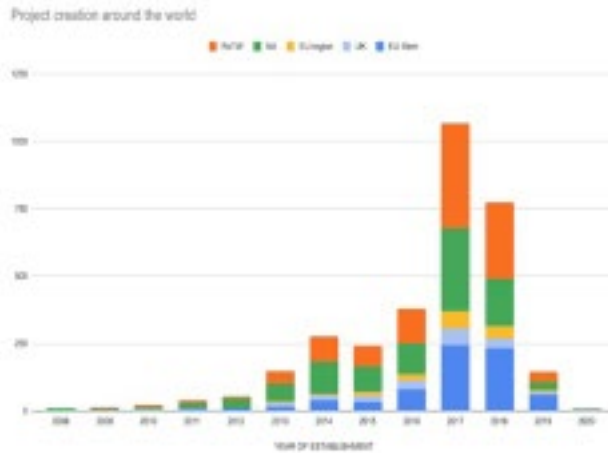
data privacy. There have been many proposals during the pandemic for blockchain-based solutions in areas like contact tracing that attempt to make use of these properties. While no one would ever have wished it to come in this way, the pandemic may in retrospect be seen as a catalyst for blockchain as many of the issues raised during this time are directly related to the kinds of problems that blockchain was invented, or has evolved, to solve.

<sup>12</sup> [Blockchain use cases in healthcare](#), EU Blockchain Observatory and Forum, 22 May, 2020.

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**Chart 1: Drop in project creation reflects (expected) post-hype consolidation**

Project creation down while more companies join consortia.



- Drop in project creation reflects (expected) post-hype consolidation

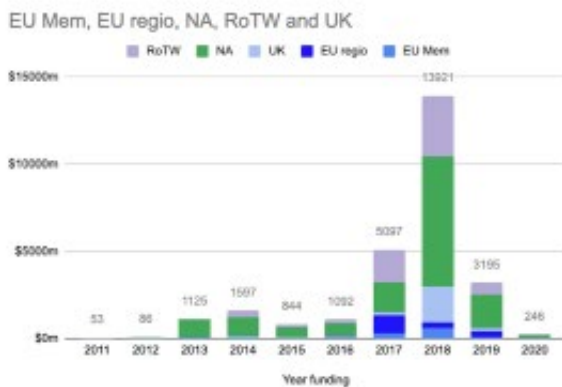
- Seen an increase in companies joining consortia since 2017
- interesting: not all want to be founding members
- People are learning to collaborate: a pre-requisite for successful enterprise blockchain

Source: [blockdata.tech](https://blockdata.tech)

Prepared by ConsenSys for the EU Blockchain Observatory and Forum

**Chart 2: Funding through token sales and venture capital has peaked**

Europe and North America roughly equal number of announced STOs – but are European rounds stuck? We believe enterprise blockchain spending is rising.



- Angel round, convertible note, grants, ICOs, STOs, traditional venture financing: seed to Series E
- Looks very much like a hype cycle
- 2018: 50% of funding in 10 mega rounds

- Did European STOs stall, fail or just not report? It is unclear.

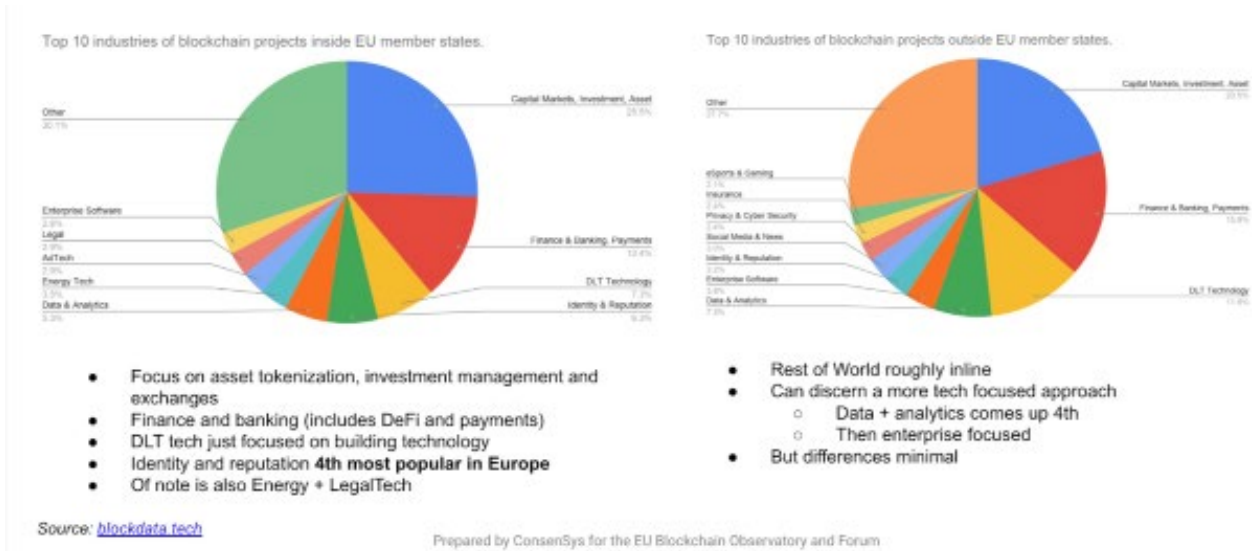
Source: [blockdata.tech](https://blockdata.tech)

Prepared by ConsenSys for the EU Blockchain Observatory and Forum

**INTRODUCTION: BLOCKCHAIN IN EUROPE - YESTERDAY, TODAY AND TOMORROW**

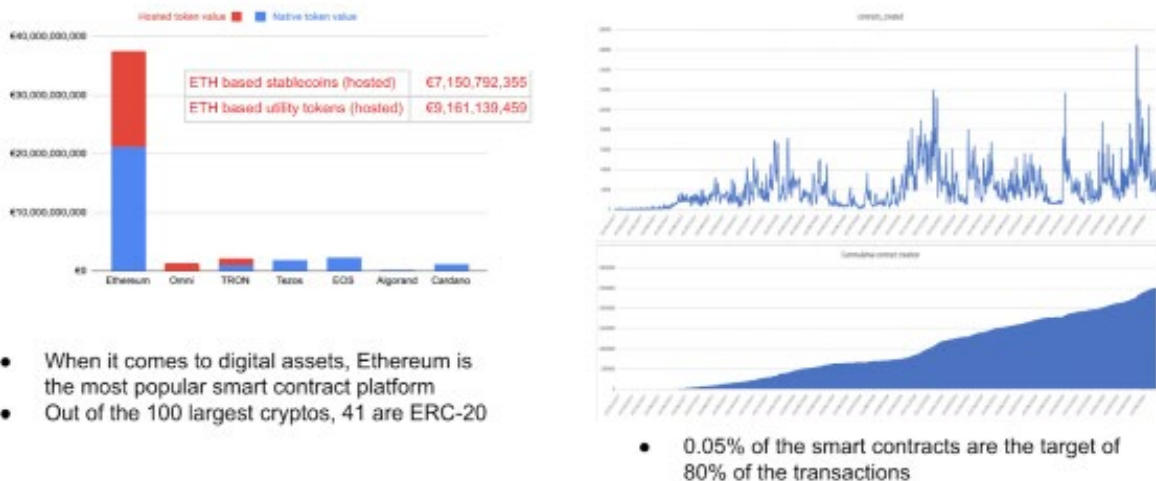
**Chart 3: Use cases are dominated by finance**

Europe and rest of the world generally aligned in terms of use focus.



**Chart 4: Smart contract ecosystem is growing steadily**

Among the metrics that show that the ecosystem is growing and maturing.



# “Blockchain enters early adulthood”

## INTERVIEW WITH EVA KAILI

*Eva Kaili is a Member of the European Parliament.*



### ***How has the narrative around blockchain changed over the last two years?***

I remember the time when I first encountered blockchain four years ago, in the thick of the financial crisis in Europe. The people around the technology had a feeling that they were participating in a revolution (maybe rightfully), against the status quo and the institutions that brought the economy to its knees. The idea was to replace the institutional trust we allocate to intermediaries by a “truth machine” that will render the legacy systems of control and decision obsolete, including the control of money issuance. However, the failure of the DAO to create a trustworthy alternative to the traditional organisational settings was, to me, a crucial moment. We started realising that disintermediation, as such, is not easy to implement with the current technological knowledge. Blockchain, at this stage, rather brings a new kind of intermediation. Also the so-called “decentralisation principle” has its own limits, especially in large-scale projects. Like most blockchain enthusiasts, I hope someday the technology will reach the desired scale and technical capabilities that will realise the ideals of disintermediation and decentralisation, but we are not there yet. Much work needs to be done at a technical level and this is something that the designers of the technology in Europe can understand. I believe that the maturity of the ecosystem increases with the understanding of what blockchain can, or cannot, do. I believe that in the next level, we will explore the utility of DLTs in their convergence with other exponential technologies and architectures like machine learning, IoT, edge/mist/fog computing, etc. Blockchain has entered into a new period: the period that moves from

## INTERVIEW WITH EVA KAILI

the “proof of concept” to the “proof of value creation and delivery”. This will create a new universe of expectations, most likely different than the expectations of the early years.

### ***What are your policy goals/ambitions for blockchain going forward?***

Blockchain enjoyed a warm welcome by the EU institutions. The European Parliament adopted a very innovative approach followed by the European Commission and the European Court of Auditors who endorsed the technology by creating space for a wide range of significant use cases in the fields of taxation, procurement, notarisation, certification, digital identity, finance, and healthcare. Effectively this means that the EU Institutions take onto their “balance sheet” the financial, technological, operational and reputational risk to develop innovative blockchain solutions, coordinate with the Member States and then trickle the tech knowledge down to the end users. This is a great initiative and I strongly support the idea. I only object to the idea of too much risk concentration to the EU institutions. I find no reason whatsoever for the Commission, for example, to concentrate all these risks into its portfolio, simply because the stakes become very high in case of a failure. I strongly believe that the EU needs to leverage the European technological ecosystem and share with it some of the fundamental risks – especially technological and financial ones. This means that the EU should revisit its old budgetary allocation policies in a way that includes consortia originated in ecosystems rather than sole contractors. We need an immediate change in the practices we employ, and the case of the European Blockchain Services Infrastructure (EBSI) is a good starting point. The Commission should come with clear KPIs, clear timeframes for delivery, clear operational standards, and then allocate the implementation of the projects to people who can deliver on time, with high technology standards and within the budget. Finally, I believe that we need, just like in the case of AI, a distinct Directorate in the DG CONNECT with responsibility to coordinate horizontally all the activities related to blockchain and decentralised computing architectures.

### ***What are the most important regulatory issues for blockchain facing the EU right now? What are your regulatory priorities?***

When I introduced the Blockchain Resolution in the European Parliament I made a strong statement in favor of technological neutrality and business model neutrality as the adequate regulatory approach that will enable blockchain technologies to evolve in a legally

## INTERVIEW WITH EVA KAILI

certain environment, but without “patronising”. As happens with every technological breakthrough, it reaches a point of “dominant design”. The same thing is true for DLTs. It is much better for this design to be explored by the market rather than the regulator – as long as the rights of citizens and consumers are safeguarded and well protected. Blockchain is, indeed, a technology open to many possible futures. The regulator should allow “every flower to blossom” as long as it keeps an eye on how things move in the ecosystem and the industry. The specific realities of blockchain, though, force the regulator to reflect more deeply around the very idea of technological neutrality. Sometimes being “tech-neutral” – or applying old regulatory “systems thinking” in new technological breakthroughs – is not necessarily an enabler for the evolution of a technology. Look for example at crypto-assets: The international practice is to categorise them as “security tokens”, “commodity tokens”, and “payment tokens”. This is a case of applied “technological neutrality”: pushing a new tool to fit into an old box. This approach ignores the universe of hybrid tokens or the case of tokens changing their characteristics over their lifetime. In this case technological neutrality is not applied wisely. It would be much smarter to categorise tokens not according to their use but according to the issuer, which means that there are two types of tokens: the ones where we know who the issuer is – and we regulate him/her; and the ones where we do not know the issuer – and we regulate the uses. This is just an example of how the regulator should always keep an open mind to alternative solutions and avoid being subject to “herd behavior”. The next step is to work on the coming file of the Blockchain Strategy for Europe that we expect to receive in the Parliament by the end of 2020.

### ***How does the EU Blockchain Observatory fit into the EU blockchain policy landscape?***

The Observatory played an instrumental role in the early stage of the technology. The ConsenSys team organised the ecosystem successfully and managed to make the Observatory our first contact point for any question about the technology. It was a very difficult job and it was delivered with excellent results. Now we are moving forward. As I often say, the Observatory will mature as the blockchain technology matures to the stage of “early adulthood”. This will happen just like the transition of the ecosystem from the era of the “proof of concept” to the era of “proof of value delivery”. In this new stage of maturity I expect to see how we can use blockchain to the edge of its capabilities, especially in convergence with other exponential technologies. Smart contracts are a vivid example. We have this discussion about the complexity of

## INTERVIEW WITH EVA KAILI

machine learning and its incapacity to produce ethical and unbiased solution spaces. A possible point of convergence would be to merge a smart contract with the machine learning algorithm and activate the smart contract every time the machine's distribution of error is skewed and biased against a certain group of people. Another possible space of engagement of the Observatory would be about the use of optimal blockchain architectures and the potential use of oracle solutions. Similarly, it would be great to see how blockchain can be instrumental to a transition from a cloud-dominant computing environment to a space where the role of edge computing is more and more significant. At the end of the day, a significant technological contribution of the Observatory is to reduce as much as possible the technological and notional gap between permissioned and permissionless blockchains. These are just a few of the ideas I have about the future of the Observatory. Most important though, is that the Observatory becomes a significant partner in all the blockchain use cases of the EU and of course the EBSI. I believe that working at the edge of the technology in the coming years, the Observatory can be a point of reference and excellence, not only for Europe but globally.



# EU Blockchain Observatory and Forum FAQ

## WHAT IS THE EU BLOCKCHAIN OBSERVATORY AND FORUM?

Created as a European Parliament pilot project, the Observatory and Forum is being run under the aegis of the European Commission's Directorate General for Communications Networks, Content and Technology (DG CONNECT). Its mission is to:

- **Identify and monitor blockchain initiatives and trends** in Europe and globally on an ongoing basis.
- **Produce a comprehensive, publicly available source of blockchain knowledge** through original research as well as gathering and collating expertise from the best European and global sources.
- **Create an attractive and transparent forum** where all of Europe's blockchain stakeholders, from thought leaders and entrepreneurs to early adopters and the general public, can share experience, debate issues, and reflect on the future of this new technology.
- **Make recommendations on the role the EU could play** in accelerating blockchain innovation and adoption.

## WHO ARE THE STAKEHOLDERS?

To carry out this work DG CONNECT via public call for tender chose a consortium led by ConsenSys, a leading blockchain venture studio with a strong European presence, and featuring such prominent blockchain academic institutions as the University of Southampton, the Knowledge Media Institute at the Open University, University College London, and the Lucerne University of Applied Sciences.

Other stakeholders include:

- **Academic Partners.** The Observatory's aforementioned Academic Partners are responsible for preparing Academic Research Papers for the Observatory on selected themes. Academic Partners also take part in the workshops.
- **Working Groups.** The Observatory and Forum's thematic Working Groups, each of which consist of 30 European blockchain thought leaders. The Working Groups are responsible for identifying and researching existing initiatives, identifying issues and potential needs for EU action, and helping to disseminate this expertise by contributing to the Observatory's analysis and reporting activities. (See full list in the Appendix on [page 89](#).)

## EU BLOCKCHAIN OBSERVATORY AND FORUM FAQ

- **Workshop Attendees.** All workshops featured expert/practitioner presenters and panelists as well as group discussion with all workshop participants. Input from all participants was used in the reports.
- **Community.** The wider community contributed to the Observatory's work through the Blockchain Map as well as the Online Forum.
- **Observatory Secretariat.** The Secretariat comprises the DG CONNECT team as well as the ConsenSys team that manages the Observatory.

## WHAT DID THE OBSERVATORY SET OUT TO DO?

The goal of the Observatory was to consolidate the insights from its various stakeholders and share them through various public-facing activities. At the beginning of the project, we summarised our intended activities as follows:

- **Events and interactive discussion.** The EU Blockchain Observatory and Forum is meant to be interactive, fostering ongoing dialogue with the wider community. Along with an Online Forum, the Observatory organises a regular series of thematic workshops as well as other events intended to facilitate healthy debate and the exchange of ideas.
- **Analysis and reporting.** The Observatory and Forum also engages in analysis and reporting on a wide range of important blockchain themes, driven by the priorities of the European Commission, and based on input from its Working Groups and other stakeholders. This work is reflected in a series of academic and thematic papers

published at regular intervals over the life of the project.

- **Mapping.** In order to better understand the technology and innovation landscape, the Observatory has initiated a comprehensive, dynamic mapping of existing blockchain initiatives, events and resources in Europe and across the globe, relying on both thought leader and community input. The map is publically available on the Observatory and Forum's platform and is continuously updated to reflect new developments in the blockchain world.
- **Education and knowledge sharing.** To help spread the word about blockchain and its potential, the Observatory and Forum offers a number of educational initiatives. These include public courses via webinars and similar channels. Through its newsletter, social media and other communications channels, the Observatory continuously reports on its progress and shares news and views on important topics and developments.

## WHAT HAS THE OBSERVATORY ACHIEVED?

Over the course of its first two years the Observatory has:

- Conducted **18 Workshops**
- Published **13 thematic reports** with **over 25,000 downloads**
- Commissioned and published **nine academic papers**
- Maintained the **Observatory website** with 91,000 visitors and 310,000 page views

## EU BLOCKCHAIN OBSERVATORY AND FORUM FAQ

- Developed a **crowdsourced European Blockchain Map** featuring over 700 initiatives
- Built an **Online Forum** with 2,200 members
- Maintained an active **Twitter account** with 9,500 followers and 800+ tweets
- Published a **Newsletter** with over 2,600 subscribers
- Posted workshop and events videos on its **YouTube channel** garnering 8,500+ views.

## WHAT THEMES DID THE OBSERVATORY EXPLORE?

The Observatory examined 18 themes over the course of its first two years. These were:

- 1. Blockchain innovation in Europe** (Workshop, Thematic Report)
- 2. Blockchain and the GDPR** (Workshop, Academic Paper, Thematic Report)
- 3. Blockchain for government and public services** (Workshop, Academic Paper, Thematic Report)
- 4. Scalability, interoperability and sustainability of blockchains** (Workshop, Academic Paper, Thematic Report)
- 5. Blockchain and digital identity** (Workshop, Thematic Report)
- 6. Legal recognition of blockchains and smart contracts** (Workshop, Academic Paper, Thematic Report)
- 7. Blockchain in trade finance and supply chain** (Workshop, Thematic Report)
- 8. Convergence of blockchain, AI and IoT** (Workshop, Academic Paper, Thematic Report)
- 9. Blockchain governance and organisational challenges** (Workshop, Thematic Report)
- 10. Blockchain and digital assets** (Workshop, Academic Paper, Thematic Report)
- 11. Blockchain use cases in healthcare** (Workshop, Thematic Report)
- 12. Blockchain use cases in financial services** (Workshop)
- 13. Blockchain cyber security and privacy** (Workshop, Academic Paper, Thematic Report)
- 14. Blockchain and education** (Workshop, Academic Paper, Thematic Report)
- 15. Blockchain for social impact** (Workshop)
- 16. The blockchain research landscape in Europe** (Workshop)
- 17. Energy and sustainability** (Workshop, Academic Paper)
- 18. Conclusion** (Workshop, Thematic Report)

## WHAT'S NEXT FOR THE OBSERVATORY?

In October 2019 the European Commission published a call for tender for the continuation of the Observatory. In May 2020 it was announced that a consortium consisting of INTRASOFT, the University of Nicosia, the Centre for Research and Technology Hellas (CERTH), and subcontractors (including Bitfury Group, OpenForum Europe AISBL, White Research, PLANET S.A.) as the new partners to operate the EU Blockchain Observatory and Forum. The new team will take up its work on June 1, 2020.

# “Setting the gold standard for blockchain”

## INTERVIEW WITH ROBERTO VIOLA

*Roberto Viola is Director General of DG CONNECT (Directorate General of Communication, Networks, Content and Technology) at the European Commission.*



***The EU has been supporting decentralised technologies and blockchain in particular as part of its policy mix for the Digital Single Market. Why is this important?***

Blockchain technologies are an important enabler of technological innovation in our data-driven economy. The Digital Single Market boosts Europe’s competitiveness in the global digital economy by making data more available and easier to travel across EU member states. This market is also built on fair competition and a high level of consumer and personal data protection. We pursue a model of data economy with inclusive and open data access, high level of privacy protection, and innovative and environmentally friendly technologies to enhance Europe’s position as a world leader in the global digital economy.

***How can blockchain serve citizens and the economy?***

Blockchain as trust technology helps us deliver on the European Green Deal, the European Data Strategy and to respond to the COVID-19 crisis. The trust provided by blockchain in the origin and authenticity of data is key, both for private and business users. Blockchain technologies

## INTERVIEW WITH ROBERTO VIOLA

provide strong privacy safeguards and help users manage their digital identities. This is key for clinical research required to fight pandemics or genetic diseases, to train artificial intelligence in autonomous driving, to manage renewable sources of energy, to track and trace carbon emissions or to find out about the origin of goods in our circular economy. Blockchain technologies also fuel effective payment solutions to the benefit of citizens. The cost of receiving and sending money to third countries, for instance, can be cut multiple times.

### ***How do you see the proper role for policy makers regarding blockchain? Are there limits to what policy makers should address?***

We lead by example to set a “gold standard” for blockchain technologies worldwide. We do so through a combination of initiatives. First, the Commission and EU Member States are building a European Blockchain Services Infrastructure (EBSI) which Member States will use for providing cross-border government services. This general blockchain infrastructure in Europe will obviously comply with all rules and regulatory standards that flow from our European values and ideals. In the future, we want to open this infrastructure also to the private sector. Second, we continuously strive to keep the regulatory framework future-proof and to strike a good balance between the freedom to innovate and addressing risks. We actively support innovation and research of blockchain and related technological solutions under the Horizon and Digital Europe Programmes. The European Commission weighs in on international standard setting bodies to ensure interoperability principles that are open and fair for all. We also work closely with the International Association for Trusted Blockchain Applications (INATBA) to develop an inclusive global governance for blockchain. Last but not least, we provide significant financial support for research and startups. Thanks to this comprehensive policy mix, the European Union leads blockchain innovation worldwide.

### ***How does the EU Blockchain Observatory and Forum fit into the EU blockchain policy landscape?***

The Observatory plays an important role for conducting in-depth research through the European blockchain community, for connecting national blockchain ecosystems in Europe and by acting as an “early warning system” for emerging issues. The Observatory has explored transversal issues such as interoperability, the blockchain legal and

**INTERVIEW WITH ROBERTO VIOLA**

regulatory framework, identity, security, or sustainability; or specific use-cases, including blockchain for government services, supply chain, healthcare as I mentioned, and so on. There is hardly an aspect of blockchain in Europe that the Observatory hasn't looked at and provided valuable insights into - which is exactly what the Observatory was designed to do. So from that perspective I think it has been a success, and we look forward to continuing to profit from its work as it moves into its second iteration.

# Convergence – The Global Blockchain Congress

As part of its mandate, the Observatory partnered with the EC, the at the time newly founded INATBA and Alastria to organise Convergence – the Global Blockchain Congress. The conference, which was held from 11-13 November, 2019, aimed to bring together a worldwide community of regulators, policy makers, industry influencers, C-suite and other corporate representatives, developers, researchers and entrepreneurs for an intense dialogue. It offers participants a chance to take part in direct discussion with the movers and shapers of the blockchain industry, and thereby help define not just the future of blockchain but the next generation Internet and digital economy.

With close to 1,400 attendees representing over 50 countries, some 230 speakers and over 80 keynotes, panels, fireside chats, roundtables and meetings, Convergence clearly met its goals in terms of size and scope.

Highlights included the President of Latvia discussing how technology can keep up with the law, Turing Prize winner Prof. Silvio Micali exploring the value of decentralisation, and the Deputy Chair of the European Data Protection Board discussing how blockchain can be reconciled to the GDPR. We also featured a conversation between the Libra Association and Facebook financial regulators

from the EU and Japan about stablecoins and their regulation; the ECB and the Bank of Japan setting out options for fiat money on blockchain; deep dives into blockchain and technical convergence with AI, Big Data and IoT; as well as close looks at blockchain for government services, supply chain, social good and many other industries. During the congress INATBA's working groups organised regulatory dialogues, bringing together regulators from all over the world to discuss all the other topics covered on the agenda.

Those who were not able to attend can relive Convergence through the videos on the website:

- [Welcome by Masters of Ceremonies. A World Ledger: DLT Five Years from Now](#)
- [Technological Convergence](#)
- [Blockchain for a sustainable society and new business models](#)
- [Stable Tokens / Europe for Blockchain](#)
- [Blockchain and Platforms: Disruption of Data Monopolies?](#)
- [Interoperability and Standardization](#)
- [Blockchain and Privacy](#)
- [Technology, Law and Ethics](#)

It is planned to return again next year with Convergence. More information can be had via the [Convergence Website](#).





The conference began with the Global Blockchain Challenge hackathon.



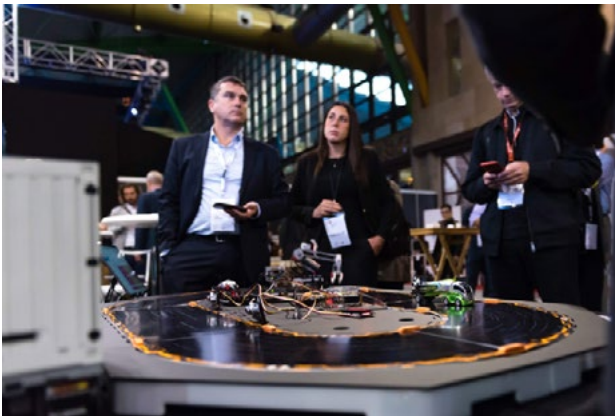
President Egil Levits of Latvia addresses the conference on its final day.



Professor Bitange Ndemo, Chair of Kenya's DLT and AI Task Force, presents on blockchain in Africa.



President Levits interviewed at the European Commission's Digital Corner.



In the exhibition hall.



Great interest from the Spanish press.



230 speakers and over 80 keynotes, panels, fireside chats, roundtables and meetings.



Professor Silvio Micali, co-inventor of zero-knowledge proofs.

# “The decentralisation element is exciting”

## INTERVIEW WITH PETERIS ZILGALVIS

*Pēteris Zilgalvis is Head of Unit, Digital Innovation and Blockchain, Digital Single Market, DG CONNECT and Co-Chair of the EC's FinTech Task Force.*



***The EU is putting a lot of resources into blockchain, including ambitious plans, through the EBP, to build its own blockchain infrastructure for use by Member States. Why this intense interest?***

At the EC and in the EU, we like the decentralisation element of blockchain, that is exciting. But we don't see decentralisation as an all or nothing prospect. There is a continuum. But we are excited about blockchain for our own use in government for many reasons. That is the impetus behind the EBP and the EBSI. By using blockchain ourselves, we learn how to build with blockchain but also how to regulate it. The EBP/EBSI serves as both a technological and regulatory sandbox for us. Among other things, we think the decentralising aspects of blockchain match very much the multi-level governance structures of the EU. The EU is not completely decentralised – not every citizen is a node – but there are aspects of decentralisation that are deeply rooted in our history.

***Will the EBSI be restricted to the Member State agencies?***

No. With the EBP we are starting with the Commission, the Court of Auditors, and 29 countries. All are equal parts of this, and each will have a node. So we will be starting with 30-40 nodes. But looking to the future, we can imagine nodes in different regions and cities, and in different ministries, for different use cases. This will not end up like

## INTERVIEW WITH PĒTERIS ZILGALVIS

a public blockchain with millions of validators, but it could get into the thousands. That's what I mean when I say it reflects that multilevel EU structure.

### ***Is there a place for the private sector in the EBP or on the EBSI?***

The EBP is conceived as a public services infrastructure. We won't be getting into selling shoes and t-shirts. But in the future you could imagine some kind of interoperability with commercial blockchains. Something that could come up very quickly in this context is with regard to some kind of regulated activity. We can imagine a situation with AML/KYC regulations where a bank or banks might wish to have the regulator on the blockchain. Obviously, we wouldn't ask the public sector to finance a commercial post-trade infrastructure. But if member state regulators were invited in, you could imagine them joining something like that. We could imagine something similar happening in other areas as well, for example on the tax reporting side.

### ***The EU has also been busy working on regulatory issues around blockchain. Digital assets is one area of great interest to many. What do you see as the most significant developments here?***

We recently closed the consultation on digital assets. So that will have a direct affect on how we set policy for this new asset class, whether by regulation or some other means. When it comes to digital assets, we would like to enable decentralised approaches the best we can. We don't want to get rid of investor protection or consumer protections by any means. But we are very interested in how we can adapt these approaches to a technology that empowers decentralisation. This won't be easy, of course. It is more difficult to regulate using a citizen-centric approach than regulating a few players in an oligopolistic market. But it is not impossible.

### ***Will we see a pan-European digital assets regulatory regime in the near future?***

It will be a political decision whether there is an EU-wide regulatory framework on digital assets or not. What is important from our perspective in the European Commission is to make sure we don't have fragmentation, for example in the area of smart contracts. We are already beginning to see this with individual Member State laws, like the Italian law on smart contracts. As I said, we think that concerns about

## INTERVIEW WITH PĒTERIS ZILGALVIS

transparency and consumer protection are very important and that protections should be applied. But this should be done in a uniform and not ad-hoc way. So we are looking for a framework that can be used cross-border. That said, if we did something it would be something simple, something pro innovation and not a new burden. As I think is clear from our actions over the past few years, we have been paying close attention, but we haven't rushed into regulation either.

### ***Identity is another issue that seems to be very important to address on an EU-wide level as opposed to individual Member States. Have there been any significant developments here?***

Decentralising online identity, at least to some degree, is a crucial element to fostering a decentralised world. We are doing a lot here for example with e-signatures and trying to make eIDs more fit for purpose for such a world. eIDAS is having a public consultation soon where they will look at this. In future, ideally, eIDAS can fit in more nicely with the idea of self-sovereign identities. This doesn't mean we are going to replace our whole e-signature regime with some decentralised, purely self-sovereign alternative. There will always be some kind of centrally issued IDs that people are just used to, and that work well for their purpose. But if there is a way that people can identify themselves or prove that they are eligible for something without always having to pull out their passport, or driver's license – and by doing so reveal a lot of information that can be used to link to other information about them that is not necessary to the transaction – then that is good. Individuals should be able to keep verifiable credentials themselves and use them as needed. A lot of people would like to see this. So it would be nice for individuals. But frankly, it would also be nice for the state. We don't want identity to be a tool for state surveillance. We think the blockchain and decentralised IDs are a good way to approach the online identity issue and mitigate this concern.

### ***We hear a lot these days about Web 3.0 and a human-centric Internet coming out of the blockchain and other communities. Are these areas the EC is looking at as well?***

Absolutely. We didn't invent these ideas nor are we the prime movers of them. But we have research programmes in things like the human-centric Internet, Web3 and related technologies. We really want to push these kinds of things in Europe. We really don't want a surveillance Internet, nor one that is dominated only by large platforms. That is



## INTERVIEW WITH PĒTERIS ZILGALVIS

nothing against the platforms at all. But it would be nice if there was more competition, other types of approaches and protocols. Blockchain fits into that group of ideas on the protocol side. Efforts like INATBA, which is trying to ensure that there is a vibrant blockchain ecosystem leading to a more decentralised financial infrastructure, are leading the way in terms of new approaches and business models.

***You seem quite serious about enabling the decentralised space in Europe. Do you think it is right for government to be so active in promoting a technology so focused on decentralisation?***

There is plenty of precedent for this. The first great decentralising technology was the Internet, certainly at least when it was conceived and it in its early days. And if you look at those early days of the Internet, with the ARPANET, with UCLA, a public university, sending the first message, clearly the government played a tremendous role. All of this started with government-funded research at the defense department and a network of universities. This enabled all kinds of commercial interactions on the Internet, and soon there was massive private investment. Blockchain's history is different in many respects, but we can certainly see a similar kind of role for government here.

# Thematic journey – An Observatory Reader

Thought leadership has been at the heart of the Observatory's activities, primarily in the form of workshops, reports and papers on blockchain-related themes. In doing so, we followed a pre-defined process. First, working with the EC we defined a list of 18 themes. For each we then organised a **public workshop**. For nine of the themes we also commissioned an **academic paper** from one of our academic partners, intended to be research-oriented deep dives in the particular topic. During the workshops, we examined the topic at hand through presentations by invited experts and thought leaders, as well as open discussion. To make the content of the workshops easily accessible we a) posted **videos** of the workshops on our YouTube channel<sup>1</sup>, b) published a short **blog post** with a high-level summary of the workshop on our website,<sup>2</sup> and c) prepared a highly detailed **workshop report** containing bullet-point summaries of all that was said as well as links.

For 13 of our 18 themes we also prepared a **thematic report**. These were written by the Observatory based on the workshop discussions, input from the Working Groups, the academic paper if available, and desk research. The thematic reports were meant to provide a detailed but accessible overview of the topic as well as recommendations for policy makers. The Working Groups reviewed and commented all the drafts and also voted on the release candidates. All of our published thematic reports have been approved for publication by the EC, the Working Groups and the Observatory team.

To give the reader a sense of this work, below we provide an overview of all the themes in the order of the workshops. For those with a thematic report, we have reprinted the report's Executive Summary and, where these were not mentioned in the Executive Summary, also added the Recommendations section. For the others, we have used the blog post from the workshop.<sup>3</sup> For each theme, we have provided links to the full set of papers and reports for those who would like to dive more deeply into the topic.

<sup>1</sup> [EU Blockchain Observatory and Forum YouTube](#)

<sup>2</sup> With the exception of the Education workshop, which was held as part of the Convergence event in Malaga.

<sup>3</sup> In some cases the original texts have also been slightly adapted, either to correct minor errors, to clarify a point, or for reasons of layout. The texts as reprinted here do not vary from those originally published in any significant way.

# Theme 1: Blockchain innovation in Europe

- Workshop Report: [Blockchain Innovation in Europe](#), Vienna, May 22, 2018
- Thematic Report: [Blockchain innovation in Europe](#), July 2018

## ***From the thematic report Executive Summary, July 2018***

Blockchain is one of the major breakthroughs of the past decade. A technology that allows large groups of people and organizations to reach agreement on and permanently record information without a central authority, it has been recognised as an important tool for creating trust online, potentially providing the infrastructure for a fair, inclusive, secure and democratic digital economy. This has significant implications for how we think about many of our economic, social and political institutions.

As a key component of the next generation World Wide Web, often referred to as Web 3.0, blockchain is also expected to become an important industry in its own right. By providing trust in information without using third parties, blockchain can greatly facilitate peer-to-peer transaction platforms, potentially catalysing new, decentralised and highly automated digital markets that will create new businesses and be an ongoing source of innovation and economic growth. That makes it an important development for Europe. Europe has responded with a number of major initiatives designed to explore and support the nascent blockchain industry. This includes the European Union Blockchain Observatory and Forum, under whose aegis this paper has been written.

Our goal at the Observatory and Forum is to get a clear picture of blockchain's current possibilities and future potential, to understand the questions it raises and to evaluate the EU's best options to foster innovation within the space, allowing its citizens and industries to benefit from blockchain applications and ensuring the region plays a leading role in blockchain both today and in the future.

As Mariya Gabriel, Commissioner for the Digital Economy and Society, has said:

"I see blockchain as a game changer and I want Europe to be at the forefront of its development. We need to establish the right enabling environment – a Digital Single Market for blockchain so that all citizens can benefit, instead of a patchwork of initiatives. The EU Blockchain Observatory and Forum is an important step in that direction".

In this paper we aim to set the scene for the Observatory and Forum's work by examining the state of blockchain innovation in Europe today, looking at both Europe's strengths and weaknesses vis-à-vis this technology, and making some recommendations on where we think Europe should set its priorities in the future.

To do so we have relied on a wide variety of sources.



## OBSERVATORY READER – THEME 1: BLOCKCHAIN INNOVATION IN EUROPE

We reviewed the existing literature, including research papers, reports and press articles. We interviewed a number of blockchain thought leaders and practitioners (you will find their quotes sprinkled throughout the text) to get their views. We also consulted the thought leaders in our two working groups, as well as those who attended our Blockchain Innovation Workshop in Vienna on 22 May 2018.

Last, but certainly not least, we relied on the many insights from the broader European blockchain community and general public which we receive through our online platform at [eublockchain.mobilize.io](http://eublockchain.mobilize.io). We have produced what we hope is a comprehensive yet easy-to-read tour d'horizon of the state of blockchain in Europe today. While it is beyond our scope to explain in detail how blockchain works, for the sake of this overview it can be good to keep in mind certain aspects of how it is used.

First, blockchain is not just one thing. Originally invented in 2009 as the technology enabling Bitcoin, over the last ten years it has evolved in many directions, taking on myriad shapes and flavours and addressing a seemingly endless list of use cases. There are however some useful distinctions.

One has to do with who can access and interact with the blockchain. Bitcoin is an example of a 'permissionless' blockchain: anyone can read the data and become part of the network or act as a validator. Permissionless blockchains represent the most decentralised form of blockchains, but blockchains can also be useful with a more limited set of actors, which is the case in permissioned implementations of

blockchains. 'Permissioned' means that access is restricted in some way, for instance only to a certain set of registered participants or validators.

Second, blockchain is important because it has the potential to disrupt or transform fundamental economic, social and political institutions and structures through the mechanism of decentralisation.

Take money and commerce. As the success of Bitcoin and other crypto assets shows, blockchain offers a relatively easy technological means for individuals or organisations to issue their own tokens, thereby challenging the traditional authority of governments to assume this role. Blockchains allow for viable, direct transactions between parties, challenging the authority of banks who today hold a virtual monopoly in the safeguarding and exchange of value.

Blockchains also make it possible to build large, direct, peer-to-peer marketplaces for products, services or information, challenging many of the middlemen – today often technology companies – who have built empires as market infrastructure providers and arbiters. Through the mechanism of the token launch (often referred to as an Initial Coin Offering or ICO), companies can now raise money by selling 'tokens' directly to investors, bypassing the venture capitalists and investment bankers who have traditionally been the conduits of startup or corporate financing.

The token launch provides a good example of how blockchain touches on many important legal questions too. As we will see below, there

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is intense debate in the legal and regulatory community about what these tokens actually represent, and what rules should govern their issuance and use. The outcome of this debate will be fundamental to how the blockchain industry develops.

By adding full programming capabilities to blockchain, as Ethereum was the first to do, individuals can program smart contracts – self-executing agreements directly between parties. These can in theory replace many of the functions carried out by the legal and judicial institutions that have developed over centuries, including writing, adjudicating on and enforcing commercial and other contracts. In practice, smart contracts raise many thorny questions, like to what extent code can really be considered law, or who can be held liable for a smart contract gone wrong. The outcome of these debates will also fundamentally shape blockchain's future.

There are many other issues at stake as well, and we hope to touch on as many as we can in the pages below. Before doing so, one little disclaimer.

To give our picture life, we have tried to provide concrete examples where we could, and in doing so we have had to make choices. For almost any illustrative project or initiative we mention, we could have easily found ten others. These mentions are not meant to be indications nor endorsements. Instead, they serve to give a taste of what is out there. We encourage any and all who are interested to explore blockchain in Europe on their own and discover this vibrant community and all the activity it has spawned. Hopefully this paper can serve a useful purpose as an initial guide.

### ***From the Recommendations section***

So where does Europe go from here when it comes to blockchain? Based on our analysis and workshop discussions, there are a number of areas where it should set its priorities.

**First and foremost**, Europe needs to clarify the legal and regulatory framework. Top of the list is resolving the tensions between the GDPR and blockchain. The legal, fiscal and accounting status of tokens must be clarified as well, along with the rules surrounding the exchange of cryptoassets and fiat money.

Ensuring that legitimate blockchain projects can get bank accounts is a high priority too for Europe's entrepreneur community, which needs reassurance that its investments in innovation are not at risk on compliance grounds. In doing this, Europe will need to decide to what extent current laws and regulations can be applied or adapted to blockchain and cryptoassets.

One way regulators can foster innovation is by implementing regulatory 'sandboxes' in which projects can experiment with new products and services under the eye of the regulator, and without fear of costly compliance breaches. Many countries have adopted such practices, which are generally welcomed by the community. However, sandboxes are limited and do not offer the same level of certainty as actual legal and regulatory changes.

Europe should also work with lawmakers and regulators in other parts of the world to share best practices, with an eye to agreeing on global norms.

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**Second**, Europe needs to continue to focus on education and research. While we have identified research as an advantage for Europe, other regions such as North America or Asia are not standing still.

Blockchain education should be a priority for Europe too. That means finding ways to tackle the blockchain talent shortage, first and foremost among developers, but also in related fields. Europe's entrepreneurs and executives need accessible means by which they can learn about blockchain's potential and use cases, and so be inspired to build the new platforms and business models that blockchain can engender. Europe should look to support blockchain education for other stakeholders as well, for instance journalists and the general public.

This naturally counts for its own representatives too. Whether regulators or administrators, European Union and national government officials have already shown a great interest in better understanding blockchain in order to better administer it. This should be supported.

**Third**, Europe should continue to drive the adoption of blockchain technology by the public and private sectors. The pursuit of flagship projects that provide real benefits to users and demonstrate the value-add of the technology, will have the dual effect of creating a domestic market for innovative entrepreneurs while encouraging investors to fund more local projects.

The European Union already has some experience in the sustained promotion of innovation and new technology adoption, for example with the Horizon 2020 programme, the biggest EU research and innovation

programme ever with nearly 80 billion euro of funding available over seven years (2014 to 2020).

**Fourth**, Europe should continue to promote collaboration in the blockchain space. Certain areas in particular could be positively impacted by a closer collaboration between the governments and companies.

Identity for instance is a crucial component to many blockchain applications, and pan-European identity standards for blockchain could play a very important role in the uptake of this technology. Europe should therefore work to design and implement them. It should also, where it can, support the development of technical and other standards applicable to blockchain technology. This is a prerequisite for any emerging technology to take off on a large scale.

**Fifth**, Europe could also foster blockchain innovation by continuing to study the ecosystem and providing data on its growth and condition, as it is doing with the EU Blockchain Observatory and Forum and other initiatives.

By gathering and sharing such information with entrepreneurs and developers, as well as other blockchain stakeholders, Europe could go a long way to stoking the flames of innovation that have already lit up its burgeoning blockchain community. That would be in the interest of all parties.

# Theme 2: Blockchain and the GDPR

- Workshop Report: [GDPR](#), Brussels, June 8, 2018
- Academic Paper: [On Blockchains and the General Data Protection Regulation](#), Luis-Daniel Ibáñez, Kieron O'Hara, and Elena Simperl, University of Southampton
- Thematic Report: [Blockchain and the GDPR](#)

## ***From the thematic report Executive Summary, October 2018***

The General data protection regulation (GDPR), which entered into force in the European Union in 2016 and into application in 2018, is the latest development in the European Union's ongoing efforts to protect the personal data of its citizens.

Designed to reach a balance between data protection and the free movement of personal data, the GDPR was written during the rise to prominence of what is considered to be one of the most disruptive new information technologies on the horizon today: blockchain.

At its core a database technology that enables radical decentralisation of data storage and processing, blockchain implies an environment and operating paradigms that would seem to make it difficult to interpret some of the GDPR's rules. In this new environment, where information does not flow linearly from users to providers and back, the necessary compliance with the GDPR may provide technological challenges.

The issue of compliance of blockchain with the GDPR is, however, an important one.

Government agencies and regulators in Europe have embraced this new technology

for its potential for innovation, and have stated many times that while their goal is the protection of individual rights, they are by no means looking to end blockchain.

So while there are certainly tensions between the GDPR and blockchain, we argue that there are paths for reconciliation too.

As this paper will explain, GDPR compliance is not about the technology, it is about how the technology is used. Just like there is no GDPR-compliant Internet, or GDPR-compliant artificial intelligence algorithm, there is no such thing as a GDPR-compliant blockchain technology. There are only GDPR-compliant use cases and applications.

Among other things, in this report we observe that many of the GDPR's requirements are easier and simpler to interpret and implement in private, permissioned blockchain networks than in public, permissionless networks. Yet public networks are here to stay, and represent a vital space of innovation that has the potential to create jobs and thriving companies in the same way that the World Wide Web did over the last twenty years.

The tensions between the GDPR and blockchain revolve mainly around three issues:

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- **The identification and obligations of data controllers and processors.**  
While there are many situations where data controllers and data processors can be identified and comply with their obligations, there are also cases where it is difficult, and perhaps impossible, to identify a data controller, particularly when blockchain transactions are written by the data subjects themselves.
- **The anonymisation of personal data.**  
There are intense debates, and currently no consensus, on what it takes to anonymise personal data to the point where the resulting output can potentially be stored in a blockchain network. To take one example, the hashing of data cannot be considered to be an anonymisation technique in many situations, and yet there are cases where the use of hashing to generate unique digital signatures of data that is stored off-chain is potentially conceivable on a blockchain.
- **The exercise of some data subject rights.**  
We note that if personal data is recorded in a blockchain network, it may be difficult to rectify or remove it. Defining what can be considered erasure in the context of blockchains is under discussion.

To be clear, these issues have not been conclusively settled by the data protection authorities, the European Data Protection Board (EDPB) or in court. In our view, it is important that regulators take the time to deeply understand each use case of blockchain technology, as well as the impact that various interpretations of the GDPR can have on the European ecosystem.

Meanwhile, we propose four rule-of-thumb principles that entrepreneurs and innovators can consider:

1. **Start with the big picture:** how is user value created, how is data used and do you really need blockchain?
2. **Avoid storing personal data on a blockchain.** Make full use of data obfuscation, encryption and aggregation techniques in order to anonymise data.
3. **Collect personal data off-chain** or, if the blockchain can't be avoided, on private, permissioned blockchain networks. Consider personal data carefully when connecting private blockchains with public ones.
4. **Continue to innovate**, and be as clear and transparent as possible with users.

Blockchain technology is new and complex to understand. Additionally, it is still immature and it should not be surprising to citizens and regulators that not every 't' has been crossed.

There are many promising research and development efforts under way to make it easier for blockchain application developers to comply with the GDPR. Even more excitingly, we are seeing many projects exploring how blockchain could even be used to support the GDPR.

By finding ways to ensure the robust protection of personal data in decentralised systems, Europe could very well replace the tensions and hurdles we have outlined in this report with a much more virtuous circle of secure information.

# Theme 3: Blockchain for government and public services

- Workshop Report: [Government Services and Digital Identity](#) Brussels, July 5, 2018
- Academic Paper: [Government services and digital identity](#), Dr Allan Third, Dr Kevin Quick, Mrs Michelle Bachler and Prof John Domingue, Knowledge Media Institute of the Open University
- Thematic Report: [Blockchain for government and public services](#)

## ***From the thematic report Executive Summary, November 2018***

European governments have long turned to digital tools to help them both deliver government services and better carry out the business of governing. It's hardly surprising, then, that the blockchain, one of the most significant innovations in data gathering and processing to appear in a long time, would capture the attention of government administrators in the Union.

Much of this interest is based on key inherent properties of the technology. Blockchain, for instance, is very good at creating trust in information and processes in situations where there are large, heterogeneous sets of stakeholders or users. Blockchain is also good at creating trusted audit trails of information and, depending on how a system is designed, makes it relatively easy to keep data both private and shareable. Because blockchains are decentralised, distributed systems with strong automation potential, they can be used to design efficient, inexpensive platforms, potentially leading to significant cost savings in data processing while increasing the robustness of the platforms.

These properties could be advantageous in a wide range of use cases. Blockchains can

be deployed to secure and share important data and records, for example the records of our identity, which could be put on chain and used to provide a secure, unique, verifiable identity to all the actors in the digital economy. Blockchains can be used for asset registries, for instance with regard to land title, or to improve the securing and sharing of important data like patient health records or educational certifications. With verified data on a blockchain, it could be possible to design trustworthy e-voting systems, too.

Another set of use cases for blockchains revolves around the monitoring and regulating of markets of various kinds, supporting governments in their task of protecting consumers and keeping markets safe and viable. Shared ledgers can help governments reduce friction in gathering and aggregating data from participants in the markets they oversee, and may even open a path to real-time data collection and market supervision. Shared ledgers could be used to combat tax fraud and streamline how taxes are calculated and collected, as well as how governments manage their own expenditures, whether in procurement, entitlements or administration. Blockchains can also help increase efficiency and reduce costs in government operations.



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However, there is still a long way to go before we will be able to implement some of these ideas, as there are still technological and regulatory hurdles to overcome. In many use cases it may also be possible to get similar results without using blockchains at all. For this reason, experimentation needs to continue, including proofs of concept that weigh not just the technological feasibility of the solutions but also their economic and social impact. To make blockchain's potential a reality, governments will need to lay the right foundations. As we argue in some detail, digital identity is the fundamental building block and a key area for governments to focus on. In particular, we feel that governments should support the development of user-controlled, "self-sovereign" identity capabilities. If governments want to successfully deploy blockchain technology for themselves, they will, of course, need the requisite infrastructure too, and should explore ways to efficiently make blockchain available to government agencies.

Another important building block, in our opinion, is having digital versions of national currencies on the blockchain, for example through blockchain-based central bank digital currencies (CBDCs). Making it possible for legal tender to become an integral part of blockchain transactions will make it easier to reap the benefits of new technologies like smart contracts. On a systemic level, CBDCs could bring the benefits of decentralisation to inter-bank payments and real-time gross settlement systems, among other things. The success of blockchain in Europe will to a large extent depend on government policy. One clear way that governments can drive adoption of the technology is by using the

technology themselves, or by supporting public/private partnerships (something Europe has historically done well). Regulation will play an important role too. There is no shortage of open issues, from reconciling blockchain's data sharing properties with the data protection provisions of the GDPR to addressing the legal status of smart contracts and digital assets.

How can Europe proceed? In our recommendations section we suggest and expand on the following aspects:

1. **Set up the right infrastructure** to make sure it is easy and fast for government agencies and institutions to build their own applications in a cost-effective and interoperable manner.
2. The ecosystem would benefit from **tailored policies and regulations**, clarifying and adapting current frameworks when relevant and implementing new rules if required.
3. **Educating** the general public, entrepreneurs and civil servants should be a priority.
4. The EU should take the opportunity to **drive high-impact projects through Member States and public/private collaboration**, as well as dedicated research and development.

Whether or not blockchain technology can fulfil its promise, enjoying widespread adoption by government agencies in Europe, remains to be seen. As we try to illustrate in this report, blockchain technology could be a powerful tool in support of this goal.

# Theme 4: Scalability, interoperability and sustainability of blockchains

- Workshop Report: [Scalability, Interoperability and Sustainability](#), Berlin, October 2, 2018
- Academic Paper: [An overview of blockchain scalability, interoperability and sustainability](#), Kaihua Qin, Arthur Gervais, Lucerne University of Applied Sciences and Arts
- Thematic Report: [Scalability, interoperability and sustainability of blockchains](#), March 2019

## ***From the thematic report Executive Summary, March 2019***

In this paper we take a look at the current and likely future state of blockchain in Europe through the lens of large-scale blockchain platforms. Along the way we ask ourselves what factors, technical and organisational, are likely to shape how platforms develop, and make some observations and recommendations for entrepreneurs and policy makers about best practice.

The timing seems right for such a paper. The blockchain ecosystem has been steadily maturing over the past several years, and projects are getting both larger and closer to going live, or have already done so. This is exciting, as we can expect several large platforms to attract significant user bases over the course of the year. Observing these projects and the development of the technology also allows us, perhaps for the first time, to see the outlines of what a “live” blockchain ecosystem might look like in the near term, as well as identify the main challenges and success factors involved.

Our vision is that the first wave of blockchain adoption will be characterised by a large

number of permissioned, purpose-built blockchain platforms geared towards a specific use case or user base. These blockchains will, however, not be completely walled off gardens. Instead, they will need to interact with the off-chain world as well as with each other. Just as TCP/IP and the rest of the Internet stack became the open, freely accessible backbone of the Web of Information, we think that a small number of global blockchain networks will also emerge as the backbone of a Web of Value. To get there, the blockchain community will need to solve an array of challenges that we have gathered into three categories:

- **Scalability:** the ability to handle large volumes of transactions at high speeds.
- **Interoperability:** the ability to exchange data with other platforms, including those running different types of blockchains, as well as with the off-chain world.
- **Sustainability:** a) the ability to run a large-scale blockchain platform or decentralised application in an environmentally responsible way, and b) the ability to govern projects, platforms and the core technology in such a way that they remain viable over the long term.

## OBSERVATORY READER – THEME 4: SCALABILITY, INTEROPERABILITY AND SUSTAINABILITY

A lot of time and effort is being expended on surmounting the above challenges, and we examine each in some detail both in the main text and in a series of technical “deep dives” in our appendix. Privacy and confidentiality, the last main technical discussion not mentioned so far, will be covered extensively in another paper.

As an increasing number of large projects reach maturity, we can also begin to identify the characteristics of the successful ones. In sum, we believe that projects need a clear vision of what they want to accomplish, a clear reason for using blockchain instead of traditional database technology, and strong governance structures that provide clarity on roles and responsibilities and support collaboration and sharing of effort and expertise among diverse stakeholders.

We think government can play a role in fostering success through supporting the development of the base blockchain infrastructure. We therefore take a look at the key success factors for such an infrastructure, and some of the principles we believe policy makers should follow to support its development.

We end with a set of recommendations as well.

**First priority remains basic research:** Europe has been very supportive in this area, but there is much still to be discovered and developed. To ensure its place as a leader in this new technology, Europe will need to continue to fund work on next-generation solutions.

As blockchain matures, there will be **an increased need for standards** both for the technology as well as how best to work with it (governance). Getting this right will require a balancing act between harmonisation and fostering technical diversity. We therefore believe that a light-touch approach, allowing for experimentation, is the right one for the moment. Last but not least, we believe European governments need to be open to these changes, **employing blockchain themselves in government services** where it makes sense and so preparing themselves for the potential mass adoption of this technology.

The good news is that Europe already has a relatively strong track record in all of the above. That makes us optimistic that our vision of a maturing ecosystem on the brink of mass adoption is a correct one.

# Theme 5: Blockchain and digital identity

- Workshop Report: [e-Identity](#), Brussels, November 7, 2018
- Thematic Report: [Blockchain and digital identity](#), April 2019

## ***From the thematic report Executive Summary, April 2019***

There are few things more central to a functioning society and economy than identity. Without a way to identify each other and our possessions we would hardly be able to build large nations or create global markets. Unfortunately, there are persistent – and increasingly serious – problems with the way digital identity works. For historical and other reasons, the digital identity experience today is fragmented, with few standards and little interoperability; and it is insecure, as the almost daily reports of hacks and data breaches reminds us. For individuals, but also for businesses and governments, the status quo is becoming less and less tenable.

Many see the problem in the haphazard evolution and “centralised” nature of the current digital identity framework. Centralised here does not mean that there is one, central source for digital identities, but rather that digital identities are almost always provided by some third-party authority (often a private company) for a specific purpose of its own. The identity information is “centralised” within that entity.

Thanks to a combination of technological advances, including the increasing sophistication of smartphones, advances in cryptography and the advent of the blockchain, it is now possible to build new

identity frameworks based on the concept of decentralised identities – potentially including an interesting subset of decentralised identity known as self-sovereign identity (SSI). Explaining what these concepts are, and how they might work in the European context, is the subject we address in this paper.

We start by defining exactly what identity is in an online context, showing that our digital identity is not a single thing, but rather the sum total of all the attributes that exist about us in the digital realm – a constantly growing and evolving collection of data points.

Under the current digital identity framework, these data are generally under the control of entities external to the individual they refer to. In the decentralised identity paradigm, the idea is to put the user at the centre of the framework and so remove the need for these third parties. In this world, the user creates his or her own identity, generally by creating his or her own unique identifier (or a number of them), and then attaching identity information to that identifier. By associating verifiable credentials from recognised authorities, for instance governments, users can in effect create the digital equivalents of physical world credentials like national ID cards and drivers’ licences. Since these are digital, they will, however, be more flexible and easier to manage than their physical counterparts.

## OBSERVATORY READER – THEME 5: DIGITAL IDENTITY

By setting up a system in which the user controls not just his or her identity but also the data associated with it, we can create what are known as self-sovereign identities (SSI). In an SSI approach, the user has both a means of generating and controlling unique identifiers as well as some facility to store identity data. Users are then free to make use of whatever identity data they like. These could be verifiable credentials, but could also be data from a social media account, a history of transactions on an e-commerce site, or attestations from friends or colleagues. There really is no limit.

This ability to collect and make use of identity from a broad set of sources can help users create rich and varied sets of digital identities for themselves. It also allows them much finer control than they have today over what personal information they share in which contexts. It could even open the door to new business models, potentially allowing users to monetise their personal data should they wish to do so.

While these are intriguing ideas, making them work will be a daunting technological challenge. We take a high-level look at what would be necessary to implement a decentralised identity framework. This includes mechanisms to allow individuals to create their own identities, often referred as Decentralised Identifiers (DIDs), as well as means to store personal data, for example in personal data lockers or identity hubs. We will also need digital wallets or other user agents to allow people to manage and use their identities.

While blockchain is not required for decentralised identity, it can be a powerful solution for different aspects of the decentralised identity framework. This includes supporting the creation and registering of DIDs, notarising credentials, providing a decentralised infrastructure for access control and data use consent, and potentially linking credentials to smart contracts to, for example, trigger automatic payments. To illustrate how this might work, we describe a number of scenarios as well as present a case study of how blockchain may be used in digital identity.

We then take a look at the European regulatory landscape as it pertains to digital identity. Perhaps the most important regulation dealing with identity in the EU is the electronic IDentification, Authentication and Trust Services regulation (eIDAS). This regulation will have a deep impact on the decentralised identity framework, above all as it pertains to government-issued/recognised identity credentials, and so we take a closer look at it.

We also examine how eIDAS touches identity on the blockchain. As fully digital ledgers, blockchains are by definition electronic documents under eIDAS. That means that blockchains – or more properly the data, including smart contracts, contained in them – cannot be denied legal force, at least not solely because of their electronic nature. Blockchains, we find, might also be useful for timestamping in an eIDAS-conform way, and we ask if perhaps blockchain-based transactions can be considered to be digitally signed under eIDAS (and if so, under what level of signature).

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Our exploration ends with a few thoughts on what policy makers might do to foster the decentralised identity landscape in Europe.

Chief among these is to **clarify the open regulatory questions**, in particular around the standing of blockchain-based signatures and timestamps under eIDAS. We also think the **EU could help bootstrap the decentralised digital identity framework** through educating government agencies and encouraging them to get involved in building it out, for example as issuers of verifiable credentials.

That Europe is looking seriously at decentralised identity and SSI, through for example the work on the European Blockchain Services Infrastructure, is, we think, a good sign that these concepts are taking hold in the Union. That bodes well for a more usable, secure and fair digital identity future.



# Theme 6: Legal recognition of blockchains and smart contracts

- Workshop Report: [Legal and regulatory framework](#), Paris, December 12, 2018
- Academic Paper: [Legal recognition of Blockchain registries and Smart Contracts](#), Dr Robert Herian, The Open University Law School
- Thematic Report: [Legal and regulatory framework of blockchains and smart contracts](#), September 2019

## ***From the thematic report Executive Summary, September 2019***

In this paper we examine the intersection of blockchain and the law. Our analysis begins with an overview of legal issues as they pertain to blockchain technology per se, and in particular issues that arise due to the decentralised nature of many blockchain-based platforms. We follow this with a look at the legal implications of different kinds of smart contracts. These include smart legal contracts, which are smart contracts on a blockchain that represent – or that would like to represent – a legal contract; as well as smart contracts with with legal implications, which are artefacts/constructs based on smart technology that clearly have legal implications, for instance in the form of digital assets, or decentralised autonomous organisations (DAOs) or other kinds of autonomous agents.

These issues are, we believe, extremely important at the moment – of keen interest to the European blockchain industry as well as policy makers looking to cement Europe’s position as an attractive location for this promising new technology. If blockchain will indeed become the catalyst for innovation, jobs and economic growth in the EU that

many hope, then there is no doubt that a key element will be a predictable legal and regulatory framework for blockchains and smart contracts. But the new paradigms for platforms, applications, agreements and assets (among other things) enabled by blockchain are not necessarily easy to reconcile with existing legal and regulatory norms. As we try to emphasise in this paper, that does not mean such reconciliation is impossible. Quite the contrary.

First to the challenges.

The innovative aspects of blockchain are generally traceable to a few of its fundamental characteristics, namely: decentralisation, pseudonymity/anonymity, immutability and automation. These characteristics are also often at the root of difficult legal and regulatory questions raised by blockchain.

Take decentralisation. In large-scale, decentralised blockchain-based networks – and in particular public/permissionless ones – it can be difficult to ascertain who the actors in the network are, where they are located, and what exactly their actions have been. That can make it challenging to assign responsibility or determine jurisdiction in

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the case of disputes. This in turn can make it difficult to perform basic legal and regulatory functions, such as ascertain liability, determine what law is applicable in a particular situation, carry out regulatory monitoring, or enforce rules.

In such an environment it is no wonder that many of the promising innovations in blockchain, whether digital assets, self-executing legal agreements, decentralised organisations or fully autonomous agents that act on their own, also pose legal and regulatory conundrums.

Yet none of these challenges, in our opinion, are insurmountable.

History shows that disruptive technology and the law always find each other in the end. We see no reason why a similar process will not unfold for blockchain. In our opinion, this will occur on two main tracks.

First will be the evolution of legal and regulatory tools to assist authorities with some of the novel aspects of blockchain technology. Many of these already exist. As is the case today with the Internet, authorities have recourse to various access points – exchanges for example – to help them monitor and enforce legal and regulatory requirements even in highly decentralised, permissionless environments. The blockchain industry itself has also been developing tools that can assist authorities (and blockchain companies) in enforcing regulatory compliance – for example methods to pierce the veil of pseudonymity on blockchains and identify network participants. Second will be the natural evolution of the legal and regulatory framework to take

account of blockchain. We are already seeing a great deal of activity in this regard in the area of digital assets (and will therefore be dedicating a separate paper to this subject in the near future). When it comes to more general legal issues around the technology, smart contracts and disruptive blockchain use cases, we also see a clear increase in activity by policy makers and regulators to understand the issues, to work on solutions and – importantly – to do so in conjunction with the wider community.

The latter is important. We believe strongly that if blockchain-enabled markets are to mature, policy makers and businesses must create the rules of engagement together. Regulators should provide guiding principles to attract private-sector investors, ensure consumer protection and citizens' rights, and provide safeguards against anticompetitive practices. The private sector can undertake initiatives to ensure industry-wide interoperability and compliance with existing legislation and overall public-sector objectives such as the collection of taxes and the prosecution of illicit activities. While the overall goal is clear, the big question will be how to get there. Will existing legal and regulatory frameworks, perhaps with some clarifications and tweaks, suffice, or will we need to write new laws and rules for blockchain's new way of thinking? We provide eight guiding principles to aid policy makers in dealing with these and other questions (detailed in the conclusion):

- **Craft simple yet usable definitions of the technology.** A simple but potentially quite useful first step would be for policy makers to clearly define what blockchains

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and smart contracts are under the law at the European level in order to have a shared definition for EU and Member State regulators.

- **Communicate legal interpretations as broadly as possible.** When blockchain is added into a law, or when a binding or highly certain interpretation of the law with regards to blockchain is reached, we think it worthwhile for authorities to make an extra effort to communicate this to the wider community.
- **Choose the right regulatory approaches for the question at hand.** When it comes to regulating new technologies like blockchain, regulators can choose from three basic approaches, each of which has its own advantages and disadvantages.
- **Harmonise the law and interpretations of it.** Whatever approach individual regulators take, we think it crucial that blockchain and smart contract regulation be as harmonised as possible throughout the EU.
- **Help policy makers develop an understanding of the technology.** Getting it right will require the respective authorities and the full ecosystem to understand this new technology and what can (and cannot) be achieved with it.
- **Work on high-impact use cases first.** In our opinion that would encompass the regulatory questions around digital assets as well as bringing clarity to blockchain and the GDPR.
- **Closely monitor developments in less mature use cases and encourage self-regulation.** As regulators know all too well,

intervening too early in novel use cases can be counterproductive.

- **Make use of blockchain as a regulatory tool.** Last but not least, we think an excellent way for regulators to help monitor and regulate the industry is to get involved themselves. For example, regulators could plug themselves into new blockchain-based platforms as they come online, unleashing new opportunities to improve the efficacy but also efficiency of their operations.

# Theme 7: Blockchain in trade finance and supply chain

- Workshop Report: [Supply Chain and Traceability](#), Brussels, 19 February, 2019
- Thematic Report: [Blockchain in trade finance and supply chain](#), December 2019

## ***From the thematic report Executive Summary, December 2019***

The supply chain and trade finance industries face serious challenges. Globalisation has made supply chains significantly more complex, involving multiple players from around the world and a great deal of coordination among large numbers of stakeholders who do not necessarily trust each other. While this has driven up operating costs, increased regulation is driving up the cost of regulatory compliance. Many processes are outdated, often paper-based, and supply chains suffer from a lack of transparency due to data not being readily available.

In this paper we examine how blockchain technology might provide a means to address many of these issues. Blockchain can be used to break existing information silos and interconnect data sources and participants. It can be used to share trusted data among large numbers of actors in a supply chain, and, via smart contracts, can support the automation of transactions. It can also be used to support innovative financial services, among other things by reducing the need for intermediaries.

Blockchain-based platforms can help combat fraud, prove quality and provenance and manage complexity. Transparent, reliable and auditable data can shine a “big light” along the chain, helping to root out counterfeits and

identify bottlenecks. Auditable supply chains with real or near-real-time data can also make it easier to trace faulty materials, ingredients or products to their source, increasing the timeliness and accuracy of recalls and other public safety measures. Auditability is also a potent tool in anti-counterfeiting and intellectual property (IP) protection. Blockchain can help streamline compliance procedures and introduce massive efficiencies to supply chain coordination, with potentially significant savings. Blockchain-based platforms could simplify border procedures and provide customs agents as well as regulators with better, more efficient tools with which to monitor and engage with supply chains.

In trade finance, blockchain could be a useful tool to streamline today's often manual and costly processes. By catalysing digitisation, blockchain-based platforms could increase the speed of transactions as well as their security, facilitating financial flows between counterparties. Blockchain-based digital identities could also help streamline know-your-customer and other compliance requirements. Automatic payments through smart contracts could help ease working capital bottlenecks, while far greater auditability of transactions could streamline reporting, accounting and other processes, as well as provide better intelligence as to the state of markets. This could in turn lead to

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new kinds of financial instruments for trade finance.

Getting there will require solving a number of challenges. Stakeholders must figure out how to handle the data “on ramp” as blockchain can do nothing against the introduction of erroneous data, whether by accident or design. Blockchain faces technical issues of scalability and interoperability that need to be overcome. Many legal and regulatory questions remain unanswered, particularly around the legal status of blockchain-based transactions. The data transparency afforded by blockchain platforms, while useful for managing and securing supply chains, can risk exposing confidential information to competitors. Since blockchain-based platforms are often best deployed in consortia, they presuppose “coopetition” of some form among stakeholders. But cooperating with competitors also requires new mindsets.

Despite these hurdles, we think the future is bright for blockchain in supply chains. To help get there, **we recommend that European policy makers continue their strong support of blockchain research and development**, including focusing on supply-chain relevant questions around interoperability among blockchains and between blockchains and other technologies. **Governments can also support dialogue between supply chain and trade finance stakeholders**, including facilitating and potentially joining consortia, as well as use blockchain themselves in order to better understand its potential. We also believe they should **continue to clarify the aforementioned legal and regulatory issues around blockchain, as well as to facilitate**

**standards-setting**, both as it pertains to blockchain and for supply chain use cases.

For companies, our message is clear: **learn about blockchain and its potential**. This requires an understanding of both the technology and its uses, including new forms of governance. Many companies may find it difficult to switch to the “coopetition” mindset that underlies many blockchain consortia. **There are certainly risks involved in new ways of working**, but we think the potential benefits, not just in increasing efficiency and reducing costs, but also in **better catering to customer needs**, may outweigh them. It is certainly worth a look.

# Theme 8: Convergence of blockchain, AI and IoT

- Workshop Report: [Convergence of blockchain, AI and IoT](#), Brussels, 28 March, 2019
- Academic Paper: [Tokenization of physical assets and the impact of IoT and AI](#), Prof. Dr. Tim Weingärtner, Lucerne University of Applied Sciences & Arts
- Thematic Report: [Convergence of Blockchain, AI and IoT](#), April 2020

## ***From the thematic report Executive Summary, April 2020***

No technology exists in a vacuum, blockchain included. In this paper, we look at how blockchain technology can be used in conjunction with two other important emerging technologies – the Internet of Things (IoT) and artificial intelligence (AI) – to complement each other and build new kinds of platforms, products and services.

We start by examining the interplay of blockchain with the IoT – the realm of sensors, smart devices and robots. The IoT promises many benefits for how we live and our environment, but there are numerous challenges, from monitoring and controlling millions (if not billions) of heterogeneous devices, to helping them to communicate and transact with each other, to keeping them secure. As the IoT continues to grow, the centralised approaches to these challenges that are in use today are reaching their limits. Blockchain can help by offering a decentralised alternative for IoT platforms – one in which devices package their data and share it in a peer-to-peer fashion instead of routing it through a centralised cloud server. Such an approach could be more scalable, more robust and more direct than centralised, cloud-based solutions, and free from potential problems like data bottlenecks

and vendor lock-in. By providing secure audit trails of information coming from a sensor, blockchains can make it easier to monitor individual machines and spot anomalies. Blockchains can also support the interoperability of IoT devices by providing a trusted, common communications layer. Via smart contracts, blockchain can also facilitate autonomous machine-to-machine transactions, bringing automation and other efficiencies to large platforms.

Like IoT, AI promises great benefits for society. But to reap these benefits, AI models need access to large amounts of data. As the cost of gathering, storing and processing these large data sets, not to mention of hiring and maintaining AI experts, is prohibitively high, the value of AI is currently being concentrated in the hands of a few large companies. This is of concern to many. Blockchain can help mitigate such concerns in different ways. Blockchains can be used, for instance, to develop open, decentralised data markets in which data producers, whether individuals or enterprises, can sell, rent or share their data. In the same way, blockchains can be used as the basis for open, decentralised markets for AI models, allowing independent AI developers to directly sell their wares, more easily collaborate with each other on large projects and even share computer resources. Such markets could also help make



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access to AI models more readily available to individuals and small companies. Using newer technologies, blockchain could also help “bring compute to data”, allowing AIs to train on data sets in privacy-preserving ways and potentially opening up more data sources.

In the real world, especially in large-scale use cases, blockchain, AI and IoT are likely to work in concert. In a smart city, blockchain could be combined with IoT and AI on an infrastructure level to manage critical systems that cities depend upon, as well as improve quality of life for residents through safer and better designed urban environments.

While these are all important benefits, realising them will mean tackling a number of difficult challenges. The performance of the technology, in particular blockchain, will need to improve to be able to manage large-scale implementations. The larger and more interdependent these platforms become, the greater the cyber security challenges will be as well. There are also legal and regulatory hurdles that will need to be addressed, for instance around data protection legislation like the GDPR or with regard to the legal standing of blockchain-based transactions. Perhaps of most concern to many, at least in large-scale, public implementations like our smart city example, will be the safe and ethical use of data. We think that technologists, entrepreneurs and researchers will be able to tackle these hurdles.

Policy makers can help. To conclude our paper, we make a number of recommendations as to how. These include **ensuring adequate funding for research**, helping to **foster and disseminate best practice** and – if necessary –

**adapting regulatory processes**. We also think that **public/private partnerships could be good vehicles** for research and development of these new types of platforms.

Last but by no means least, we think **policy makers should keep ethical considerations in mind**, particularly within the context of smart cities and other large-scale platforms involving personal data. In this way we can avoid undesired consequences and truly reap the benefits that the convergence of these technologies can potentially bring.

# Theme 9: Blockchain governance and organisational challenges

- Workshop Report: [Governance and new organisational challenges](#), Brussels, 30 April, 2019
- Thematic Report: [Governance of and with blockchains](#), May 2020

## ***From the thematic report Executive Summary, May 2020***

In this paper we look at blockchain governance – by which we mean the processes, challenges and issues around how blockchain protocols, projects and the community organise themselves, as well as ways in which blockchain could be used for governance tasks in the real world.

We start our investigation of blockchain governance with a look at blockchain protocols, by which we refer to large-scale, generally open source projects like Bitcoin, Ethereum or Hyperledger that provide basic blockchain infrastructure, as well as broad-based decentralised applications providing a basic infrastructure-like service.

There are many governance issues that arise as such projects move along the lifecycle from conception and launch through to day-to-day maintenance and eventual upgrades. Of these, there are a few key questions that all projects must face. One is who can use the network. Here we find a range of possibilities, from “public, permissionless” blockchains like Bitcoin that are open to all, to “private, permissioned” blockchains that are walled gardens built to serve a specific purpose and user base.

Another basic question is who manages the protocol and how. Here models run roughly along a continuum from formally constituted, member-backed consortia, in which governance rules are agreed to in advance, to fully open, grassroots, community-run projects with no established authority, and where governance rules and enforcement mechanisms must depend on tradition and group consensus.

In the latter case in particular, one of the most difficult governance challenges is how to decide on changes to the protocol. There are different models here too. Proponents of fully on-chain governance believe the rules for changing the protocol should be hard-coded into the protocol itself. Proponents of off-chain governance think it wiser for decisions to be made via formal and informal processes among the broad community of stakeholders. Should members of the community not agree, they are generally free to split away, a process known as forking. Here too we find an array of possibilities, from benign soft forks that represent simple upgrades to the protocol, to contentious hard forks that signal a major schism and often result in competing platforms.

In the next section we focus on enterprise blockchain projects, in which groups of

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(generally) medium to large-sized businesses come together to build a common blockchain platform. Here we recommend a number of best practices. Since these consortia, as they are often referred to, tend to be born of shared business problems, it is important to first be clear exactly what this common problem is. Next, they should ascertain whether or not blockchain is the right solution, and we provide a number of criteria that can be used to make that decision. Assuming there is value to be found in a blockchain solution, consortia members will next have to set up a formal organisation. There are a number of models to choose from, although today there is a trend towards private companies with stakeholders as shareholders and a dedicated executive team, staff and in-house developers.

With the organisation in place, the next step is to establish the project governance. Governance structures should balance the interests of all stakeholders, and the decision processes and criteria should be crystal clear. Finally, because a blockchain consortium very often involves competitors coming together to build a common infrastructure, members often have to get used to new ways of working. To be successful, the executive management and project teams of the individual consortium members should have a clear idea about what this kind of co-opetition means for their organisation, and be prepared to accept its potential difficulties.

To close, we take a look at how blockchain can be used to solve real world governance challenges. We focus on a number of potential use cases. One is in the area of dispute resolution, in which smart contracts and

blockchain-based platforms could be used to streamline (and dramatically reduce the cost of) settling certain kinds of business disputes. Blockchain has also been proposed for various types of e-voting situations, including political elections and citizen participation platforms. Blockchain has also been proposed to help streamline as well as bring more transparency and inclusivity to corporate governance processes. One important governance trend born of the blockchain movement – and still largely confined to it – is that of the decentralised autonomous organisation (DAO). Generally understood as an organisation governed not by people but by code, DAOs are still a new phenomenon. Yet they are becoming more popular. Whether, as some have predicted, 2020 will be the year of the DAO remains to be seen. As we write, it is however hard to imagine any concept more true to the decentralised ethos of blockchain than that of the DAO.

### ***From the Recommendation section***

As always, we end with a number of recommendations for policy makers:

- 1. Prioritise research into governance related topics.** As we have seen, the governance topic in blockchain is very broad, and there are still many open issues. There is a need in the community for more information and insight. In our Research Priorities Workshop participants suggested that policy makers make blockchain and decentralised governance a research priority in Europe, whether in the governance of applications, networks

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or the question of on-chain versus off-chain governance. We concur, and so reiterate the observation here.

### 2. **Collect and communicate best practice.**

As more information is available from researchers and also the experience of live projects, we think policy makers could support the community by collecting and disseminating the results so that others can benefit from the knowledge.

### 3. **Clarify the regulatory framework for blockchain consortia.**

In our Conclusion Workshop it was pointed out that blockchain consortia face some specific hurdles. Filing processes, especially for multi-regional consortia, can be quite complex and difficult to finalise. One way governments could help facilitate the launch of blockchain consortia is to streamline these registration processes.

### 4. **Clarify the legal and regulatory**

**framework around DAOs.** In our paper on the legal and regulatory framework of blockchains, we have a very long passage on DAOs, where we point out many of the unique aspects of these new types of organisations, and raise the possibility of potentially creating a new kind of legal structure or special regulation. Here too we would like to reiterate the point, and suggest that policy makers continue to

educate themselves and consider the regulatory implications associated with existing types of contracts.

### 5. **Continue to examine how blockchain could play a role in e-governance.**

E-voting, citizen participation and other forms of e-governance are promising ways to foster and innovate in participatory democracy. Here too there are many legal, regulatory and policy questions that need to be addressed, both in general and in terms of using blockchain in such contexts.

# Theme 10: Blockchain and digital assets

- Workshop Report: [Digital Assets](#), Brussels, 24 May, 2019
- Academic Paper: [Blockchains and Digital Assets](#), Luis-Daniel Ibáñez, Michał R. Hoffman, Taufiq Choudhry, University of Southampton
- Thematic Report: [Blockchain and the future of digital assets](#), February 2020

## ***From the thematic report Executive Summary, February 2020***

Since the advent of Bitcoin and blockchain in 2008, digital assets have become one of the most talked about innovations in financial services and the broader economy. While digital assets existed before blockchain and can exist without it, in this paper we focus on the emerging world of blockchain-based digital assets in all its diversity and complexity, covering their background, their promise, the challenges and issues they pose, as well as how policy-makers and other authorities are reacting to their rise.

This new world of digital assets is extremely diverse. Digital assets can represent almost anything, from physical assets, securities and property to more intangible items like rights, identity or attestations of fact. Thanks to blockchain, digital assets can be created by almost anyone with the technical know-how, a process generally referred to as “tokenisation”, and can be distributed in a number of innovative ways. The technology also makes them easy to trade on secondary markets, but introduces new concepts and raises new challenges when it comes to asset custody. Thanks to smart contract technology running on blockchain, digital assets can also be “programmed” – adding new capabilities that are not possible using traditional means of

asset issuance and exchange. As such, digital assets can both reflect the traditional world of assets and represent something completely new in the world.

This has ignited debate around how to categorise and legally qualify them. While public authorities in many jurisdictions have been examining these issues, today there is no globally recognised, binding taxonomy in use. That said, an informal working consensus has developed around the three basic digital asset categories of: a) payment/exchange/currency tokens; b) investment/security tokens; and c) utility/consumption tokens. The existence of a number of hybrid tokens, which have features spanning more than one of these categories, shows, however, the difficulties that still remain in coming to an agreement on how digital assets should be classified. Regardless of their definition, digital assets promise a number of important benefits for asset markets. For example, digital assets based on smart contracts can be audited, meaning that they will execute as written.

This can add new levels of transparency to markets. Since smart contracts can be programmed to comply with existing regulations, they can also bring legal security. As a single version of the truth, a blockchain can also foster confidence in shared information and so bring reliability

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to markets. Digital assets also represent a promising field for innovation, for example through automation or fractional ownership. There is still a great amount of work to do to realise these benefits. As we point out, while tokenisation can make certain assets more easily tradable on secondary markets, this does not automatically mean there will be a demand for them. The legal uncertainty that surrounds the digital asset environment is also a major roadblock at the moment, as is the cost of technical innovation, the difficulty of onboarding users and investors to new platforms, a general reluctance on the part of banks to support the growth of digital assets, and the lack of central bank-issued digital currencies – something which, as we explain in the paper, could prove a major catalyst for digital asset uptake. We can expect most if not all of these hurdles to eventually be overcome.

Along with ongoing technical innovation, a key element in the development and acceptance of digital assets will be the legal and regulatory environment. Public authorities around the world continue to work to understand and regulate digital assets, looking to strike a balance between their innovative potential and important concerns like consumer protection, the smooth functioning of market infrastructure, and financial stability. We look at the overall regulatory response so far, before taking a deeper dive into particularly sensitive topics such as anti-money laundering and counter-financing of terrorism, the tax and accounting treatments of tokens, and other topics including custody and ownership and the challenges raised by decentralisation. While

there are certainly risks associated with digital assets, in our conclusion we also urge policy-makers to consider the potential rewards. To move the digital assets revolution forward, we recommend, among other things, that policy-makers in Europe develop a harmonised understanding of digital assets, determine the legal treatment of digital assets, strengthen the synergies between public authorities and private actors, and clarify regulatory oversight.

### ***From the Recommendations section***

Even though the digital asset phenomenon is well under way, there is still a long way to go and obstacles to overcome before it becomes a real revolution.

In our opinion, the European Union is currently focused more on the risks that arise from digital assets, to the detriment of the great opportunities that they bring.

We think authorities should continue their efforts to ensure the healthy growth of digital assets in a safe environment for consumers and established players and take additional measures to help innovative actors progress, experiment and prove their positive potential for the European economy and markets.

This starts with providing legal certainty for these actors, which actually means greater clarity for regulators to supervise the digital asset ecosystem. Below are some recommendations that should be followed in this perspective:



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### 1. **Develop a harmonised understanding of digital assets.**

At the EU level, efforts should be engaged to help all member states converge towards the same level of understanding of the digital asset phenomenon, from their technical functioning to the benefits that arise from them. Indeed, risks are often more easily understood than advantages. This common comprehension could provide a fundamental basis for discussions to establish the legal qualification of digital assets and their regulation. Once this scope is clarified, the list and scope of digital asset activities that might be supervised should be clearly drawn. Whereas security tokens are already defined and covered by financial rules, and to the extent that stablecoins will probably qualify under an existing legal status, defining other digital assets is an essential prerequisite. Broadening current legal concepts – for example “financial instruments” defined in MiFID 2 – is not the solution as these rules were not initially designed for digital assets. That means they would most likely not be applicable, either because it would not be practical to apply these rules to digital assets, or because they are not relevant. The classical distinction between payment and utility tokens (security tokens being treated under financial rules) must be overhauled, or even questioned. Is it really necessary? Should digital assets be classified regarding other criteria than their economic functions? Even within one single activity, there can be substantial differences depending on the layer of

the blockchain system on which actors operate, as they might fulfil different roles. A high level of granularity in defining and classifying digital assets and related services is likely to require a long and thorough investigation.

### 2. **Determine the legal treatment of digital assets.**

Once digital assets and “crypto-activities” are universally understood, the EU should assess which regulatory perimeter they should enter. This requires first ascertaining which existing laws apply to which type of activities on which subgroup of digital assets. A major effort may be necessary to establish clear, efficient and non-overlapped rules for digital assets activities. For digital assets that meet existing legal concepts, how current rules apply to related activities should be clarified: are they perfectly adequate? Are adjustments needed? As mentioned above, this is likely to be the case in situations where it can be argued that the distributed ledger itself fulfils some of the functions of traditional intermediaries. For digital assets that would not qualify under one current legal definition, an ad hoc or a bespoke pan-European regime is necessary. In both scenarios, such regimes should take into account the technological features of digital assets and activities related to them, and capitalise on the benefits of blockchain. In the case of an ad hoc regime, this would help build accurate but proportionate rules. In the case of a bespoke regime, this would alleviate the regulatory burden on business by simplifying rules whenever possible. In both situations,

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this would also represent an efficient means assessing specific risks arising from such technology. One methodology to find the right balance could be proving – with technical arguments – that blockchain can be a platform to support major economic functions carried out by traditional regulated intermediaries while complying with the objectives of the related regulatory requirements (protection of digital asset holders, stability within the whole financial and economic system, fair competition, etc.) as well as the responsibilities that such intermediaries must carry out. It would also underline areas where the blockchain could not replace traditional actors, and thus where the current regulation is still necessary.

- 3. Strengthen the synergy between public authorities and private actors.** When designing the regulatory framework of digital assets, regulators should cooperate with the digital industry to assess if existing laws or those on the horizon are adequate or should be adapted. One main debate to be conducted thanks to this dialogue is on the “technology neutrality” principle (“same activity, same regulation”). This “precept” should be questioned as it can have harmful limitations: for example, rules applying to “crypto-custody” of financial digital assets could not be adapted and leveraged by the technological specificities of blockchain, whereas regulation of “crypto-custody” of non-financial digital assets could be efficiently designed to take them into account. Finally, legal certainty will both help players formulate a long-term vision for their business and public authorities

better monitor the growing digital environment.

- 4. Clarify regulatory oversight.** The supervision of actors operating on digital assets involves two sides. First, the allocation of responsibilities between national authorities and European bodies should be clearly defined. ESMA and EBA have already taken the pulse of the digital asset reality and should now deepen their analysis and identify their roles in the regulatory work and practical oversight of digital assets. Second, industry players are not always aware of their responsibilities as regards all applicable regulations. The EU should favour communication and training with actors engaged in digital asset activities – especially those who are new to the game and are not familiar with regulation to the same extent as regulated entities – to provide them with information and answers to their questions when willing to start a digital asset activity in the EU. This would help innovation settle down in Europe and allow it to participate in the dynamics of the economy.

# Theme 11: Blockchain use cases in healthcare

- Workshop Report: [Use cases in healthcare](#), Frankfurt, 4 Sept, 2019
- Thematic Report: [Blockchain use cases in healthcare](#), May 2020

## ***From the thematic report Executive Summary, May 2020***

There is no doubt that the healthcare industry faces a number of serious challenges. In this paper we examine how blockchain might be used to help address them.

We begin with looking at the problems from the perspective of the individual and his or her health data. Despite how vital and valuable personal health information (PHI) is, as we note, most individuals have no control over it. With the help of blockchain, we could apply self-sovereign identity (SSI) paradigms to health data, allowing individuals to store their own health records and control access. This could have a number of advantages. It would make it easier for individuals to aggregate all their health-related information themselves, and so have an overview of such data. Once aggregated, individuals could choose to take their data to market via blockchain-based patient-mediated health data exchanges. Such markets would make it possible for individuals to share, rent or sell some of their personal health data to interested parties, allowing them to both support research but also, if they wish, monetise their health data. Using new federated learning and secure computational techniques, this could in theory be done in a privacy-preserving way, so that the data itself is never revealed nor leaves the possession of its owner. Such markets could be a boon not just to individuals but also

to society as a whole, by making more and better quality data available to the healthcare system. It could have a great impact in promoting healthier lives and improving healthcare outcomes too, by making it easier for individuals to more actively collaborate with their physicians and other healthcare professionals in their own personal healthcare. This could include facilitating value-based care models, in which physicians are compensated based on outcomes not treatments, as well as provide new means for incentivising healthy behaviour.

We next look at the issues from the perspective of the healthcare industry. As we point out, there is hardly any part of the healthcare system today that isn't data-driven. And while the good news is that there is plenty of health-related data to be had, the bad news is that it is often locked in impenetrable silos and can be hard to find or make use of. Blockchain could help address many of these issues. It could be combined with the Internet of Medical Things (IoMT) to help ensure the authenticity of IoMT-generated data along the data lifecycle, as well as more securely control devices remotely. It could be used to support large-scale health data markets for medical research and development. These could become an important source of high-quality, large-scale data sets that, using the novel techniques already mentioned, could be assembled in privacy and IP-protecting ways. Blockchains

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could also support clinical trials, helping reduce the cost and complexity of recruiting participants, facilitating remote trials, and potentially enabling safe re-use of data in subsequent trials. Blockchain-based medical supply chain platforms could help fight counterfeit medicines and parts for medical devices by providing reliable provenance information as well as monitoring the entire production chain (often in conjunction with IoT sensors).

We also look at how blockchain could support the administration of healthcare. Self-sovereign health records could help first responders get quick access to a patient's medical history in an emergency, and also simplify admissions and streamline and improve care at doctors and hospitals. Large-scale, tokenised ecosystems for healthcare that bring together all players in the system on one platform could enable new models of healthcare distribution. Decentralised health data and tokenised data markets and incentive schemes could help improve preventive and after care procedures. Healthcare workers could benefit from blockchain too. Blockchain could be used to set up decentralised accreditation regimes on the self-sovereign identity model, helping relieve some of the serious problems around professional credentialing of doctors. Blockchain could be used as a basis for community-driven organisations for healthcare professionals. These could include tokenised, decentralised marketplaces for doctors and healthcare workers to share services among themselves, as well as introduce new types of grassroots professional

associations run under decentralised principles (e.g. DAOs for doctors).

Considering that this report was prepared in early 2020 during the global COVID-19 pandemic, we also look at how the blockchain community has been responding to the crisis. Among other things, blockchain has been proposed as a means to help mitigate the supply chain disruptions that have caused shortages of the personal protective equipment (PPE) and other medical equipment. It could also be used to support privacy-preserving contact tracing techniques to bring both privacy and transparency to efforts to monitor populations and share COVID-19 related health data. Blockchain-based solutions have been proposed to help mitigate the effects of lockdowns by enabling straightforward distribution of relief funds and insurance payments, supporting research and development of novel methods for treatment and prevention, as well as supporting privacy-preserving approaches to social distancing.

### ***From the Recommendations section***

We have seen that blockchain has a lot of potential in the healthcare industry. This is not surprising as many of the issues facing healthcare relate to the kind of data management and track and trace problems that blockchain is well suited to address. Policy makers looking to support blockchain in healthcare can do a lot simply by supporting blockchain in general. Many of the more general recommendations that we have made in previous works, for example our reports on Digital Identity, GDPR, Legal Recognition

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of Blockchains and Smart Contracts, Supply Chain and the Convergence of Blockchain with AI and IoT, would apply to the specific use case of blockchain and healthcare as well.

Adding to those, we would make the following more specific recommendations.

- 1. Support healthcare-based blockchain consortia and public/private partnerships.** The recently launched PharmaLedger consortium, which is a public/private partnership under Europe's Innovative Medicines Initiative (IMI), aims to build a blockchain-based platform and reference use case implementations for medical supply chains, clinical trials and health data. Such efforts can be very effective and policy makers should look to develop and support more such efforts.
- 2. Support blockchain-based healthcare projects.** The INATBA COVID-19 Task Force has shown how public/private partnerships can react quickly in a healthcare crisis. By leveraging INATBA and other European blockchain organisations, including the Observatory, the EU could help support blockchain-based healthcare projects and companies, and so develop the ecosystem.
- 3. Healthcare as part of EBSI.** Among the initial EBSI use cases are both support for self-sovereign identity, academic credentialing and trusted data sharing across borders (notarisation). As the EBSI continues to expand, we recommend that healthcare-specific use cases be considered as well.

# Theme 12: Blockchain use cases in financial services

- Workshop Report: [Use cases in financial services](#), Paris 11 September, 2019

## ***From the Observatory blog, December 2019***

It's no secret that banks today face increasing costs and decreasing revenues thanks to a number of factors including more costly regulation, more volatile and risky markets and highly complex products, coupled with the fact that many banks are built on technology stacks dating from the 1970s and 1980s.

While meaningful change is needed, this cannot be achieved with marginal upgrades. What is needed is structural change of the kind that blockchain, at least potentially, could provide. At our workshop in Paris on 11 September, we brought together representatives of banks, regulators, central banks, FinTech companies and businesses to discuss just what such change could look like.

Below is a short overview of the highlights of the discussion.

### **A vision of the future of financial services thanks to blockchain**

The day began with a high-level overview of how blockchain might transform financial services.

It was pointed out that successful blockchain consortia in the financial space tend to use the technology to digitise processes that could not be digitised with the simple Internet

– for example, trusted document exchange. This is an indication of how blockchain could in future automate and to an extent replace the role of certain intermediaries, and do so in a more cost effective and safe way than is possible now.

Regulation was also touched on. It was pointed out that a lot that can be done in the blockchain space with existing regulation, but that banks and clients often don't have enough information about what is possible. Regulators need to do a better job of educating the public on the current state of regulation and as well as regulatory change. This in turn could help catalyse more projects to test and pilot the new processes, products and services that the financial industry needs.

### **Public vs. private network: which blockchain for your financial services infrastructure**

The workshop then took a deep dive, in the form of a "talk battle" or group debate, into the relative merits of public versus private blockchains for financial services.

The "pro public blockchain" side pointed out that the Internet is built on decentralised systems that not only work well, but have also proven themselves highly adaptable. We should therefore focus on making blockchain into a common good like the Internet, keeping it as public as possible.



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The “pro private blockchain” side responded that, for their part, banks do not care about decentralisation; they care about performance, privacy, simplicity, ease of implementation, reduction of cost, and security. Blockchain can solve for complexity and inefficiency only if it is simple and performant itself. Private blockchains have the clear edge here, and can be particularly effective in single organisations or groups where people already trust each other. Even in such “closed” situations blockchain can be a superior alternative to a centralised database as there is plenty of fruitful middle ground on the decentralisation curve, and it is possible to profit from a degree of decentralisation and disintermediation as opposed to complete decentralisation.

### **What’s the best way to regulate decentralised finance?**

When looking at the best way to regulate decentralised finance, it was pointed out that good regulation is technology neutral. There generally is no reason to create specific regulation for a technology. That said, regulators should take into account technological evolution, and react – in a technology neutral way – to new market developments that clearly do not fall under existing rules, as France has done with cryptocurrencies.

Speakers also came out in favor of EU-wide guidance on blockchain regulation, to avoid having 28 different national regulations as is the case today in crowdfunding. The representatives of the European Commission said they were working with the national authorities on these issues, but they were

complex. One problem is that we are at an early stage. Are market obstacles really about regulation? Should we change things now, or should we wait because sometimes things solve themselves or at least become clearer? Sometimes it is not so clear.

### **Decentralising payments: the future of stablecoins**

The day ended with a look at stablecoins.

The value of stablecoins is in addressing the market volatility of cryptocurrencies and other natively digital, blockchain-based assets. One way is to do so through central bank digital currencies (CBDCs). Another is through private stablecoins like Facebook’s Libra. The ECB said it understood that there were a lot of worries about Libra, but from its perspective it could reassure people: the Swiss regulator had clearly stated that Libra is a payment system and subject to the applicable regulation, so there are mechanisms to deal with it.

It was also pointed out that stablecoins need not be only about carrying out existing processes faster and more cheaply. They could also catalyse fundamental innovation in how money works. Stablecoins can meet market needs as well. Retailers see how the younger generation is diversifying their money in the digital sphere. They may very well demand digital currency options, and retailers need to be prepared for that. Here too, stablecoins could be very useful.

# Theme 13: Blockchain cyber security and privacy

- Workshop Report: [Cyber Security](#), Brussels, 29 October, 2019
- Academic Paper: [Blockchain and cybersecurity: a taxonomic approach](#), Stefano De Angelis, Gilberto Zanfino, Leonardo Aniello, Federico Lombardi, Vladimiro Sassone, University of Southampton
- Thematic Report: [Blockchain and cyber security](#), May 2020

## ***From the thematic report Executive Summary, May 2020***

In this paper we examine the issue of cyber security as it pertains to blockchain through a number of different perspectives. Considering that many blockchain use cases involve transactions and custody of value, whether in the form of digital assets or high-value data, this is certainly one of the most important themes in the blockchain space.

We start with the question: are blockchain protocols secure? The short answer is: yes. As we show, users can have high confidence in both the distributed ledger in which blockchain data is saved, and the various consensus mechanisms used to validate transactions and agree on their order. This does not mean that there are no vulnerabilities. Data on a blockchain ledger, secured against tampering by a Merkle tree of hashes (based on well-known cryptographic principles), could be vulnerable if the cryptography currently in use is broken. Yet this is a problem facing all encrypted data and communications today, not just those on a blockchain. The consensus mechanisms currently in use all have different vulnerabilities as well, depending on how the mechanism is designed and the environment it operates in. Yet, if applied in the appropriate settings, people can be confident that these

mechanisms, and the blockchain protocols they serve, are safe and dependable.

The next question we ask is: are digital assets on blockchains secure? Here unfortunately the short answer is: not really. Firstly smart contracts, which power digital assets, are susceptible to a Pandora's box of vulnerabilities, and this has already led to a number of serious hacks involving the theft and loss of millions of dollars. These vulnerabilities tend to be related to the complexity of the underlying code and the business logic, as well as to the fact that this is relatively new technology with as yet no widely accepted set of standards and security best practices. Luckily new tools and techniques to audit smart contracts and publicise vulnerabilities and best practice are being developed, and we can expect smart contract security to improve. Secondly, in most blockchain implementations, the blockchain itself makes up a rather small portion of the overall platform. Digital assets are therefore susceptible to a large array of what we might call traditional cyber security vulnerabilities, for example vulnerabilities in database software, websites or APIs; or vulnerabilities related to human error. While the steps needed to mitigate these vulnerabilities are often well known, they are unfortunately as often overlooked. This too is not a problem specific to blockchain.

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The third question we tackle is: are blockchains private? We trust our banks to keep our transaction data private because that is their job, and that is the law. But can we trust a public blockchain run by a large but loose community of anonymous nodes? Here the answer is mixed. Contrary to popular belief, even though they contain no personally identifying information, transactions on public blockchains like Bitcoin often can be traced back to real identities. This is possible because the ledger is public and therefore open to forensic analysis. It is much easier to protect data on private blockchains, yet here too there are vulnerabilities, as data privacy depends more on best practice and the honesty of network participants. There is, however, good news on the horizon for data privacy on blockchains. New data obfuscation and privacy-preserving technologies, like ring signatures, homomorphic encryption and zero-knowledge proofs, are maturing and will provide tools to greatly enhance data security.

Last but not least, we look at the question of whether or not we can use blockchain to enhance cyber security generally. We find that, despite some of the privacy concerns with public ledgers, blockchains can potentially be used to enhance the security of data. For example, they can be used to defend against unauthorised access to data, and so enhance data confidentiality; they can be used to prevent data tampering and provide audit trails of transactions that can be used to investigate fraud, and so help support the integrity of data; and they can be used to help secure information on the provenance and validity of data, and so

support data authenticity. We also look at a number of specific cyber security use cases for blockchain, including at the network level or in such areas as supply chains, medical records, verifiable software updates and anti-counterfeiting. We close with some recommendations. Firstly, policy makers should encourage the systematic disclosure and documenting of protocol and smart contract vulnerabilities to help more quickly spread the word about issues and so support best practice. Second, we think that policy makers should strongly recommend – and, potentially, require – that all smart contracts be professionally audited. In lieu of direct regulation, policy makers could consider issuing quality certificates for smart contracts indicating if they have been audited and how. We believe that education and best practice will be a key element in increasing blockchain security as well. Policy makers should look to support efforts in this direction.

### ***From the Recommendations section***

As we have seen, the topic of cyber security is core to blockchain technology. For this reason, ensuring that blockchain technology and the platforms that are built on it are secure and behave as expected is of great importance to furthering adoption. Below we provide some recommendations for ensuring that blockchains and digital assets can be safely deployed and used.

- 1. Disclosure of protocol and smart contract vulnerabilities.** It is important to incentivise responsible vulnerability disclosure in blockchains. Considering that blockchain protocols often hold large

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amounts of value, there can unfortunately be strong economic incentives to not acknowledge problems that could affect the economics of a blockchain network. The community has begun to come together to develop clear communications and resources about vulnerabilities, for instance with the SWC registry. Such efforts should be supported and expanded.

2. **Recommendation or requirement for smart contract audits.** Developers and other actors in the blockchain space should leverage the existing tools that let you formally verify smart contracts or make informed security decisions based on mathematical facts you can discover from these protocols and contracts. This could potentially become a regulatory requirement, although over-regulation could be a barrier to innovation (see next point).
3. **Certification.** In lieu of regulation, policy makers could consider various kinds of security certifications for blockchain protocols, smart contract platforms, and perhaps smart contracts themselves. A good set of quality certificates could be a middle ground between safety and innovation.
4. **Education and best practice.** One issue facing blockchain is the fact that not enough people understand cryptography and how to use it properly. There are incidents of blockchain projects not using it properly or developing their own cryptography, which does not necessarily work as intended. We recommend efforts to increase education, expertise and dissemination of best practice

in this area. The same can be said of smart contract technology. It is equally important that people understand how big the consequences can be of errors in immutable contracts and with blockchain protocols.

5. **Regulatory landscape.** As for blockchain and privacy, the regulatory and policy issues here are by now well known, particularly the tensions between blockchain and the GDPR. We continue to recommend that policy makers look at the standard for anonymisation of personal data, particularly in light of new technologies like zero-knowledge proofs.

# Theme 14: Blockchain and education

- Workshop Report: [Blockchain Skills and Education](#), Malaga, 13 November, 2019
- Academic Paper: [Blockchains and Education](#), Dr Allan Third, Dr Kevin Quick, Mr Chris Valentine, Mrs Michelle Bachler and Prof John Domingue, Knowledge Media Institute of the Open University

## ***From the Workshop Report, February 2020***

For our Education theme, we relied heavily on the academic paper prepared by the Open University, on our own Observatory blockchain skills survey, and on the Education Workshop that was held during the Convergence conference in Malaga. There was no thematic report or blog post on this particular theme. For this reader, we have therefore reprinted the Workshop Report. We encourage readers interested in the subject to consult the online version of that report, which contains links to slides as well as the video from the workshop.

## ***Working session 1 – Developing a strategy to foster a pool of skilled people in Europe***

Moderated discussion with participants

### **Objectives:**

- Analysing what set of skills are the most needed for creating blockchain projects.
- Brainstorming on an action plan related to the current skills related programs of the European Commission.

### **Main results from the EU Blockchain survey:**

- Smart contract engineering, blockchain solutions architecture, cryptography, distributed network engineering and protocol engineering are the most needed technical, blockchain-related skills.
- Frontend development, software quality assurance, backend development DevOps and Agile are the most needed technical, non-blockchain-related skills.
- Legal, business analysis, cryptoeconomics and business development are the most needed non technical skills.
- Blockchain specific skills are the hardest to find.
- Multidisciplinary profiles are the most valued on the market.

### **Other discussions:**

- There is currently a lack of education programs focusing on blockchain related skills. A vast majority of blockchain engineers are self-taught.
- Potential actionable follow-ups for the European Commission include: financing education programs to increase the number of engineers currently trained,

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facilitate interdisciplinary collaboration, keep a decent portion of the efforts focused on non-technical skills.

- eIDAS and the GDPR should be considered from the beginning when implementing solutions.

### ***Working session 2 – Accelerating the use of blockchain in the area of diplomas and certificates***

Moderated discussion with participants

#### **Context:**

- An increasing amount of actors are creating blockchain-based solutions for the issuance of diplomas and credentials.

#### **Discussions:**

- Blockchain and decentralised identity are core components of the infrastructure.
- Leveraging standards such as DIDs and verifiable credentials is a must. This will allow full interoperability between solutions.
- A good example of project is the Digital Credentials initiative, regrouping universities around the globe including European ones.
- This use case has been identified by the EBSI as a priority.
- There is a strong business case for large enterprises to use these solutions.
- Companies are spending a sizable amount of money in HR resources to verify their new recruits actually hold diplomas.
- This use case is highly dependent on network effects and the EU has a role to play in kick starting the ecosystem through the EBSI and standard setting.



# Theme 15: Blockchain for social impact

- Workshop Report: [Use cases in social impact](#), Barcelona, 30 January, 2020

## ***From the Observatory blog, 25 February, 2020***

Blockchain has long been seen as an important tool to support initiatives focusing on social impact, and today there are hundreds of organisations around the world looking to implement blockchain in areas ranging from banking the unbanked and providing identity services for vulnerable populations to protecting land rights and combating climate change.

At our “Use cases in social impact” workshop, held in Barcelona on 30 January, 2020, we took a deep dive into the subject with a number of practitioners working on the front lines of blockchain for good. Below are some highlights from the day.

### **Update from the Blockchain for Social Impact Coalition**

In the opening presentation, Vanessa Grellet, President of the Blockchain for Social Impact Coalition (BSIC), gave an update and learnings from the organisation’s latest work. Among the more impactful use cases BSIC has seen are identity and vulnerable populations, financial inclusion, supply chain and energy and environment. An analysis of 20 case studies out of BSIC and ConsenSys-related projects showed that most were connected to one or more of the UN Sustainable Development Goals (SDGs), demonstrating that the SDGs do serve as effective guideposts for channeling activity. On a positive note,

some 40% of these projects were live and another 40% in advanced testing phase, showing the maturity of the space. That said, many social impact projects face hurdles in terms of regulatory uncertainty as well as the fact that many large actors remain uncomfortable with blockchain due to its connection to cryptocurrencies. And while funding is available for SDGs, it is often challenging to match funds with the right projects.

### **Supporting financial inclusion and empowering citizens**

Grellet’s talk was followed by two panels featuring representatives from different projects focused on either financial inclusion or citizen empowerment.

The financial inclusion panel focused largely on the role of stablecoins and local currencies. Large stablecoin projects like Facebook’s Libra had a lot of potential for supporting financial inclusion, panelists said, particularly as they would likely be acceptable to institutional users, but they also raise questions in areas like governance and control. For these reasons, smaller local currencies, provided they had enough liquidity, provide an interesting alternative. To be successful, local coins need to be inclusive of the whole community, poor and rich. Central bank digital currencies (CBDC) could be a positive addition to the equation, helping the adoption of crypto

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currencies, but such currencies also raise privacy issues.

During the citizen empowerment panel discussion ranged empowering knowledge workers to support a more democratic knowledge economy, the World Food Programme's blockchain project to support Syrian refugees through grants of blockchain-based digital cash, as well as different approaches to blockchain-based e-voting for giving voice to members of different communities.

### **Blockchain for the World Food Programme**

After the panel Bernard Kowatsch of the World Food Programme presented a deep dive into the WFP's blockchain projects. Building Blocks is a WFP project to provide cash transfers on blockchain that was first piloted in Pakistan and is now live in Jordan. The program provides cash to Syrian refugees in Jordan so they can buy food in stores using a ledger on the Ethereum blockchain. Blocks for Transport is a project to create a digital platform to digitise the supply chain between Djibouti and Ethiopia, while The Atrium is an interagency development sandbox designed to enable collaboration across UN agencies who are interested in blockchain technology. Such knowledge sharing is important, Kowatsch said, as experience had shown that the solution for one use case is often transferrable to other contexts.

The day ended with a panel on the subject of using blockchain to reconnect people with society. Here the conversation turned largely on different aspects of the personal

data/digital identity discussion. Fostering the sharing of data for the common good, panelists noted, is one of the promising use cases for blockchain, but this has to be done in a safe, privacy-preserving way. Doing so will require more user-centric digital identity approaches than we have today. That in turn means developing standards as well as improving the usability of applications designed to help users manage their own online identities. As in so many other blockchain scenarios, panelists also said that we need work on the legal and regulatory side before we can have truly user-centric identity regimes in Europe.

# Theme 16: The blockchain research landscape in Europe

- Workshop Report: [Research priorities](#), Brussels, 18 February, 2020

## *From the Observatory blog 3 May 2020*

Research is at the heart of innovation and technological advance. This is certainly the case with blockchain. Because many blockchain use cases involve replacing traditional centralised approaches to economic, social or even political structures with decentralised ones, blockchain touches on a wide range of non-technical subjects too, from regulation and the law to economics, ethics and even philosophy. That makes for a large number of potential fields of research. At our workshop on Research Priorities we explored the state of play of blockchain research in the EU in form both technical and non-technical angles.

### **There are a lot of technical topics to tackle in blockchain**

The first presentation looked at blockchain-related technical research from a researcher's perspective. There are four main sets of problems in blockchain.

- **Scalability** problems have to do with ways to increase transactions per second, for instance via sharding, sidechains or rollups.
- **Privacy** problems have to do with how to hide transactions and data on a blockchain, either generally or selectively, while maintaining the viability of the chain. Here research is often around developing new cryptographic methods, like zero-knowledge proofs (ZKP), or new privacy-

preserving computational methods, like multi-party computation.

- **Generalisation** problems have to do with what kinds of things you can do on the blockchain, for example is the smart contract language Turing complete (so all purpose), and if so, can complex things be done in a scalable way.
- **Decentralisation** problems have to do with to what degree the platform is and remains decentralised. Both Bitcoin and Ethereum were designed to be decentralised, but have seen mining centralisation.

There is another problem that underpins these four that is very important but should be considered separately: User experience, or how we can safely implement systems, and how easy are they to use, administer and regulate.

These basic problem sets often result in a very broad array of specific research topics, so it makes sense to generalise the problems as much as possible. For example, one way to solve a number of problems simultaneously is by distribution (sidechains, sharding); another is by specialising (state channels); and so on. Research problems in blockchain can also be looked at in terms of two fronts: developing new cryptographic tools, and developing good UX.

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### Academic collaboration in the EU for blockchain

This was followed by a presentation on a study of the blockchain ecosystem by the Blockchain & Distributed Ledger Observatory of the Politecnico di Milano. According to the researchers, the number of worldwide business applications of blockchain is growing, but the number of concrete projects worldwide is still low. The market is still more focused on platforms than applications. The EU ecosystem could benefit from best practice, collaboration among academics, and blockchain education students and professionals.

During the panel discussion that followed, panelists focused on a number of issues facing the ecosystem that are relevant to the research agenda. For instance, while there is a lot of academic research on technical topics, there is less work analysing practical uses for businesses. Mapping the ecosystem also remains a huge challenge. Blockchain education also needs to be multi-disciplinary. It is important that students have a good overview of the technology but also of other fields, like social sciences, political science or the law. Similarly, we need to better study the impact of technology. In particular, we need methods to predict the development of a technological process in society, to monitor the actual development, and to stop unhealthy technological developments if needed.

### Research priorities for early implementations in live applications

In the next panel discussion subject turned to what research priorities should be to help foster live applications and early adoption. One area of great promise is privacy-preserving technologies. Blockchain, with its distributed ledger and group consensus, is very much about transparency. Yet people want privacy too. Privacy-preserving technologies like zero-knowledge proofs can help square the circle, and there is a lot of excitement in this area. The ecosystem could also profit from more research on integration between blockchains, which is not the same as interoperability, but rather more about coordinating transactions between different blockchains. Another challenge is to reconcile the legal and regulatory framework with the fast moving technological advances. Here, regulatory sandboxes, where regulators and companies can learn together in a controlled environment with near market conditions, are a very good idea. Governance of blockchain projects, particularly where groups of competitors need to cooperate on a shared infrastructure, remains a real challenge. Research in best practice in this area is therefore important.

### Research priorities and way forward for the EU

The final session of the day was dedicated to an open discussion among all participants on the subject of research priorities for the EU. Questions revolved around the technology

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itself, risk assessment in areas like security, governance and the legal framework, as well as research into high impact use cases. Among other things, it was noted that many sectors work on the same underlying use case just in different contexts. If there was an agreed path to follow research learnings and best practice could more easily be shared. New sectors would then not have to constantly reinvent the wheel. Design is an important area of research that often gets overlooked. One participant thought decentralisation should have overall priority because it is the desire for decentralisation that drives a lot of the efforts in blockchain. Therefore you need to understand what decentralisation means first. In terms of risks, focus needs to be on security risks, legal and compliance risks, systemic risks of decentralised technologies and user experience related issues (e.g., loss of private keys). Since blockchain is the technology of trust, we also need ways to evaluate how trustworthy blockchain-based platforms really are. This is not just a question of technology but also governance and related items. to identity information.

# Theme 17: Energy and sustainability

- Workshop Report: [Energy and Sustainability](#), Online Video Conference, 5 March, 2020
- Academic Paper: [Towards a Peer-to-Peer Energy Market: an Overview](#), Luca Mazzola, Alexander Denzler and Ramon Christen, Lucerne University of Applied Sciences and Arts, February 2020

## ***From the Observatory blog, 26 May 2020***

### **P2P energy markets**

The day started with a presentation from the University of Lucerne on how we might use blockchain to create peer-to-peer (P2P) energy markets. Today's energy markets are run on a top-down basis, with a local power distributor providing energy to the grid, and consumers buying it. Yet today there are many more opportunities for individuals to create their own power, for example via solar cells. These "prosumers" do not have an open market in the status quo setup: if you want to sell energy back to the grid today, you have to go through the Local Power Distributor (LPD), which, as the only customer, can set the conditions. Using blockchain, we could create P2P energy markets based around a decentralised auction house (DAH), in which consumers and prosumers can come together in a multilateral market. Such a market could provide prosumers with more incentives to produce surplus energy, catalyse decentralised energy production in general, and help local communities attain a degree of energy autonomy.

### **Reinventing energy grids with P2P and decentralised technologies**

The presentation was followed by a panel discussion on reinventing energy grids with P2P technologies. Among the points made was the fact that payments are a big issue. Despite an extremely heterogeneous landscape, it is desirable to have a common payments solution as that is easier for users. Trust is a big issue in local P2P energy markets too, particularly trust in the identity of actors on the network and the provenance of the data. Blockchains can help in certifying what has happened with an asset, which is an advantage. The real hurdles in P2P energy however are not technical but in the legal and regulatory framework. How do you handle liability, for example in the case of a blackout? How can you incentivise all actors to behave for the common good of the grid?

Another important element that blockchain brings to P2P energy markets is smart contracts. But while smart contracts can automate payments, they cannot be used to actually deliver energy. Fairness is also a big issue in P2P energy markets. If only those who can afford solar panels, for instance, can join



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such markets, that will be seen as unfair. While P2P energy markets have a lot of promise, for example in promoting energy sustainability, it can be difficult to demonstrate short-term ROI. This can be a barrier to investment, and may be a reason why, despite a lot of experimentation, there are so few such markets in production now. That said, payments has been discovered as an excellent use case for blockchain in energy markets. Grid+ in Texas, for example, uses blockchain to make it less costly to collect payments, and to do so daily. This has been welcomed by many. There are many legal and regulatory issues that need to be settled before P2P energy markets can go mainstream. For one, it needs to be legally permissible to use personal energy usage data to bill someone. Regulatory sandboxes can be a good way for policy makers to understand these issues. Japan's sandbox for energy use cases, for instance, led to an amended law allowing use of energy data in other fields.

### Presentation by the Energy Web Foundation

This was followed by a presentation by the Energy Web Foundation, a non-profit with over 100 members that is building open source blockchain solutions for the energy sector. The EWF's technology stack includes an Ethereum-based blockchain layer, two SDKs to enable building applications on that blockchain, and a set of seven dApps addressing energy use cases. The presenter showcased the two SDKs. EW Origin is an SDK to build track and trace solutions for renewable energy and trading of certificates. EWF is currently working with a Thai energy

producer to use the EW Origin toolkit to build a decentralised, open market for renewable energy. EW Flux is an SDK that supports the otherwise complex process of onboarding and managing decentralised energy resources (DERs), for example solar panels on a residence, onto a grid. EWF is working on a pilot with E.IDS, a transmission system operator in Germany, and Sonnen, a German battery company whose batteries are located in individual homes, to develop a pilot for settlement via blockchain for grid services provided by Sonnen that allow excess energy to be stored on batteries located in residences.

### How to accelerate use cases

The transition to a zero carbon society could become one of the largest markets on earth, and blockchain can help with the transition through the unique identification and tracking not just of objects and producers but also of outcomes. By being able to trade and monetise good outcomes, it incentivises good energy behavior. Making a significant market for this will however require public support. The idea for carbon markets is quite old. But they haven't been successful so far due to a number of technological and governance issues. Blockchain could help dramatically on the technical side and parts of the governance side through tokenisation, track and trace and enabling various forms of incentivisation and gamification. This could support the "re-internalisation of externalities": with transparent, trustworthy track and trace people will be more aware of the impact of their energy behavior, and therefore may be more inclined to change it.

**OBSERVATORY READER – THEME 17: ENERGY AND SUSTAINABILITY****EU priorities for sustainability of blockchains**

Sustainable energy is a big issue facing companies and also the public. There has been a lot of bad press for blockchain due to the energy question. Discussion therefore took place around how we can assess the energy usage of blockchains, measure their improvement, and get that message out. This included suggestions for an EU ratings system for blockchain sustainability, an idea with its pros and cons. Another option is to fund more targeted research, so we have better facts and figures and can therefore make better comparisons. By looking at real energy use per transaction, for example, we may be able to compare blockchains to other sectors, such as cloud providers. That could also put the energy consumption of blockchains into perspective.

# Theme 18: Conclusions of the EU Blockchain Observatory and Forum

- Workshop Report: [Conclusion](#), Online Video Conference, 6 May, 2020
- Thematic Report: This publication

## ***From the Observatory blog, 29 May 2020***

All good things, they say, must come to an end. The EU Blockchain Observatory and Forum is certainly no exception to this rule. After more than two years of work, on 6 May, 2020, we held the final workshop of the Observatory. Due to the COVID-19 crisis, the workshop was held online, where some 300 people logged in. The purpose of the workshop was to look back at the Observatory's work, to take stock of blockchain in Europe today, as well as to look forward to the future.

Below we present some highlights of the discussion. For a more detailed account, as well as links to the slides and videos, please refer to our full Workshop Report.

### **Introduction and overview of European context and activities**

The workshop began with a presentation by Pēteris Zilgalvis, Head of Unit, Digital Innovation and Blockchain, Digital Single Market, DG CONNECT and Co-Chair of the EC's FinTech Task Force. The EU Blockchain Observatory and Forum, he said, is an essential part of the EU's blockchain strategy. Other elements of that vision include the European Blockchain Services Infrastructure (EBSI) project as well as INATBA, a public/

private partnership designed to bring the Member States of Europe together with the private sector to further the blockchain ecosystem in Europe. Europe is also investing in research, innovation and startups through a number of Initiatives including Startup EU. On the regulatory front, the EU is promoting and enabling blockchain as part of the Digital Single Market legal framework and looking at the Digital Services Act to see what can be done to support the mutual recognition of smart contracts. In terms of policy, the EC cooperates with bodies like ISO, CEN/CENELEC and ETSI on interoperable standards, will be introducing initiatives focused on skills development for blockchain, and has created an AI/Blockchain Investment Fund. The EC will also soon be publishing its Blockchain Strategy.

### **Speech by Eva Kaili (MEP, European Parliament)**

Up next was a speech by Eva Kaili, a Member of the European Parliament and a strong advocate for blockchain in Europe. The Observatory, Kaili said, has been instrumental to the effort to widen the understanding of the uses and the value of blockchain. Today blockchain is ubiquitous in the markets and public sector and is an integral part of any innovation ecosystem. We also now have a much clearer understanding of what

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constitutes a blockchain-based solution. Today, Kaili continued, we are moving from blockchain's period of childhood into an era of adulthood, one in which we have a clear understanding about the importance of blockchain governance and a clear view of blockchain Key Performance Indicators. Kaili ended with a number of recommendations, including warning against the fragmentation of the European blockchain ecosystem, creating a mechanism to link the new EU Blockchain Observatory with INATBA and EBSI, and setting up a distinct Directorate on Blockchain in DG CONNECT. In closing, Kaili thanked all those who had contributed to the work of the Observatory and promised to continue her strong support for these efforts in the European Parliament.

### **Presentation: Blockchain technology now and tomorrow, technology advancements and adoption**

In the third session Tom Lyons, Report Manager of the EU Blockchain Observatory and Forum, provided a review and updates on the Observatory's thematic work, which was carried out primarily through its 18 workshops, nine Academic Research Papers and 13 Thematic Reports. A number of priorities raised by the community and communicated to policy makers through the Observatory have since been acted upon. These include clarifying the legal and regulatory framework, which the EC is doing through various regulatory reviews; educating stakeholders, which is happening both through EBSI and EC skills initiatives; supporting blockchain research and startups, which the EU addresses through Horizon 2020 and its AI/Blockchain

Investment Fund; and supporting public/private flagship projects, which has now been realised among other things through the creation of INATBA. The second part of the presentation focused on the current state of the blockchain ecosystem in Europe and globally via market research prepared by the Observatory in cooperation with the blockchain-based market research firm Blockdata. Among the findings: Since its height in 2017 during the ICO boom, creation of blockchain-focused projects has dropped considerably around the globe, while more and more companies are joining blockchain consortia. This seems to indicate both the expected post-hype consolidation as well as an interest in companies to start to put the technology to practical use. Funding through token sales and venture capital has also peaked, while the smart contract ecosystem is growing steadily.

### **Deep dives into key Observatory themes**

The next part of the workshop consisted of deep dives into three of the Observatory's key themes: Supply Chain, Digital Assets, and Digital Identity.

**Supply chain.** In the supply chain discussion, it was pointed out that a lot of the legal, regulatory, technological and governance issues in blockchain for supply chain were being discussed before the pandemic. The crisis has however highlighted how fragile global supply chains are. Of all the blockchain for supply chain issues, the governance ones are probably the most important. These are not related to the rhythm of the advance in technology, but rather to difficult questions

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around getting a very diverse stable of stakeholders to sit around a table and agree on how to do business in a collective setting. That said, even in this short period, we have seen a lot of progress, for example in trade finance. There are not only a lot of consortia being formed, but many have actually gone to market and are delivering services.

**Digital Assets.** A representative of the SEC gave a detailed overview of the SEC's approach to regulating digital assets. When it comes to classifying digital assets a lot depends on what the rights and expectations of the parties to a transaction are. The threshold issue with the SEC is always analysing whether a digital asset is a security or used in a securities-related activity. That said, the SEC regulates digital assets the way it regulates any other asset, by being technology neutral and looking at conduct and activity. After that, the discussion turned to central bank digital currencies (CBDCs). According to the Bank of International Settlements (BIS) some 70% of central banks are considering CBDC, and while initial focus has been on wholesale CBDC, most central banks are now considering retail CBDC – or digital cash – as well. Today the most advanced initiatives are in retail CBDC. Many are already in an advanced experimentation phase and could go live by 2020. There are many non-technical questions and challenges central banks have to consider before implementing a CBDC. A CBDC can have a negative impact on the legacy financial system, yet there can also be risks to central banks in not implementing a CBDC and leaving the field of digital cash to private entities.

**Digital identity.** The digital identity panel focused on the state of decentralised identity in Japan and in Europe with EBSI. In Japan, participants were told, digital identity is quite advanced. The government is an identity provider already for individuals and legal entities. It is developing some decentralised identity technologies as well. In Europe, EBSI is building a blockchain infrastructure based on nodes hosted by Member States. One core component that has been identified is the need for an identity framework for the infrastructure but also to add decentralised identity to many processes. The digital identity ecosystem is heavily dependent on network effects, yet there is no real incentive for actors in the ecosystem to be first movers. So there is a 'chicken and egg' problem as decentralised and self-sovereign identity (SSI) is only effective if large numbers of people can use it in multiple sectors. This requires someone to move first and make the initial investment, and is where government could play an important role.

### Blockchain in a Changing World

The next session featured presentations by INATBA and ConsenSys Health on the topic of blockchain in a changing world, with a focus on how blockchain can help in the fight against COVID-19.

**INATBA.** COVID-19 has caused some changes in the world. For one, digital has become the new normal. In times like these it is ever more important that we develop appropriate policies at speed, but those policies need to be strong and take into account the public

## OBSERVATORY READER – THEME 18: CONCLUSION

and private sector views. This is the idea behind the INATBA COVID-19 task force, which has been initially focusing on use cases in pandemic supply chain and donations. So far 25 solutions have been presented to the organisation. Six were around helping to bring the business community together for collective action against COVID-19. Seven were around how to protect people's livelihood and facilitate business continuity during the crisis. And 12 were aimed at mobilising cooperation and business support for the COVID-19 response.

**Consensys Health.** In the post-COVID-19 world more people are paying attention to blockchain and DLT. There is a lot of focus on practical use cases like how blockchain can improve the medical supply chain, be a matching engine for resources, for data sharing, and similar challenges. But blockchain and DLT can also help us augment our resilience. Many people are concerned by the fact that large governments, given the choice between mass testing and mass surveillance, are opting for mass surveillance. In this context blockchain can be seen as a dignity-preserving technology. Blockchain can support multilateral collaboration through computational trust, through transparency and by helping to decrease costs and add efficiencies to processes. Consensys Health is focusing on this through developing a rapid pandemic response platform with large federal partners. The intent is to create a platform that uses not just blockchain but also

privacy-preserving technologies and federated learning techniques.

### **Conclusion: A two year journey: the Observatory and Forum by the numbers and practical feedback**

In the final session of the workshop, Ludovic Courcelas, Project Manager of the Observatory, presented a quantitative look at the Observatory's achievements over its first two years. The numbers included: 13 thematic reports, a European Blockchain Map featuring over 700 initiatives, the Observatory Website with 91,000 visitors and 310,000 page views, an active Twitter account with 9,500 followers and 800+ tweets, an online Forum with 2,200 members, a monthly Newsletter with over 2,600 subscribers, and a YouTube channel for workshop and events videos on with 8,500+ views. The Observatory's work, Courcelas concluded, is important for Europe for a number of reasons. These include aiding Europe in crafting and shaping regulation to help accelerate the development of the technology and the industry; helping identify actionable use cases to receive support as needed; contributing to building a better global understanding of the technology among all stakeholders, advancing research and education; helping ensure that European citizens and businesses benefit from the promise of the technology. Courcelas then thanked all the attendees and with that, the final workshop of this version of the Observatory came to a close.



# Appendix 1: Observatory Links, Key Figures and Achievements

## LINKS

- [EU Observatory Website](#)
- [EU Observatory Blockchain Map](#)
- [EU Observatory Online Forum](#)
- [Observatory YouTube Channel](#) (Workshop Videos)
- Observatory Twitter Account [@EUBlockchain](#)
- Observatory LinkedIn [linkedin.com/company/eu-blockchain-observatory-forum/](https://www.linkedin.com/company/eu-blockchain-observatory-forum/)
- [EU Observatory newsletter](#)

## KEY FIGURES AND ACHIEVEMENTS

As of 1 June, 2020.

- 18 Observatory Workshops
- 13 Thematic Reports (written by the Observatory) with 25,000+ downloads
- 9 Academic Research Papers (written by Academic Partners)
- 3 Education Videos
- Convergence – The Blockchain Congress event - Malaga, Spain, Nov 11-13, 2019. Ca. 1,400 attendees, 230 speakers, 80 keynotes, panels, fireside chats, roundtables and meetings. Observatory part of Organising Team which included EC, INATBA, Alastria and ConsenSys.
- Observatory Website 91,000 visitors and 310,000 page views
- Observatory Twitter Account with 9,500 followers and 800+ tweets
- Observatory YouTube Channel with 8,500+ views
- Observatory Newsletter with 2,600+ subscribers

# Appendix 2: Index of publications by theme

## **Theme 1: Blockchain innovation in Europe**

- Workshop Report: [Blockchain Innovation in Europe](#), Vienna, May 22, 2018
- Thematic Report: [Blockchain innovation in Europe](#),

## **Theme 2: GDPR**

- Workshop Report: [GDPR](#), Brussels, June 8, 2018
- Academic Paper: [On Blockchains and the General Data Protection Regulation](#), Luis-Daniel Ibáñez, Kieron O'Hara, and Elena Simperl, University of Southampton
- Thematic Report: [Blockchain and the GDPR](#)

## **Theme 3: Government services**

- Workshop Report: [Government Services and Digital Identity](#) Brussels, July 5, 2018
- Academic Paper: [Government services and digital identity](#), Dr Allan Third, Dr Kevin Quick, Mrs Michelle Bachler and Prof John Domingue, Knowledge Media Institute of the Open University
- Thematic Report: [Blockchain for government and public services](#)

## **Theme 4: Scalability, Interoperability and Sustainability**

- Workshop Report: [Scalability, Interoperability and Sustainability](#), Berlin, October 2, 2018
- Academic Paper: [Scalability, interoperability and sustainability](#), Dr Arthur Gervais, Lucerne University of Applied Sciences and Arts
- Thematic Report: [Scalability, interoperability and sustainability of blockchains](#), March 2019

## **Theme 5: Digital Identity**

- Workshop Report: [e-Identity](#), Brussels, November 7, 2018
- Thematic Report: [Blockchain and digital identity](#), April 2019

## **Theme 6: Legal and regulatory framework**

- Workshop Report: [Legal and regulatory framework](#), Paris, December 12, 2018
- Academic Paper: [Legal recognition of Blockchain registries and Smart Contracts](#), Dr Robert Herian, The Open University Law School
- Thematic Report: [Legal and regulatory framework of blockchains and smart contracts](#), September 2019

## APPENDIX 2: INDEX OF PUBLICATIONS BY THEME

### **Theme 7: Blockchain and Supply Chain**

- Workshop Report: [Supply Chain and Traceability](#), Brussels, 19 February, 2019
- Thematic Report: [Blockchain in trade finance and supply chain](#), December 2019

### **Theme 8: Convergence of Blockchain with AI and IoT**

- Workshop Report: [Convergence of blockchain, AI and IoT](#), Brussels, 28 March, 2019
- Academic Paper: [Tokenization of physical assets and the impact of IoT and AI](#), Prof. Dr. Tim Weingärtner, Lucerne University of Applied Sciences & Arts
- Thematic Report: [Convergence of Blockchain, AI and IoT](#), April 2020

### **Theme 9: Blockchain Governance and Organisational Challenges**

- Workshop Report: [Governance and new organisational challenges](#), Brussels, 30 April, 2019
- Thematic Report: [Governance of and with blockchains](#), May 2020

### **Theme 10: Digital Assets**

- Workshop Report: [Digital Assets](#), Brussels, 24 May, 2019
- Academic Paper: [Blockchains and Digital Assets](#), Luis-Daniel Ibáñez, Michał R. Hoffman, Taufiq Choudhry, University of Southampton
- Thematic Report: [Blockchain and the future of digital assets](#), February 2020

### **Theme 11: Blockchain and Healthcare**

- Workshop Report: [Use cases in healthcare](#), Frankfurt, 4 Sept, 2019
- Thematic Report: [Blockchain use cases in healthcare](#), May 2020

### **Theme 12: Blockchain and Financial Services**

- Workshop Report: [Use cases in financial services](#), Paris 11 September, 2019

### **Theme 13: Security and Privacy**

- Workshop Report: [Cyber Security](#), Brussels, 29 October, 2019
- Academic Paper: [Blockchain and cybersecurity: a taxonomic approach](#), Stefano De Angelis, Gilberto Zanfino, Leonardo Aniello, Federico Lombardi, Vladimiro Sassone, University of Southampton
- Thematic Report: [Blockchain and cyber security](#), May 2020

### **Theme 14: Blockchain and Education**

- Workshop Report: [Blockchain Skills and Education](#), Malaga, 13 November, 2019
- Academic Paper: [Blockchains and Education](#), Dr Allan Third, Dr Kevin Quick, Mr Chris Valentine, Mrs Michelle Bachler and Prof John Domingue, Knowledge Media Institute of the Open University

## APPENDIX 2: INDEX OF PUBLICATIONS BY THEME

### **Theme 15: Social Impact**

- Workshop Report: [Use cases in social impact](#), Barcelona, 30 January, 2020

### **Theme 16: Research Priorities in Blockchain**

- Workshop Report: [Research priorities](#), Brussels, 18 February, 2020

### **Theme 17: Energy & Sustainability**

- Workshop Report: [Energy and Sustainability](#), Online Video Conference, 5 March, 2020
- Academic Paper: [Towards a Peer-to-Peer Energy Market: an Overview](#), Luca Mazzola, Alexander Denzler and Ramon Christen, Lucerne University of Applied Sciences and Arts, February 2020

### **Theme 18: Conclusion**

- Workshop Report: [Conclusion](#), Online Video Conference, 6 May, 2020
- Thematic Report: Conclusions of the EU Blockchain Observatory and Forum (this publication)

# Appendix 3: List of Observatory Working Group members

## “BLOCKCHAIN POLICY AND FRAMEWORK CONDITIONS” WORKING GROUP

- Anastasios Antoniou (Antoniou McCollum & Co, Partner)
- Dr. Roman Beck (European Blockchain Center, Professor)
- Dr. Stefan Beyer (S2 Grupo, Head of R&D)
- Jamie Burke (Outlier Ventures, Founder & CEO)
- Cristina Cobos (Legal Counsel & Professor at IE Business school )
- Savino Damico (Intesa Sanpaolo, Head of Fintech Ecosystem Monitoring)
- Dr. Primavera De Filippi (Permanent research at CERSA/CNRS; Faculty Associate at the Berkman-Klein Center at Harvard)
- Julio Faura (Banco Santander, Head of Blockchain)
- Nadia Filali (Caisse des Dépôts, Head of blockchain)
- Dr. Michèle Finck (Senior Research Fellow – Max Planck Institute for Innovation and Competition and Lecturer in EU Law, Keble College, University of Oxford)
- Janis Graubins (Notakey, Co-Founder)
- Dr. Dominique Guegan (University Pantheon-Sorbonne, Professor)
- Marta Ienco (GSMA, Head of Government & Regulatory Affairs, Identity)
- Luukas Ilves (Lisbon Council, Deputy Director and Senior Fellow)
- Christoph Jentzsch (Slock.it, Founder)
- Dr. Hab Iwona Karasek (Jagiellonian University, Associate Professor of Law)
- Ad Kroft (Dutch Blockchain Coalition, Program manager)
- Arnaud Le Hors (IBM, Senior Technical Staff Member)
- Leila Nassiri Jamet (Government Blockchain Association, VP Europe)
- Marina Niforos (Visiting Faculty HEC, Blockchain Advisor to IFC/WBG)
- Nejc Novak (Novak Law, Founder)
- Isabella Porchia (Latham & Watkins, Counsel)

### APPENDIX 3: WORKING GROUP MEMBERS

- Dr. Andrea Renda (CEPS, Senior Research Fellow)
- Dr. Philipp Sandner (Frankfurt School of Finance and Management, Head of Blockchain Center)
- Javier Sebastián (BBVA research, Principal Economist Digital Regulation and Trends)
- Dr. Nina-Luisa Siedler (DWF, Partner)
- Ivona Skultetyova (Tilburg University, Lecturer/Researcher)
- Thibault Verbiest (DS Avocats, Partner)
- Gilbert Verdian (Quant Network AG, CEO)
- Jean-Luc Verhelst (Author of Bitcoin, the Blockchain and Beyond) As of 1 June, 2020.

## “USE CASES AND TRANSITION SCENARIOS” WORKING GROUP

- Andrius Adamonis (Bank of Lithuania, Blockchain Project Manager )
- Irina Albita (FilmChain, Co-founder)
- Nicolas Bacca (Ledger, CTO)
- Anja Bedford (Deutsche Bank, GTB Head of Blockchain)
- Diana Biggs (HSBC, Head of Digital innovation)
- Oliver Bussmann (Crypto Valley Association, President)
- Tamás Chlepkó (Tax & Customs Administration of Hungary, Senior Project Manager)
- Daniel Du Seuil (Flemish Government, Program manager)
- Goncalo Fernandes (Emirates Integrated Telecommunications, Head of IoT and Blockchain)
- Dr. Alexander Grech (Commonwealth Centre for Connected Learning, Director)
- Bo Hembæk Svensson (Blockchain Advisor)
- Dr. Stefan Junstrand (Grupo Tecma Red, CEO)
- Clément Lesaege (Kleros, CTO)
- Manuel Machado (Worldline, Global Blockchain Solutions Manager)
- Johan Mastenbroek (Ledger Leopard BV, Advisor)
- Dr. Julie Maupin (IOTA Foundation, Director of Social Impact & Public Regulatory Affairs)
- Martin Pospěch (Smart Contract Labs, Founder)
- Simone Ravaioli (Digitary, Business Development Executive)
- Sandra Ro (UWINCorp, Co-founder)



**APPENDIX 3: WORKING GROUP MEMBERS**

- Dr. Plamen Russev (Webit.Foundation, Founder & Executive Chairman)
- Ville Sointu (Nordea Bank, Head of DLT and Blockchain)
- David Suomalainen (Land Registry Sweden, Legal advisor)
- Jolanda Ter Maten (TerMaten Business Consultancy, Blockchain Trainer & Consultant)
- Dr. Hitesh Tewari (Trinity College Dublin, Assistant Professor)
- Nikica Tomasic (CRIB Consulting, CEO & Co-Founder)
- Marcello Topa (Citi, Director, EMEA Market Policy & Strategy)
- Dr. Konstantinos Votis (Centre for Research and Technology Hellas/ Information Technologies Institute, Senior Researcher)
- John Whelan (Santander, Blockchain Lab Director)
- Vlad Zamfir (Ethereum, Researcher and Blockchain Architect)

# Appendix 4: Blockchain terminology

## **What is a blockchain?**

Blockchain is one of the major technological breakthroughs of the past decade. A technology that allows large groups of people and organisations to reach agreement on and permanently record information without a central authority, it has been recognised as an important tool for building a fair, inclusive, secure and democratic digital economy. This has significant implications for how we think about many of our economic, social and political institutions.

## **How does it work?**

At its core, blockchain is a shared, peer-to-peer database. While there are currently several different kinds of blockchains in existence, they share certain functional characteristics. They generally include a means for nodes on the network to communicate directly with each other. They have a mechanism for nodes on the network to propose the addition of information to the database, usually in the form of some transaction, and a consensus mechanism by which the network can validate what is the agreed-upon version of the database.

Blockchain gets its name from the fact that data is stored in groups known as blocks, and that each validated block is cryptographically sealed to the previous block, forming an ever-growing chain of data. Instead of being stored in a central location, all the nodes in the network share an identical copy of the blockchain, continuously updating it as new valid blocks are added.

## **What is it used for?**

Blockchain is a technology that can be used to decentralise and automate processes in a large number of contexts. The attributes of blockchain allow for large numbers of individuals or entities, whether collaborators or competitors, to come to a consensus on information and immutably store it. For this reason, blockchain has been described as a “trust machine.”

## APPENDIX 4: BLOCKCHAIN TERMINOLOGY

The potential use cases for blockchain are vast. People are looking at blockchain technology to disrupt most industries, including from automotive, banking, education, energy and e-government to healthcare, insurance, law, music, art, real estate and travel. While blockchain is definitely not the solution for every problem, smart contract automation and disintermediation enable reduced costs, lower risks of errors and fraud and drastically improved speed and experience in many processes.

### Glossary

The vocabulary used in the context of blockchains is quite specific and can be hard to understand. Here are the essential concepts you should know in order to navigate this breakthrough technology:

- **Node:** A node is a computer running specific software which allows that computer to process and communicate pieces of information to other nodes. In blockchains, each node stores a copy of the ledger and information is relayed from peer node to peer node until transmitted to all nodes in the network.
- **Signature:** Signing a message or a transaction consists in encrypting data using a pair of asymmetric keys. Asymmetric cryptography allows someone to interchangeably use one key for encrypting and the other key for decrypting. Data is encrypted using the private key and can be decrypted by third-party actors using the public key to verify the message was sent by the holder of the private key.
- **Transaction:** Transactions are the most granular piece of information that can be shared among a blockchain network. They are generated by users and include information such as the value of the transfer, address of the receiver and data payload. Before sending a transaction to the network, a user signs its contents by using a cryptographic private key. By controlling the validity of signatures, nodes can figure out who is the sender of a transaction and ensure that the transaction content has not been manipulated while being transmitted over the network.
- **Hash:** A hash is the result of a function that transforms data into a unique, fixed-length digest that cannot be reversed to produce the input. It can be viewed as the digital version of a fingerprint, for any type of data.
- **Block:** A block is the data structure used in blockchains to group transactions. In addition to transactions, blocks include other elements such as the hash of the previous block and a timestamp.
- **Smart contract:** Smart contracts are pieces of code stored on the blockchain that will self-execute once deployed, thus leveraging

## APPENDIX 4: BLOCKCHAIN TERMINOLOGY

the trust and security of the blockchain network. They allow users to automate business logic and therefore enhance or completely redesign business processes and services.

- **Token:** Tokens are a type of digital asset that can be tracked or transferred on a blockchain. Tokens are often used as a digital representation of assets like commodities, stocks and even physical products. Tokens are also used to incentivise actors in maintaining and securing blockchain networks.
- **Consensus algorithm:** Consensus algorithms ensure convergence towards a single, immutable version of the ledger. They allow actors on the network to agree on the content recorded on the blockchain, taking into consideration the fact that some actors can be faulty or malicious. This can be achieved by various means depending on the specific needs. The most famous consensus algorithms include proof-of-work, proof-of-stake and proof-of-authority.
- **Validator nodes:** Validator nodes are specific nodes in a network that are responsible for constituting blocks and broadcasting these blocks with the network. To create a valid new block they have to follow the exact rules specified by the consensus algorithm.

**Learn more about blockchain by watching a recording of our [Ask me Anything session](#).**