4. When disruptive meets streamline: international standardization in blockchain

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I INTRODUCTORY REMARKS

Blockchain is a shared, immutable ledger that aims at revolutionizing the way different sectors and industries work and interact. Open-source technology is at its core: Blockchain is a non-hierarchical, bottom-up distributed data structure consisting of blocks of transactions chronologically recorded in a network of participating computers (or 'nodes'). Every block in a blockchain, once approved through a certain predefined procedure, is 'chained' back to its previous block, by creating a cryptographic hash (that is, a fixed output in the form of a mathematical algorithm) of the representation of the previous block and embodying it to its structure. New blocks are added to the sequence of blocks provided that the participating computers (acting as economic agents) of the decentralized network reach consensus as to the validity of the transaction – or, generally, the true state of shared data. This contrasts with conventional systems where multiple participants submit new inputs and one counterparty is responsible for assessing validity.

Those computers or 'nodes' support the blockchain network by carrying out a variety of tasks, including to maintain a copy of a blockchain and to process transactions; and they are rewarded for that. They are the individual parts of the larger data structure. Whereas these nodes will not store full copies of blockchains nor validate transactions, full nodes will. Records are tamper-proof. In other words, after being recorded in a block, data cannot be altered without changing every block that followed, as blocks in the chain are

[1] The research on which this chapter is based was conducted in accordance with the rules set out in the Royal Dutch Academy of Sciences (KNAW) Declaration of Scientific Independence. Any remaining errors or misconceptions are of the author's alone. Contact: p.delimatsis@uvt.nl.

interdependent. This process ostensibly makes fraudulent transactions unable to pass collective approval of this type.[2] A system of incentives is put in place to incentivize the nodes. As the system is essentially one displaying network interdependence, blockchain is indeed a game-theoretical equilibrium system (in that it promotes good behavior and punishes bad behavior by nodes) that adjusts in a dynamic manner.[3]

Once added to the blockchain, a transaction record encrypted in the annexed block demands a tremendous amount of difficulty and energy so as to be altered or erased; in principle, a record cannot be altered or disappear after its creation and acceptance by the blockchain. This allows blockchains to become a digital ledger of a quite transparent and accessible nature thanks to its immutability, peer-to-peer networking and public key cryptography and with no need for a central monitoring authority or 'clearing house'.

Thus, by allowing people to transfer a unique piece of digital property or data (which can be a dedicated cryptocurrency such as bitcoin) to others, in a safe, secure, and immutable way, the technology can create digital currencies with no need for backing by any governmental body; self-enforcing, automated 'smart' contracts for the execution of which no human intervention is warranted; decentralized marketplaces in the shadow of any regulated space; decentralized communication platforms that will be gradually hard to wiretap; or Internet-enabled assets (so-called smart property, including real-world assets or fiat currency).

Blockchain is sometimes depicted as a 'trust-free' technology.[4] By removing the need for middlemen and by enhancing trust, this digital, cross-sectorial platform created to record and verify transactions drastically minimizes transaction costs, while catering for increased security, notably through hashing and no centralized ownership of the data.[5] Along with challenging existing business models by bringing intermediaries under strain, blockchain heralds – at least for some – a new era of digitization in bottleneck service sectors whereby tasks are split and sourced to a crowd rather than to well-defined institutions. One of the allegedly security-enhancing features of blockchain is anonymity:

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[2] See also A. Wright and P. De Filippi, 'Decentralised Blockchain Technology and the Rise of Lex Cryptographia' (2015), p. 7, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664 (link last viewed 6 August 2018).

[3] See also B. Biais, C. Bisière, M. Bouvard and C. Casamatta, 'The Blockchain Folk Theorem', Toulouse School of Economics Working Paper No. 17-817, 5 January 2018.

[4] F. Hawlitschek, B. Notheisen and T. Teubner, 'The Limits of Trust-Free Systems: A Literature Review on Blockchain Technology and Trust in the Sharing Economy' (2018) 29 *Electronic Commerce Research and Applications* 50.

[5] See also *The Economist*, 'If Blockchains Ran the World – Disrupting the Trust Business', 15 July 2017.

the identity of each node is concealed behind cryptography, which makes the technology quite appealing.

More importantly, blockchain fundamentally changes the way the digital marketplace operates. The lack of intermediaries diminishes the possibility of substantial market power concentration (and abuse thereof) within the network. Since no single player has full control over the underlying digital assets and shared data (as intermediaries would otherwise have), newcomers can directly compete with entrenched incumbents and share rents among each other (developers, users, investors). Thus, the new technology creates a fertile landscape for increased competition and permissionless innovation in digital marketplaces: with such low entry barriers and virtual lack of information asymmetries, innovation simply needs to be compatible with the existing protocol and consensus rules in order for it to be deployed.[6] This, however, does not mean that in the medium run, anticompetitive practices such as collusion or collective abuse of dominant position are impossible to occur; on the contrary, such phenomena may happen just like in any digital platform despite the absence of any distinct firm.[7]

Since blockchain does not depend on servers or centralized network structures, it can be established as a public or private network. Broadly speaking, a public (or permissionless) network would refer to a system that is accessible to anyone and every node can participate in verifying a transaction (that is, participate in the distributed consensus process). For instance, blockchain underpins cryptocurrencies such as bitcoin, which is based on a decentralized network in which every node has access and can proceed to transactions. In a private setting, on the other hand, access permissions would be controlled in that only a preselected group of nodes can participate in verification (read and/or conduct transactions).[8] Typically, such nodes would be purpose-built and part of a single organization, for instance, a financial institution. The latter would be much more akin to conventional centralized systems that, for instance, are currently active in the financial sector such as clearing and settlement-related entities, but with a touch of cryptographic auditability that

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[6] See C. Catalini and J. Gans, 'Some Simple Economics of the Blockchain', NBER Working Paper No. 22952, 19 December 2016.

[7] If this occurs, enforcement against anticompetitve practices will be the most important challenge for any antitrust authority. See C. Catalini and C. Tucker, 'Antitrust and Costless Verification: An Optimistic and a Pessimistic View of the Implications of Blockchain Technology', MIT Sloan Research Paper, June 2018.

[8] Note that in both cases those miners who validate transactions receive tokens such as bitcoin or Ether. The consensus rules established in the code define under which circumstances tokens are earned.

characterizes blockchain. Of course, a similar structure could be used to ensure adequate regulatory data management.[9]

Finally, there are also so-called 'consortium blockchains', which are partly decentralized and thus offer an alternative between fully decentralized systems and traditional single entity systems. The reading of blockchain in that case may be public but the consensus process would be fully controlled by a pre-selected set of nodes which belong to the consortium (for instance, a group of auditing firms). More generally, the design and architecture of the blockchain can have important repercussions for the functioning of consensus and collusive behavior.[10]

While the new technology is still in its emergence and the jury is not out yet as to its disruptive features,[11] its potential to redefine transactions in sectors such as health, business or financial services is beyond doubt. Like with every technological advance, promoting innovation and reducing transaction costs while ensuring consumer protection; respect for privacy and personal data as well as intra-industry competition is the challenge that regulatory authorities have to tackle. In this respect, standard-setting can exert an important role in establishing ex ante clear rules for the various aspects of the relevant market, thereby enhancing market confidence as to the security and beneficial effects of innovative technologies such as blockchain.

Against this backdrop, the present chapter maps recent developments in the area of standardization in blockchain within the International Organization for Standardization (ISO). Standards can play a key role in ensuring interoperability and avoiding unnecessary bottlenecks, creating a common understanding and consensus as to ways to address security-, privacy- and resilience-related issues associated with blockchain; or reinforcing end-user trust in the new technology. It proceeds as follows: Section II discusses the reasons that standardization may be beneficial for blockchain. An in-depth, critical analysis of the initiation and current blockchain-related work of ISO as exemplified in the mandate and meetings of the ISO technical committee (TC) 307 is offered in Section III. Section IV concludes.

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[9] Cf. 'Banks ap Ethereum Smart Contracts for MiFID II Compliance', 15 December 2017 (discussing the consortium of UBS, Barclays, Credit Suisse, KBC, SIX and Thomson Reuters with a view to improving the quality of counterparty reference data through anonymous reconciliation in order to comply with the MiFID regulatory requirements regarding data quality), available at https://www.finextra.com/newsarticle/31465/banks-tap-ethereum-smart-contracts-for-mifid-ii-compliance (link last viewed 6 August 2018).

[10] See L. Cong and Z. He, 'Blockchain Disruption and Smart Contracts', NBER Working Paper No. 24399, March 2018.

[11] See J. Kelly, 'Blockchain Insiders Tell Us Why We Don't Need Blockchain', *Financial Times*, 2 May 2018.

II WHY STANDARDIZE BLOCKCHAIN-RELATED MATTERS?

II.A The Benefits of Standardization

Standard-setting has escaped public scrutiny for a long time mainly due to its *voluntary* nature. Without any coercive power, voluntary standardization[12] was simply indifferent for many. Recent developments at the international and regional level but also an increased understanding of the impact of standardization on competition and innovation have put standardization on the spotlight of regulators, supervisors, policymakers, and courts.[13] In the case of actively evolving technologies like Distributed Ledger Technologies (DLT) and blockchain, standardization, as a quasi-legal form of self-regulation,[14] can be an adequate way to create some tentative, non-binding norms and thus a common vernacular in a new landscape whereby 'harder' forms of law may have undesirable results in terms of stifling innovation or creating unwelcome barriers to entry.

Indeed, standards are a form of codified technical knowledge that enables the development of products and processes. While voluntary, standards regularize and constrain behavior (regulative function); lend a taken-for-granted quality to certain technologies and *modi operandi* (cognitive function); and favor cooperative strategies over adversarial ones (normative function).[15] The last function in particular can have a long-lasting beneficial effect: this is because standardization creates an infrastructure that, once created, gives

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[12] Art. 1.1 of the ISO/IEC Guide 2:2004 defines standardization as the 'activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context. Note 1: in particular, the activity consists of the processes of formulating, issuing and implementing standards.'

[13] See, among others, FTC, *Motorola Mobility/Google*, Docket C-4410, Decision of 23 July 2013, available at

www.ftc.gov (link last viewed 6 August 2018); Case AT.39985, *Motorola* [2014] OJ C 344/6; Case AT.39939, *Samsung* [2014] OJ C 350/8; C-170/13, *Huawei Technologies*, ECLI:EU:C:2015:477; and C-613/14, *James Elliott Construction*, ECLI:EU:C:2016:821.

[14] N. Brunsson and B. Jacobsson (eds), *A World of Standards* (Oxford University Press, 2000).

[15] C. Lane, 'The Social Regulation of Inter-Firm Relations in Britain and Germany: Market Rules, Legal Norms and Technical Standards' (1997) 21 *Cambridge Journal of Economics* 197.

parties an incentive to use it, resulting in increased cooperation and enabling users to take full advantage of the network effects of standardization.[16]

In addition, first-mover advantages in standardization are substantial incentives for firms to (continue to) innovate.[17] Absent some form of standard-setting, technological progress would miss an important instrument for benchmarking and capitalizing on advances in the field of technology. In that sense, standards are constitutive of markets[18] and a decisive instrument for economic growth.[19] Additionally, a well-known advantage of standardization is its bottom-up nature, whereby certain 'soft' norms are created swiftly by experts whose everyday work directly relates to the subject of standard-setting. Depending on the field of standardization, it is the work of engineers and other scientists that ensures the accuracy and topicality of standards adopted.[20]

An underlying assumption is that the voluntary character of a standard will ensure that the best available technology will be enshrined in the standard. As a self-interested utility maximizer, the industry will necessarily converge towards a standard that is best for it and, by implication, for global welfare. In a later stage, standards can acquire legal status through reference in official legal instruments, which, again, points to the uneven relationship between the State and non-State actors involved in all stages of standard-setting.[21]

This approach is consistent with the premises of technological rationality[22] – a sort of technocratic legitimacy – and is considered the result of low sovereignty costs for governments that such delegation of power entails.[23] The more complex a given area of standardization is, the more likely a hands-off approach will be chosen. As a result, standard-setting consortia in highly vol-

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[16] M. L. Katz and C. Shapiro, 'Systems Competition and Network Effects' (1994) 8 *Journal of Economic Perspectives* 93, 109.

[17] Again, and more generally, if we consider standardization as infrastructure, it can promote but also hamper innovation. See also Daron Acemoglu, G. Gancia and F. Zilibotti, 'Competing Engines of Growth: Innovation and Standardization' (2012) 147 *Journal of Economic Theory* 570, 573.

[18] H. Schepel, *The Constitution of Private Governance – Product Standards in the Regulation of Integrating Markets* (Hart, 2005).

[19] K. Blind and A. Jungmittag, 'The Impact of Patents and Standards on Macroeconomic Growth: A Panel Approach Covering Four Countries and 12 Sectors' (2008) 29 *Journal of Productivity Analysis* 51.

[20] L. Senden, *Soft Law in European Community Law* (Hart, 2004).

[21] See Regulation 1025/2012 of the European Parliament and the Council on European standardisation [2012] L 316/12, Art. 10:6.

[22] See L. Cabral and T. Kretschmer, 'Standards Battles and Public Policy' in S. Greenstein and V. Stango (eds), *Standards and Public Policy* (Cambridge University Press, 2007).

[23] See K. Abbott and D. Snidal, 'Hard and Soft Law in International Governance' (2000) 54(3) *International Organization* 421, at 441.

atile and constantly changing areas such as information and communication technologies (ICT) are mushrooming. Such a soft and gradual approach to legislation has the advantage of potentially avoiding 'overdoing' it with overly strict regulation; at the same time, its disadvantage is that standards could potentially influence unduly any future regulatory attempt on the side of the State.

In an era where globalization, facilitated by the rapid development of the Internet and ICT, has dramatically affected the way humans interact and produce, seeking action at the global level appears to be a cost-effective forum for rule-making.[24] If standards are developed internationally, substantial gains can be made through the diminution of compliance and other transaction costs and by addressing network externalities and information asymmetries. As a result, international standardization has become the preferred layer of regulatory action, be it government- and private-driven.[25]

The cost of this virtually irreversible shift of locus of standardization towards the multilateral level depends on the level of sophistication of the relevant firms but also the nature of the industry. For instance, financial transactions are aterritorial, while global financial markets are highly interconnected and thus interdependent. The same would go for consumer goods such as smartphones or tablets; standards in this case can only be international if the objective is that the reach of innovations is global. In this equation, the consumer is a net winner. To be sure, economic theory would suggest that an international standard reduces consumer costs as information becomes more readily available and prices more readily comparable.[26]

Standardization can offer a forum for the identification of the best available technologies. However, in practice, it may also become the battlefield for strategic behavior by innovators and technology users. To avoid problems that strategic behavior may cause, international standard-setting has to adhere to a given set of pre-established principles. These principles have been discussed and developed under the auspices of the Technical Barriers to Trade (TBT) Committee of the World Trade Organization (WTO) in 2000 in a period during which international standardization was regarded as a highly unbalanced process whereby not all relevant interests were taken into consideration.

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[24] World Economic Forum (WEF), *The Global Enabling Trade Report 2012 – Reducing Supply Chain Barriers* (2012).

[25] W. Mattli and T. Büthe, 'Setting International Standards – Technological Rationality or Primacy of Power?' (2003) 56 *World Politics* 1, 7; K. Tamm Hallström, *Organizing International Standardization – ISO and the IASC in Quest of Authority* (Edward Elgar, 2004).

[26] See WTO, *World Trade Report 2012* (2012), 136.

Heralding a period of a more intensive scrutiny towards non-WTO rules affecting commercial transactions, the TBT Committee, then, decided that the following criteria should be adhered to when international standards are developed by international standard-setters: transparency; openness; impartiality and consensus; effectiveness and relevance; coherence; and addressing the concerns of the developing world (the so-called 'development dimension', which requires international standard-setters to address the concerns of developing countries). At the time, this was an unequivocal, consensus-driven signal by the WTO that due process in international standard-setting had to be strengthened.[27] Having an observer status in the TBT Committee, ISO has been following the developments within the Committee very closely and adopted a relatively open stance towards constructive criticism, notably stemming from developing countries.

Nowadays, the six TBT Committee principles figure prominently in the ISO Code of Conduct.[28] Only to accentuate their importance, the code upgraded the status of the TBT principles and already regards them as 'the key principles of international standardization'.[29] Thus, not only are the WTO principles relating to the development of international standards endorsed by ISO; they have allegedly become guiding principles for its technical work. This is an important development towards the quest for more representative international standards and more inclusive standard-setting practices at the international level.

II.B The Benefits of Creating International Standards for Blockchain

The technology underlying blockchain is based on five principles: (1) distributed database: in principle, each party has access to the entire database and its complete history with no central controller of the data or the information. As access is pervasive, verification can occur without middlemen; (2) peer-to-peer transmission: each node stores and transmits information to all other nodes; (3) transparency with pseudonymity/cryptography: each transaction is visible to anyone that has access to the system. Users have a unique alphanumeric address as their respective identifier which allows them to remain anonymous if they so desire; (4) irreversibility of records: records are immutable because

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[27] See WTO, TBT Committee, 'Second Triennial Review of the Operation and Implementation of the Agreement on Technical Barriers to Trade, annex 4: Decision of the Committee on Principles for the Development of International Standards, Guides and Recommendations with Relation to Art. 2, 5 and annex 3 of the Agreement', G/TBT/9, 13 November 2000.

[28] See ISO Code of Conduct for the technical work, 2016.

[29] Ibid. at 4.

they are linked to all previous transaction records. Algorithms make sure that the recording is properly stored, ordered and available to all network users; and (5) computational logic: blockchain transactions are programmed, which allows users to set algorithms and rules that automatically trigger transactions between nodes.[30]

In all these traits, standardization can play an important role in solidifying knowledge, consolidating best practices and increasing trust. In fact, much of the technology used in the underlying network is already based on international standards. Blockchain-specific standardization would be vital already for the survival and expansion of blockchain technology. This is because blockchain is after all a network business which relies on the (high) numbers of its network users.[31] Standardization can also ensure interoperability among multiple blockchain-based platforms. Such interoperability is bound to take various forms: first, it may relate to data connectivity in that the data source identifier, the data item identifier and the binding protocol between them is subject to standardization. Second, a common denominator connecting the different forms and types of data block and chain functionalities needs to be identified through the standardization process. Third, interoperability with regard to data trust management shall be standardized. This would in all likelihood also entail some standardization of application programming interfaces (APIs), but also interfaces relating to users and application support.

Ensuring a base layer of connectivity that can take into account all these different forms of interoperability can lower implementation and integration costs and reduce the risks associated with fragmentation between different ecosystems, be it existing or emerging. This, however, is more easily said than done in the area of blockchain whereby much of its existing architecture is largely based on open source. Whereas open source has its benefits when it comes to costs and easy access to innovators or implementers of innovations, this also means that standardization and interoperability may be moving targets as continuous interventions (even if only, paradoxically enough, they lead to improvements) could potentially accentuate such fragmentation. Again, such challenges could be overcome relatively easily by focusing on reaching agreements on the architecture and the potential modularity of DLT.

More crucially, as explained below, it appears that common terminology and vocabulary is a central theme for developing a commonly shared understanding of the technology with a view to fully reaping the benefits and potential

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[30] See P. De Filippi, 'What Blockchain Means for the Sharing Economy' (2017) *Harvard Business Review*.

[31] See UK Department for International Trade, 'From Concept to Reality: How Blockchain Will Reshape the Financial Services Industry' (written by the Economist Intelligence Unit), September 2017, p. 61.

of DLT systems but also expanding their use.[32] Taking into account existing blockchain-related ecosystems, one could submit that the main components of a DLT system would relate to access rights; consensus rules; auditability; and interoperability. Depending on how they deal with each one of these components, international standardization could offer a taxonomy of DLT systems offering additional clarity, transparency and market confidence.

In addition, international standards in this field would be necessary to improve the security and resilience of the relevant systems but also address any privacy and data governance and management challenges with a view to building trust and confidence in the technology among participants but also end-users.[33] For instance, if adequate safeguards through the creation of international standards are in place, 'smart' contracts, whose terms are recorded in a computer language and are automatically executed by a computing system as a response to different type of events relating to the contractual terms, could soon replace conventional contracting, leading to substantial efficiency gains.[34]

Another example showcasing the importance and usefulness of international standards relates to addressing information asymmetries. For instance, an international standard relating to the governance of blockchain would allow to any end-user who receives multiple blockchain solution offers to distinguish among or evaluate the quality of these offers adequately so that she makes an informed decision. Similarly, for a blockchain solution provider, a standard of this type that she complies with is a means of educating the potential customer and build confidence in the service provided.

Work on standard-setting for DLT at the international level would have multiple benefits. First, it would help confront the veil of mystery relating to blockchain. Much of the current suspicion and distrust discouraging entry and use of DLT could be eliminated if a common terminology was established among industry, regulators and other relevant stakeholders. Quite importantly, work within ISO would be crucial because it would not only clarify the need for new standards but also the relevance of existing ones with a view to

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[32] Leading national standard-setting institutions have already produced their early take on how to define central concepts surrounding the blockchain technology. See the document produced by the German standard-setting organization (which, crucially, is not a standard, technically speaking, but a technical specification): DIN, 'Terminology for Blockchains – Terminologie für Blockchain', DIN SPEC 16597, February 2018.

[33] See A. Deshpande, K. Stewart, L. Lepetit and S. Gunashekar, 'Understanding the Landscape of Distributed Ledger Technologies/Blockchain: Challenges, Opportunities and the Prospects for Standards', Report prepared by RAND Europe for the British Standards Institution (BSI), 2017, p. 11.

[34] In essense, what one would expect to be standardized quite easily are contractual terms rather than entire contracts, at least in the short run. See also Blaise Carron and Valentin Botteron, Chapter 5 in this volume.

avoiding unnecessary overlaps. For instance, the standards from the ISO 9000 (quality management); ISO 27000 (information security management) and ISO 31000 (risk management) could be applicable to DLT-related technologies and systems.

For instance, ISO/TC 68 work program on financial services covers various security-related aspects of Fintech which are of obvious relevance to blockchain.[35] The same goes for supply chain related standards developed under the auspices of ISO/TC 292 on security and resilience. The work of the ISO/International Electrotechnical Commission (IEC) Committee JTC 1 SC 38 on cloud computing and distributed platforms will also be of prominence when the TC 307 tackles the controversial issue of terminology.[36]

Furthermore, with all its imperfections,[37] ISO is the leading legitimate standards development institution globally, which means that work within ISO can in theory allow for more inclusive and representative standards than in other standard-setting fora. As blockchain-related standards is an unchartered territory for the most part and no single standard or protocol exists, international standards could potentially ensure interoperability and thus some coherence in the blockchain-related ecosystem early on.

Such 'motion of confidence' by ISO could facilitate the evolution of blockchain with higher levels of transparency and market confidence, while inducing subsequent innovation. Developments of this type could have positive spillovers on the productivity and the opportunities for increased cost-efficiency of multiple industries but also on the provision of public services.[38] The latter would range from land transfers and property title registrations to voting and management of health records to welfare distributions and monitoring.

Moreover, current regulations in the financial sector require that banks identify and verify the identity of their clients ('know your customer' or KYC). Compliance with KYC-related regulations such as counterterrorism

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[35] See also the report submitted by ENISA in the discussions of a sub-committee of TC 68 which deals with security aspects of digital currencies: ENISA, 'Distributed Ledger Technology and Cybersecurity – Improving Information Security in the Financial Sector', December 2016, available at https://isotc.iso.org/livelink/livelink/fetch/-17688250/17688252/17687842/EBF_025274_-_WP2016_3-1_4_Blockchain_Security.pdf?nodeid=18721281&vernum=-2 (link last viewed 6 August 2018).

[36] For additional potential overlaps or chances for cooperation among ISO technical committees, see Standards Australia, 'Roadmap for Blockchain Standards – Report', March 2017, p. 19.

[37] On this particular issue, see P. Delimatsis, 'Global Standard-Setting 2.0: How the WTO Spotlights ISO and Impacts the Transnational Standard-Setting Process' (2018) 28 *Duke Journal of Comparative and International Law* 273.

[38] See UK Government Office for Science, 'Distributed Ledger Technology: Beyond Block Chain' (2016), p. 9.

or anti-money laundering rules[39] requires significant financial resources and constitutes a significant burden for financial institutions but also globally active multinationals. Such costs may be the direct result of quite sophisticated legal instruments that are binding and produce extraterritorial effects but may also be associated with a considerate corporate social responsibility strategy implemented by the company.

Blockchain can significantly reduce such costs by, inter alia, allowing the participants of a network to share one distributed ledger where transactions are jointly recorded. International standards for blockchain could play an important role in this regard in offering additional tools for compliance; filling loopholes but also reinforcing the 'teeth' of existing standards in this area. In addition, DLT technologies may offer increased capabilities for financial supervisors so that they can monitor exposures and transactions in real time as nodes on the network. Standardization could play a crucial role in enabling such monitoring but also ensuring that safeguards for financial institutions are in place.[40]

Finally, development- and inclusion-related concerns could be well-served by international standards in the field of blockchain.[41] Disintermediation is a significant feature of blockchain which can ensure financial independence of individuals in the developing world by facilitating real-time transfers of remittances without the need to have recourse to middlemen. The low-cost feature of blockchain can also open new opportunities for small- and medium-sized enterprises which are currently burdened with sometimes excessive transaction costs of all types in their dealings with consumers, other businesses or regulators.

III STANDARDIZING BLOCKCHAIN – THE WORK OF THE ISO TC 307

III.A Setting Things in Motion – the Role of the Australian Standard-setting Body

Standards Australia, the Australian standard-setting organization, triggered the creation of a technical committee within ISO in April 2016 following the

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[39] See, for instance, EU Directive 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing (4th anti-money laundering Directive) [2015] OJ L 141/73, Art. 14.

[40] See Basel Committee on Banking Supervision, 'Sound Practices: Implications of Fintech Developments for Banks and Bank Supervisors', 31 October 2017, p. 35.

[41] See also ITU-T Focus Group on Digital Financial Services, 'Distributed Ledger Technologies and Financial Inclusion', March 2017.

ordinary procedure as laid down in Article 1.5 of the ISO Directives.[42] As explained above, in its proposal for a new field of technical activity, Standards Australia, identified the benefits of creating international standards for blockchain. Furthermore, it identified the significance of promoting interoperability among emerging blockchain protocols but also of ensuring compatibility between existing systems so that the technology is widely deployed.[43] The Australian standard-setter proposed that the new work program focuses on key technical aspects such as terminology; process and methods; authentication and privacy; cybersecurity; interoperability; and other technical aspects of blockchain.

The Technical Management Board (TMB), which alone decides about the establishment of TCs established TC 307 on a provisional basis. As provided for by Article 1.5.5 of the ISO/IEC Directives, the TCs are established provisionally with a short-term task to prepare a strategic business plan. Once drafted within a time period of no more than18 months, the plan has to be submitted to the TMB, which decides to formally establish a TC. Crucially, this provisional regime does not preclude the initiation of standardization projects during that period. In the case of blockchain, the TMB approved Standards Australia's proposal for new international standards relating to the emergent technology and established TC 307 in September 2016, which is currently composed of 35 participating and 13 observing members.

In addition, there are five liaison organizations: the European Commission; the International Federation for Surveyors; the International Telecommunication Union (ITU); the Society for Worldwide Interbank Financial Telecommunication (SWIFT);[44] and the United Nations Economic Commission for Europe (UNECE). All five entities are so-called 'category A'.[45] This means that they are expected to make an effective contribution to the work of the technical committee on any question the Committee has to deal with. In order to do so, they have access to all relevant documentation and can attend the meetings. If applicable, these organizations can also nominate experts to participate in a working group, as discussed below.

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[42] See ISO/IEC Directives, Part 1, Consolidated ISO Supplement – Procedures Specific to ISO, 8th edition, 2017.

[43] The proposal for a new field of technical activity (NFTA) submitted by Standards Australia (ISO/TS/P 258) in April 2016 is available at http://www.jisc.go.jp/international/nwip/tsp258_Blockchain_and_electronic_distributed_ledger_technologies.pdf (link last viewed 6 August 2018).

[44] SWIFT is the global guardian for ISO standards on data interchange (ISO 20022), which clearly has an interest in ensuring that it keeps apace with any updated standards for financial platforms in order to accommodate blockchain technology.

[45] See ISO, IEC Directives, supra n 42, para. 1.17.2.1.

In its application, Standards Australia also referred to the possibility for ISO to work with a large array of other external bodies with an existing or potential interest in the blockchain technology. These include the United Nations Conference on Trade and Development (UNCTAD); the United Nations Information and Communication Technologies Task Force; the World Economic Forum; the R3 Consortium; the Association of National Numbering Agencies; the Bank for International Settlements (BIS); the Coalition of Automated Legal Applications; the Digital Assets Transfer Authority and the World-Wide-Web Consortium (W3C); the Electronic Frontier Foundation; the Global Legal Entity Identifier Foundation; the Internet Governance Forum; or the MasterCard and VISA International.

Many of these bodies have developed some crucial, 'backbone' standards, allowing for rapid technological progress. Interestingly, however, no blockchain-specific solution providers are in the list mentioned above. This may be due to the lack of scale and size (it is rather impossible to currently identify blockchain multinationals or associations representing blockchain service providers); the anonymity as a key trait of blockchain-related actors; the lack of a body that collectively represents blockchain-related providers and experts; or, rather, the well-known ISO policy to encourage national standard-setting bodies to adopt an inclusive and continuous consultation process domestically which will subsequently be fed into the ISO functioning through the representatives of each national standard-setter.

III.B The Structure of the Work of the ISO/TC 307

In the current decentralized structure of ISO, managing the Secretariat in a technical committee goes with very important responsibilities but also increased levels of influence as far as the priorities and final deliverables are concerned.[46] In the newly created TC 307, Standards Australia has been tasked with managing the Secretariat. Thus, Standards Australia was asked to appoint a Secretary and nominate a Chairman, including the Chair of any sub-committees or working groups that may have to be established.

Working groups are quite important in that they are set up to expedite development of one or more approved work items. Becoming a convener in those groups can influence the structure, content and form of the final standard. Conveners are appointed by the technical committee for an up to three-year term but may be reappointed. Working groups are composed of a restricted number of experts individually appointed who are brought together to deal with the specific task allocated to the working group. Although appointed by

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[46] See Delimatsis, supra n 37, at 295.

their national standardization body, experts are required to act in their personal capacity rather than as representatives of their organizations.[47]

The work of a technical committee can also be facilitated by study groups. Such groups are established to investigate the feasibility and need for guidance or even additional standard-setting in a technical area. Typically, study groups will prepare recommendations after an in-depth study in a particular area in line with their mandate.

While initially foreseen to focus on a limited number of four topics, the work of TC 307 is currently sub-divided into three working groups: the first is on foundations, taxonomy and terminology (WG 1); the second is on security, privacy and identity (WG 2); and the third on smart contracts and their applications (WG 3). In addition, three study groups were established. The first was assigned to deal with use cases and applications, in particular financial services, government services and supply chain management (SG 2); the second with the governance of blockchain and DLT systems (SG 6); while the third examines issues relating to interoperability and compatibility of blockchain and DLT systems (SG 7).

III.C The 10 Blockchain-related ISO Standards under Development

TC 307, including its working groups and study groups, currently deals with the development of 10 international standards on blockchain-related fields. The first relates to terminology and concepts (ISO/AWI 22739); the second on the protection of privacy and personally identifiable information, which is horizontal in nature and one of the most difficult to tackle because of the distributed nature of the ledger and the fact that most privacy-related rules are enshrined in State laws and regulations (ISO/NP TR 23244); the third deals with security risks and vulnerabilities (ISO/NP TR 23245); the fourth tackles issues relating to standardizing blockchain identities but also the use of blockchain for identity management (ISO/NP TR 23246); the fifth covers reference architecture (ISO/AWI 23257); the sixth relates to the preparation of a standard on taxonomy and ontology (ISO/AWI TS 23258); the seventh tackling the issues surrounding smart contracts, with a particular emphasis on their legally binding character, the potential standardization of contractual legal components or clauses and the corresponding structural software elements (ISO/AWI TS 23259); the eighth focuses on the interaction between smart contracts and DLT systems (ISO/NP TR 23455). Two critical matters are expected to be discussed in the preparation of the last two standards in this area: the first related to the security of digital asset gatekeepers (ISO/NP TR

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[47] See ISO, IEC Directives, supra n 42, para. 1.12.

23576) and the second has a more explorative mission for now relating to the discovery of interoperability-related questions (ISO/NP TR 23578).

These standards under development appear to be use-enabling standards for blockchain; they are, in this respect, covering less technical aspects as one would expect. This may mean that the nature of blockchain technology does not allow for a hands-on approach on the side of ISO. Nevertheless, it could also mean that ISO intentionally adopts a hands-off approach, as it acknowledges the possibility of stifling innovation in this emerging and promising area. In any event, the standards will be instrumental in empowering end-users and increasing their confidence of and trust in the technology.

When adopted, these ten standards will constitute an original set of global rules of non-binding nature that offers the most comprehensive outlook of standards relating to the governance of blockchain. Other than the issue of definitions, terminology and concepts, immutability and interoperability (including compatibility with existing ISO standards) will be some of the most complex and key areas to discern. Once consolidated in the technical committee and sub-committees or groups that currently work on the drafting of the various aspects associated with their respective overarching themes, these standards will greatly influence the future governance framework of blockchain and its interaction with other systems, which may be blockchain-based or not.

Compliance with existing rules such as those relating to financial services, as noted earlier; rules relating to privacy such as the infamous General Data Protection Regulation (GDPR) at the European Union (EU) level; [48] or anti-trust rules relating to collusive behavior may also alter or at least confine the nature of blockchain and DLT.

In this respect, any standardization-related discussion on blockchain will very soon be inextricably associated with the future architecture of data governance. In the meantime, technical aspects will be shaped mutually and ad hoc standardized by the distributed networks (in case they are open source/public)[49] or by those who run a controlled blockchain established to operate a specific function (in case of permissioned blockchains). The interest in the safety and resilience of technical aspects and how they interact with legal rules will most likely increase when services supplied by governments or public procurement start using extensively blockchain-related technologies. This would

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[48] See EU Regulation 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data [2016] OJ L 119/1.

[49] See such projects as Hyperledger, Interledger, the Chain Protocol, or Blockcerts, which advance open standards and protocols in various areas of use. See Deshpande et al, supra n ~~29~~, pp. 4–5.

be because of the increased responsibility for due diligence on the side of the State as gatekeeper of certain regularly collected data of its citizenry.

IV CONCLUSION

This chapter attempted to offer a succinct yet critical account of the standardization-related activities surrounding blockchain on the side of the international community after discussing in a succinct manner the potential justifications that one could raise in promoting the creation of international standards in this field. At this juncture, the chapter identified the current activities within ISO and under the aegis of the TC 307 that aim at spelling out all those aspects of blockchain that may be challenging. Indeed, the work within ISO currently focuses on all those aspects where blockchain may demonstrate certain weaknesses, including protection of security, privacy, interoperability among multiple protocols or identity.

International standardization in blockchain can be instrumental in increasing trust in the new technology and its applications by end-users and market confidence. This will in turn allow for rapid dissemination of DLT systems, which are largely dependent on network effects for their survival. Other than bottom-up efforts undertaken by full nodes or other initiators to de facto standardize technical aspects of the blockchain networks, work within an international organization such as the ISO can assign to the technology the necessary legitimacy so that it can expand in scale and applications.

Standardization in this field has come into the limelight in the aftermath of the creation of the TC 307 within ISO and the ensuing mobilization by representatives of various sectors in various developed countries, including many EU Member States led by the UK and Germany. This appears to suggest that the streamline view that first-mover advantages in standardization are prominent incentives for firms to innovate in their processes, production methods or level of service would also hold in the case of blockchain technologies and DLT.[50] Importantly, the standards under development are of an enabling nature, aiming at making the blockchain technology more interoperable, regulation-proof and streamlined but also compatible with existing ISO standards.

While standardization may sometimes stifle innovation by adopting solutions that are not efficient in the long run and lock in stakeholders to inefficient outcomes, in the case of the ISO strategy with respect to blockchain it

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[50] See, inter alia, D. Spulder, 'Innovation Economics: The Interplay among Technology Standards, Competitive Conduct, and Economic Performance' (2013) 9(4) *Journal of Competition Law and Economics* 777.

is submitted that the open-ended nature of the mandate of the working and study groups as well as the focus on adopting enabling standards rather than merely technical ones are two important traits for increasing the chances of overall success of this multilateral endeavor. The rapid increase of interested ISO members from some 20 to 35 (as of May 2018) is also indicative of the growing acknowledgment of national standard-setters of the potential far-reaching effects that standardization in this area may have on businesses, innovation, and development. In view of the potentially disruptive effects and pervasive use of the blockchain technology, a more inclusive approach at the ISO membership level (for instance, via twinning between developed and developing ISO members) would allow for benefits of this work to be spread more widely around the globe.