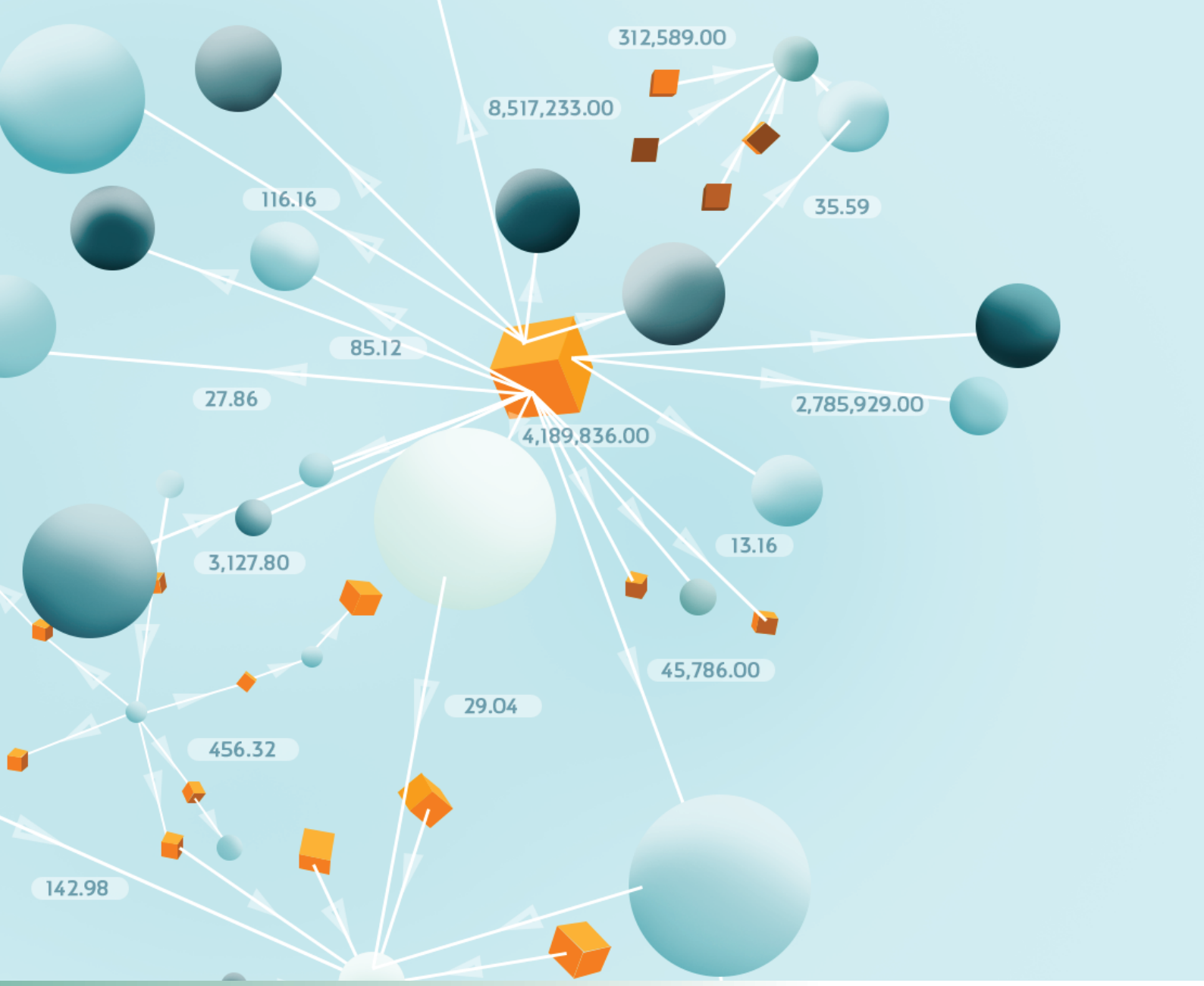

Executive Summary

Developing Blockchain Application to Enhance Trade and Economy Project

Trade Policy and Strategy Office (TPSO)

By Thammasat University Research and Consultancy Center (TURAC)

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Executive Summary

Global organic agriculture has been growing in terms of area and trading volume. Consumers are more aware of pesticide's harmful residues on their well-being. As one of the world's largest producers and exporters of agricultural products and food, Thailand also produces organic products, especially organic rice. Thailand has been acknowledged as an environmental-friendly producer of ~~a~~ healthy organic rice. Thailand has been exporting organic rice to many countries. By the year 2019, Thailand exported organic rice of 1.67 billion tons worth 780 million baht. Although Thailand is reputed as a high-quality exporter of organic products, the country still has some problems such as uncertain output, decreasing productivity, lack of the traceability system to verify the authentic and standard compliance.

To promote and increase the value of Thai organic agriculture, the Trade Policy and Strategy Office (TPSO) has initiated a project to develop blockchain application to enhance trade and economy of which Thammasat University Research and Consultancy Center (TURAC) is a project adviser. The objective of this project is to study the organic certification process and develop the prototype of the traceability system by blockchain. The prototype developed in this project initially focuses on organic rice due to its high value on export. Moreover, it has a clear process of inspection and certification.

Blockchain is a new technology that potentially enhances the supply chain management of agricultural products. Blockchain technology enables data integrity, privacy, and traceability of the products' origin. The data of manufacturers, locations, production dates, processing information, product distribution, inspection, and certificates can be stored as public and private data in the blockchain network. Once the data is recorded, it is technically impossible to edit without a trail. This is pertinent to protect the integrity of data and enhance trust among users. Blockchain traceability system, therefore, increases the value of Thai products by assuring data integrity to trading parties. For the first time, consumers can verify the authenticity and standard of Thai products. The data exchanged via the system can increase bargaining power to the Thai organic rice producers and raise the productivity of the whole supply chain through speedy communication.

This report describes key results of the prototype development of blockchain organic agricultural product traceability system or TraceThai.com. The project advisor studied, compiled, and analyzed data related to organic agricultural certification by means of in-depth interview and focus group. Nine interviewees included organic rice producers, certification bodies (CB) and government agencies in April 2020. Three focus groups were conducted during April 27-29, 2020 among 57 participants consisting of organic rice producers, traders, CBs, relevant state agencies, and blockchain experts. The research team visited 5 organic rice producers in Nakhon Pathom and Suphanburi to observe production and processing process of organic rice during May 26-29, 2020. This is to ensure that the system design can facilitate the current method of organic rice production. To test the user interface, the researcher demonstrated the prototype system to users and tested the data input. The draft of feasibility study and guidelines for developing the prototype of the blockchain traceability system were presented for public comments on June 9, 2020 at Landmark Hotel, Bangkok with a live broadcast via Zoom and Facebook. After that, the project advisor tested the prototype with a group of stakeholders. First, the online test was conducted via Zoom program with 7 farmers and entrepreneurs during August 3-7, 2020. Second, TPSO officers and project advisors visited 6 farmers and entrepreneurs to demonstrate the prototype and conduct a system test in the Northeastern region during September 8-11, 2020. Then the blockchain traceability prototype system was adjusted according to comments from the testing period. During October 8-9, 2020, the seminar was held at Cholapruek Resort in Nakorn Nayok in order to publicize blockchain traceability knowledge. The adviser organized the prototype system workshop, presented the roadmap of the blockchain development project, and created awareness among stakeholders, target users, and public. A total of 132 people from 63 agencies participated in the seminar, with 56 regional participants from 14 provinces, including Nakhon Pathom, Suphanburi, Buriram, Sisaket, Surin, Yasothon, Chaiyaphum, Amnat Charoen, Ubon Ratchathani, Nakhon Nayok, Chai Nat, Chiang Rai, Kamphaeng Phet and Chumphon. Finally, 17 operators participated as the pilot group namely, Green Living Camp (Nakhon Pathom), Ban Suan Khao Kwan, Xongdur Thai Organic Food Co., Ltd. (Suphanburi), Nature Food Products and Marketing Limited Partnership, Kwan Thung Kula Organic Farming Community Enterprise, Khao Kidkid Thung Kula Organic Farming Community Enterprise (Surin), Ban Ma Yang Community Rice Center, Sisaket Creative Farming Network Community Enterprise, Rai Thong Organics Farm Co., Ltd. (Sisaket), Nam Om Sustainable Agricultural Community Enterprise Network,

Nongyor Organic Farming Community Enterprise, Plookhug (Thailand) Co., Ltd., Yasothon Organic Co., Ltd. (Yasothon), Ban Nong Phai Organic Community Enterprise, Lava Sroew Tlung Organic Rice Production Group (Buriram), Samsuan Organic Rice Farmer Community Enterprise (Chaiyaphum) and Amnat Charoen Organic Farming Community Enterprise Network (Amnat Charoen Province).

Evaluating the benefits of blockchain organic agricultural product traceability system, this prototype system can enhance the reliability of Thai organic products, reduce the process and time to examine certification document. It can create supply chain visibility and provide necessary information for operators to manage inventory and sales planning. The complete and sufficient information from the prototype system can also reduce fraud and low-quality inputs/ products as well as production loss. The project advisor assessed the benefits of the prototype system relating to the certification document review process. In the traditional way of organic product trading, the seller will ask for a transaction certificate (TC) from a certification body (CB) when the buyer requires TC or in the case of export. TC is used to verify that raw material or product is organic. If the seller and the buyer use different CBs, TC document should be examined. The prototype system (TraceThai.com) can simplify the verifying process of TC between CBs. The CB who issued TC can confirm the validity of the document recorded by the seller in the prototype system. This can reduce the working process form the original 4 steps to 1 step, so the workflow or time spent is reduced by 75%. To assess the productivity or efficiency of the system, there are assumptions that the trading contract is worth 50,000 baht and takes an average of 2 hours in each step. So, the efficiency of the system increases up to 300% when comparing the value of a contract and the duration of TC examination between before and after using the system.

In addition, the survey of the pilot group on prototype system found that two answers have the highest average satisfaction score, namely overall system satisfaction and accurate and suitable data display with an average satisfaction score of 4.29 points out of 5 or 85.8% of the total scores. Collecting useful information has an average satisfaction score of 4.12 points. The system is user-friendly with an average score of 3.94 points. The clarity of the menu and interface has an average score of 3.76 points. The opinion of the pilot group about the benefit of organic products traceability system are as follows: First, building credibility for Thai organic products and

increase trade opportunity for farmers with an average score of 4. 29 points. Second, the traceability system can increase the value of Thai organic products with an average score of 4.06 points. Third, it can reduce the working time, average score of 3.76 points. Fourth, it can shorten the current working procedures, average score of 3.71 points. Finally, reducing operating cost got an average score of 3.65 points.

In this project, the traceability system was designed by considering two aspects of the current system which is usually a combination of data integrity and efficiency. The study identifies five principles of the current inspection process used by certification body (CB). (1) The upstream production process is intensively controlled by a production plan to ensure the estimated output from the certified crop. (2) Information is recorded for the whole process but being certified only when the product is sent from one unit to another unit which is not the same juristic person. (3) The unit defined in (3) means only the juristic person. (4) There is a mass control process to verify the integrity of the output volume along with product movement ~~in~~ (3). (5) The validity of the certificates across different CBs is manually operated through a cross-recognition protocol. There are caveats in the traditional process. For example, the certification process when the product moves across units is incomplete since domestic trade might not require certification documents. This creates the loophole for fraud since the mass control will fail to recognize non-certified domestic sale. In addition, manually certification cross-checks among CBs consumes time and resources. The blockchain traceability system can solve these problems. For the next phase, the development can enhance the better estimation of agricultural outputs by combining blockchain traceability system with IoT, Big Data or Normalized Difference Vegetation Index (NDVI).

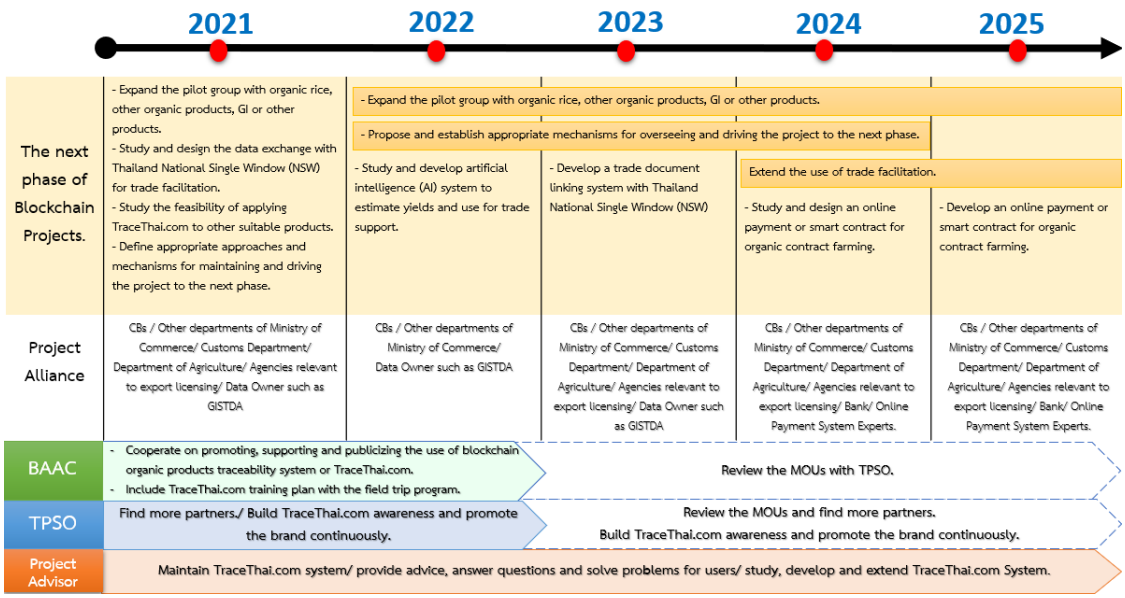
The prototype is designed based on Input-Output framework along the supply chain. The system is highly flexible, enabling it to be extended to any agricultural product besides organic rice. The mass control model is programmed in the system and all transactions regardless of the certification process are recorded in the system to ensure that total output in each process cannot exceed total input in the previous process. The Organic Certificate information will be verified by CBs and secretly stored by encryption method. The data owner, however, can grant access right to their trading partners, or inspection units to decrypt data and speed up communication.

More importantly, the price data is not recorded in the system because it is a very sensitive trading secret.

This organic rice traceability prototype can be accessed at www.TraceThai.com. The user interface supports 3 groups of users, which are consumers, producers/ rice traders and CBs. Certification data will be verified by CBs before being stored in the Ethereum network. For trade secret data, the data will be encrypted in the blockchain network. The system design is based on TCASS principles.

T= Trust	Raise credibility by using blockchain technology and inspection by CBs.
C= Connectivity	Support data exchange with other systems by using Web Services/ API.
A= Accessibility	Responsive website enables adjustable display to fit with PCs and mobile devices. The system is deployed on the Cloud service like Google Cloud service, allowing automatic scalability to match with increasing traffic in the system.
S= Security	High-security system with firewall and data encryption between the Web Server and Database Server.
S= Stability	The user interface module is installed on the Cloud service like Google Cloud service with a load balancing feature to catch up with demand. Real-time data backup is supported to guarantee the stability of the system.

To extend the scope of the service, the project advisor suggests two Quick Win projects by developing the prototype system to support geographical indications (GI) products as well as data exchange with relevant agencies. The potential partners are the Department of Intellectual Property and GISTDA who are in charge of geographic farm data from G-Rice system. However, the implementation relies on the availability of data and cooperation of the data owner.



The roadmap to extend the project and scope of the blockchain services for 2021-2025 defines key activities as follows:

2021
- Expand the pilot group with organic rice, other organic products, GI or other products.
- Study and design the data exchange with Thailand National Single Window (NSW) for trade facilitation.
- Study the feasibility of applying TraceThai.com to other suitable products.
- Define appropriate approaches and mechanisms for maintaining and driving the

2022
- Expand the pilot group with organic rice, other organic products, GI or other products.
- Study data exchange with other agencies such as GISTDA' s Normalized Difference Vegetation Index (NDVI) and develop artificial intelligence (AI) system to estimate yields and use for trade support.
- Propose and establish appropriate mechanisms for overseeing and driving the project to the next phase.

2023
- Develop a trade document linking system with Thailand National Single Window (NSW)
- Expand the pilot group with organic rice, other organic products, GI or other products.
- Propose and establish appropriate mechanisms for overseeing and driving the project to the next phase.

2024
- Study and design an online payment or smart contract for organic contract farming.
- Expand the pilot group with organic rice, other organic products, GI or other products.
- Propose and establish appropriate mechanisms for overseeing and driving the project to the next phase.
- Extend the use of trade facilitation.

2025
- Develop an online payment or smart contract for organic contract farming.
- Expand the pilot group with organic rice, other organic products, GI or other products.
- Extend the use of trade facilitation.

Furthermore, in order to ensure the continuity of the project, TPSO and the Bank for Agriculture and Agricultural Cooperatives (BAAC) signed a memorandum of understanding on cooperation in promoting and supporting the use of blockchain organic products traceability system or TraceThai.com on October 6, 2020. Two agencies will work together to exchange information, recruit and screen suitable farmers, community enterprises or entrepreneurs of organic agriculture to join the project. Both will organize activities to disseminate knowledge and how to use TraceThai.com to the target group. They will also support activities to enhance the features of TraceThai.com as well as jointly analyze the data at the aggregate level for the benefit of public policy planning or Thai organic trade promotion.

TPSO, BAAC and the advisor of the project will work together to extend the number of users of TraceThai.com system. For example, expanding the system to other organic rice producers and producers of potential products such as other organic products and GI products, negotiating, and requesting cooperation with the Certification Body (CB) to verify information of certified persons through the system. They will organize the workshop training and create the "Train the Trainer" mechanism by selecting suitable trainers to train how to use TraceThai.com to target farmers or entrepreneurs. They will cooperate with provincial commerce officers, provincial agricultural officers, community leaders, Biz Club network, community enterprise leaders or the ICS committee (Internal Control System) of farmers group to form the trainer group. In addition, there will be public relation activities to promote Thai trade and build TraceThai.com awareness among exporters and consumers by cooperating with commerce ambassador for international markets.

For domestic markets, the connection with other trade channels such as traditional channel, modern trade and e-commerce should be formed to increase distribution channels for Thai farmers and entrepreneurs.

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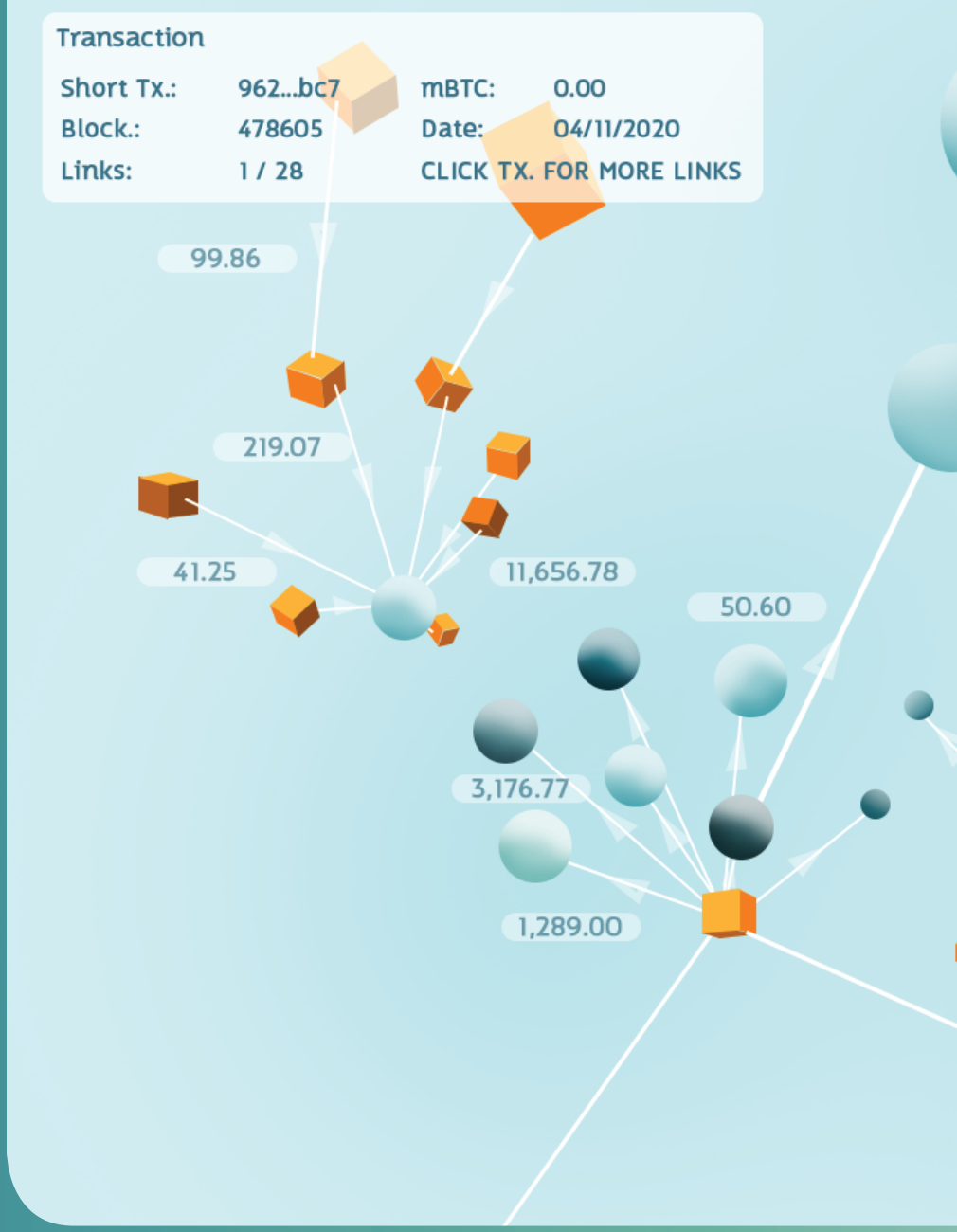
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