Interview: Jacob Lee – Co-Founder & CEO, DTCO, Taiwan

"I expect the development of blockchain technology to be as disruptive as the dawn of the Internet."

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Jacob Lee, co-founder and CEO of DTCO, a Taiwan-based company focused on industrial blockchain services, documents the disruptive impact that the development of the blockchain technology in the healthcare and life sciences sectors could entail for both patients and healthcare providers. He also provides insights into the in-house development of bioIPSeeds, which proudly stands as the first application of the blockchain technology in the life sciences field and aims to revolutionize the collaboration between academia and the global healthcare industry.

You recently described the development of the blockchain technology as a crucial milestone marking a *fourth industrial revolution*. Why do you believe blockchain holds such a promising and impactful potential?

I expect the development of blockchain technology to be as disruptive as the dawn of the Internet. From intranet to internet, user-generated content has become an almost infinite source of information and has revolutionized the way we live our lives. In the same way, blockchain technology promises to revolutionize the internet: affecting everything from the way society communicates and shares information, to education, business and international trade.

First, blockchain technology is based on a peer-to-peer (P2P) network, which implies two crucial specificities: no intermediary operator is needed to connect any parts of the network and no single party controls the data shared by the network's users. Other tools we use in our daily lives are based on the same concept: for example, emails are also processed and sent without a middleman. Another well-known example is Napster, a pioneering P2P platform created in 1999, which allowed

file sharing between its users and became particularly famous for the sharing of digital audio files, typically songs, encoded in MP3 format. Based on this P2P model, Napster users were both clients (as they were downloading music stored on other users' computers) and servers of the platform (as they would also share some of their files with other users).

Blockchain technology, however, is more sophisticated than file-sharing platforms such as Napster, as it allows value transfer and therefore enhances value-based and financial operations throughout the network. To understand how blockchain works, you have to imagine a spreadsheet (such as an Excel Workbook) that would be duplicated X times across a network comprising X number of computers (or "nodes"). Every time a transaction happens anywhere throughout this network, all members' spreadsheets are updated: the blockchain network automatically operates *in a state of consensus*, which means it continuously reconciles each and every transaction that occur in ten-minute intervals.

To summarize, blockchain stands as a mutually distributed ledger which stores both static records and dynamic transaction data without the need of a central administrator (or middleman) to collect and distribute information, thanks to a consensus mechanism that automatically checks the validity of all transactions occurring throughout the network.

All transactions occurring within ten-minute intervals are then aggregated in "blocks". Thanks to a specific algorithm, the latter are then fingerprinted and embedded within the network as a whole. As a result, information cannot be corrupted, as it is not centralized in any single location, such as for traditional databases: data is instead stored in all the computers that the blockchain network comprises. In the meantime, with the blockchain technology, there is no single version of the information – located at a single location – to be hacked, which substantially increases data security. On the other hand, corrupting blocks would then require holding a computing power that is huge enough to corrupt the entire P2P network – which is hardly plausible.

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Blockchain was initially developed as the supporting technology of the Bitcoin, the first ever digital and decentralized currency introduced in 2008 – before being increasingly used for other financial services. Could you provide us with an overview of some of its main applications in the financial services area?

Beside Bitcoin, the blockchain technology initially gained traction as a pioneering tool to support international payments. Traditionally, the latter would take a few days to be processed, while requiring centralized banking institutions to conduct the process – which of course comes at a cost.

With blockchain-based networks, international payments can now be processed within a few seconds while payment confirmations can be received in less than 30 minutes, without paying any fees to a central administrator or clearing agent.

Looking at more experimental applications, blockchain is also set to become a catalyst for the fast-growing P2P lending industry, by enhancing the matchmaking process between lenders and lendees. Insurance companies are also in line to develop an increasing number of related applications to improve their operational efficiency: with blockchain-based smart insurance contracts, all their beneficiaries could then receive immediate compensation payments as soon as an accident occurs.

You co-founded blockchain-focused DTCO in October 2014, what is the area of expertise of the company?

Prior to founding DTCO, my team and I honed our skills in the financial services industry, including the development of stock trading software. Furthermore, one of DTCO's key advisors and consultants, Dublin-based Flavien Charlon, is a blockchain scientist who invented the Open Assets Protocol (Bitcoin 2.0), which empowers Bitcoin blockchain technology for non-financial applications.

After having developed a Bitcoin wallet and few other products in the financial services arena, we found out it would be more interesting to build new tools – based on blockchain technology – that could be useful to other industries; hence, we shifted our focus from financial to non-financial applications. In the grand schemes of things, DTCO now operates as a technical bridge between businesses and blockchain by providing blockchain-based operating systems in a wide range of industries -including healthcare, energy markets, and supply chain.

How did you end up developing bioIPSeeds, the first application of the blockchain technology in the life sciences field?

When we decided to focus our efforts on bringing blockchain applications into new industries, such as the healthcare sector, closely working with industry experts and associations quickly appeared to us as a critical success factor. As part of our business model, holding a deep understanding of the needs and issues faced by a given industry's players is absolutely crucial: we are blockchain experts, not drug development specialists, for example. As we held the ambition to bring the blockchain technology into the biopharmaceutical field, we engaged with TRPMA *[the association gathering 28 R&D-driven Taiwanese biotech companies, e.d.]* and its COO Carol Cheng to jointly identifying the structural issues that blockchain technology could solve within this industry.

At first, we explored a vast array of unmet industry needs, ranging from drug traceability to personal healthcare, but the opportunity of improving IP transfer between researchers and the international pharma industry while fostering global open innovation ultimately caught our attention.

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As a company holding extensive experience in the development of blockchain-based platforms, including both non-financial and financial tools, we were able to do proof of concept (POC) and swiftly design a prototype, which eventually convinced TRPMA that DTCO was the right partner to develop such pioneering platform.

When designing bioIPSeeds and its main specificities, what were the main issues commonly associated with academia-industry collaboration that you wanted to solve?

First, it is extremely time-consuming for companies to access and evaluate early-stage projects developed by all universities and research centers, which all hold different databases. Scattered, hard-to-access information stands a true hindrance to academia-industry collaboration at both national and international levels. In the meantime, a significant share of these universities' databases is not regularly updated by the lack of dedicated human resources, rendering collaboration opportunities even more difficult to seize for the industry. On the other hand, when a given company has identified a promising IP seed, its transfer from academia to the company remains cumbersome and lengthy – without even mentioning all the required administrative steps as well as the language barrier. Finally, at the global level, there was only a very limited number of online platforms gathering IP summaries – written in English – coming from a large number of researchers and accessible to all countries and companies.

In this regard, our strategic thinking overarching the development of bioIPSeeds is the following: to protect the interest of life sciences and healthcare-related researchers and increase the visibility of their IP seeds by building a collaboration-oriented platform that would be extremely safe, flexible, and cost-efficient. Fulfilling such objective was no bed of roses. Actually, even by leveraging the blockchain technology, we had to face tremendous challenges when designing bioIPSeeds. Without entering into too deep technicalities, this platform now proudly stands as a very complex, hybrid tool, which combines a Bitcoin blockchain (for the security brought by its decentralized P2P model) with a proprietary distributed ledger that decreases the marginal cost of each transaction and their processing timelines.

Why would a traditional database not be suitable to connect researchers' IP seeds with the global healthcare industry?

Traditional databases require a centralized operator to collect information. In this regard, researchers could be reluctant to provide any early stage, non-IP protected, and confidential information about their projects to a middleman – especially for a platform that ultimately aims to gather projects from all around the world. To say it differently, by eliminating the middleman, we expect the blockchain technology to increase researchers' willingness to store and make visible their IP seeds on our platform.

The second aspect relates to security, as researchers want to ensure their IP seeds are safely and visible in the market if IPs. The P2P, a decentralized, structure of bioIPSeeds leverage the security and reliability of the Bitcoin Blockchain's record keeping and tracking features which provide the required feature set better than any centralized database – as protected as it might be. As a matter fact, bitcoin already gathers more than 6,000 nodes (or computers) within its network as we speaking. Given the computing capacity needed to hack such a dense and at the same time powerful network, bioIPSeeds' data record security immutable.

Finally, we identified that a blockchain-base platform could help IP and patent authorities to streamlines their processes, by providing so-called "blockchain evidence" of the IP transfer from academia to the industry. Beside some pioneering States in the US, most national and international law hasn't yet been able to keep pace with the opportunities offered by the blockchain technology. Nevertheless, I expect that – in the very near future – IP laws will start to catch up: digital signature *[such as for the online Non-Disclosure Agreement (NDA) offered by bioIPSeeds, e.d*] will be more largely recognized by IP authorities all around the world while governments will allow blockchain evidence to be deemed admissible in courts without requiring the external help of a blockchain expert – which however remains the norm so far. As a matter of fact, we are already closely liaising with Taiwan's Intellectual Property Office and strive to bolster their understanding of the blockchain technology, while their sheer interest in our platform is also very promising.

Have you already received some feedback from the first users of bioIPSeeds, which started operating in March 2017?

Actually, the BioIPSeeds project was kicked off more than a year ago and we ran a rather long period of online testing before its official release. In terms of upcoming improvements based on the first feedback we received, we now look at integrating new functions into the platform.

So far, BioIPSeeds already integrates IP Summary and IP Notary functions, which both follow harmonized formats at the global level. Nevertheless, we hold the ambition to soon make available more comprehensive information about the IP seeds featured on the platform, such as the results of laboratory testing already conducted by the researcher himself or by a third party, as well as the therapeutic areas targeted – in addition to the IP summary. Overall, the idea is to help companies to better identify the development potential of a given project and – in turn – further increase the attractiveness and visibility of the researchers' IP seeds.

> "One of our main missions is to ensure we provide our customers and partners with the blockchain technology that is perfectly aligned with their needs and expectations."

Overall, as DTCO, one of our main missions is to ensure we provide our customers and partners with the blockchain technology that is perfectly aligned with their needs and expectations. In this regard, we are also developing a new version of the platform based on the emerging and very promising Ethereum blockchain, which is set to offer an even greater scalability than the current Bitcoin blockchain while significantly increasing the number of potential usages.

With bioIPSeeds, DTCO developed the first application of the blockchain technology in the pharmaceutical and healthcare fields. What do you identify as upcoming applications of this technology in our industry?

Blockchain truly holds the potential to lead the data revolution in the life sciences and healthcare fields. When it comes to healthcare digitalization, we currently identify three main issues: security, privacy, and interoperability.

Looking at security and privacy, blockchain undoubtedly emerges as the perfect tool to accompany the industry transition that has been evolving healthcare services from a centralized to a patient-centric approach. So far, healthcare data are usually stored at the hospital or clinic level. While only a very limited number of health systems in the world have already implemented nation-wide data management systems, separate databases running different operating systems render data exchange between healthcare institutions extremely difficult or impossible, even more when these are not located in the same country.

Nevertheless, by implementing a blockchain-based approach, patient would then be empowered to allow any hospitals or doctors in the world to access his health data, hence shifting from a centralized to a mobile care approach, where the patient carries healthcare data and holds the power to authorize healthcare providers and professionals to read his personal records. In this

regard, blockchain would then allow increasing security and privacy levels, and fostering patient-centricity while giving healthcare data ownership back to the patients. As a matter of fact, we are already working on developing such pioneering tools: DTCO's upcoming Healthcare Blockchain Project, which we have been developing with Taipei Medical University *[one of the main medical centers in Taiwan, e.d.]*, aims to establish a patient-centered healthcare record system based on blockchain accounts.

With regards to interoperability, enabling blockchain protocols on all medical devices – from MRIs to implants – would also allow to fully exchange and make use of information at a very limited cost and transform emergency or surgery rooms into a connected, healthcare ecosystem.

On the other hand, blockchain could also revolutionize the private healthcare insurance sector. Traditionally, insurers have to collect a large number of invoices and medical records before authorizing reimbursement, which is extremely time-consuming. Patient-centric blockchain accounts could however tremendously reduce the time needed to conduct background check and extensively review beneficiaries' medical records. With the development of this blockchain-based system, we can expect that patients could be reimbursed immediately.

Overall, the most advanced health systems in the world have already implemented electronic medical records (EMR), whose security, privacy, and interoperability remain far from being satisfactory. In this regard, blockchain-based accounts clearly stand as the next development step in the ongoing healthcare digitalization process and should soon take over current EMRs. Furthermore, developing countries would also get the opportunity to easily upgrade their health systems and directly embrace blockchain technology – without having to waste resources on building an IT structure based on EMRs.

In the long term, another crucial trend that is set to transform the healthcare sector relates to the development of the artificial intelligence (AI) within our health systems. Again, patient-centric blockchain accounts gathering high-quality, comprehensive healthcare data stand as the best ally to propel the implementation of such revolutionary health resources, such an on-demand AI doctors, it can also help medical system reduce the incidence of medical errors. The rise in ransomware attacks will continue to increase as healthcare organizations work to put in place cybersecurity technologies that work, and blockchain could be the solution.

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