PEER REVIEWED RESEARCH

Parameters for Building Sustainable Blockchain Application Initiatives

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Abstract

Despite the demand and interest for the blockchain technology, there are still major challenges for blockchain application initiatives (projects and ventures) to be sustainable and reliable. While starting a non-blockchain initiative already comes with its own sets of challenges and has around 50% failure rate, starting a blockchain initiative rises the rate to 90% due to additional variables and confusion on top of this. Such a situation deters innovators and eventually dampens innovation, requiring priority for actions. This paper attempts to contribute by compiling and outlining the various key variables to be considered, as a set of parameters for blockchain initiators. Through secondary data collection: literature reviews, report studies and primary data collection: interventional and observational case study, interviews with blockchain researchers, businesses and entrepreneurs, this paper categorises variables into blockchain-related and business-related categories, outlining consideration points for each of the variables. By summarizing and integrating the variables and referring to theories of innovation and adoption, it is concluded that concept validation entailing both initiative feasibility and user-demand, is of key importance for blockchain innovations.

Keywords: *blockchain, business, initiatives, challenges, barriers, parameters, feasibility, concept*

JEL Classifications: *D04, D07, D08, I07, O03, Y04*

1. Interest Vs Progress

Blockchain is a type of distributed ledger technology (DLT) which has garnered a lot of attention in the past few years from researchers to business and governments. According to the Deloitte 2018 Global Survey [1], more than 80% of companies in Canada, China, France, Germany, Mexico, UK either have blockchain projects in production or have production plans for 2019. Looking beyond companies, government are exploring this technology, the UAE Government is leading the wold's first blockchain powered government initiative, including the 'smart Dubai' initiative, and launched the 'Emirates Blockchain Strategy 2021', where they aim to exploit the technology and to transform 50% of government transactions into the blockchain platform in the next three years [2]. It should be noted that there are no International Standards in place presently for the standardisation of blockchain and distributed ledger technologies, however there is a process for that in place [3]. In the UK, the Financial Conduct Authority (FCA) for example has accepted 29 blockchain businesses for their fourth sandbox cohort, accounting for more than 40% of the total numbers with the attempt to explore suitable regulatory approaches [4].

Contrary to the amount of interest from various stakeholders, according to Gartner Hype Cycle, developed by the Gartner information technology research company, blockchain has gone down from the Peak of Inflated Expectations to the Trough of Disillusionment [5]. This can also be seen from the Deloitte's report where 39% respondents say that blockchain is overhyped and the drop in global cryptocurrency market taking place at the time of writing. There are various explanations for the contrast of interest versus progress including the availability of required resources, technological capability and limitation, ecosystem support and even lack of compelling applications. Although discussing & determining the root causes are not in the scope of this paper, all the points above lead to possibilities of failed blockchain initiatives or in other words, lack of practical use-cases which can add doubts about the technology and therefore can be seen in the hype cycle.

The next phase in the Gartner Hype Cycle is called Slope of Enlightenment which is described as "More instances of how the technology can benefit the enterprise start to crystallize and become more widely understood. Second and third generation products appear from technology providers." [6]. With the level of interest remaining, blockchain technology is well placed to make progress from the current downwards phase towards the next upwards phase by understanding how to get to the next phase and what is blocking the progress. By making it a priority to compile and understanding some barriers that impede the success of blockchain initiatives, not only efforts can be better directed so that challenges can be gradually overcome, but they also help innovators to invent by being aware of the possible challenges and consideration points, so time and investment risks can be strategically planned. With less amount of wasted resources from innovators, it can also prevent creating more doubts from the society, allowing interests to continue growing.

2. Methodology

This paper, which draws contents from a postgraduate research project, summarises critical barrier points that will be useful for blockchain initiatives to consider early on. As blockchain initiatives can be businesses or projects, consideration points for venture-related variables are briefly pointed out while focusing on blockchain-related variables. Through literature review, challenging points for blockchain initiatives are initially gathered and categorised into a set of 38 hypotheses. The points were then selected further via primary data collection through interviews with researchers, businesses and entrepreneurs in the blockchain industry with 1-6 years of experience, totalling 12 participants. Individual interviews were chosen to allow constructivism approach to gather and interpret various views and opinions from participants. Participants chose their areas of expertise to comment on and were asked in the format of open-ended questions to allow commentaries, if in their opinion, the relevant hypotheses are challenges for blockchain initiatives. Their answers and commentaries were analysed to validate the hypotheses. The results of this small-scale qualitative study are written in this paper but due to the scope and space limitation, the set of hypotheses, participant information, result and analysis as well as participation information sheet, consent form and interview questions are not included. However, for ease, the resulting set of consideration points are put together as a checklist and is included in the Appendix of this paper.

3. Consideration parameters for blockchain initiatives

3.1 Blockchain parameters

This section includes barrier points that blockchain initiatives might face in relevance to their usages of blockchain technology. The points gathered in the literature review were first categorised together which were then used in the individual interviews as described in the methodology brief above. This includes data audit, scalability, societal, regulation, governance, operational, security and privacy.

3.1.1 Blockchain data audit

This section includes barrier points that blockchain initiatives might face in relevance to their usages of blockchain technology. The points gathered in the literature review were first categorised together which were then used in the individual interviews as described in the methodology brief above. This includes data audit, scalability, societal, regulation, governance, operational, security and privacy. Even if transactions are validated through blockchain itself, there is still a possibility for data tampering especially in private and consortium blockchains where the quantities of nodes responsible for verifying are limited in general if compared to public blockchain. This means that there is a need for auditing to make sure that the blockchain is functioning as intended. It is important to consider if the project requires real-time transaction analysis and if system auditing is required. Data read from blockchain might have latency and not be 100% real-time [7]. According to Interactive Advertising Bureau (IAB) guidelines for example, data timeliness for real-time auctions must be less than 100 milliseconds [8]. There are two reasons for latency, first being that at any given time, a node might only get the version of the data that is given to it while other nodes might yet receive the most recent version of the data. The second reason is that there is a possibility for every transaction that the network of nodes agrees on different sets of data, creating a fork [9]. Whereas if auditing the system is required so that it is running as intended, including for example if participants are behaving as they should, or if data is managed and transacted appropriately, the auditor's technical capability needs to be taken in consideration.

3.1.2 Scalability

Blockchain scalability issues can be related with two main metrics which are transaction throughput and latency. The first one refers to transaction per second while the latter one refers to transaction confirmation and propagation time [10]. Trade-offs between different approaches are made towards scalability, security or decentralisation. For example, to improve security, there is a possibility of pegging into the Bitcoin network, but with the result of having lower scalability, and improvement of security is debatable. Some opt to forgo decentralisation in improving security and scalability by choosing permissioned ledgers with closed participants [10]. It is therefore important to consider beforehand if the public decentralisation is required as well as if immediate high throughput is required for the initiatives. Further, as different consensus mechanisms make different assumptions, it is important to consider one that suits the initiatives.

3.1.3 Societal elements

Points worth consideration relevant to this subsection include technology awareness, skills, control and accessibility. For any blockchain initiatives, it is important to consider if the target users or audiences have the required technical awareness and capability [11]. Blockchain initiatives also should plan so that target users or audiences have the necessary level of accessibility

required, whether it is technical such as internet access or non-technical such as government authorisations [12]. Different and rare skill-sets might also be needed including cryptographers, lawyers or even social experts depending on the blockchain architecture. It is also important to consider the viability in terms of willingness to cooperate from industry partners as blockchain is a technology that also shifts control power in general [11].

3.1.4 Regulation

Some countries have regulation first, business second approach while others such as in East-Asia have approach the other way around therefore complying with regulatory approaches can vary. In general, however, it is important to analyse the relevant regulatory approaches particularly if digital currencies or Initial Coin Offerings (ICOs) are involved, or if traditional securities are involved. Even though the UK regulatory approach towards blockchain technology seems to be non-prohibiting as for example, the FCA remains open to the process and technology if the result is protected and risk is mitigated [4], digital currencies face regulatory questions in terms of their security status, and which activities are legally allowed as well as the imposes on various jurisdictions. As regulatory landscape is constantly changing and can be uncertain, preparing steps to have sufficient legal assurances can be crucial.

3.1.5 Governance

Blockchain provides and requires possibilities of new governance structure and different governance models are still being tested and developed [13]. Success rate can be increased if blockchain initiatives consider ahead how to make sure future upgrades as well as how future governance model changes can be introduced. This is because governance involves the decision-making processes related to the management of the system protocol, in this case, blockchain protocol, including creation, update or abandoning of rules pertaining smart contracts, fees, conflict resolutions, roles of participants [14]. Making plans so that future upgrades and changes can be done efficiently will prevent network issues and therefore maintain system operations which involves various and numerous participants. Relevant to this, it is also important to consider how to sufficiently incentivise network participants for the sustainability of the network [7]. If disputes among participants happen, it is also worth considering how such issues can be settled in a timely and efficient manner. For consortium governance, on top of the internal blockchain governance, it is important to also manage governance among participants. This is because a consortium is normally business-related, and counterparties will have different priorities due to the possibility of relation to profit and loss of their businesses. Further, as a starting consortium, it is worth keeping the number of parties manageable as too few can be unappealing while too many can be challenging to govern.

3.1.6 Operational

Interoperability can be a major challenge which can be solved through early planning. For blockchain initiatives that require interoperability with existing IT systems such as an Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM), it needs to be considered how these systems can exist and be interoperable from the beginning. This can be further complicated when different businesses and organisations are required to interoperate if they are using different and complex systems. It is also important to consider if interoperability with other blockchain systems, including reliance of information between one to another, is required for the initiatives as different blockchain systems might have vastly different architectures and functionality. As blockchain is not currently the most efficient way to store data [15], it is worth considering if the system initiatives require a high volume of storage in the future. While some systems allow running on top of existing infrastructure, most will require additional infrastructure, potentially including specialised hardware devices. It is therefore important to also consider if additional infrastructure is required for the blockchain system to operate as intended.

3.1.7 Security

As with most technology, security is a constantly improving matter. For blockchain technology, it helps to know beforehand if private keys are going to be stored in mobile and computer devices as they provide entry points where security breaches can happen. As third-party integrations increase the number of security variables to account for, requiring plenty of them can create challenges and is worth considering early in the design process [16]. Blockchain initiatives should also determine if their system will be written in a Turing-Complete language, as it allows for more functionality but at the same time opening more possibility for vulnerabilities. Penetration tests, especially for blockchain systems, are crucial in terms of security as they allow attack vectors to be discovered. Further, with options available for using the services of freelancers, contractors or agencies to develop the system, it helps to determine if the code will be written and maintained by a trustworthy party.

3.1.8 Privacy

Privacy issues are a major barrier towards the public acceptance and mass adoption of blockchain applications [17]. There are situations where elements of transparency in blockchain can have negative impacts and this is especially true if the information involved is sensitive or personally identifiable data such as medical, financial or governmental [18]. It is therefore important to consider beforehand if the initiatives are dealing with sensitive data and if it is required to share personal data with other third parties. It is important to note that personal data might include hashes, transactions and or other personally identifiable information [19]. On top of the matter of user preferences, privacy is also affected by the regulatory policies such as General Data Protection Regulation (GDPR). According to GDPR, it is important in general for blockchain

initiatives to consider how to implement and allow a 'right for erasure' policy for personal data.

3.2 Business parameters

This section briefly points out the barriers that blockchain initiatives might face. These points were gathered and categorised from the commentaries from blockchain businesses and entrepreneurs in the individual interviews described in the methodology brief above on what some challenges for their blockchain initiatives are. This includes funding, market needs, team, marketing, feasibility and implementation, legal and regulatory. This section contains lesser focus than the previous section as the parameters pointed out below were gathered from participant commentaries rather than initialised by literature review but were included in this paper due to its relevance. Also, the focus of this paper is on blockchain parameters leaving business parameters to be explored in more details in further work.

3.2.1   Funding

With options to choose from token offerings, venture capital firms, angel investors and other funding routes, it is important to create a plan detailing the steps towards how necessary funding can be obtained for the venture.

3.2.2   Market needs

While the general approach caused by the inflated hype for blockchain technology is to offer solutions to a problem, it is important for blockchain initiatives that want to be sustainable to find and ensure market needs.

3.2.3   Team

As an emerging technology, talent with the necessary skillsets can be a challenge to find, therefore it helps to consider how to find the right team for the business venture.

3.2.4   Marketing

Marketing strategy and its message, audience and timing are crucial, especially for blockchain initiatives that are targeting end-users as their audiences. This can be relevant to how the technology might be seen as a hype and requires communication and presentation that appeals to target audiences.

3.2.5   Feasibility and Implementations

It is important to consider how feasible a blockchain initiative is, which the parameters in this paper should help determine by providing an initial gauge, and how to implement, including mitigations for future challenges and risks.

3.2.6   Legal and regulatory

With the legal and regulatory landscape constantly changing, it is important to closely refer to the relevant approaches and consider how to be compliant.

4.   Conclusion

Observations and analysis process are not included in this paper due to space limitation, hence their summaries are reflected in the paper in the form of the written parameters above. The parameters aim to help blockchain projects that are still in the initial stages, to promote early considerations so that unnecessary resources can be avoided but at the same time directed efforts can be put in. Ongoing projects, however, might still be able to benefit from the parameters when for example re-prioritising. Journal and article sources are used as much as possible, but as some blockchain research and development are done mostly by individual developers, researchers and companies, it is to be noted that company reports and, in some cases, blogs are also used. Due to time-limitation and the lack of established standardisation in the blockchain industry, only a small sample size of participants was collected. This means that the findings in this study are partly-limited by views and opinions of the participants and by the literature review conducted. As the interest and demand for blockchain technology improves however, there will be more opportunities to work with established researchers and industry leaders to further validate the barrier points written in this paper. Future work that attempts to further validate the points in larger sample size and in different stages of the technology maturity, as well as work that covers business variables above in more details will allow this paper to serve better in supporting blockchain initiatives.

By consulting the Diffusion of Innovation (DOI) theory by E.M. Rogers [20], [21] which explained how an innovation gains adoption through a specific population spread, it can be said that adoption must start with the individual making choices to accept a certain innovation, before spreading to market level, creating diffusions. This means that offering working blockchain solutions for problems of individuals is useful to give blockchain technology an adoption momentum. It can then be concluded that among the parameters listed in the paper, individual or market needs as well as feasibility should be the main considerations for blockchain initiatives and the technology.

Appendix

BLOCKCHAIN IMPLEMENTATION REQUIREMENT CHECKLIST

C (C1,C2,C3, etc) refers to the term 'Checklist'

C1: Is real-time transaction analysis required?

C2: Is system auditing required?

C3: Are control variables to be audited and analysed determined from the beginning?

C4: Is it required to be publicly decentralised?

C5: Is high throughput required in the immediate future?

C6: Is fitting consensus-mechanism chosen and used?

C7: Does the target audience require technological capacity?

C8: Are specialised skill-sets required?

C9: Will institutions and organisations be required to fully give up control?

C10: Do the target audiences have the necessary relevant level of accessibility?

C11: Are there any digital currencies or ICO involved?

C12: Are there any traditional securities involved?

C13: Is it under supportive jurisdicitons?

C14: Is there sufficient legal assurances?

C15: Can future system upgrade be done efficiently?

C16: Can future governance model be improved and changed efficiently?

C17: Are participants incentivised sufficiently?

C18: Can issues and disputes be settled in a timely and efficient manner?

C19: For consortium, is consortium governance model put in place?

C20: For consortium, is the starting participant numbers more than 5 and less than 50?

C21: Is interoperability with existing IT system required?

C22: Are there plenty of cooperations with other businesses required?

C23: Is interoperability with other blockchain systems required?

C24: Is high storage required in the near future?

C25: Is additional infrastructure required?

C26: Is it required for private keys to be stored in mobile and computer devices?

C27: Are plenty of third party integrations required?

C28: Will it be written in Turing-Complete language?

C29: Is penetration test done and passed?

C30: Is the codebase written by trustworthy party?

C31: Does the case deal with sensitive data?

C32: Is it required to share personal data with other third parties?

C33: Does it comply with Data Protection Act for personal data?

C34: Does it comply with GDPR?

Disclaimer

Please remember that this list produces nothing more than an evaluation, and serves not more than a guide or framework. The framework relates to implementation, but does not include business feasibility which covers business-case related variables such as market needs, funding, management team among others.

It is out of the scope of this framework to suggest potential directions. The framework can be used in collaboration with relevant consultant or specialist to create lists of potential directions.

This framework may be updated in the future as the area develops. You should not rely on this framework as legal advice.

References:

[1] Deloitte, "Deloitte's 2018 global blockchain survey", 2018. [Online] Available:https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-fsi-2018-global-blockchain-survey-report.pdf. Accessed on: Jan. 3, 2019.

[2] United Arab Emirates Government, Emirates Blockchain Strategy 2021, 2018. [Online]. Available: https://government.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/emirates-blockchain-strategy-2021. Accessed on: Jan. 10, 2019.

[3] International Organization for Standardization, ISO/TC 307 Blockchain and distributed ledger technologies, 2019. [Online]. Available: https://www.iso.org/committee/6266604.html. Accessed on: Jan. 10, 2019.

[4] Financial Conduct Authority, "Regulatory sandbox - cohort 4", 2018. [Online]. Available: https://www.fca.org.uk/firms/regulatory-sandbox/regulatory-sandbox-cohort-4-businesses. Accessed on: Jan. 5, 2019.

[5] Gartner, "Gartner Identifies Five Emerging Technology Trends That Will Blur the Lines Between Human and Machine", 2018. [Online]. Available: https://www.gartner.com/en/newsroom/press-releases/2018-08-20-gartner-identifies-five-emerging-technology-trends-that-will-blur-the-lines-between-human-and-machine Accessed on: Jan. 5, 2019.

[6] Gartner, "Hype Cycle Research Methodology", 2018. [Online]. Available: https://www.gartner.com/en/research/methodologies/gartner-hype-cycle. Accessed on: Jan. 3, 2019.

[7] I. Aldridge and S. Krawciw, "Real-time risk: What Investors Should Know About FinTech, High-Frequency Trading, and Flash Crashes", 1st ed. John Wiley & Sons, 2017, p. 30-40.

[8] Interactive Advertising Bureau, "Programmatic Trading: An IAB Europe White Paper", 2014. [Online]. Available: https://www.iabeurope.eu/files/8614/0776/0957/IAB_Europe_Programmatic_Trading_White_Paper_July_2014_v2.pdf. Accessed on: Jan. 10, 2019.

[9] E. Ben, K. Brousmiche, H. Levard and E. Thea, "Blockchain for Enterprise: Overview, Opportunities and Challenges", 2017. [Online]. Available: https://www.researchgate.net/publication/322078519_Blockchain_for_Enterprise_Overview_Opportunities_and_Challenges. Accessed on: Jan. 10, 2019.

[10] S. Bano, M. Al-Bassam and G. Danezis, "The Road to Scalable Blockchain Designs", Shehar Bano, 2017. [Online]. Available: https://sheharbano.com/assets/publications/usenix_login_2017.pdf. Accessed on: Jan. 5, 2019.

[11] Deloitte, "Blockchain Enigma. Paradox. Opportunity", 2016. [Online]. Available: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-blockchain-full-report.pdf. Accessed on: Jan. 3, 2019.

[12] W. Al-Saqaf and N. Seidler, "Blockchain technology for social impact: opportunities and challenges ahead", Journal of Cyber Policy, vol. 2, no. 3, pp. 338-354, 2017. Available: 10.1080/23738871.2017.1400084. Accessed on: Jan. 10, 2019.

[13] F. Niederman, R. Clarke, L. Applegate, J. L. King, R. Beck, and A. Majchrzak, "IS Research and Policy: Notes From the 2015 ICIS Senior Scholar's Forum", Communications of the Association for Information Systems: Vol. 40, Article 5, 2017. [Online]. Available: http://aisel.aisnet.org/cais/vol40/iss1/5. Accessed on: Jan. 10, 2019.

[14] L. Bosankic, "Blockchain governance: takeaways from nine projects", Medium, 2018. [Online]. Available: https://medium.com/@leo_pold_b/blockchain-governance-takeaways-from-nine-pr ojects-8a80ad214d15. Accessed on: Jan. 10, 2019.

[15] D. Treat, L. McGraw, C. Helbing and C. Brodersen, "Blockchain Technology: Preparing for Change", Accenture, 2015. [Online]. Available: https://www.accenture.com/t20160608T052656__w__/us-en/_acnmedia/PDF-5/Accenture-2016-Top-10-Challenges-04-Blockchain-Technology.pdf. Accessed on: Jan. 10, 2019.

[16] M. Orcutt, "Blockchain could be the key to revolutionizing our energy grid", MIT Technology Review, 2017. [Online]. Available: https://www.technologyreview.com/s/609077/how-blockchain-could-give-us-a-smarter-energy-grid. Accessed on: Jan. 5, 2019.

[17] A. Kosba, A. Miller, E. Shi, Z. Wen and C. Papamanthou, "Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts", 2016 IEEE Symposium on Security and Privacy (SP), 2016. Available: 10.1109/sp.2016.55. Accessed on: Jan. 5, 2019.

[18] S. Goldfeder, H. Kalodner, D. Reisman and A. Narayanan, "When the cookie meets the blockchain: Privacy risks of web payments via cryptocurrencies", Proceedings on Privacy Enhancing Technologies, vol. 2018, no. 4, pp. 179-199, 2018. Available: 10.1515/popets-2018-0038. Accessed on: Jan. 10, 2019.

[19] W. Maxwell and J. Salmon, "A guide to blockchain and data protection", Hogan Lovells, 2017. [Online]. Available: https://www.hlengage.com/_uploads/downloads/5425GuidetoblockchainV9FORWEB.pdf. Accessed on: Jan. 3, 2019.

[20] E. Straub, "Understanding Technology Adoption: Theory and Future Directions for Informal Learning", Review of Educational Research, vol. 79, no. 2, pp. 625-649, 2009. Available: 10.3102/0034654308325896. Accessed on: Jan. 10, 2019.

[21] W. W. LaMorte, "Diffusion of Innovation Theory", School of Public Health - Boston University, 2018. [Online]. Available: http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html. Accessed on: Jan. 10, 2019.