

TEMCO

SUPPLY CHAIN MANAGEMENT
REIMAGINED



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Abstract

With multiple outbreaks of health hazards in food products such as the toxic insecticides found in eggs occurring in Europe, South Korea and other countries in 2017, consumers are faced with rising fears.

However, existing supply chain management systems are failing at addressing such concerns. Because they do not provide for monitoring of pre-delivery stages, even if a problem arises, it is difficult to understand at which stage the problem occurred, and to manage the problem. There is a growing tendency for consumers to demand transparency in how a business deals with its supply chain process.

TEMCO is a public supply chain blockchain system that utilizes Smart Contract to overcome the limitations of existing supply chain management systems. In the existing system, the information of each distribution participant within the supply chain process was cut off, but TEMCO has made it possible to connect each participant through a blockchain so that the pre-delivery stages can be grasped in real time. This not only builds consumer trust regarding the supply chain process, but it also has a cost-cutting effect through more efficient supply chain management.

Introduction

The 2017 pesticide-contaminated egg crisis was one which directly revealed the flaws of existing supply chain management systems. The government and corporations contributed to consumers' fears by failing to keep track of records regarding the contaminated eggs.

The only clue that could help trace the origin of the contaminated eggs was the "eggshell code" printed on the eggs for records management. But because every manufacturer has different ways of printing these codes, and several variations of codes are used even within the same farm, the management system was haphazard and lacking standards and regulations, ultimately leading to failure to quickly cope with the crisis. The government repeatedly misreported eggshell codes from substandard farms and had to make corrections daily. According to a representative of the government, it has been a challenge to track unfit farms as well as to identify the farms that manufactured the substandard eggs.

Due to the sloppy nature of existing supply chain management systems revealing the reality of serious limitations in crisis management, the need for transparency and systemization of supply chain processes is becoming increasingly clear. As income levels rise and IT infrastructures expand, consumers also demand a higher level of quality in products. They want to purchase products that have come through a trustworthy supply chain process. Moreover, companies also want to elevate trust in their products and enhance their level of service to allow for more efficient management capabilities.

In order to meet these new expectations regarding supply chain management systems, large conglomerates are developing their own supply chain management systems, but because these systems are individually tailored to each company's environment, they inevitably lack versatility. Small and mid-sized companies face difficulties investing in such systems due to poor IT infrastructure and the burden of cost.

Introduction

The TEMCO project aims to create a system that can overcome the limitations of the existing supply chain management system by utilizing Smart Contract within the public blockchain ecosystem. The goal is to enable all participants to have access to real-time information on the entire supply chain process from production through distribution to sale at retail outlets.

Through TEMCO, consumers can select products that have passed through a reliable standards. Companies are expected to increase their profitability by streamlining supply chain structure and building a competitive product sale strategy through the TEMCO platform.

The cost of introducing infrastructure for SMEs can also be drastically reduced. In the past, it took several billion won to develop supply chain management infrastructure for SMEs. The TEMCO platform, however, connects every Participant under a single platform without the need for a large initial investment, as the only cost is for Smart Contract execution without any additional subscription fees.

There is also an advantage in strengthening the product safety mechanism. In the existing system, it was difficult to identify the cause of quality-related claims. With the introduction of the TEMCO platform, it is possible to trace distribution history down to a single order, which can help identify the responsible party if a dispute occurs. Therefore, it is expected that it will help manage food safety at the government level including the Ministry of Agriculture and Forestry and the Food & Drug Administration.

TEMCO also took advantage of the private blockchain. Confidential information that should not be disclosed can be managed without being exposed on the platform.

The TEMCO team will also build a TEMCO marketplace where suppliers and consumers can participate. This allows consumers to purchase safe products that have come through the proper supply chain process, and manufacturers and distributors can create a virtuous cycle structure that reduces distribution costs and rewards legitimate value.

Problems of Current Logistics System

Disconnection of Information due to Lack of Supply Chain ICT Infrastructure

Consumer expectation levels for product distribution management are rising due to the increase in the national income level. However, the current supply chain management systems lack infrastructure investment, so there is no unified system that connects the manufacturer to the end consumer. As a result, consumers' confidence in product distribution is very low.

Some large corporations are developing their own systems to manage sourcing, logistics, and distribution of goods. However, the system is tailor-made for individual companies, which means their versatility is low. Small-scale logistics/distribution companies lack the investment capability to develop their own supply chain management systems. According to the data, the investment cost for the informatization of domestic supply chain companies is 1% of the sales amount, which is lower than the industry average (1.6%). The rate of utilization of ICT is 44.6%, which is very low compared to the average of all industries (70.7%).

Retailers who do not have individual warehouses are entrusted to warehouses to store inventories. These local warehouses provide only minimal basic inventory management and delivery systems. Therefore, it is difficult for general retailers to secure consumer credibility of products as compared with large companies.

Without a platform to connect every Participant within complex supply chains processes, there is a limit to the information that consumers receive. A vicious cycle results, where the asymmetrical nature of information intensifies as consumer trust in retail products decreases.

Investment Rate in Informatization Infrastructure & Informatization Rate for Domestic Supply Chain Companies

[Source : Hyundai Research Institute]

- The Average of Supply Chain Industry
- The Average of All Industries



TEMCO's Proposal for an Integrated Supply Blockchain

Data-Centric Smart Supply Chain Solutions

TEMCO started with the idea, "How can products be distributed and delivered to consumers in a reliable way?"

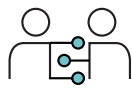
As previously mentioned, existing supply chain management systems do not satisfy consumers who demand reliability, mainly due to the fact that consumers do not have direct access to reliable information, instead receiving information verified by a third party only indirectly.

The TEMCO project aims to ensure that accurate supply chain information is contained within a blockchain when a product is transferred via Smart Contract. This connects manufacturers, warehouses, transport companies, distributors, and end consumers, enabling supply chain information to be shared in real time.

As a data and information-based supply chain solution, the TEMCO project seeks to achieve ① high connectivity between users, ② reliability of supply chain information, ③ transparency and stability of supply chain information, and ④ high efficiency.



TEMCO's Proposal for an Integrated Supply Blockchain



High Connectivity Between Users TEMCO stores the product's supply chain information from the manufacturer to the end consumer through smart tagging technology such as QR codes through a blockchain protocol. This creates a new type of distribution ecosystem where all participants can access the TEMCO platform anytime, anywhere. Manufacturers, warehouses, transport companies, distributors, and consumers are connected on a single platform, and supply chain information, which was previously disconnected and difficult to identify, is bundled together and shared by all participants.



Reliability of Supply Chain Information All participants in the supply chain ecosystem except the end consumer go through a vendor verification program implemented by the TEMCO project and follow the correct transport guidelines. By linking the transfer process between participants to a Smart Contract-based authentication system, supply chain information (product location, takeover agent, distribution environment, etc.) can be collected without loss or tampering when the product is transferred from one operator to another. These two processes ensure that the information contained in the blockchain is fully reliable, and the end consumer can confidently utilize this information.

TEMCO's Proposal for an Integrated Supply Blockchain



Transparency and Stability of Supply Chain Information

Supply Chain information stored in a blockchain based on peer-to-peer (P2P) networks is fully distributed and shared among users and verified through unspecified nodes in the system. Smart Contract based supply chain information is unmodifiable and recreated in the form of transparent information that can be verified by anyone in the decentralized system.

Information generated within the TEMCO platform is stored on a decentralized server. Since a specific key value in a blockchain can be backed up at any time, there is no possibility that an existing transaction can be altered by a malicious third party when a dispute occurs. Based on these features, TEMCO transparently provides complete information to all consumers and vendors using the platform.



High Efficiency

Except in the case of large corporations, participants in the supply chain process are passive about investing in supply chain management system due to high cost, even while recognizing the necessity of informatization. The TEMCO project seeks to provide retailers with an open platform for supply chain management innovations without the need for large-scale infrastructure investments. Through such a platform, participants in the supply chain process can digitize their entire business process, increase productivity by utilizing various supply chain information, improve existing supply chain systems, and develop service innovations to respond to the Fourth Industrial Revolution Era's demand for quality and completeness in a supply chain service.

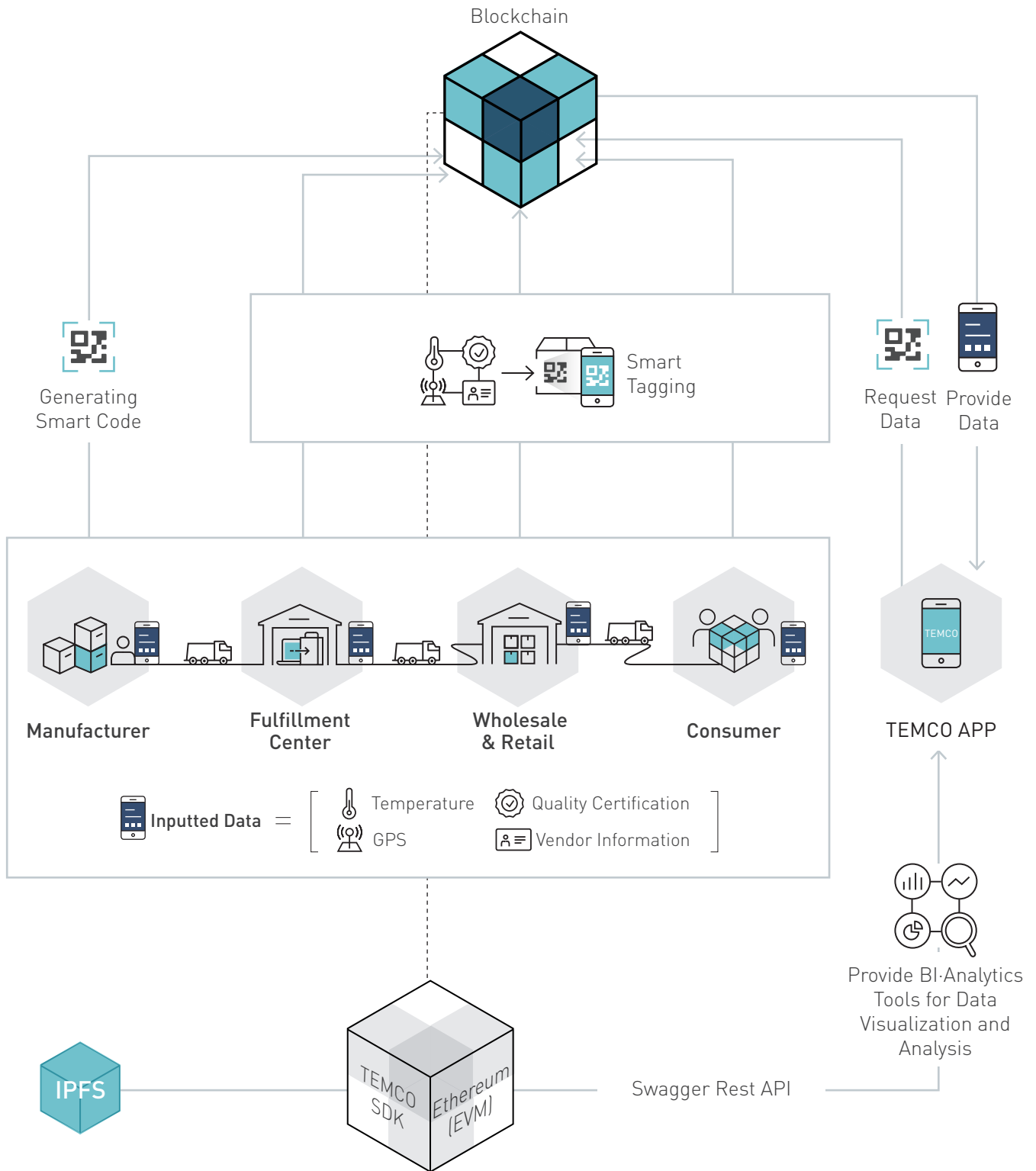
TEMCO's Supply Chain Solution

The use of blockchains and Smart Contracts in supply chain management systems can ensure interoperability between different systems in manufacturing, storage, and transportation.

The vendor authentication system is used to emphasize the reliability of the information generated in the supply chain process. This will provide transparency by minimizing the time it takes to identify problems in case of a dispute and provide a basis for immediately analyzing the necessary data.

As such, the blockchain based supply chain management system will increase efficiency of the entire ecosystem, lower the cost of establishing infrastructure, and increase consumer trust in products.

In order to meet consumers' high demands, various information such as manufacturers, warehousing companies, transport companies, distributors, etc. occurring in supply chain management should be shared in real time through a single network. The TEMCO project aims not only to provide simple and basic information such as transportation records and product location, but also to provide a platform for reliable supply chain information sharing through the blockchain. Through this structure, the TEMCO project intends to implement a customer-oriented advanced supply chain management system.



TEMCO's Supply Chain Solution

TEMCO's Technical Structure

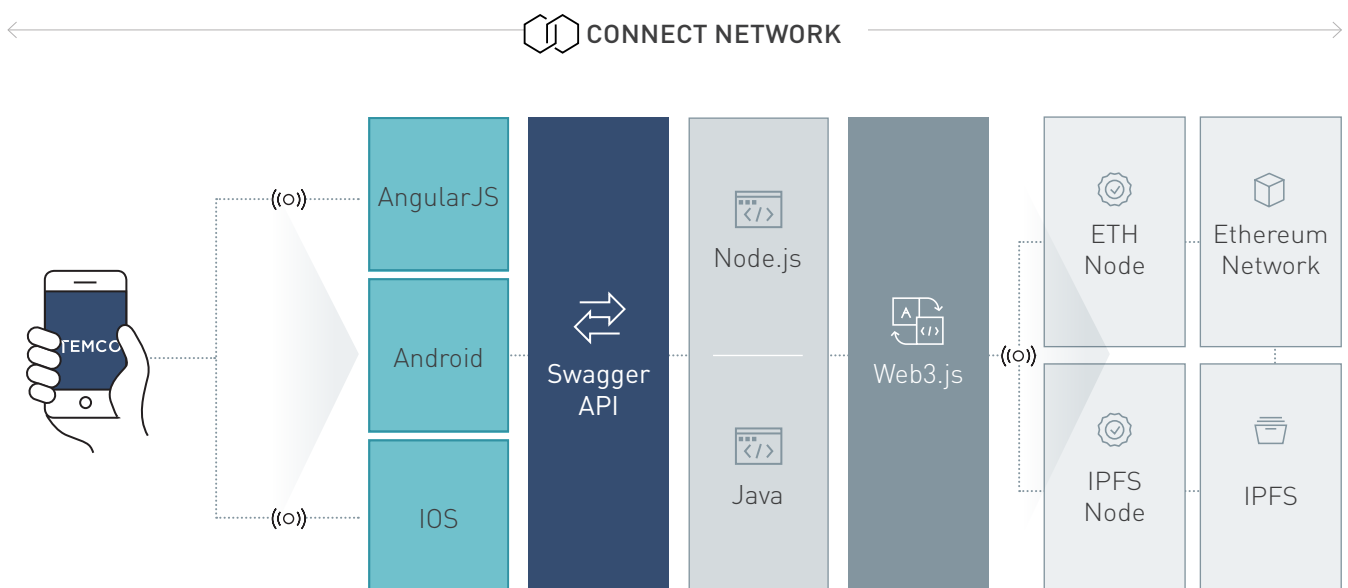
TEMCO uses a hybrid model to reduce the “Gas” costs. When data is stored in individual blocks using Smart Contract on Ethereum, there is no problem when the size of the data is small, but when it is large, “Gas” costs can be high. To solve this problem, TEMCO adopted a hybrid model that uses blockchain and IPFS in data storage.

IPFS is implemented as nodes connected to P2P networks, uses encrypted hash values to identify files, and provides decentralized storage such as blockchains and distributed services.

The back-end uses JAVA and Spring Framework, and the service API uses Swagger API Framework. The REST API provided by Swagger is returned in JSON format and can be used in both web and mobile applications.

Front-end dApp Web GUI is built on AngularJS 4 on a typed script that provides an Object Oriented Object. Web3.js is used to interact with the Ethereum node and is used to store or retrieve code compiled with Solidity in the blockchain on an Ethereum Virtual Machine (EVM) environment.

TEMCO is also interested in new technologies and scalability. If more advanced blockchains like EOS or NEO are developed in the future, we will use a better framework through prototypes and user cases.



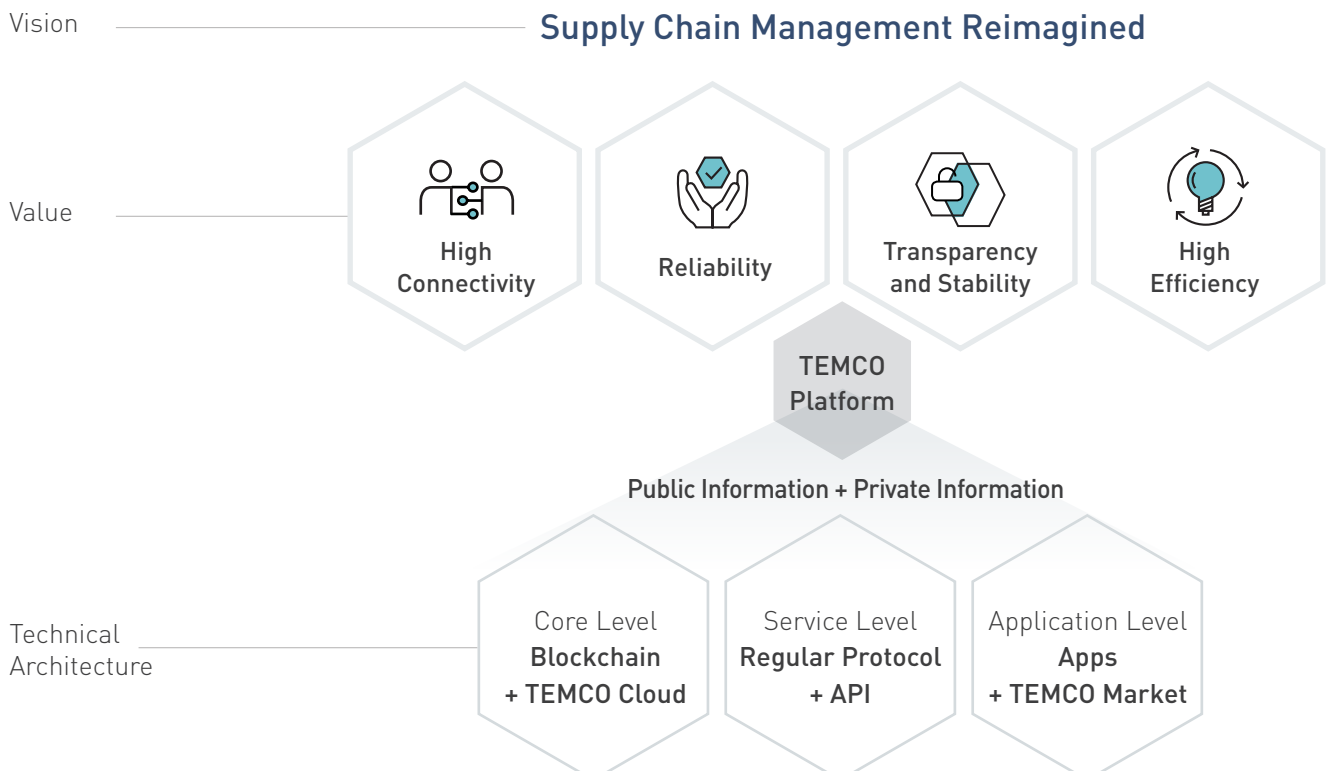
TEMCO's Supply Chain Solution

TEMCO's Operating System Layer Diagram

Core Level At TEMCO, data is scanned through the dApp provided by TEMCO at each point in the supply chain. The scanned data is stored in the blockchain via the TEMCO protocol. The information collected by TEMCO is classified as public and private information, and the public information that can be shared is stored in the blockchain through the TEMCO protocol.

Relatively sensitive confidential information is cryptographically stored in the TEMCO cloud and allows only specific users to view the stored data. This ensures that all information, from publicly available information that everyone can share to confidential information that should be disclosed only within the retailing company, can be securely stored and used independently in the connected distribution chain.

The reason for using the TEMCO cloud is for efficiency. If tens of thousands of supply chain transaction data are stored everyday only through Smart Contract within a blockchain, it is difficult to efficiently process exponentially growing data. The TEMCO cloud is a separate storage solution for efficient storage and sharing of supply chain data.



TEMCO's Supply Chain Solution

Service Level The service level serves as an intermediary for connecting the user dApp and the distribution partner dApp, and for providing integrated supply chain information.

To operate a stable TEMCO ecosystem, the service level uses a blockchain platform without a central intermediary. This structure enables real-time information such as various contract information, global positioning system (GPS) information, and time information generated in the distribution process to be browsed through the web or dApp.

This will provide a basis for the stable processing of supply chain transactions that grow exponentially after the Genesis block (the first block created in the system) while maintaining decentralization, verifiability, and transparency of the data which the blockchain pursues.

The TEMCO project is based on blockchain platforms such as Ethereum. These platforms already have many bugs fixed by many developers, so they have the advantage of a stable operation and continuous technical improvement.

TEMCO is also aiming for a high level of scalability. In the future, we plan to establish a basis for developing various application programs by disclosing regular protocols and APIs. This will facilitate the analysis of companies' supply chain management performances.

Application Level Consumers will be able to obtain more transparent and reliable information and to provide feedback on the products they use through user applications. This will also enable consumers to serve as major contributors to the quality of the supply chain information.

Using the vendor application, distribution channel participants will be able to identify real-time information needed for innovation and management of supply chain processes in the company, and to monitor the integrated supply chain information in real time. This will increase the quality of the supply chain process and will ultimately lead to a direct link between consumers and manufacturers through the TEMCO Market.

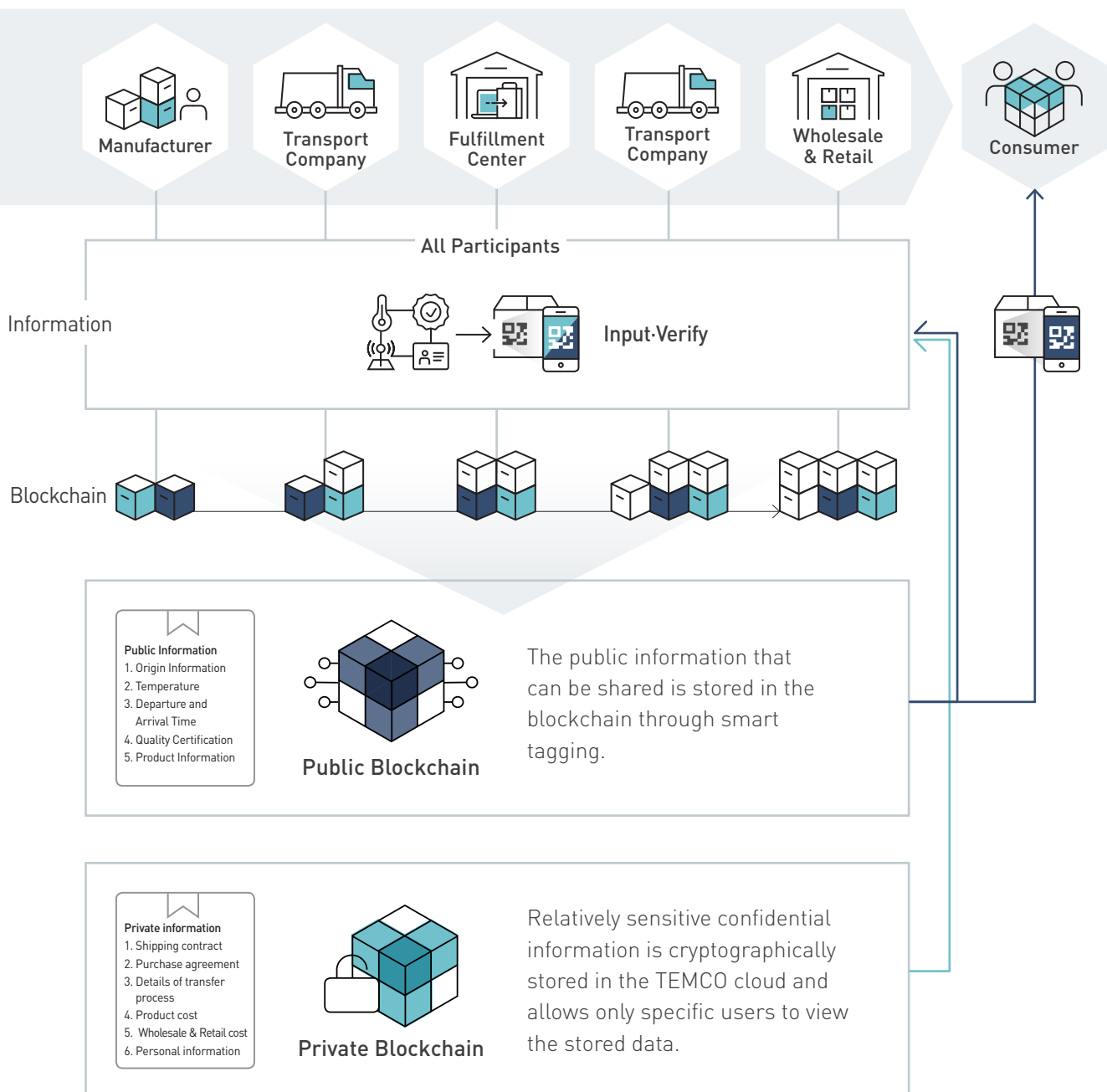
For companies, we aim to create a virtuous cycle ecosystem that expands consumer segments and the possibility of lowering supply chain management costs while enabling consumers to buy products that they trust.

TEMCO's Supply Chain Solution

TEMCO's Operating Cycle

TEMCO operates through a vendor verification system, information storage, verification, evaluation, and the TEMCO Market. Through each process, manufacturers, warehouses, transporters, distributors, and consumers are connected to each other and the creation, verification, storage, evaluation, and utilization of supply chain information takes place in real time.

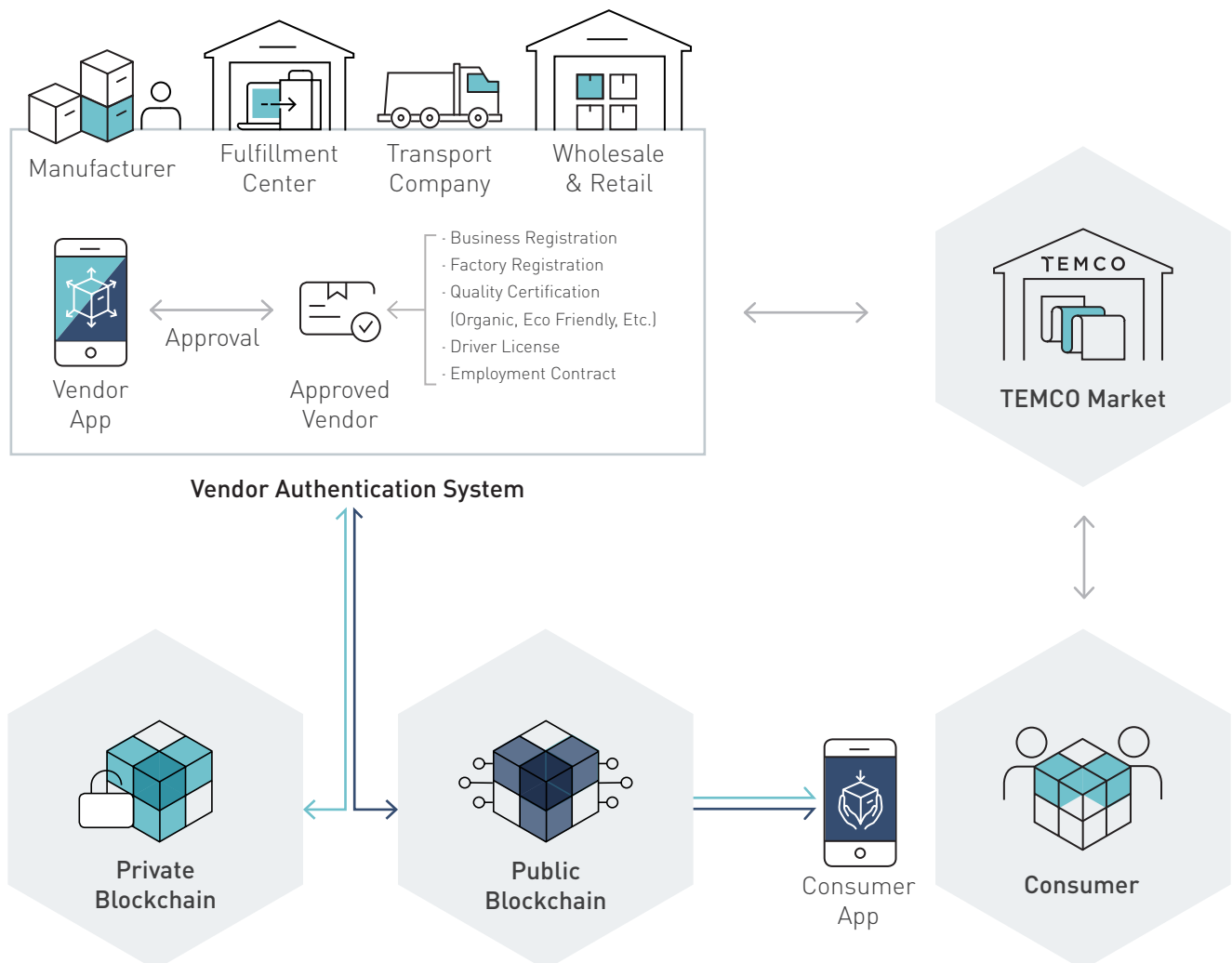
Product



TEMCO's Supply Chain Solution

Vendor Verification System TEMCO operates vendor verification systems for manufacturers, warehouses, and distributors. Through the vendor application, vendors are verified according to business registration, factory registration, quality certification, etc. depending on the company.

Only certified vendors can communicate with consumers using the supply chain management solution services provided by TEMCO. Consumers can see the exact information of the vendors through the consumer application and know what vendor the product was purchased through.



TEMCO's Supply Chain Solution

Supply Chain Information Storage Process Companies registered through the vendor verification system store supply chain information in a blockchain through smart tagging and data verification.

Once the manufacturer has handed over the product to the warehouse vendor and the process is complete, it will request verification through the vendor application.

As the warehouse company acquires the product from the manufacturer, it tags the QR code and RFID of the product into TEMCO's smartphone application. If the product is delivered correctly, the application verifies and approves the data. This process is based on Smart Contracts.

The warehouse manages the product in accordance with the product retention guidelines as required by the manufacturer, and when it ships, it requests approval from the carrier.

Carriers use smart tagging to verify the storage information of the products such as temperature and environment, and to approve after verification. This process is also based on Smart Contracts, and all of the information gathered are stored in the blockchain.

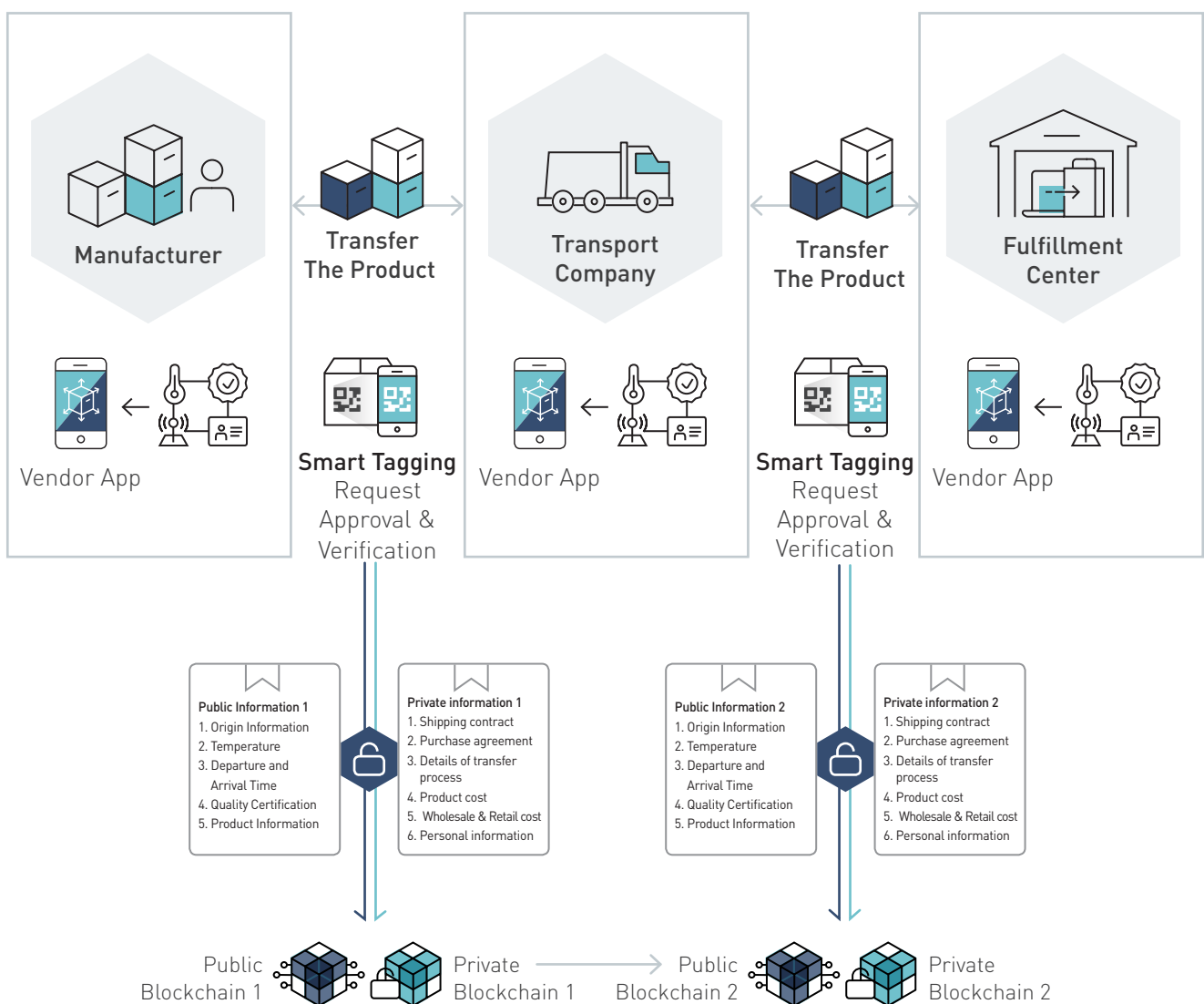
The acquired product is shipped to the wholesaler and distributor in accordance with the shipping guidelines as required by the manufacturer. Carriers also request approval upon delivering the product, and wholesalers and retailers approve after verifying smart tagging and data upon receiving the correct product.

Smart tagging and data validation are done through Smart Contract each time the management company changes during the supply chain process, and the information is stored in the blockchain in real time.

TEMCO's Supply Chain Solution

Customer's Confirmation of Supply Chain Information With smart tagging provided by the consumer application, consumers can access product supply chain information anytime, anywhere. Consumers can learn more about how their products are managed as they flow from manufacturer to end-user, including temperature, distribution channels, as well as location information.

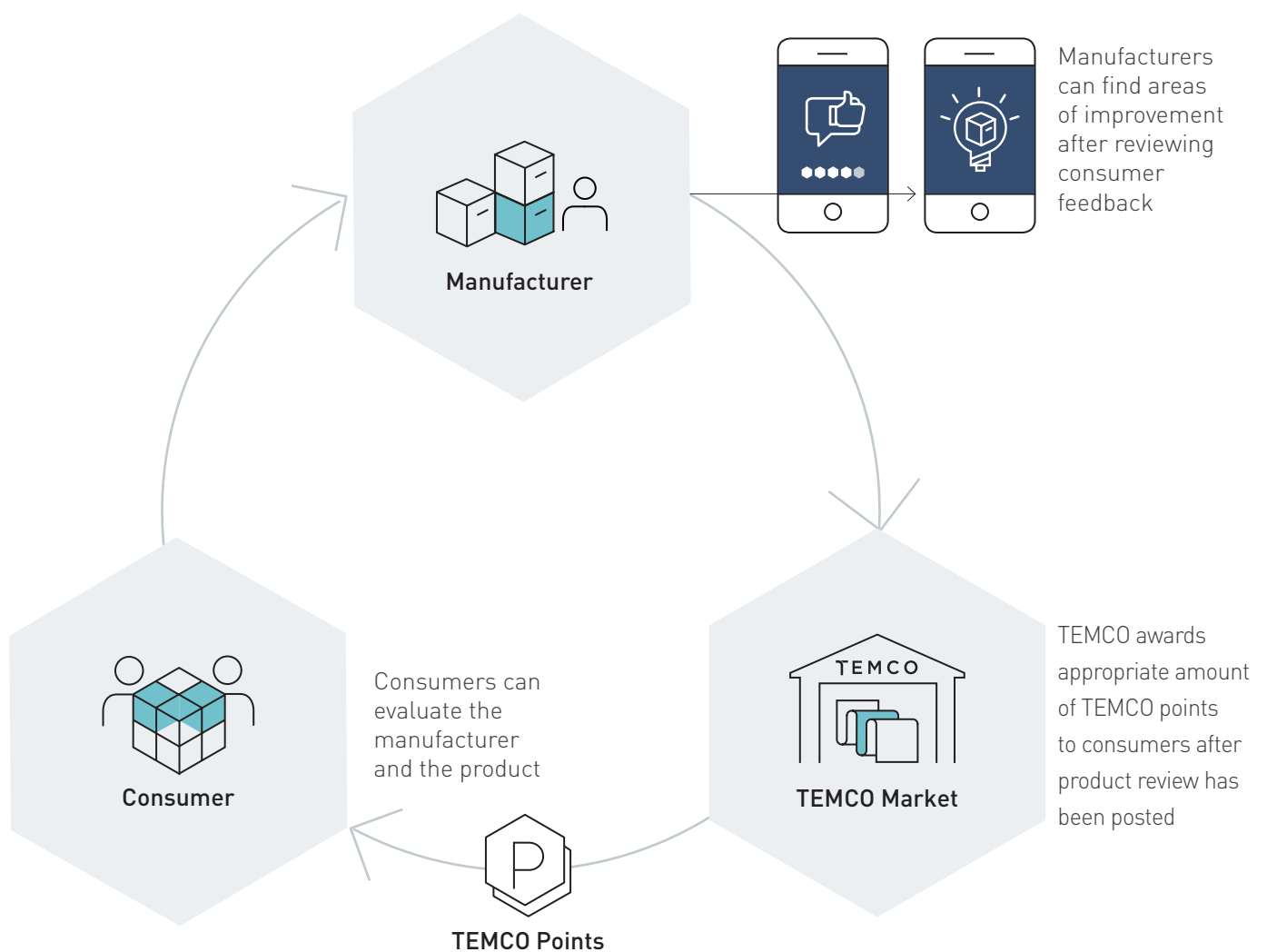
Smart Contract is also prepared for the possibility of information forgery at the book entry stage. The TEMCO project has the ability to track product distribution through the blockchain down to a single order thus reducing the possibility of moral hazards such as suppliers recording inaccurate information regarding the actual condition of the products at the Smart Contract stage.



TEMCO's Supply Chain Solution

Consumer Reviews and Product Ranking System Consumers can evaluate the manufacturer through the consumer application after purchasing a product. Evaluation is comprised of satisfaction evaluation, reviews, etc., and TEMCO discloses the manufacturer's ranking by period according to consumer evaluations.

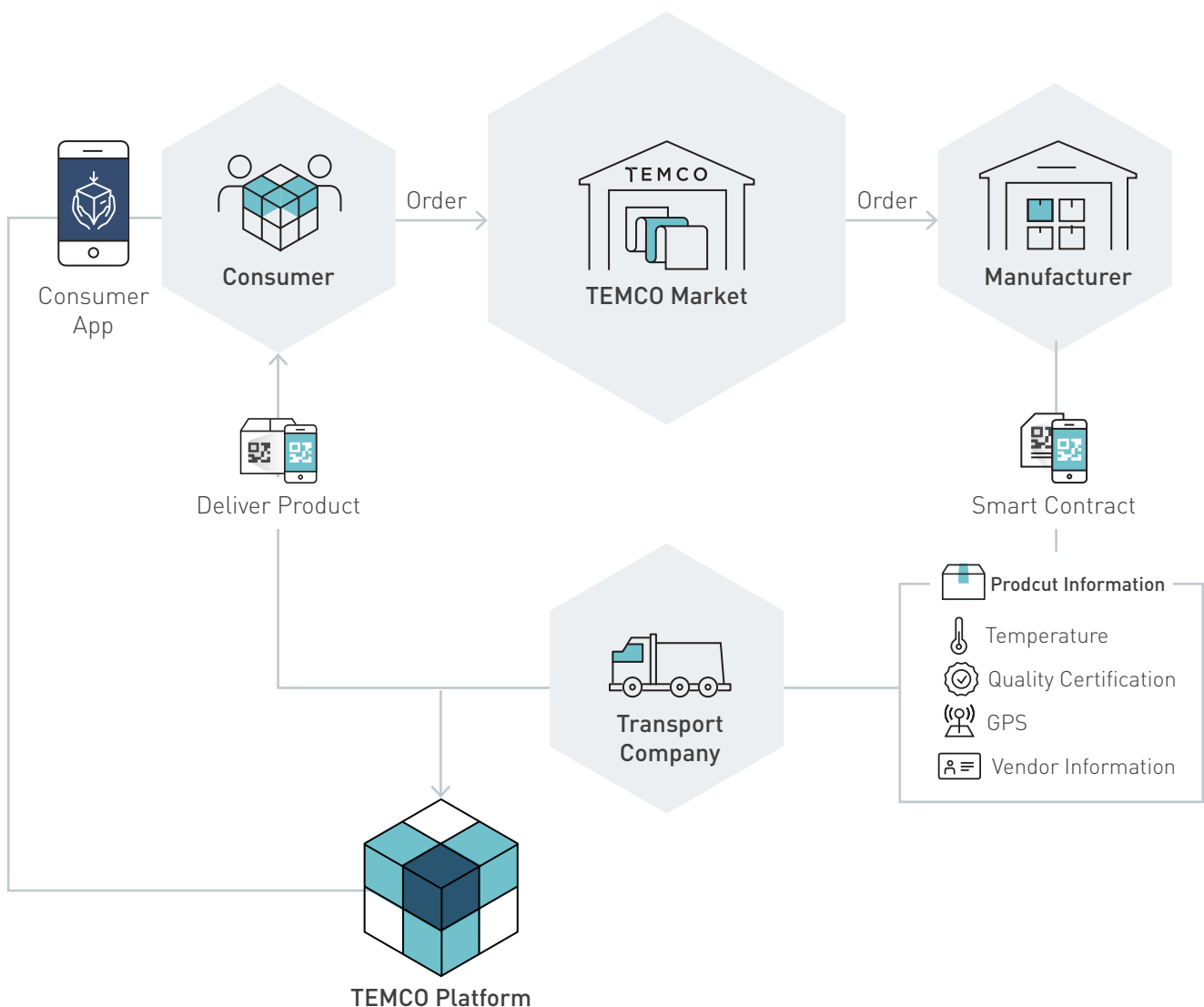
The ranking given here cannot be the absolute evaluation standard for the manufacturer. However, the review system allows consumers to receive more information, and manufacturers can accurately and quickly identify and improve upon consumer demands.



TEMCO's Supply Chain Solution

TEMCO Market TEMCO will build an online marketplace to create a direct link between manufacturers/distributors and consumers. The manufacturers/distributors who have passed through the vendor verification system can be registered in the TEMCO Market, and consumers can buy the products directly in the market using TEMCO tokens.

If the supply chain structure is simplified in this way, manufacturers/distributors can save on costs, and consumers can buy reliable products. Evaluations of manufacturers based on the review system are also disclosed in the market. The TEMCO Market serves as a hub to connect the entire supply chain process.



TEMCO's Supply Chain Solution

TEMCO's Token Model

The TEMCO system is based on 'tokens' and 'points'. TEMCO tokens are issued based on Ethereum's Request for Comment 20 (ERC20). TEMCO tokens are used as transaction intermediaries within the platform. Specifically, it is a key means of payment for the implementation of Smart Contracts and the purchase of products and is a major vehicle for economic activities with versatility to be able to link to external exchanges.

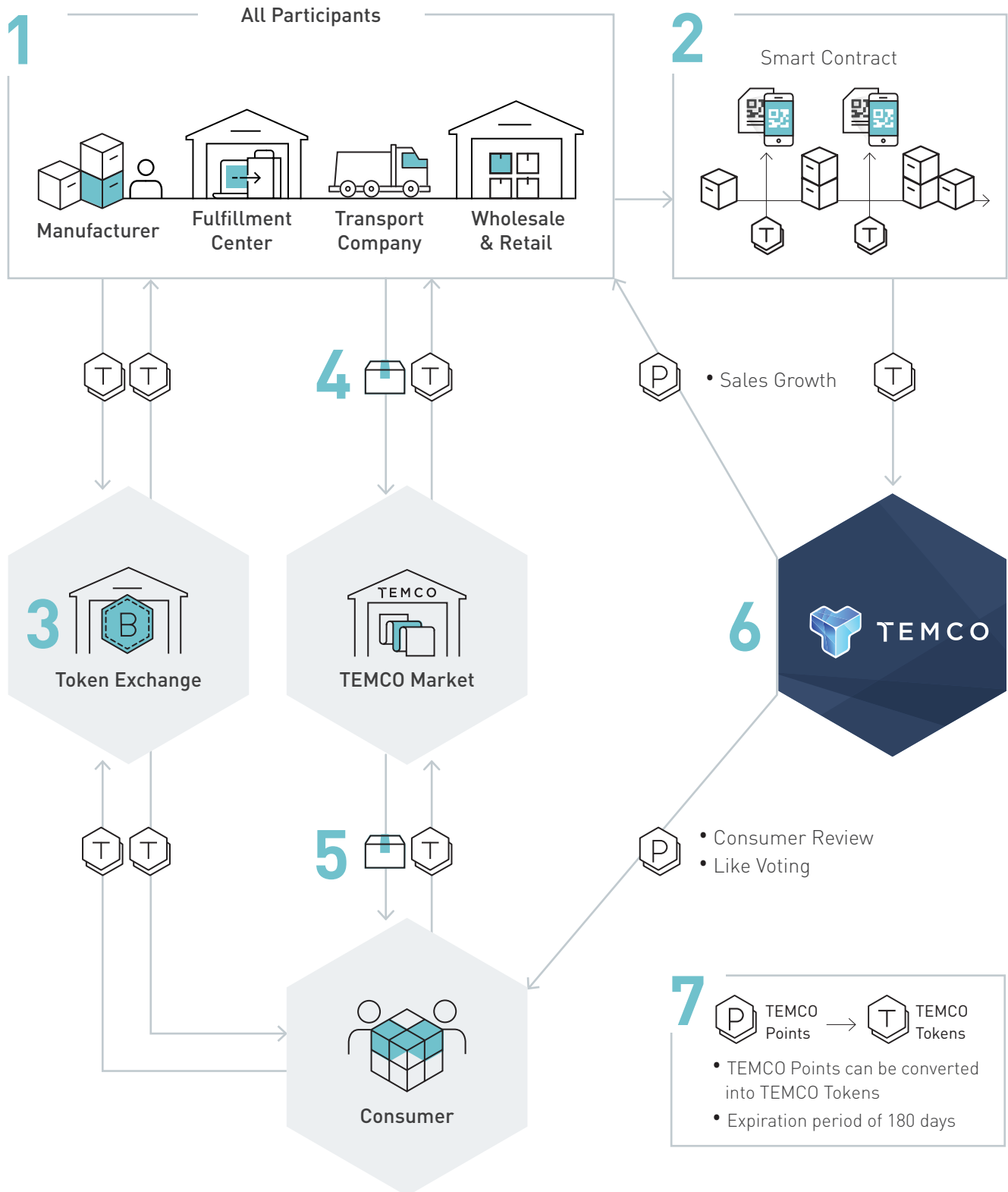
TEMCO Points will be used to build sustainable compensation schemes for Market and TEMCO platform participants. TEMCO points serve as token of appreciation to encourage users to voluntarily participate in community activities. If the consumer buys a product using a token, or if he or she participates in the community (such as by writing a review or sharing an empathic reaction), the system calculates the value of the contribution and compensates with TEMCO points.

Vendors can also receive points based on monthly product rankings and quarterly market sales growth. It may also be possible to pay for Smart Contract fulfillment by leveraging revenue from product sales.

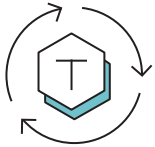
TEMCO points have a validity period of 6 months. This will encourage users to keep their tokens and engage them with continued interest in the long-term success of the platform.

The TEMCO community is most meaningful when all participants are engaged in active and ongoing activities under token and point-based economic incentive schemes. Under this structure, consumers can purchase safe products that have gone through a proper supply chain process, and manufacturers and distributors can create a virtuous cycle structure that is rewarded with fair value.

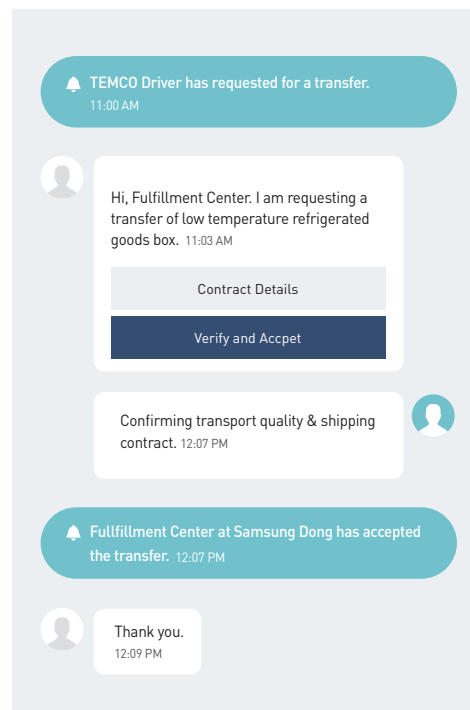
Token Appreciation



TEMCO's Supply Chain Solution



1 Requesting and accepting a transfer between supply chain participants (eg. Manufacturers, transport companies, warehousing companies, distributors, etc.) will occur through a chat system.



2 Processing Smart Contracts based on blockchain will require TEMCO tokens to cover a transaction fee. TEMCO tokens paid for that purpose will return to TEMCO.

3 Consumers and all supply chain participants can use token exchanges to convert TEMCO tokens into other forms of token.

4 TEMCO points are given as a reward for selling on the TEMCO Market or experiencing sales growth from the TEMCO Market. TEMCO points can be converted into TEMCO tokens.

5 Consumers must use TEMCO tokens to make purchases. TEMCO points are given as a reward for participating in the TEMCO platform through reviews and "Like"s. TEMCO points can be converted into TEMCO tokens.

6 TEMCO tokens received by TEMCO for processing Smart Contracts and selling products on the TEMCO Market will be used to reward consumers and supply chain participants.

7 TEMCO points can be converted into TEMCO tokens but not vice versa. TEMCO points have an expiration date of 180 days to foster consistent participation in the TEMCO Market.

TEMCO's Supply Chain Solution

Contribution Level Evaluation Algorithm

Consumers can review and “Like” their purchased products, and they can select the best reviews by commenting on and “Liking” other consumer reviews.

The best reviews represent information that has been selected as useful by many consumers, so there is confidence in trusting this information. Voting for other consumer reviews is also considered a community contribution, so voters can get the corresponding rewards.

However, since comments and ratings may be manipulated, the following constraints will be designed with the algorithm to minimize the risk of information distortion.

Reviews can be modified after creation but cannot be modified by other consumers. Creation of duplicate postings for the same product within 24 hours is limited. In addition, the number of “Like”s that users can leave on products and reviews in a day is limited in order to improve credibility of reviews.

The contribution evaluation algorithm for distribution participants is divided into a quarterly sales growth model and a monthly product feedback compensation model. The quarterly sales growth rate compensation model is an algorithm that compares the sales growth rate of products sold in the TEMCO market by quarter. The formula is as follows:



$$\frac{\text{Product Price} \times (\text{Current Sales Volume} - \text{Past Sales Volume})}{\text{Past Sales Volume}} \times \text{Incentive Rate} \times \frac{1}{\text{Temco Point Price}}$$

TEMCO's Supply Chain Solution

The Product Feedback Compensation System is intended to quantify consumer feedback on the product and to announce the rankings to the community on a monthly basis so that the distribution participants have a certain weight on the incentives for community contribution by product rank. Through this system, consumers' reviewing power, in the form of reviews and Likes, can encourage the production and distribution of honest products. TEMCO points are provided in the Point Pool and the related formulas are as follows:

$$\begin{aligned}
 & \text{✓} \quad \text{TPP} - (R \times D \times S) \times T + [MV_0 \times \{(1 + GR_1)(1 + GR_2) \dots (1 + GR_T)\} \times I \times \left[\frac{1}{P}\right] \times T \\
 & \quad - \left\{ \left(\sum_{n=1}^T MV_{n-1} GR_n \right) \times D \times \frac{1}{P} \right\} \times T \leq 0
 \end{aligned}$$

* TPP = TEMCO Points Pool, R = Contract Usage Fee,

D = Distribution Rate S = Number of Smart Contracts,

MV_n = Market Turnover at point in time "N",

GR_n = Market Growth Rate at point in time "N", I = Market Transaction Fees,

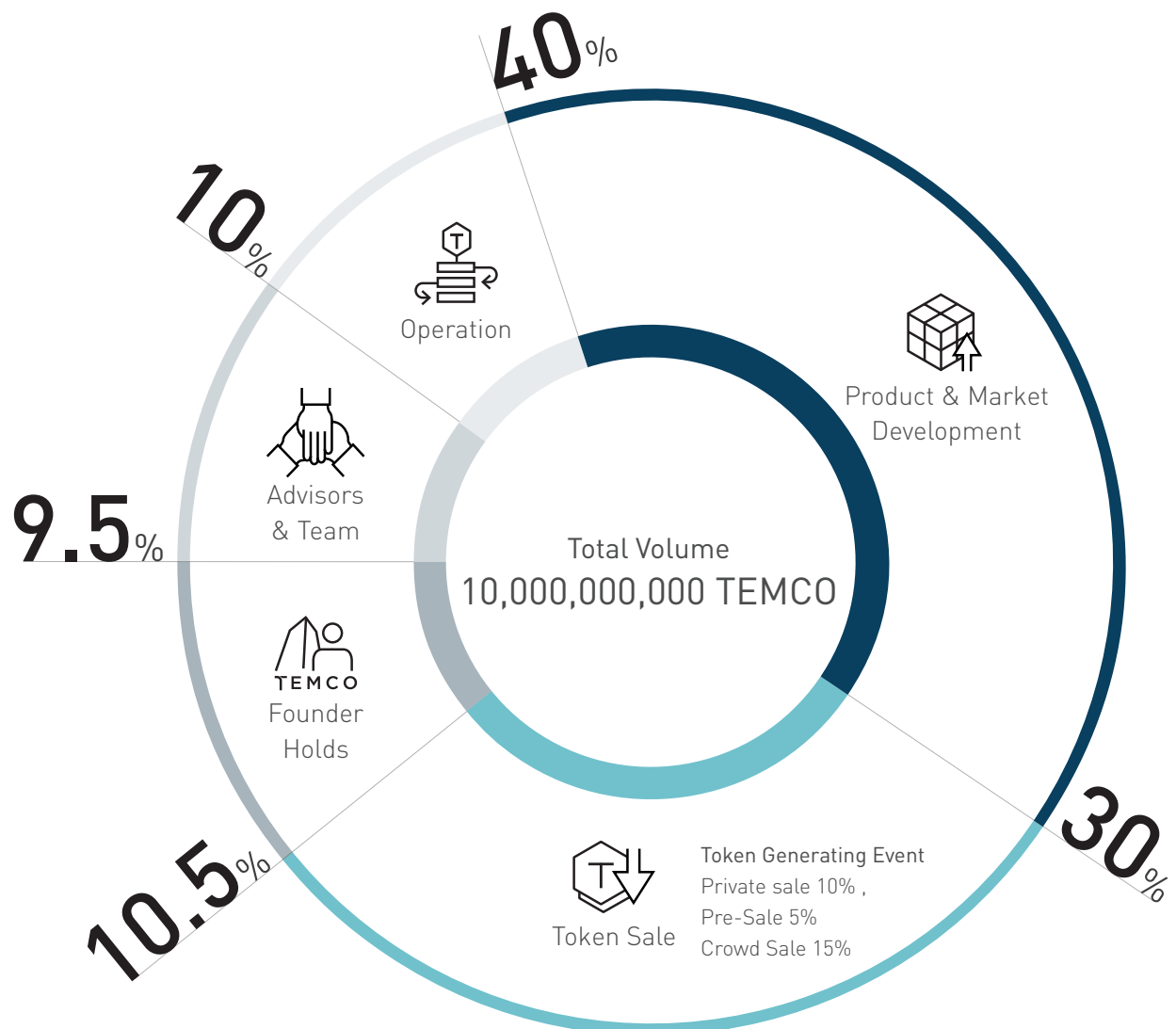
P = TEMCO Point Price, T = Full Dissolution Period

Points earned by the consumer can be converted into TEMCO tokens assigned to the point pool at any time within the validity period. The TEMCO token conversion ratio of TEMCO points will be further optimized through future simulations.

When the points that should be paid to the community contributor are not delivered, 50% of the points are given to all participants and the rest are returned to the point pool. This is designed to prevent changes in the value of TEMCO tokens due to the rapid depletion of point pools.

Token Distribution

Token sales are intended for the development of the TEMCO platform and the construction of the ecosystem, and participation is through Ethereum (ETH). The exact exchange rate will be announced through the official channel (homepage, etc.) prior to token issuance. Tokens paid through token sales account for about 30% of the issue volume. 40% of the total token issuance is used for TEMCO product and market development, 10.5% goes to the TEMCO founders, and 9.5% goes to advisors and team.



Roadmap

'18.5	Website Launch Whitepaper Release
'18.6	Token Generating Event Development of Advisory Board
'18.3Q	Partnership and Business Development
'18.4Q	Initiate TEMCO Platform Pilot Test with Partners
'19.1Q	Begin Developing Decentralized Distribution Network
'19.2Q	Consumer App Launch -Smart Scan and Voting System
'19.3Q	E-commerce Partner's Mall and Points Mall Launch Initiate TEMCO Blockchain API Service
19.4Q	Vendor App Launch -Vendor Verification System -Smart Contract (transfer, compensation, and penalty agreements etc.)
'20.1Q	TEMCO Big Data Platform & BI Tool Release -Data Warehouse(Hadoop), Analytic Engine(Spark) -Data Visualization Tool -PKI Tool
'20.2~4Q	Development of TEMCO Blockchain

Issues & Risks

The TEMCO team (including TEMCO LABS Inc. and its shareholders, employees, and affiliates) has written this white paper for reference only to those interested in specific information on the new supply chain management platform planned by the TEMCO Project. In other words, this white paper is not intended to invite you to invest in the platform and team that the TEMCO project is planning. In addition, this white paper is prepared and provided according to information that is correct at the time of writing, so we do not guarantee that everything in the white paper, including the conclusions, will remain accurate in the future.

The TEMCO team does not guarantee the legitimacy of any of the information in the white paper and therefore is not legally responsible for any of its content. The TEMCO team does not assume any legal responsibility for ① the white paper being legitimately written, ② the white paper having commercial value, ③ the white paper coinciding with your specific purpose, and ④ the information contained in the white paper being perfect and free of errors.

All the results (profit, damages, etc.) arising out of the matters determined by using the white paper and other information are entirely at your discretion, and the TEMCO team does not bear any legal responsibility (compensation, reward, etc.) for it.

* To Note) The possession of TEMCO tokens has nothing to do with the decision-making of all matters related to the TEMCO project, and the TEMCO team does not provide any compensation (profit or share allocation, dividends, etc.) for token ownership.

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- <https://github.com/ethereum/go-ethereum>
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- <https://github.com/professormarek/traceability>
- <https://github.com/EOSIO/eos/tree/master/contracts/eosio.system>



TEMCO