Blockchain4Good:

How New Startups Around the World Are Pioneering Land Registries, Supply Chains and the Solar Industry

Anna Laesser*

The Startup Digest section introduces startups and grassroots initiatives from around the world that push the boundaries of emerging technologies. Most conversations around emerging technologies are stuck in silos and are quite hyped, making it hard to understand their actual impact on businesses, society and governance. The Startup Digests aim to demystify what is happening on the ground by establishing a discourse via case studies and interviews with startups and grassroots initiatives. Each edition will take a critical look on how these movements apply emerging technologies to achieve a specific purpose – facilitating a discourse that makes the (new) thinking, the approach and potential impact become more tangible.

This first edition of the Startup Digest focuses on the nascent blockchain technology that is strongly driven by startups. These enterprises are exploring new opportunities and business models that may have the potential to transform many existing processes in business, society and governance. According to the World Economic Forum, blockchain technology can be a game-changer in how the 17 Global Sustainable Development Goals (SDGs) are tackled: It enables a shift towards 'cleaner and more resource-preserving decentralised solutions, to unlock natural capital, and to empower communities'[1] and thus incentivise new behaviour.

This edition features three startups that pioneer blockchain technology, exploring new business models designed to create a positive impact. The startups that have been sourced via the global network of Impact Hub Berlin are: (1) BenBen – land & real-estate market, Ghana,(2) Minespider – mineral supply chain, Germany and (3) SolarLux – solar energy, Thailand.

Each interview will give insights on opportunities for growth, challenges and risks to reveal what is happening on the ground. Additionally, possible spill over effects to other emerging technologies will be taken into consideration.

Interview I: BenBen – Digitising Land and Real-Estate Markets through Blockchain

Name of your startup: BenBen
Name: Emmanuel Noah, Co-founder
Location: Accra, Ghana

Question: *What is the current situation of land and property management in Ghana?*

It's not a coincidence that Ghana, Sri-Lanka, Peru and many indigenous nations suffer from land tenure and management issues. '65% of the world's land holding falls under traditional land tenure systems.'[2]

1 Celine Herweijer, Dominic Waughray, Sheila Warren, 'Fourth Industrial Revolution for the Earth Series – Building Block(chain)s for a Better Planet' (World Economic Forum, September 2018) <http://www3.weforum.org/docs/WEF_Building-Blockchains.pdf> accessed 19 November

2 Rights and Resources Initiative, 'Who owns the world's land?' (September 2015) <https://rightsandresources.org/wp-content/uploads/GlobalBaseline_web.pdf> accessed 10 October 2018

The recent fast paced, and uninformed post-colonial adoption of foreign land tenure practices has created a legally pluralistic land tenure ecosystem in Ghana where 'modern' and formal land governance, and administration practices are in conflict with traditional (informal) ones. The culminating result is one where data and transactions within the local Ghanaian land and real-estate market are distributed between the two systems which ends up leaving a trail of lost transactions, data inconsistencies and asymmetry in the land market ecosystem.[3] Remember, this applies not just to Ghana but to '65% of the world's land holdings which represents $26 Trillion in dead capital globally'.[4]

Moreover, due to the ever-increasing pace of urbanisation, the demand for land as the foundation for these efforts has given birth to an array of new challenges (land fraud, high transaction costs, land litigation, increase in dead capital). However, despite the challenges, there's always the opportunity to innovate.

Question: *What is your solution?*

The idea behind BenBen was to create a trusted and reliable transaction environment to unlock this dead capital and eliminate the barriers of entry into local housing, mortgage, and land markets. BenBen builds distributed ledger transaction systems for public and private land sector related institutions. Our primary solution focuses on facilitating end-to-end housing finance transactions between property developers, commercial lenders, property buyers and land sector agencies. By offering services with institutions that simultaneously act as a property market data sources ie mortgage banks, property developers, land courts, land registries etc, we are able to aggregate formal market and off-market land transaction data. The end result is a self-sustainable land registry that runs in parallel to the official land registry.

---

3   Mawuli Y. Ahorlumegah, 'National Mortgage and Housing Initiative to provide Ghc1bn Housing Fund', (Ghana News On-line, 4 July 2018) <http://ghananewsonline.com.gh/national -mortgage-and-housing-initiative-to-provide-ghc1bn-housing -fund/> accessed 19 November 2018

4   Alan Gilbert, 'Viewpoint: De Soto's The Mystery of Capital: reflections on the book's public impact' (2012) <https://www .researchgate.net/publication/279207595_De_Soto's_The _Mystery_of_Capital_Reflections_on_the_Book's_public_impact> accessed 10 October

Question: *How do you leverage blockchain technology?*

Utilising blockchain in our solution allows us to ensure transparency and immutability in transactions through the platform. Trust is a key factor in land market transactions and by decentralising transactions, each party within the chain is provided equitable access, visibility, and control to data based on pre-set rules within the transaction process. Extending this principle further allows us to validate audit trails on aggregated formal and off-market transaction data. Furthermore, as opposed to our previous pilots our future pilots are looking at leveraging the EOS blockchain due to its high transaction rates, affordable contract execution costs and compatibility with BenBen's consortium model for client interaction.

Question: *Why did you decide to focus on the nascent blockchain technology?*

Deciding to focus on blockchain technology was a gradual process as well as a direct result of my interest in African land economics. In 2014, I was part of a team out of the University of Michigan that won a Bill & Melinda Gates Foundation grant to research into the prospects of crypto in the Sub-Saharan African mobile payments ecosystem. My research took me on an 18-month journey where I began to relate my learnings to the African land economy as well as involve myself more and more in the crypto scene. Shortly after completing my studies at the University in 2015 I returned to Ghana where I decided to look at how I could apply my findings to the land payments sector and hence BenBen was born. Through our pilots with stakeholders such as the Lands Commission and Barclays Bank Ghana we were able to finally pivot into the mortgage finance sector. The working principles of 'trustlessness' 'auditability', 'consensus' and 'accountability' of blockchain systems particularly caught my attention. In indigenous African society, community decisions are woven by similar principles of community, decentralisation and consensus. As such I believe the principles behind blockchain tech represent a paradigm shift that will remedy many of the ailments in our 'modern' economic systems as a whole – land & property chief among them.

Question: *How do you address current issues of property disputes?*

Although we don't involve ourselves in dispute management, we employ risk-mitigation techniques that map out asymmetries and conflicts in land record information and assign risk-ratings to properties. Commercial lenders utilise this in grading collateral risk, as such, we tend to look at dispute prevention.

Question: *Will and should blockchain for the land and real-estate market be regulated?*

Regulation is an inevitable and necessary part of ensuring cohesion between specific country land policy and technology frameworks. However, it should not be rushed into. Many of the expected challenges can be prevented by running operations within a regulatory sandbox aimed at ensuring compliance and protection amongst stakeholders until national and continental policy is developed. The results from these sandbox tests will then be able to inform policy formation. One initiative spearheading this effort is the Pan-African Digital Asset Framework that's being led by Marvin Coleby, Director of the Africa Digital Assets Forum (ADAF).[5]

Countries such as Uganda and Kenya have also set up dedicated blockchain task-forces to handle policy development. That said, consultations should always be done in collaboration with sector working groups (Land, Payments, Capital Markets etc) to ensure that all potential blockchain use-cases are accounted for in the policy formation process.

Question: *What are the biggest opportunities for BenBen to use blockchain to record and verify land and property data in Ghana? How does it impact (new) business models?*

Big constraints represent big opportunities. Over the past decade, high population growth and urbanisation rates have led to a considerable increase in land market activity. So naturally the two biggest opportunities we are targeting are the mortgage/land financing and housing delivery sectors. With a housing deficit of over 1.5 million housing units, the Ministry of Finance and Economic Planning has commissioned work on a $200 National Housing and Mortgage Initiative as well as the $5Bn Social Impact Housing Initiative between the Government of Ghana and the United Nations Office for Project Services (UNOPS) aimed at granting access to afford-

able construction financing and mortgage financing.[6]

Although very laudable, the present disconnect between stakeholders in the housing delivery value chain threatens to frustrate innovative projects and investments akin to those mentioned earlier. In order to overcome these barriers, we have signed formal agreements with key bodies such as the Ghana Real Estate Developers Association (GREDA) were we facilitate end-to-end housing delivery and mortgage origination between its membership body of 154 developers and stakeholders across the real-estate market value chain. In addition to the reduced turnaround times and collateral perfection costs, financial institutions benefit from access to real-time property market data as well risk-mitigation data which translate into lower collateral risk premiums hence access to cheaper credit for borrowers/mortgagors.

Question: *How does BenBen disrupt land and property management of Ghana (and add to its digitalisation)?*

Unlike many tech competitors in our space, BenBen builds upon existing government land registry infrastructure by integrating with both public and private sector actors in the land market (land registries, mortgage bank institutions, developers etc). Leveraging shared and public transaction data has also positioned us as a key facilitator in the mortgage finance space by streamlining the process of connecting mortgage financing to development opportunities on verified real-estate holdings. Furthermore, our model represents a market-based compliment to large scale donor funded land registry digitalisation projects where we are able to reconcile off-market data with formally registered transactions as well as carry out subsidised per-parcel record digitalisation on a transactional basis – all of which we are currently exploring with the Lands Commission of Ghana. Our

5   CryptoDavid, 'ADAF Holds Nairobi Inaugural Meeting to Establish a Pan-African ICO Framework' (May 2018) <https://bitcoinke .io/2018/05/adaf-meeting-for-pan-african-ico-framework/> accessed 10 Ocotber

6   Peter Nii Lartei Lartey, 'Ministry of Water Resources, Works and Housing Blog' (2018),<http://dailyguideafrica.com/ghana-gets -5bn-un-housing-deal/ and http://www.ghana.gov.gh/index.php/ blog-categories/blog-quisque-gravida-purus-vitae/53-gov-t -projects/266-ministry-of-water-resources-works-and-housing> accessed 10 October

current model does not seek to displace any key actors in the chain but is on the trajectory to reduce the dependency on intermediaries (notaries, land agents, land guards, etc).

Question: *Do you see connections to other emerging technologies such as big data analytics and AI?*

As markets become more connected, I see the general trend for the underlying infrastructure to evolve in a similar fashion. In a hyper-connected world, AI and big-data will have an immense impact on the future of proptech.

Question: *What motivates you to push the boundaries of land and property registry through blockchain technology? What are your aspirations and future plans?*

Technology is fast-becoming a determinant of national geopolitical standing; hence, its role needs to be highlighted and paid particular attention to. Africa is home to 20% of the world's total land mass and 60% of the world's arable land – proportions that keep the continent on the current world economic system's radar. Aside from building the right political, institutional and cultural frameworks I am excited about the new ways exponential tech can shape our land administration systems in the next 30 years. However, as CEO of BenBen, my aim is to grow Ben-Ben into the premier Pan-African firm for building digitised land and real-estate markets and serve as the basis for securing land-based investment, growth and development on the continent. After building a solid foundation for spatial and off-chain land data, the next logical step will be tokenisation as well as exploring how AI in combination with Decentralised Autonomous Organizations (DAOs) can be used in bridging statutory and customary land tenure systems and bring us closer to a trusted, secure, transparent, and risk-free African land market.

Interview II: Minespider – Tracking Raw Materials through Blockchain-based Certification

Name of your startup: Minespider
Name: Nathan Wiliams, Founder
Location: Berlin, Germany

Question: *What is the current situation of the mineral industry and the due diligence of its supply chains? What main challenges and inefficiencies do you see in the current system?*

About 10 years ago the US passed a regulation, Section 1502 of the Dodd-Frank act, requiring companies to disclose if the Gold, Tin, Tantalum, or Tungsten they purchase was funding armed groups in the Democratic Republic of Congo. This put the spotlight on the mineral industry in the same way that the spotlight was on the clothing industry in the past. One way companies dealt with this challenge was supply chain mapping – asking all their suppliers if there were conflict minerals in what they were purchasing and if they didn't know, having them ask their suppliers. This was a slow, expensive process that did help, but did not eliminate the risk that there were conflict mines in their supply chains.

There were unintended consequences of these efforts to make the mineral supply chain more responsible. Companies who wanted to make a difference started to actively avoid sourcing from the Congo, meaning only companies who did not prioritise responsibility remained, making the problem worse. In addition, it was often the miners themselves who had to bear the increased costs of due diligence programs, giving a negative incentive for them to participate in legal sourcing programs.

Another big issue is that minerals are fungible. Unlike unique items like diamonds, antique cars, or designer handbags, metals from multiple sources are smelted together during processing, masking the original source. We can put ores in a container with a tag to uniquely identify them but eventually the container has to be opened and shipments are mixed together. This makes tracking difficult beyond points of processing.

Question: *What is your solution? How do you leverage blockchain technology to solve this problem?*

To track beyond the points of production we use a mass-balance approach, essentially treating minerals the same way we treat green energy on the electrical grid. If you purchase green energy tomorrow, your electricity will still come from the grid, mixed with coal and nuclear power, however because we've tracked how much energy was produced at the solar farm, we know all the money paid has gone to the

solar company. We realised ultimately the problem isn't that the material itself is corrupted, but that the money paid for the materials has funded the armed groups using illicit extraction practices.

Rather than moving backwards through the supply chain, we start at the point of responsible production and allow the companies to create digital blockchain-based certifications based on the amount of material produced. As long as these certifications are sold along with an equivalent amount of material, we can be sure that the money paid for the material has gone to a responsible source.

Question: *Why did you decide to focus on the blockchain technology?*

Blockchain is most useful in situations where we see 4 main factors at play:
a. There is a middleman adding no value that can be removed.
b. There are multiple parties that need to work together who do not trust each other.
c. We need to decentralise a traditionally centralised system.
d. We need to shift incentives so that the parties contributing value to the system are the ones who receive value for it.

In the mineral supply chain, we have all of those factors at play which is why it is likely a best-fit solution for supply chain transparency.

As for why I personally was attracted to blockchain, I've always been most comfortable dealing with emerging technology. It gives you the most freedom to innovate because many of the use cases haven't been thought through yet. With the excitement and hype around blockchain, it made promoting the solution much easier than any of my previous projects because so many people are looking into how blockchain can be best used.

Question: *What are the biggest opportunities for Minespider to use blockchain to track responsibly sourced minerals and overcome complex and opaque value chains?*

Right now the world's eyes are on cobalt because so much of it comes from Congo and goes into lithium ion batteries. The other element the industry is really focused on is gold because it is has a high value to mass ratio, which makes it easy to fund armed groups with gold mining.

Question: *What are the biggest challenges Minespider faces to enhance supply chain integrity for raw materials?*

There are plenty of challenges with any new technology, especially one that crosses borders and languages, requires internet connectivity in undeveloped rural areas, requires multiple old-economy companies to adopt technology, and political buy-in from multiple state entities. The main challenge we see for the near term, however, is preventing the fragmentation of the industry.

Supply chain data is very sensitive data. No company wants their competitors to see their supply chain information, and yet the entire benefit of blockchain is in its transparency and immutability. We could build a tracking system much more efficiently with a centralised database, but that would give way too much control to whoever runs that database, and there would be a single point of failure for any sort of data breach.

Some companies are looking at private permissioned blockchains as a solution. If you control access to your blockchain, you prevent external entities from seeing the supply chain data. The problem is that it is very hard to make blockchains talk to each other. If brand X and brand Y each have their own blockchain and they use the same supplier, the supplier has two different systems to use that do not talk to each other. Expand this to 50 or 100 companies and the whole system can collapse.

Our solution to this is to create one standard protocol on a public blockchain, like the Internet of responsible supply chain tracking. We encrypt the data in such a way that each company owns and controls their own data. No one else can access the data without owning the access even though it is on a public chain. This removes the incentive for companies to create their own private permissioned blockchains.

Question: *Who are the key stakeholders you collaborate with to innovate responsible mineral sourcing?*

The key stakeholders are the mines, transporters, smelters, manufacturers, mining consultants and auditors, regulators, and NGOs, as well as the end consumers who ultimately want responsibly sourced

products. Most of the demand for responsible sourcing is driven by the manufacturers downstream who want to protect their brand from supply chain risk, although we have seen a number of mineral producers take a leading role in responsible production as well.

Under the status quo, mineral producers collect due diligence data on the minerals they produce: reports, audits, certificates of origin, quality, and so on. All of this data has a cost, and the cost is born by the mine. With Minespider, the mineral producer uploads this data to create a digital due-diligence data packet that is rated for the amount of minerals in a shipment. The mine can then sell this data to their customers and recoup the value it contains. This digital due diligence is essentially a commodity for the customers as well who can add their own information and re-sell to their customers, ultimately being beneficial for the downstream manufacturer who can see the origin of their materials.

Moreover, there's an efficiency gain here. Mineral shipments can be delayed if the proper paperwork isn't all in place at the right time. With an immutable blockchain record of all the due diligence information companies can avoid costly delays.

Question: *How does Minespider disrupt the way the world manages environmental resources and help drive sustainable growth and value creation? How does it impact existing and new business models?*

The first step to making sure that our minerals are sourced sustainably is to have good data about the provenance of the material and the conditions under which it was extracted. By incentivising good data collection, we build a foundation for the next generation of industry which we expect will be more inclusive, circular, and sustainable than industry of the past.

Consumers want responsible products, but up until now have had no way of gauging the impact their products had. Our protocol makes responsibility data feasible for manufacturers and ultimately consumers, and so we can expect demand for responsibility certification and governance systems in the mineral supply chain to increase as the technology is adopted.

Question: *What principles for developing blockchain applications for the environment do you believe are*

needed to create a responsible blockchain ecosystem?

There are always unintended consequences. Blockchain's strength is incentives, immutability, and game theory. The outcomes of a blockchain system or new incentive model aren't always easy to predict so it is important to think through and then test your hypotheses to make sure your application is making a positive environmental impact and that the unintended consequences aren't hurting more than they help.

Question: *What motivates you to push the boundaries of responsible mineral sourcing through blockchain technology? What are your aspirations and future plans?*

Responsible sourcing is more than just an interesting problem to solve or a way to make money, it's a serious social issue and before now we didn't really have a way to make a difference. Having the ability to craft a new infrastructure that can alleviate serious issues while also having a business case is a magic bullet scenario that doesn't come along every day. Our entire way of life starts with raw materials and sourcing, and I hope Minespider is at the centre of the shift to a more ethical, sustainable and responsible global economy.

Interview III: SolarLux – Incentivising Solar Energy Through Blockchain

Name of your startup: SolarLux Ltd.
Your name: Thomas Chrometzka
Location: Hong Kong / global

Question: *Tell me about the solar market in Thailand.*

Thailand is spearheading solar market development globally. In the past, solar markets were catalysed when governments provided incentives in the form of subsidies. Nowadays, markets are undergoing changes, solar is becoming more competitive, however, this still depends on the specific market segments and geographies.

In Thailand, solar installations are installed on a purely competitive basis in the commercial and industrial rooftop systems. A process to phase out gov-

ernment subsidies and provide smarter market-based, bottom-up incentives and rewards, such as SolarCoin, is a challenge that needs to be addressed.

Question: *What is your solution?*

SolarCoin was founded in 2014 with the vision to incentivise a solar-powered planet. As rewards drive action, SolarCoin is rewarding solar energy producers. The SolarCoin Foundation grants solar energy producers with blockchain-based digital tokens, one SolarCoin per one unit of solar energy (a megawatt hour) produced.

We realised that the project was not getting enough traction and founded SolarLux to make SolarCoin accessible. We assist energy companies and monitoring platforms to access and distribute SolarCoin to as many users as possible. This will massively drive user adoption and increase the usability of SolarCoin. Eventually, SolarCoin will be the first sustainable currency.

Question: *Why did you decide to focus on the blockchain technology?*

Blockchain is a breakthrough technology that allows currency to be issued by others than central authorities, such as governments. We used to base currency on national economies, however, basing currency on global solar energy production promises to be more stable and offer more value to society. Blockchain technology is a viable option to achieve the SolarCoin mission. Low transaction cost, speed of transaction, immutability of transactions records, counterfeit-proof, etc are a few of the characteristics that make it not only feasible but also desirable.

Question: *What are the biggest opportunities to make SolarCoin accessible to enterprises?*

In a global world, energy companies are doing projects around the globe. Imagine a world where companies can earn SolarCoins in Morroco, pay their suppliers in China and do their accounting in Singapore in one single currency. Basing trade on commerce on a currency that is shared by the participants of this industry will have huge benefits for the industry. And beyond: The theory of value for SolarCoin is based on the assumption that the more active users (nodes) participate in SolarCoin the more valuable

the network gets. Solar is decentralised meaning everyone who produces solar energy can get SolarCoins for free. On top of this, the more SolarCoin is used, the more valuable the network. Which means that more people will want to install solar to earn SolarCoins – a virtuous circle.

Question: *What are the biggest challenges for SolarLux in integrating blockchain technology into the solar industry?*

The industry is nascent and the technology is just developing. As such, we are working on improving user experiences and onboarding energy companies to the new world of blockchain-based business. SolarLux is focusing firstly on making it easy for energy players to access these new technologies and be able to use them. Even more important is explaining and building capacities of potential partners and users.

Question: *Who are the key stakeholders you engage with to innovate the energy and climate sector via blockchain technology?*

SolarLux firmly focuses on large energy companies and monitoring platforms. Energy companies (i.e ACWA Power) must be our champions. They draw the attention of other energy players and create traction that is needed to spread the word and create followers. We focus on the monitoring platforms (ie SMA Solar) to get SolarCoin to the end-customer. They aggregate the final users. If we partner with a monitoring company, they can immediately distribute SolarCoin to thousands of users – which will make our network more valuable.

Question: *How does SolarLux disrupt the solar market in Thailand and ASEAN?*

If SolarCoin is successful, government incentives for solar globally will phase out. It is massive change. The SolarCoin blockchain would become a public database of solar produced around the globe. This data will be crucial for utilities and grid operators to plan more sustainable energy systems. It will provide transparency in a market that suffers from a lack of publicly available data in a world where data is power. At the same time, SolarCoin verifies solar energy production data. This is relevant for the climate sec-

tor (carbon credits, guarantees of origin) where SolarCoin might have better value propositions in store. A publicly traceable, yet freely tradable SolarCoin that can't be counterfeited will have impact on this sector.

Question: *How does it impact existing and new business models in the energy sector?*

SolarCoin could massively impact business models in the sector. Today, solar energy operators receive revenue from selling solar. SolarCoin offers a new revenue stream with the value add mentioned above.

Currently, the energy markets are determined by energy scarcity. We believe that energy will become more abundant with the advent of new sustainable energy technologies such as wind and solar. SolarCoin, however, would continue to reward those who install solar with its use case as global sustainable currency. Selling solar energy might not be that financially viable any more, producing SolarCoins, however, might.

Question: *What motivates you to push the boundaries of the energy, climate and solar industry through blockchain technology? What are your aspirations and future plans?*

At SolarLux, we want to shape a world that is powered by solar energy. We think that SolarCoin can massively contribute to this goal. We are all in.

Conclusion

BenBen, Minespider and SolarLux show that there certainly is momentum on the ground. They all apply different blockchain solutions to tackle societal and environmental problems that the traditional system is unable to solve. BenBen and Minespider build their own blockchain whereas SolarLux saw an opportunity to work with an existing token system to build more traction. The three startups are actively creating a new ecosystem in which they collaborate with key stakeholders, decision-makers and governments to test and explore their 'playing field'. This

openness and enthusiasm enables them to further develop and integrate their solution to build a better future.

Their common opportunities and challenges can be summed up as follow:

Opportunities

– *Potential to overcome complex challenges*
  Blockchain technology creates trust – as it allows transparency, traceability and immutability of transactions. Thereby it can stop fraud, information asymmetries and create powerful new incentives. Decentralised data management and tokenization can:
  – empower citizens to invest differently based on the value of land they are buying;
  – change the consumption behaviour of consumers based on the information they have of a product; and
  – reward companies to become more sustainable.
– *Catalyse a paradigm shift*
  The interviews above show that the traditional centralised systems are limited in their ability to help overcoming some complex issues. They revealed that key stakeholders are curious and eager to work together to further understand its potential. Thereby Blockchain-technology allows to craft and play with new infrastructures that can pave the way to novel business models, shift of power and impact.

Challenges

– *Interoperability*
  Overall governance is tricky. The lack of standards makes it hard to integrate different platforms, systems, languages and stakeholders within and across borders. This is important during implementation and scaling.
– *Regulations & policy making*
  Current regulations and policies are not ready to incorporate blockchain yet. However, they should not be rushed as it requires regulatory sandbox testing and close collaboration among stakeholders to form suitable policies.