Blockchain Standards for Sustainable Development

Jed Horner[1] and Philippa Ryan[2]

[1]*Policy Manager, Standards Australia, Australia*
[2]*Senior Lecturer, Australian National University, Australia*
E-mail: Jed.Horner@standards.org.au; Philippa.Ryan@anu.edu.au

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Abstract

Sustainable development requirements are often regarded as adding a layer of cost to production of goods and delivery of services. This perception can result in the dilution of sustainable development goals. To address this concern, it is necessary to improve both the methods by which sustainable development is achieved and the validation of its long-term benefits. Identification of better and more quantifiable indicators of value and progress are clearly linked to achieving sustainable development. This article explores the way that International Standards can help government agencies and development organizations to make sense of information communication technology and the way they can be used to improve and report outcomes. Standards can help ensure that innovations and processes are interoperable, reliable and secure. Blockchain standards will improve blockchain's reputation as a useful layer of technology for tracking and auditing data, exchanges and transactions, making it an invaluable tool for achieving transparency and trust in sustainable development programs.

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Abbreviations

ICT	Information communication technology
ISO	International Organization for Standardization.
UN SDGs	United Nations Sustainable Development Goals.

1 Introduction

Hunger, poverty, and environmental degradation, continue to affect millions of people globally. Many more are affected by unfair trade practices, lack of personal safety and poor educational opportunities. The importance of addressing these challenges, or 'wicked problems', which often have multiple underlying causes, is acknowledged through a set of global goals – termed the Sustainable Development Goals (SDGs).[1] Developed through a United Nations-led process, involving civil society, national governments and other actors, these provide a global blueprint of the world we want to resemble by 2030.

Concerted global action to tackle these 'wicked problems', ranging from hunger to gender inequality, on a global scale has many antecedents.[2] Initially encompassed within the Millennium Development Goals (MDGs), impetus grew for a revised set of international goals that are both aspirational, but grounded in real needs, and accompanied by a renewed focus and vigor. Prior to the adoption of the SDGs in 2015, the World Health Organizations' *Commission on the Social Determinants of Health*, as early as 2008, called for clear action, asserting that "[b]y 2010, the Economic and Social Council, supported by WHO, should prepare for consideration by the UN the adoption of health equity as a core global development goal."[3]

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[1] HWJ Wittel and MM Webber, 'Dilemmas in a general theory of planning' (1973) 4(2) *Policy Sciences* 155.

[2] United Nations, 'Millennium Development Goals Report 2015', *Geneva: United Nations* (2015) <https://webcache.googleusercontent.com/search?q=cache:29mgxU8HQ2QJ:https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%25202015%2520rev%2520(July%25201).pdf+&cd=1&hl=en&ct=clnk&gl=au&client=firefox-b-d>

[3] Commission on the Social Determinants of Health, 'Closing the Gap in a Generation: Health Equity through Action on the Social Determinants of Health', Geneva: World Health Organization, 170 (2008) <https://apps.who.int/iris/bitstream/10665/43943/1/9789241563703_eng.pdf>

1.1 Rationale and Background

The importance of tackling the SDGs has been acknowledged by many different international and national actors, including the International Organization for Standardization (ISO), as well as the myriad of governments who report in the context of United Nations (UN) processes. As recently as 2018, the ISO hosted a dedicated session on achieving the SDGs through its annual General Assembly, where experts from academia, civil society, and the private sector converged to discuss the pivotal role International Standards can play in realizing the aspirations outlined through each of the SDGs, and associated indicators.[4] Sergio Mujica, ISO Secretary, used the occasion to comment:

> *Companies, governments and organizations around the world will increasingly find in our collection of International Standards solutions to ensure their sustainability – and, in so doing, exercise their intrinsic value to the sustainable development of the planet. Together, with ISO standards, we can contribute to making the 2030 Agenda a reality, so no one is left behind.*[5]

One area where Standards are assuming a new-found importance in doing precisely this is in the domain of emerging technologies, including blockchain. In 2016, ISO established Technical Committee (TC) 307 – Blockchain and Distributed Ledger Technologies, following a New Work Item Proposal (NWIP) led by Standards Australia. There are now 44 participating countries in TC 307, working across areas like terminology, security, through to smart contracts to bring these Standards to fruition.[6] The notion that tech can play a critical role in tackling complex social and environmental challenges is not new.[7] Nonetheless, there are a few characteristics of blockchain, including its decentralized nature and immutability, which might make it uniquely placed to assist with the implementation of interventions, and to enable accountability.

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[4] 'Sustainable Development Goals', *International Standards Organisation* (2018) <https://www.iso.org/sdgs.html>.

[5] S Mujica, 'Unleashing action with International Standards,' 130 *ISOfocus* 2–3. (2018) <https://www.iso.org/files/live/sites/isoorg/files/news/magazine/ISOfocus%20(2013-NOW)/en/2018/ISOfocus_130/ISOfocus_130_en.pdf>

[6] ISO (2019). *TC/307 – Blockchain and distributed ledger technologies*, accessed 28/05/2019 from: <https://www.iso.org/committee/6266604.html>.

[7] K Lee and J Mathews, 'Science, technology and innovation for sustainable development', *CDP Background Paper No. 16. New York: United Nations Department of Economic and Social Affairs* (2013) <https://www.un.org/development/desa/dpad/publication/cdp-background-paper-no-16/>

This is the argument we advance in this paper, paying close attention not just to the potential of blockchain, but equally to deployments we see as holding promise in different areas, ranging from fair trade to climate change, to the overall frameworks needed to ensure that interventions are effective and that accountability prevails – for communities, for governments and for funders and donors.

1.2 Methodology

In order to support the claim that blockchain standards can enable and support sustainable development, it is necessary first to identify barriers to sustainable development; and then to show how the standardization of key features of blockchain technology can help to overcome those barriers. While identifying these features in the abstract is necessary, it is not sufficient for the purposes of explaining how standardization of blockchain technology will overcome these barriers. For this reason, use-cases are included here to provide working examples of how standardization of blockchain's features can help to achieve sustainable development. To this end, four use-cases in this paper explore fair trade; climate action; accountability; and tools for mapping norms, frameworks and policy-making.

This article is not intended to provide a detailed explanation of the mechanics of blockchain technology. There are other authors who have admirably met such a brief.[8] In the same way that it is possible to discuss e-commerce without explaining how the Internet works, this discussed how blockchain's features can help to solve complex problems that hamper efforts to address the UN SDGs.

1.3 Structure

Part 2 of this paper identifies some of the main barriers to sustainable development. Parts 3, describes four examples of how blockchain standards can help to address the SDGs. The first two use-cases align directly with one or more of the SDGs:

[8]See for example, R Hanson, A Reeson, and M Staples, Distributed Ledgers: Scenarios for the Australian economy over the coming decades, page 16 (May 2017, Data61), <https://publications.csiro.au/rpr/pub?pid=csiro:EP175257>; I Weber, M Staples, X Xu, *Architecture for Blockchain Applications* (Springer, 2019)

- Fair trade and the various and complex elements that drive it are addressed in SDGs 2 (zero hunger), 5 (gender equality), 8 (decent work and economic growth), 12 (responsible consumption and production), 16 (peace, justice and strong institutions), and 17 (partnerships for the goals);
- Climate action is SDG 13.

The third and fourth examples address the broader challenge of how to improve the delivery and review of SDG programmes:

- Blockchain standards can help to overcome corruption by ensuring transparency in the delivery of SDG programmes;
- Blockchain standards and mapping tools provide frameworks, norms, policies and capacity-building so that programmes for sustainable development can be implemented in an informed and meaningful way.

Part 4 of this paper suggests that standards can help to overcome barriers to sustainable development.

2 Barriers to Sustainable Development

Barriers to sustainable development exist on a number of levels. At its most basic, it has been suggested that difficulty identifying a single comprehensible definition of sustainable development is itself a significant barrier to achieving its goals.[9] While the conceptual and structural barriers may continue to prevent the articulation of a meaningful definition, it is generally hoped that steps will be taken to tackle each of the three pillars of sustainable development set out in the Johannesburg Declaration: economic development, social development and environmental protection – at the local, national, regional and global levels.[10] However, there are also barriers to implementation. Whether they are social, cultural, economic, political or systemic, consistent through any attempts to overcome them is a need for transparency and trust in data and tools used to monitor implementation and to evaluate outcomes.

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[9]HM Osofsky, 'Defining Sustainable Development after Earth Summit 2002' (2003–2004) 26 *Loyola of Los Angeles International and Comparative Law Review* 111.

[10]United Nations, 'Johannesburg Declaration on Sustainable Development – A/CONF.199/20 Chapter 1, Resolution 1 – UN Documents: Gathering a body of global agreements', *World Summit on Sustainable Development*, (4 Sep 2002) <https://unhabitat.org/wp-content/uploads/2014/07/A_CONF.199_20-Johannesburg-Declaration-on-Sustainable-Development-2002.pdf>.

2.1 Social and Cultural Barriers

An understanding of sustainable development must focus on the pragmatic consideration of practical implementation-level factors other than the goals themselves. One such factor is "optimal living conditions" within a community.[11] Culture, which could be defined as embedded social practices, subject to change over time, can give meaning and content to development. According to UNESCO, "[d]evelopment divorced from its human or cultural context is development without a soul".[12] Culture shapes contemporary debates onsustainable development. It is only with the recognition of cultural norms in context, including how these are marshalled politically, that global treaties and local policies promoting sustainability can be embedded into organizations, communities and markets.[13]

Cultural expectations about wealth and lifestyle, which might channel specific political discourses, can function as barriers to sustainability. High income economies have largely grown used to a lifestyle dependent on clean and cheap water and energy. Meanwhile, less developed countries may harbour a sense of entitlement to experience their own version of the industrial revolution of the 19th Century, without having to meet 21st Century standards in relation to waste management and pollution control. This thinking may seem equitable, but it is important to note that the world's population at the end of the 19th Century was only 1.65 billion.[14] This is fewer people than the current (2018) combined populations of China and Indonesia. Population size matters in this context because the pressure placed on demand for resources

[11]IL Owosuyim, 'The Pursuit of Sustainable Development through Cultural Law and Governance Frameworks: A South African Perspective' (2015) 18(5) *Potchefstroom Electronic Law Journal* 2012, 2104. See also, Principle 1 of the *Rio Declaration*, which states that "human beings are at the centre of concerns for sustainable development" – United Nations General Assembly, 'Rio Declaration on Environment and Development – A/CONF.151/26 Annex 1, Principle 1, *Report of the United Nations Conference on Environment and Development* (12 Aug 1992).

[12]J Perez de Cuéllar, 'Our Creative Diversity: report of the World Commission on Culture and Development', *UNESCO* (1996) <https://unesdoc.unesco.org/ark:/48223/pf0000105586>.

[13]Dr S Bertels, 'Embedding sustainability in organisational culture: A systematic review of the body of knowledge', Network for Business Sustainability, Simon Fraser University (2010) <https://www.sustainable.org/economy/economics-a-finance/1154-embedding-sustainability-in-organizational-culture>.

[14]Based on estimates by the *History Database of the Global Environment* and the United Nations, OurWorldInData.org (2019) <https://ourworldindata.org/uploads/2018/11/Annual-World-Population-since-10-thousand-BCE-for-OWID.png>

only grows with increased population, conflict, natural disasters, and climate change.

If policy shifts our goals from maximising growth of the market economy to maximising sustainable human well-being then societal adaptation can start to happen.[15] As observed in Principles 3 and 4 of the *Rio Declaration on Environment and Development*, the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations. In order to achieve sustainable development, environmental protection needs to constitute an integral part of the development process and cannot be considered in isolation from it.[16]

2.2 Economic and Political Barriers to Sustainable Development

Business sustainability targets a 'triple bottom line.' This means decision-making takes into consideration financial, social, and environmental risks, obligations and opportunities.[17]

In order to make this change meaningful and effective, it is important to periodically evaluate results and review performance. Any system that can automate this process and produce validated results data will reduce the cost of implementation and support trust in its purpose. An example of automated results data might be produced by sensors that monitor air and water quality or apps installed on devices that display dashboards with live ratings and financial outcomes resulting from the use of green energy or reducing waste.

It is inconceivable that any meaningful progress towards any of the sustainable development goals can be achieved without public acceptance.[18] There is an expectation of global participation, so that any negative economic consequences arising from the cost of implementing the SDGs are shared

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[15]R Beddoe, R Costanza, J Farley, N Myers. et al. 'Overcoming systemic roadblocks to sustainability: The evolutionary redesign of worldviews, institutions, and technologies'(2009) 106(8) *Proceedings of the National Academy of Sciences* 2483.

[16]United Nations General Assembly, 'Rio Declaration on Environment and Development – A/CONF.151/26 Annex 1, Principle 1, *Report of the United Nations Conference on Environment and Development* (12 Aug 1992) <https://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>.

[17]Dr S Bertels, 'Embedding sustainability in organisational culture: A systematic review of the body of knowledge', Network for Business Sustainability, Simon Fraser University (2010), 9. <https://www.sustainable.org/economy/economics-a-finance/1154-embedding-sustainability-in-organizational-culture>.

[18]P Macnaghten and M Jacobs, 'Public Identification with sustainable development: Investigating cultural barriers to participation' (1997) 7(1) *Global Environmental Change* 5, 5.

and therefore have equal impact between and across competitive markets. A change in culture and the acceptance of sustainability as a business takes time and persistent reinforcement.[19] While nations endeavour to agree to concrete measures for action and progress, it is increasingly important for there to be reliable and transparent indicators for progress.

If coherent policies are to be devised and measures are to be imposed for failures to attempt sustainable development, then it becomes necessary to find ways to audit such efforts and any outcomes. Measurements need to be accurate and they must resonate with the community whose efforts are being audited. An example of an early attempt to measure progress towards achieving sustainable development is the "Seattle salmon indicator" – a measure of the number of salmon runs in local rivers that has been used by the city of Seattle as both a specific indication of water quality and as symbol of a more general local environmental quality. This particular measure has been so successful that it has become influential in the development of other indicators.[20] In 2017, it was reported that – in an alarming development – for the first time in 20 years, the nets are coming up empty. Salmon stocks are at an all-time low.[21] David Huff, estuarine and ocean ecology program manager in the fish ecology division at the United States' National Oceanic and Atmospheric Administration (NOAA) reported that until 2017, there was always a fish in the net. However, he noted on this occasion:

> *Three times we pulled that net up, and there was not a thing in it. We looked at each other, like, 'this is really different than anything we have ever seen.' It is alarming.*[22]

While evidence of this sort and the alarm it raises should be sufficient to motivate change, trust in government agencies and the data they publish is at an all-time low. The NOAA is not immune to criticism for its management of

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[19] Dr S Bertels, 'Embedding sustainability in organisational culture: A systematic review of the body of knowledge', Network for Business Sustainability, Simon Fraser University (2010), 27 <https://www.sustainable.org/economy/economics-a-finance/1154-embedding-sustainability-in-organizational-culture>.

[20] See also, P Macnaghten and M Jacobs, 'Public Identification with sustainable development: Investigating cultural barriers to participation' (1997) 7(1) *Global Environmental Change* 5, 5.

[21] LV Mapes, 'Scientists survey Pacific Northwest Salmon each year. for the first time, some nets are coming up empty', *The Seattle Times* (9 Oct 2017) <https://www.seattletimes.com/seattle-news/environment/empty-nets-signal-trouble-for-columbia-river-salmon/>.

[22] LV Mapes, 'Scientists survey Pacific Northwest Salmon each year. for the first time, some nets are coming up empty', *The Seattle Times* (9 Oct 2017) <https://www.seattletimes.com/seattle-news/environment/empty-nets-signal-trouble-for-columbia-river-salmon/>

fisheries. In 2012, President Obama joked at his State of the Union address about the intricacies of federal bureaucracy in the United States, claiming that,

> *The Interior Department is in charge of salmon while they're in fresh water, but the Commerce Department handles them when they're in saltwater. And I hear it gets even more complicated once they're smoked.*[23]

As a consequence of this quip, President Obama was accused of falling into error about fisheries management and which agency managed salmon on the Pacific coast. Then, in 2017, commercial fish farming (or aquaculture) came under fire for apparently feeding farmed fish a carcinogenic toxin. An online discussion of this issue published by the University of Melbourne, argued that this was "fake news" and that a reliable source of truth is the NOAA. However, a couple of months later, a senior (Trump-appointed) NOAA official controversially called for the retraction of a paper that alleged one-fifth of Alaska pollock exports to Japan were either illegal, unreported, or unregulated.[24] None of these comments served to promote the aims of the NOAA's Seattle salmon indicator. Indeed, they were counter-productive and undermined the authority that the NOAA sought to assert by gathering the data in the first place.

In an era when deliberate misinformation (or 'fake news') in both social and mainstream media has been widely reported and blamed for manipulating public sentiment, it is important for leaders and their agencies to be accurate when reporting on the economic and environmental matters for which they are responsible. Without reliable information, the public will not participate in collective efforts towards sustainable development, particularly if there is a perception (real or imagined) that such an effort comes at a cost to the economic bottom line.

In free markets, there are only a few mechanisms available to win customers over the competition – namely, price and quality. All things being equal, when producers of like-goods compete on price they place downward pressure on the sustainability of their marketplace. If there are costs savings to be found during production, lower prices can be achieved more sustainably.

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[23] President Obama, '2011 State of the Union Address', *C-Span* (25 Jan 2011) <https://www.c-span.org/video/?c4515144/obama-smoked-salmon>

[24] 'Senior NOAA appointee calls for retraction of paper on illegal fishing', *Retraction Watch* (6 Nov 2017) <https://retractionwatch.com/2017/11/06/senior-noaa-appointee-calls-retraction-paper-illegal-fishing/>

These costs include regulatory compliance, licensing, fair work conditions, and clean management and disposal of waste.

Pollution results from waste. Holding companies liable for the cost of waste and pollution is very difficult. This is despite the magnitude of the problem. In a 2010 report prepared for the United Nations, it was revealed that the cost of pollution and other damage to the natural environment caused by the world's biggest companies would wipe out more than one-third of their profits if they were held financially accountable for their actions.[25] The biggest single impact on the $2.2tn estimate, accounting for more than half of the total, was emissions of greenhouse gases blamed for climate change. Other major "costs" were local air pollution such as particulates, and the damage caused by the over-use and pollution of freshwater.[26]

The best way to deal with pollution is to finding new efficiencies so that it is not created in the first place, through understanding how waste is produced and how it can be minimised or even prevented. Fundamental ideas of preventing pollution, rather than fixing problems, are essential for efficient, economically viable manufacturing and for addressing environmental problems.[27] However, none of these initiatives will take root in the consciousness of potential polluters unless there is transparency and trusted data to showcase socially responsible conduct, and accountability for any pollution.

2.3 Corruption as a Barrier to Sustainable Development

Corruption has long been regarded as a major force in the erosion of trust in low and middle income countries. Corruption comes in many forms. The most prevalent and insidious are accepting bribes, taking secret commissions, and hiding income or assets from creditors (include tax authorities).

The cost of hiding money is significant. Estimates run to the billions of dollars worldwide. According to the Organization for Economic Co-operation and Development, the cost of corruption is more than 5% of global gross domestic product. Corruption increases income inequality and poverty by reducing economic growth. Overall, corruption reduces efficiency and

[25] J Jowit, 'World's top firms cause $2.2 trillion of Environmental Damage, report estimates' *TheGuardian.com* (19 Feb 2010) <https://www.theguardian.com/environment/2010/feb/18/worlds-top-firms-environmental-damage>

[26] European Commission, 'The Economics of Ecosystems and Biodiversity', *Europa.eu* (2016) <http://ec.europa.eu/environment/nature/biodiversity/economics/>

[27] DW Jorgenson and P Wilcoxen, 'Environmental regulation and U.S. economic growth' (1990) 21(2) *RAND J Econ* 314.

increases inequality. Centralised systems and processes require intermediaries to distribute goods and aid. This arrangement is costly and is easily corruptible.[28]

To understand the success of any initiative, collection and analysis of relevant data, is crucial. Sustainability programs are no exception. Sustainability reports communicate an organization's progress and future commitment toward sustainability. They serve as a public record of an organization's goals and encourage transparency and accountability. These reports also maintain dialogue with many stakeholders, including shareholders, customers, business partners, government, and employees throughout the organization.[29] Ultimately, performance data can be used to drive decision-making and new initiatives. However, data collection and tracking progress can be labour-intensive and expensive. Overcoming this barrier to accurate reporting is an important step towards to implementation.

3 Addressing the SDGs with Blockchain Technology

The critical factors that connect the use of the Internet with its potential to support sustainable development or to deliver government services, e-commerce and social good are transparency and reliability. Transparency can support sustainability revealing the intricacies of complex systems, exposing risks so that they can be managed, discover best practices and hidden incentives so as to improve conditions, and assess progress with the benefit of accurate data and measurements.[30]

3.1 Fair Trade

Corruption is a barrier to fair trade. Blockchain can reduce corruption. It is a technology that verifies and authenticates human identity, scientific data, provenance and transactions can also break down the barriers that have impeded previous attempts to end poverty, deliver sustainable energy, reduce

[28]JM Sklaroff, 'Smart Contracts and the Cost of Inflexibility' (2017) 166 *University of Pennsylvania Law Review* 263, 276. See, fn 49

[29]F Maon, A Lindgreen, and V Swaen, 'Designing and implementing corporate social responsibility: An integrative framework grounded in theory and practice' (2009) 87(S1) *Journal of Business Ethics* 71, 88.

[30]TA Gardner, et al, 'Transparency and sustainability in global commodity supply chains' (2019) 121 *World Development* 163, 164.

inequality, and the accountability of institutions. Ultimately, what blockchain creates is a relationship of trust between users and content.

When a platform provides essential or centralised services (including banks and government), corruption of reputation data or reputation ratings may have negative consequences for the wider network. A significant problem that arises from the manipulation and corruption of online reputation ratings is that it erodes trust – both online and off. Trust in public and financial institutions in any society or economy is key to ensuring the fair and equal distribution of power and wealth.[31] Blockchain can contribute to fair trade by coordinating antagonistic interests in the pursuit of common goals, in a way that is quantifiable and verifiable.[32]

By automating processes, it is possible to make transparent and reliable the decisions made by business and government.[33] Blockchain technology can provide the mechanism to support a new engagement with civic trust. It can also challenge the traditional financial institutions that have failed to share their wealth and services with vulnerable populations and developing countries.

3.2 Climate Action

There is strong evidence to support the view that impoverishment and human insecurity may arise as a result of climate change.[34] As long as scientists cannot explain or predict climate change with precision, there will be room for deniers exploiting this imprecision as a basis for arguing that climate change is either non-existent or not man-made.

A human activity that has come under particular scrutiny for its tendency to degrade air quality and to cause pollution is the generation of electricity. It has been estimated, that when the emission of greenhouse gases continues

[31]Transparency International, 'Corruption Perceptions Index 2016', *Transparency.org* (25 Jan 2017) <https://www.transparency.org/news/feature/corruption_perceptions_index_2016>

[32]DMT Denny, RF Paulo, and D de Castro, 'Blockchain and Agenda 2030' (2017) 7 *Brazilian Journal of Public Policy* 122, 122.

[33]JD Sachs, 'Restoring Civic Virtue in America' Earth Institute, *Columbia University: Centre for Sustainable Development* (2016) <http://csd.columbia.edu/2016/12/05/restoring-civic-virtue-in-america/>.

[34]See, for example, R Watson and RO Ackerman, 'Poverty and climate change' *World Bank – Environment Matters Annual Review* (2000) <http://www.worldbank.org/en/topic/environment/publication/environment-matters>; O'Brien K.L. and Leichecnk, R.M., 'Double exposure: assessing the impacts of claimate change within the context of economic globalisation (2000) 10 Global Environmental Change 221.

at the same rate in the coming decades, the earth average surface temperature could exceed historical values by 2047.[35]

Sharing green energy has also been a recent contender for decentralization, sharing, and automation, with the support of blockchain technology. Quite apart from blockchain-enabled smart grids, there are multiple other ways in which Blockchain can help reduce carbon emissions. It can enable reliable real-time data analysis of consumption rates and improve energy distribution. Multiple startups around the globe have undertaken research and development to explore how Blockchain enables custom, distributed and decentralised value flows that can benefit any producers or consumers of electricity.

Perth-based Power Ledger is developing such peer-to-peer renewable energy trading platform, using the blockchain. The platform enables consumers to buy, self, or exchange excess renewable electricity, directly with each other. This works via a crypto token, which are tradeable digital assets representing a certain energy production. These can be sold to others via the Blockchain to prevent double spending and to ensure valid transactions. As such, Blockchain enables Power Ledger to offer a transparent, auditable and automated marketplace, that settles and clears transactions between consumers in minutes, without the need for a trusted centralised third party such as an energy company that charges a fee for its services. The objective of the platform is to empower consumers in relation to their energy consumption and production.

It is important to note here that a goal of sustainable development is providing humans with their basic needs in a way that ensures that any resources or means of production (including electricity) will be available for generations. The benefit of micro-grids is that they are also more resilient in storms and hurricanes, than large centralised power plants. They also reduce both the loss of fugitive emissions and the cost of electricity consumption, in the short-term. This is important for communities in less developed economies that may not have legacy systems to hamper innovation. If solar power can be generated, stored and shared within local communities and networks, then expensive intermediaries would not be needed, thereby reducing the cost of electricity.

Blockchain-enabled energy trading platforms remove the need for trust between individual energy traders. In this way, energy transactions can be automated seamlessly between strangers. For consumers to participate in the

[35]C Mora, 'The projected timing of climate departure from recent variability' (2013) 502(7470) *Nature* 183.

energy trading platform, they would need to install a piece of hardware, which needs to be connected to a standard digital energy meter. This 'Internet of Things' sensor can track the amount of energy created, bought or sold and then convert it into tokens that can be monetized into any fiat or digital currency. When households turn into mini-generators and consumers become prosumers, then real incentives emerge to adopt this new technology.

3.3 Monitoring SDG Programmes

All spheres of government and all organs of state within each sphere need to co-operate with one another in mutual trust and good faith, which includes co-ordinating actions, processes and legislation.

To illustrate the potential of blockchain standards to accelerate progress on meeting the SDGs, it is useful to use a nested heuristic, with levels, ranging from the local, to the regional and global. Governments report on progress against SDGs with an aggregate overview published through the UN. Civil society groups organize similarly, at regional and global levels, providing a reading of the performance of both national governments and other international actors. Within this heuristic, whilst contractual relationships between the providers of solutions and funders might remain remarkably similar to previous years, the means to achieving contractual obligations, including data collection, might be transformed, and in a positive way, through a pivot to more real-time reporting, from members of affected communities, or beneficiaries, themselves. Recipients of food parcels, of medical care, or of housing, might then find themselves in a transformed relationship marked less by antiquated bureaucratic processes marked by thousands of forms, and more straightforward digital interactions – provided that processes are *digitalized*, and not merely *digitized*.

The benefits of blockchain technology include reduction in transaction costs, increase in regulatory compliance, instantaneous settlement, increased security, and streamlined international trade finance through global interoperability.[36]

3.4 Mapping Policies to Support SDG Programmes

The connection with *macro*-level reporting and mapping is equally important. For global aggregate data, in a world marked by increasing distrust, to be

[36]D Tapscott and A Tapscott, *Blockchain Revolution: How the Technology behind bitcoin is changing money, business and the world* (Penguin, 2016), 71

robust, the underlying systems that provide the data, including the standards around data collection, and classification, are vital. Here, blockchain-centric standards on smart contracts could play a central role in not just enabling the everyday transactions necessary in delivering aid, for example, but providing a traceable account of these transactions and the parties to them. We might label this *responsive reporting*, which can differ from earlier analogue models insofar as it is real-time, platform based and can, in some circumstances, provide a dashboard view of delivery.

But achieving the goal of responsive reporting is dependent on:

(1) unlocking capability and
(2) capacity building, particularly in relation to blockchain standards.

Unlocking capability refers to identifying the technical solutions that exist in a given domain, including the local solution providers who might be overlooked, whilst capacity building refers to efforts to promote not just literacy in the world of digital standards, but the practical, learned, knowledge necessary to scale businesses in light of global norms, including International Standards on blockchain.

In 2015, the *Third International Conference on Financing for Development* recognized the imperative of both, noting, in relation to capacity building, that it "... must be country-driven, address the specific needs and conditions of countries and reflect national sustainable development strategies and priorities."[37] The logical extension of this, within the ambit of capacity building, is to encourage the active involvement of middle and income countries in the adoption and evolution of International Standards, including through membership of relevant Standards Committees, including by drawing analogies with the diffusion of International Standards in related areas, such as payments.

4 Standards can Overcome Barriers to Adoption of Blockchain for the SDGs

The global competition to service blockchain and distributed ledger technology by incorporating it into the existing financial services industry became a

[37] United Nations (2015). *Addis Ababa Action Agenda of the Third International Conference on Financing for Development.* New York: United Nations, p. 51.

reality during 2017.[38] The World Economic Forum estimates that more than 25 countries have a stake in blockchain technology,[39] filing more than 2,500 patents and investing $1.3 billion.[40]

In complex societies, including low and middle income countries, common International Standards might provide a pro-competitive architecture for emerging companies and solutions providers tackling the SDGs, enabling them to compete more effectively in their own markets, or to scale their solutions globally. An analogy might be the architecture that underpins payments globally, including ISO 20022, which is a global language for payments processing – part of the story that enables consumers to 'tap and go' with their credit cards as they travel, across borders, time zones and language frontiers.[41] What this Standards architecture does is provide a platform for the development of different, but related, payment products. Having a related architecture within blockchain might unlock similar possibilities, particularly in low and middle-income countries, where grounded talent and practical solutions often abound, but the importance of enabling infrastructure – such as common Standards – is not always assured and cannot be overemphasized.

But the focus on an enabling environment for blockchain-based SDG interventions must extend beyond the realm of blockchain standards alone, to encompass International Standards around quality management (for example, ISO 9001) and information security (for example, ISO 27001). These remain, at least in an institutional sense, some of the building blocks for effective digital services. Whilst the decentralized nature of some blockchain platforms change the nature of data collection, what constitutes adequate information security, at a platform and institutional level, and legally in many jurisdictions, arguably remains the same. The implications of this are that commissioning, or funding, agencies, national governments and other partner agencies in implementation, retain obligations to take proactive standards-based measures to enable them to more effectively meet their legal obligations too. This ranges from areas such as information security, information management to governance, and

[38] JC Giancarlo, Commissioner, 'Address to the American Enterprise Institute, 21st Century Markets Need 21st Century Regulation', *U.S. Commodity Futures Trading Commission* (29 Sept 2016), <http://www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo-17>

[39] 'Disruptive innovation in financial services: A Blueprint for Digital Identity', *World Economic Forum* (12 Aug 2016), <http://www3.weforum.org/docs/WEFA_BlueprintforDigitalIdentity.pdf>

[40] See, MM La Belle and HM Schooner, 'Big Banks and Business Method Patents' (2014) 16 *University of Pennsylvania Journal of Business Law* 431, 477–87.

[41] ISO 20222: Universal financial industry message scheme, accessed 30/05/2019, from: <https://www.iso20022.org/payments_messages.page>

extends beyond the realm of a particular technology, including blockchain. This is surely a logical extension of any mature assurance function.

The use of technology to achieve social good, and advance sustainability goals, depends upon the existence of trust in the technology itself. Blockchain's inherent transparency fosters the accuracy in certification needed to create pro-social effects in a growing market for companies with sustainable business practices. These effects should outweigh potential concerns arising from a perception that sustainability will erode profits or undermine long-term competition and wealth-creation.

While the adoption of most standards in most jurisdictions is voluntary, they are useful as they provide a basis for mutual understanding among individuals, businesses, public authorities and other kinds of organizations. They facilitate communication, commerce, measurement and manufacturing. Importantly, standards can improve the reputation of disruptive innovations. Standards can also contribute to global knowledge; and act as a voluntary source of authority.

4.1 Standards Improve the Reputation of New Products and Processes

With the assistance of thousands of experts from around the globe who volunteer their time to this effort, the International Organization for Standardization (ISO) publishes standards that validate quality processes and systems as meeting specific criteria for ensuring consistent quality. Recalling the example of ISO 9001, the standard has since 1987 been recognized internationally as the basis of a well-managed, customer-focused business system. This standard is based on a number of quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement.[42]

For companies that have achieved ISO 9001 certification, the benefits are numerous, including cost savings, enhanced customer satisfaction, access to new markets, increased market share, and environmental benefits. Essentially, an official Registrar who can grant certification verifies the organization's ISO 9001 QMS, and the ISO 9001 QMS is audited on an ongoing basis –

[42]Certification under this standard is available, although not a requirement. See, International Standards Organization – ISO 9000 family – Quality management (Retrieved 1 Jun 2019) <https://www.iso.org/iso-9001-quality-management.html>

typically every three years.[43] With this certification, an organization can make the claim to its potential and existing customers that it has an established and functional quality management system (QMS) that meets the highly respected requirements of the international community.

Like telephony and the Internet, blockchain technology needs interoperate at scale and across geographic and economic borders. Just as the Internet fundamentally changed the way we share information, blockchain is an open-source innovation that is going to revolutionize the way that transactions are conducted among individuals and between, governments, businesses, and machines.[44] However, successful adoption of global technologies requires standardization. As well as technology itself, regulatory changes have also impacted the standardization regime. The deregulation and demonopolization of national telecommunications systems has effectively ended the domination of single service providers and platforms over standardization.

Blockchain is not only disruptive and innovative, it has had a dark side. In its infancy, it broke new ground for shady marketplaces,[45] enabling a fantasy gaming platform that collapsed spectacularly,[46] and numerous Ponzi schemes.[47] It was only in 2015 the that the international community began to take blockchain seriously and consider its real value.

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[43]Quality Management System Education and Resources <http://qualitymanagementsystem.com/what-is-iso/iso-9001-certification-what-does-it-mean/>.

[44]See, P Boring, 'The Beauty of The Blockchain', *Forbes.com* (17 Jun 2016) <https://www.forbes.com/sites/perianneboring/2016/06/17/the-beauty-of-the-blockchain/#11390bd14cd1>.

[45]In 2013, the United States Department of State shut down *Silk Road*, a website that traded in guns, fake identity documents, credit card numbers, and drugs. It used blockchain technology and hide the identities of participants on the network.

[46]Mt Gox filed for bankruptcy in Japan on 28 February 2014, with liabilities exceeding US$60 million – See, Hern, A., 'MtGox files for bankruptcy in Japan after collapse of bitcoin exchange', *The Guardian.com* (1 Mar 2014) <https://www.theguardian.com/technology/2014/feb/28/bitcoin-mtgox-bankruptcy-japan>

[47]For example, Bitcoin Savings and Trust was a Ponzi scheme that collapsed in 2012 with the loss of 700,000 bitcoin. Trendon Shavers, who operated Bitcoin Savings and Trust, was ordered by United States District Judge Lewis Kaplan in Manhattan to forfeit $1.23 million and pay restitution in the same amount for operating what the judge called a "classic Ponzi scheme." Shavers, who pleaded guilty in September 2015 to one count of securities fraud and who now supports himself as a cook, said in court he had "royally messed up," and had lost friends and embarrassed his family as a result of his fraud. See, N Raymond, 'Texan gets 1–1/2 years in prison for running bitcoin Ponzi scheme', *Reuters* (22 July 2016) <https://www.reuters.com/article/bitcoin-fraud-texas-idUSL1N1A7270>.

Already, there are a proliferation of companies that profess to provide blockchain-based implementation solutions for the SDGs, including through architecting solutions. Formed through consortia and sometimes NGOs, these entities exist at regional, national and international levels, running hackathons, consulting and deploying solutions in local contexts, as well as at scale within entities. In low and middle-income countries, these are often grounded in tackling protracted social issues, and instances of pervasive social exclusion, manifest in a drive through some blockchain applications to connect the unbanked. It is therefore not surprising that some of the proponents of blockchain adoption, including advocates who draw attention to the need for the right enabling protocols and standards, come from middle income countries. In early 2019, for example, outgoing Premier of the Western Cape in South Africa, Helen Zille, went so far as to assert,

> *[In] ten years' time, blockchain will be mainstream," but on the proviso that 'protocol' related issues were addressed, lest we follow "the wrong roadmap.*[48]

It is fundamentally important, then, to consider the specific role that International Standards developed in relation to blockchain might play in supporting new technologies that can help to realize the SDGs. For example, standards can streamline the development of new technologies though processes and systems that are known to work. By doing this, standards can reduce the time taken to commercialize new technologies.

4.2 Standards Contribute to Global Knowledge

Traditionally, only standards that involve health and safety have been made mandatory. However, with increasingly globalization, it is becoming clear that standardization has become more technology-driven than market-driven.[49] Some scholars have argued that the biggest challenge to blockchain adoption is the lack of a coherent regulatory framework.[50] In an earlier era, it was possible for an early innovator create a product and then dominate a whole

[48]B Leighton, (2019). "Ten years from now, Blockchain will be mainstream" – Helen Zille at Blockchain Africa 2019, accessed 29/05/2019, from: <https://www.coininsider.com/blockchain-africa-2019/>

[49]K Jayakar, 'Globalization and the Legitimacy of International Telecommunications Standard-Setting Organizations' (1998) 5 *Indian Journal Global Legal Studies* 711, 724.

[50]G Hileman and M Rauchs. '*Global Blockchain Benchmarking Study*', Cambridge Centre for Alternative Finance. (2017) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3040224>

industry, setting the standards globally by default. However, because technology services operate across platforms, need to comply with local laws and interact with financial transaction systems, and interface with users of many different types of device, standards to enable interoperability and reliability have become crucial to sustainability.

4.3 Standards are a Source of Authority

Human and technical systems can also support sustainability through standardization. This is because standards organizations, including National Standards Bodies (NSBs) contribute to quality control. Indeed, in some countries, the standards body is also a national quality control authority.[51] The benefit of this role of standardization is that quality control suggests reliability and safety, providing important signals to investors, regulators and insurers. This dynamic arguably supports sustainable economic development, including through the adoption of technology.

Science, Technology and Innovation (STI) have long been recognized as important to the achievement of the SDGs, with detailed technical roadmaps now forming part of the comprehensive approach to achieving the SDGs.[52] However, the absence of global technical standards in this area might continue to pose a barrier where funders, donors and national governments are seeking assurance or certainty, particularly over issues such as cross-platform security or the viability of cross-border blockchain-based transactions. Standards are recognized as one means to achieve greater certainty, and are often embedded within Information Technology (IT) assurance functions for this very purpose. Similarly, the Australian Productivity Commission has recognized the centrality of Standards in driving the adoption of new technologies, asserting:

> *Standards play an important role in facilitating the adoption of new technologies. Mandatory minimum standards are set to ensure products and processes meet a threshold for product performance and/or safety and to avoid undue risks for consumers. The claim of meeting a standard, such as a product energy rating, is also enforced by certain regulators. In this way, standards help address information asymmetries between producers and consumers. For firms, compliance with developed standards is often used as a*

[51] For example, Pakistan, the European Committee for Standardization, and South Africa.

[52] United Nations, 'Addis Ababa Action Agenda of the Third International Conference on Financing for Development', *New York: United Nations* (2015) <https://unctad.org/meetings/en/SessionalDocuments/ares69d313_en.pdf>

> *marketing point. In addition to this role in quality assurance, standards can also facilitate interoperability.*[53]

Given the current pace of development of standards for blockchain and distributed ledger technology, many of these questions and concerns are likely to be answered within years. Security, interoperability, and common terminology, within this realm, may move to a place resembling the positioning of common software languages in the late 1990s and 2000s, where International Standards provided answers, not just barriers, functioning much like a common 'glue'. This is the story of MPEG, for example, which facilitated the digitalization of music or short video clips, for example.[54] A common global language, and format, is powerful – for technology and for trade. With up to 80 per cent of global trade (USD $4 trillion annually, based on earlier estimates) affected by standards or associated technical regulations, paying attention to Standards, and the architecture they provide, is critical to accelerating interventions aimed at achieving the SDGs too.[55]

5 Conclusion

The UN SDGs, and their related indicators, are ambitious. Spanning social, environmental and economic concerns, the implementation of programmatic responses to achieve these goals, in areas like fair trade, climate change, and in human health, will require clarity, persistence and accountability. It will also require refined technical solutions that exhibit security, immutability of data and that are capable of real-time reporting – all characteristics, albeit not exclusively, of blockchain.[56]

Achieving the aspirations embodied in the SDGs, and maintaining the trust necessary to stimulate and assure funders, donors and national government, is dependent on accountability. Whilst this can be achieved through existing reporting processes, at local and global levels, it must be buttressed by appropriate and innovative technical solutions. But, for these solutions to move

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[53] Productivity Commission, 'Digital Disruption: What do governments need to do?', *Canberra: Commonwealth of Australia*, 103 (2016). <https://www.pc.gov.au/research/completed/digital-disruption/digital-disruption-research-paper.pdf>

[54] 'Motion Picture Experts Group Standards, *Science Direct* <https://www.sciencedirect.com/topics/engineering/motion-picture-experts-group-standards>

[55] OECD (1999). *Regulatory Reform and International Standardisation.* Paris: Organisation for Economic Co-operation and Development, Trade Committee Working Party, p.4

[56] M van Rijmenam and P Ryan, *Blockchain Transforming Your Business and Our World* (Routledge, 2019).

beyond functioning as mere widgets, and being seen from within the prism of *emerging technology* alone, nascent International Blockchain Standards, including those being developed by ISO TC 307, are essential, should be adopted, and may be embedded and scaled within blockchain deployments.

Together, transparency and reliability can lead to certainty and trust. Standards can shore up the reputation of blockchain and distributed ledger technology, ensuring that different systems and networks can interoperate reliably.

Biographies

Jed Horner is Policy Manager for Standards Australia. His responsibilities have included next generation infrastructure, with a focus on smart technologies, social policy, Industry 4.0, and digital transformation more broadly. Previously, he worked for the NSW Government on innovation and digital government transformation, NGOs on creating new service models, as well as social policy law reform, helping to deliver Australia's most significant anti-discrimination amendments in decades. Jed is also a board member in the human services sector and his PhD in public health focused on access to healthcare services for migrants and how political discourse impacts on healthcare seeking practices.

Philippa Ryan is a barrister and a senior lecturer in the College of Law at the Australian National University in Canberra. Pip chairs the Standards Australia Blockchain Technical Committee's smart contracts working group. On ISO's Blockchain Technical Committee, she is the lead author of the technical specification for smart contracts. In September 2018, Pip spoke at the ISO General Assembly on how standards support ICT innovation. While in Geneva, she addressed the UN ECE on blockchain's potential to solve some of the UN SDGs. In 2019, Pip won the Standards Australia Emerging Leader Award. She is on the editorial board of Stanford's Journal of Blockchain Law and Policy. With Dr Mark Van Rijmenam, Pip co-authored Blockchain: Transforming Your Business and Our World (Routledge 2019). Her forthcoming title is Trust and Distrust in Digital Economies (Routledge 2020).