

# Robot economics

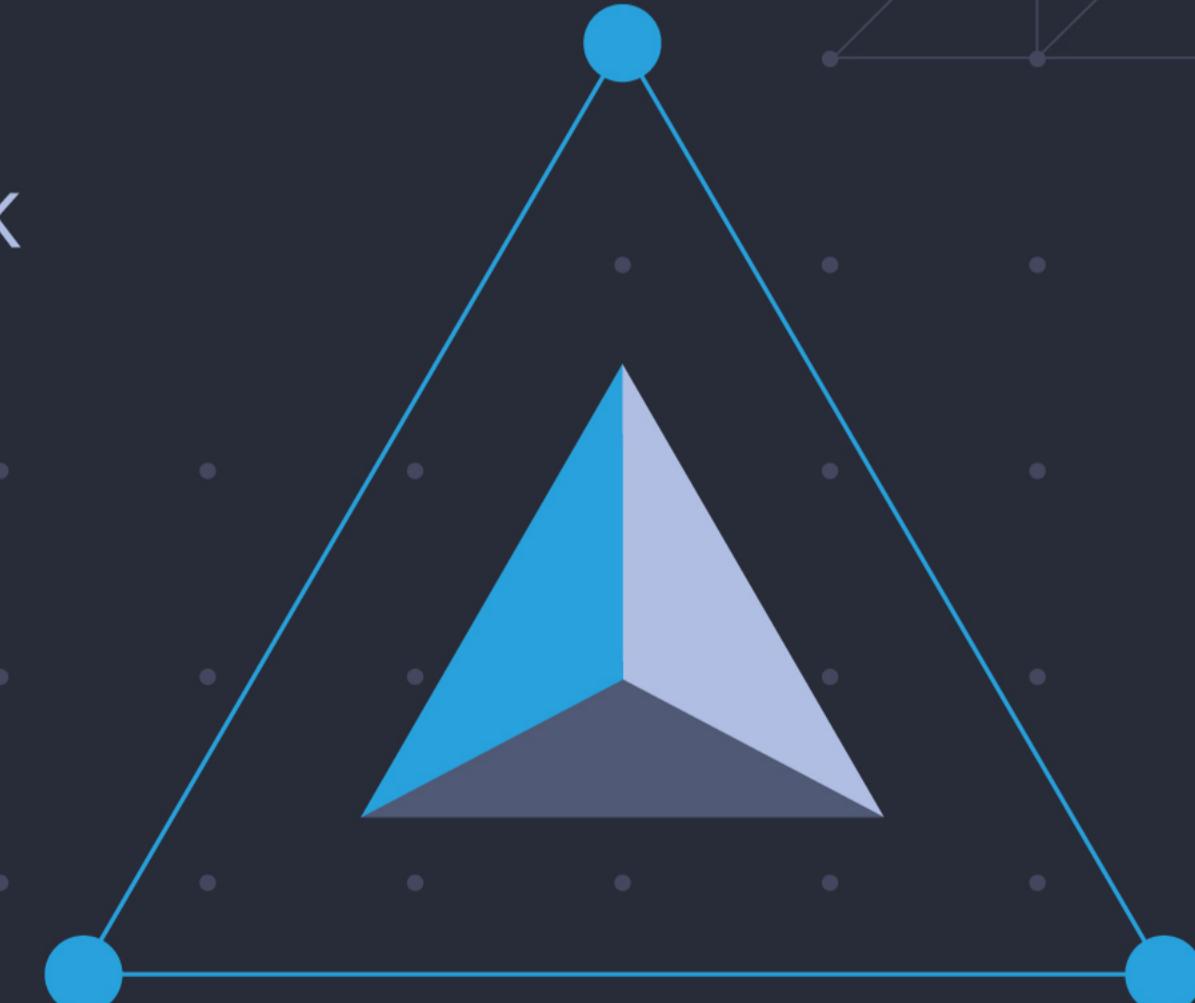


ROBONOMICS.NETWORK

2018

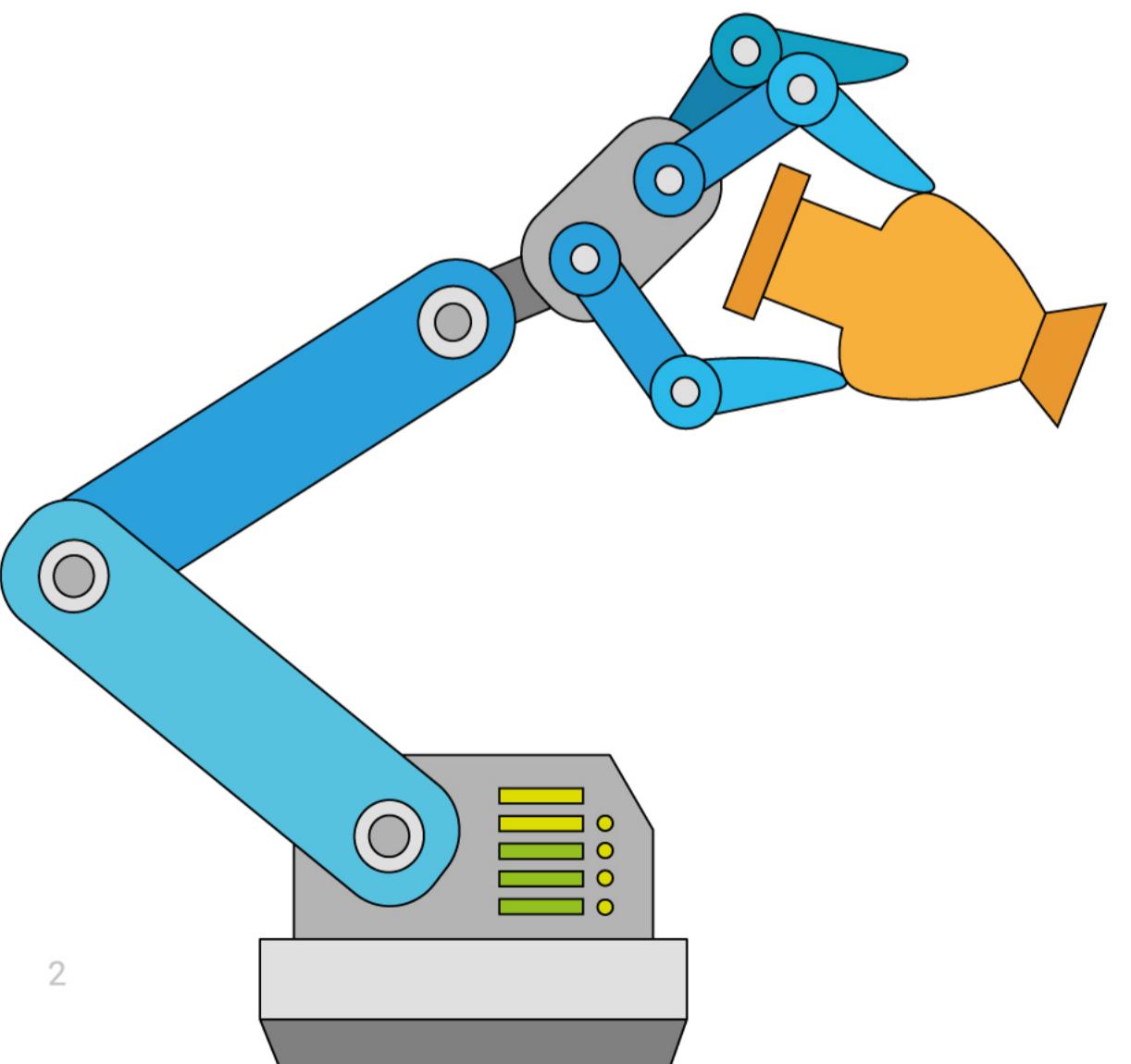
BOOK №2

ROBONOMICS NETWORK



# ERA OF INDUSTRY 4.0

Economic theory considers the issues of economic management in conditions of an unlimited set of needs and limited resources. Society's desire for automation is an element of solving the problem of rational, more efficient spending of resources in order to satisfy an increasing number of needs. We are physically incapable of producing as many goods and services as we already consume via manual labor. In addition to the quantitative indicator, the question of quality is also important: the complexity of both the goods themselves, and ensuring control over their production, go beyond human capabilities.



## ROBOTS

*Total robotization of goods production in a comparative proximity to consumers is likely to produce even greater changes in the optimization of our generation's production chains.*



## HUMAN LABOR

### An indication of the product as "Handmade".

People who like doing manual work and creating something themselves will always maintain their place in society. A human surrounded by machines can certainly yearn for human-to-human communication in production-consumption interactions.

**An engineer** as the pillar of humanity in the world of machines. After all, every doctor, policeman and teacher's work depends upon machines that perform tasks inaccessible for humans; these machines will be set up precisely by the engineer.

**A supercapitalist.** There is almost a complete submission of production decisions to those who invest. Capital management is a sufficient form of determining the goods and services produced by the world of machines.

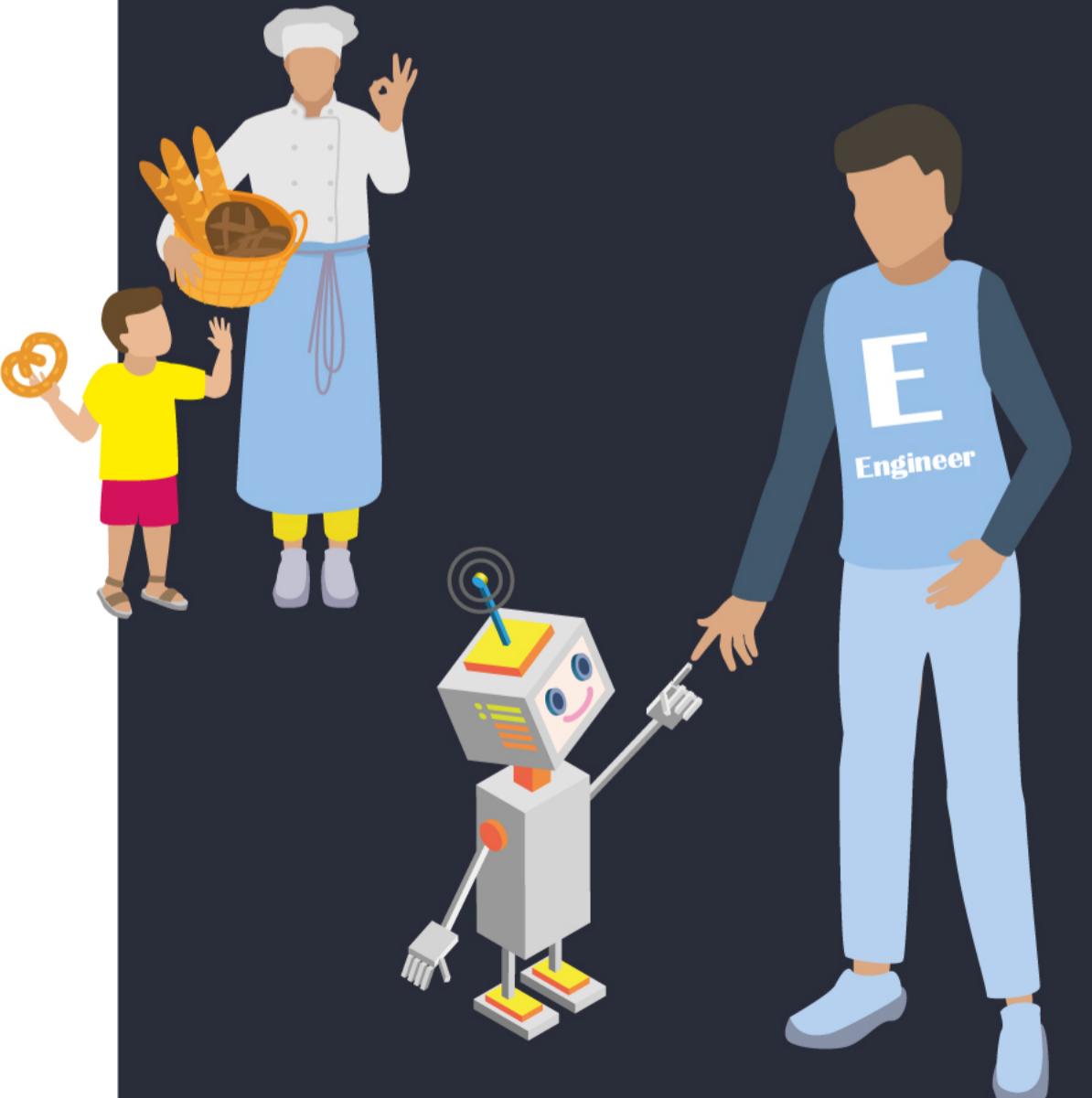
**A citizen.** Any work done in the name of human, and for the sake of human by human will receive support. Being a Citizen with a capital "C" is already a job.



*Total robotization will more than likely eradicate world hunger, as opposed to increase it. Likewise, technologies will provide easier access to knowledge.*

*Yes, the changes are serious. As for me, I foresee the growth of creativity among humans to be a result of a drastic reduction of the expenses for their basic welfare. I see a world that rapidly adapts to the changes and, as a result, becomes more viable. The world that is a little bit sentimental to its past, and proud of the fact that it is the creator of everything around.*

Lonshakov S.



# THE ECONOMY OF ROBOTS

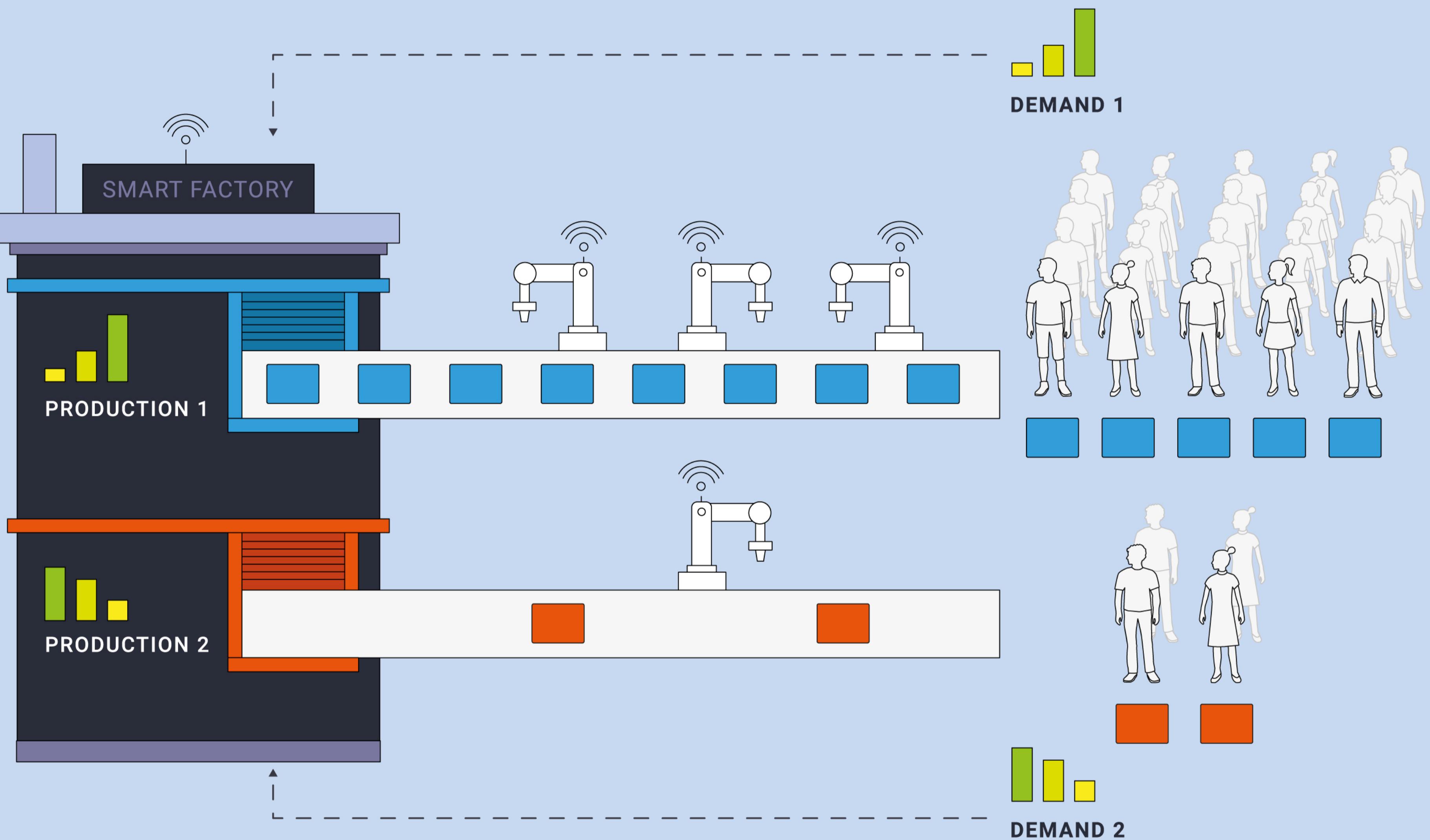
In the work of industrial zones and urban life, the emergence of fully automated enterprises is inevitable. The enterprises that are controlled by cyber-physical systems (CPSs) provide services as autonomous agents.

The process of forming the networks from autonomous CPSs, in order to increase the speed and the quality of communication in the process of goods production and service delivery is inevitable.

We protect the market mechanism as a way of building a network of cyber-physical systems. The market, on the one hand, will make the CPS network adaptable to the changing needs of humans. On the other hand, it will regulate the size of the CPSs in terms of their economic efficiency as autonomous agents.

Integration of CPSs with the help of the market mechanism gives us an opportunity to implement a planetary system of mass production of goods and services that will be directly integrated into the economy of society.

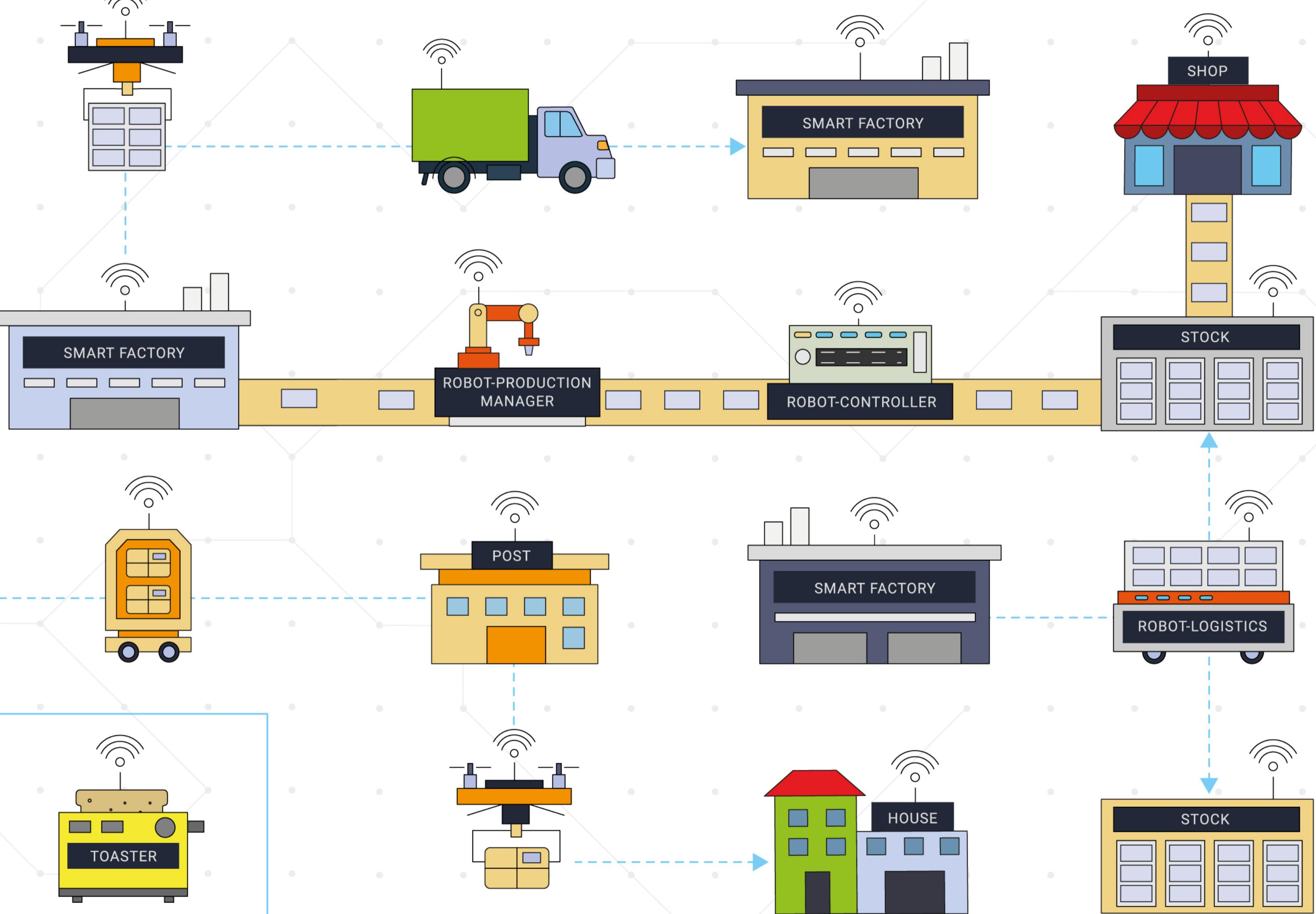
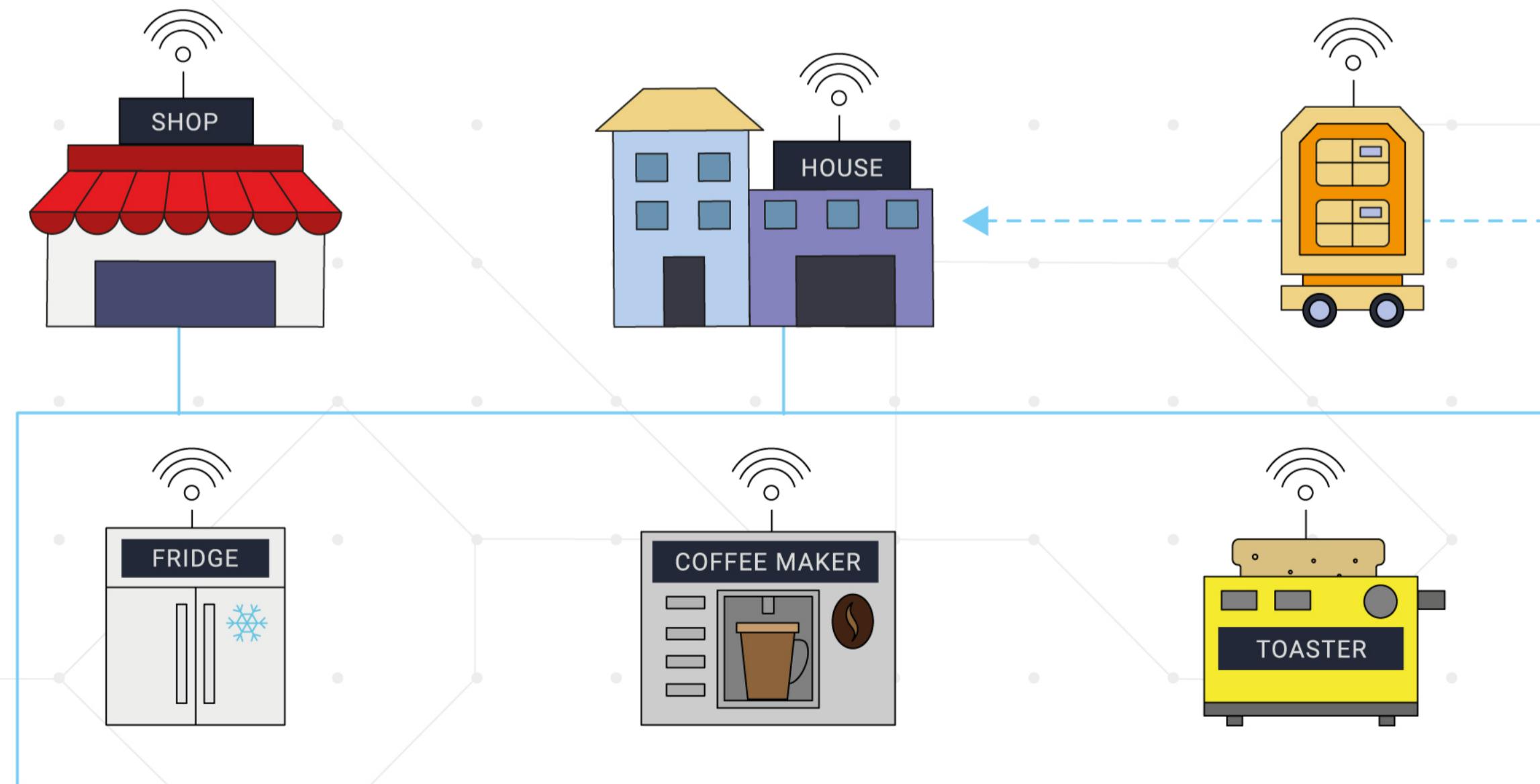
**THIS SYSTEM IS NAMELY THE ROBONOMICS NETWORK.**



# THE IDEA OF A CYBER-PHYSICAL SYSTEM

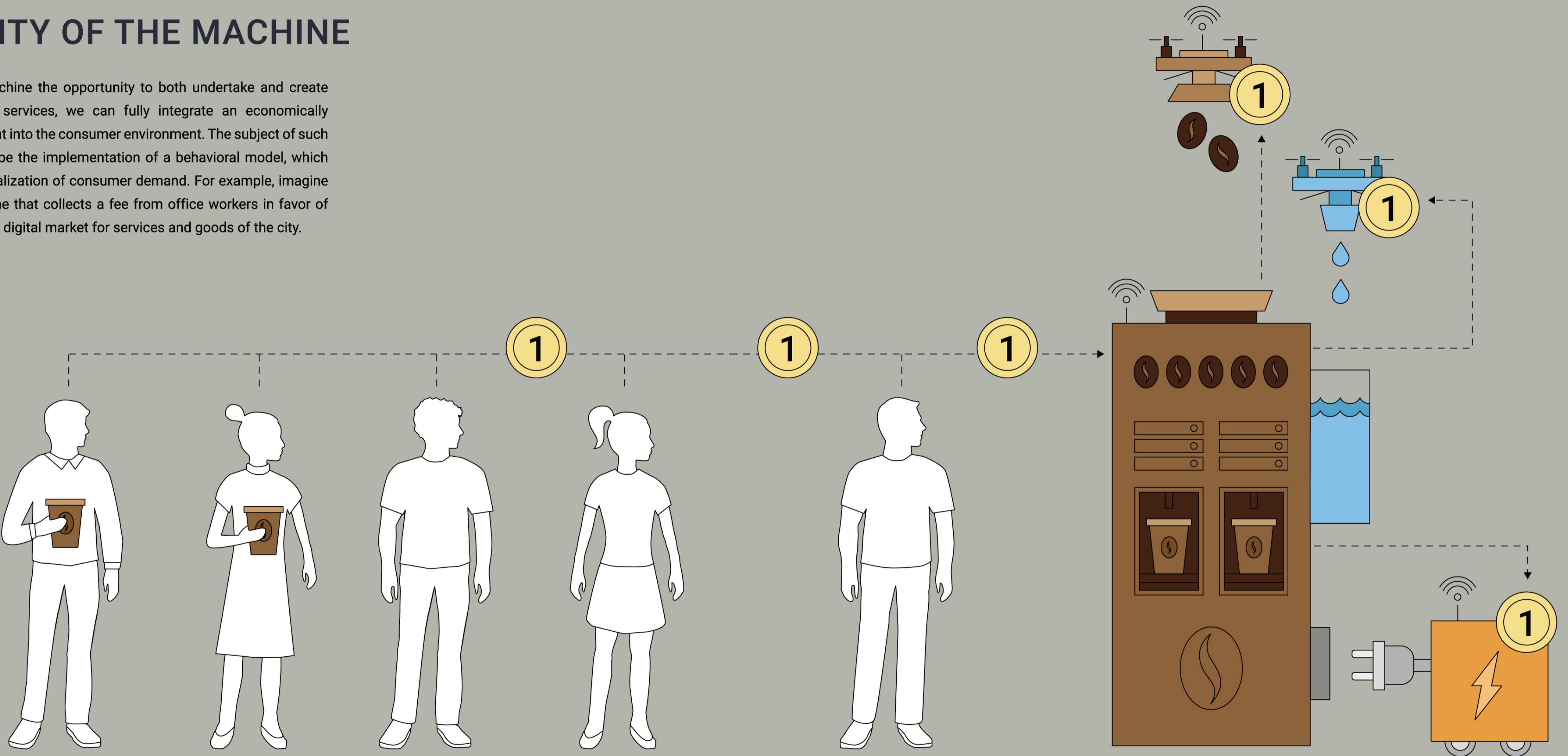
It is important to take into account that the use of market mechanisms for network integration imposes a requirement to represent CPSs as economic agents while designing robotized services.

Similar to a firm in the economy, a cyber-physical system (CPS) integrates a lot of robots into a closely connected network of sensors and actuators that are capable of organized collaboration.



# LIABILITY OF THE MACHINE

By giving the machine the opportunity to both undertake and create liabilities for its services, we can fully integrate an economically autonomous agent into the consumer environment. The subject of such a liability should be the implementation of a behavioral model, which will enable the realization of consumer demand. For example, imagine a vending machine that collects a fee from office workers in favor of self-service at the digital market for services and goods of the city.



# ROBONOMICS PLATFORM

We call the network of CPSs, working as services and united on the basis of market mechanisms, the Robonomics network.

We are considering a scheme that allows us to organize the Robonomics network using technologies that already exist.

Based on the results of the experiments carried out between 2015 and 2018, we propose using Ethereum as an infrastructure that provides the minimum necessary facilities for combining the technical and economic parameters of the machine's liability to implement a user-aligned behavioral model.

With the implementation of the ability to create one's own segment in the Ethereum network, Robonomics can exude into the segment with increased capacity. Robonomics allows repeatedly increasing the number of possible executions of contractual liabilities by robots, in order to cover the requests of the whole Industry 4.0 with a transaction value over \$1,000.

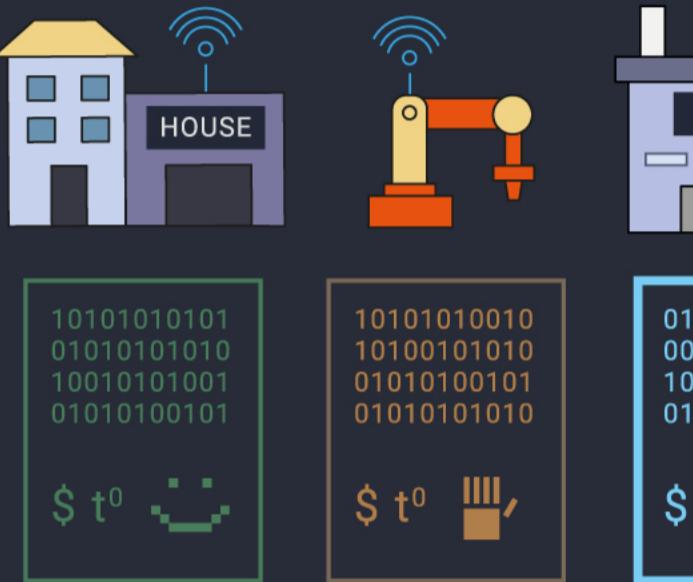


# ROBONOMICS.NETWORK

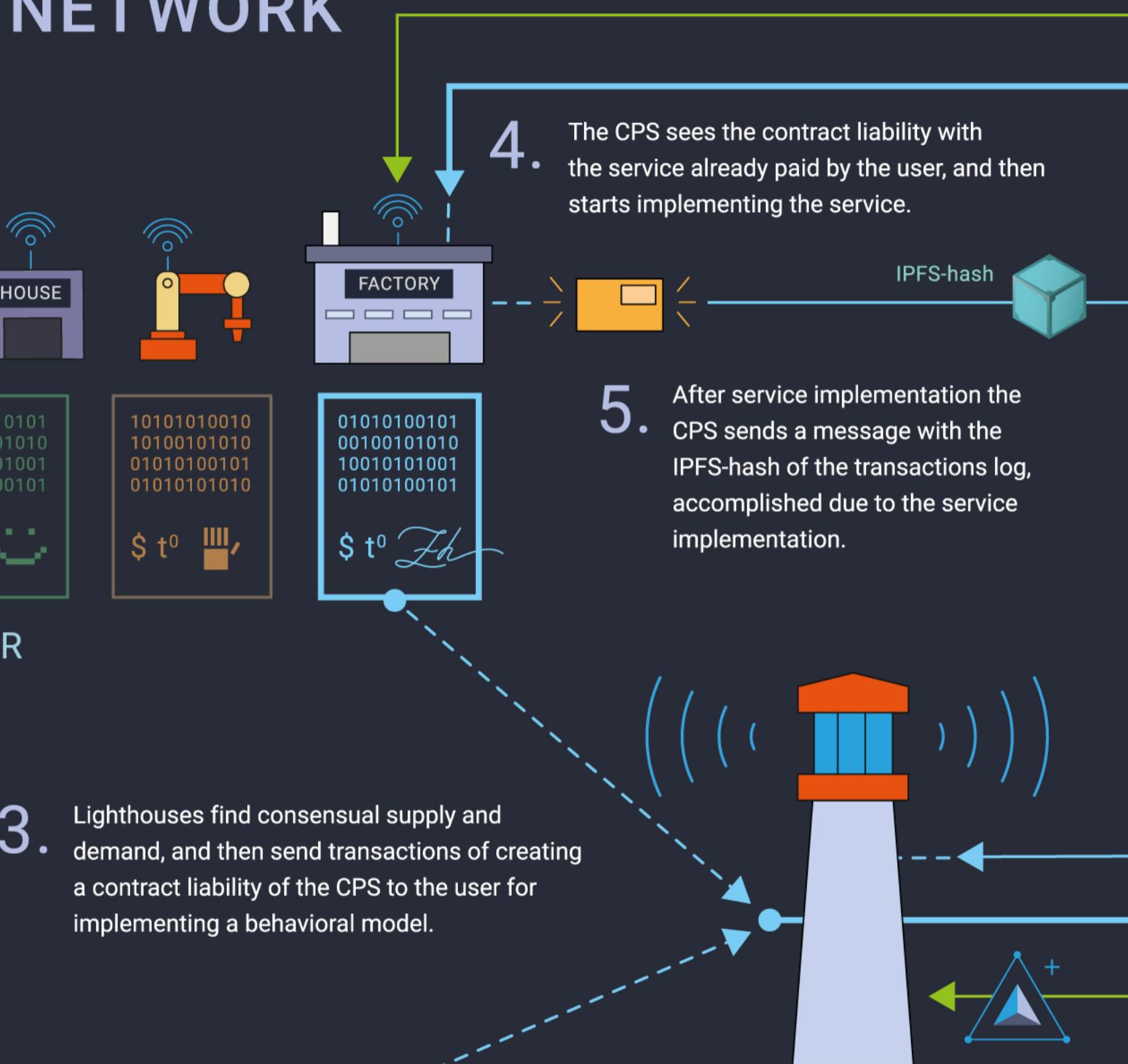
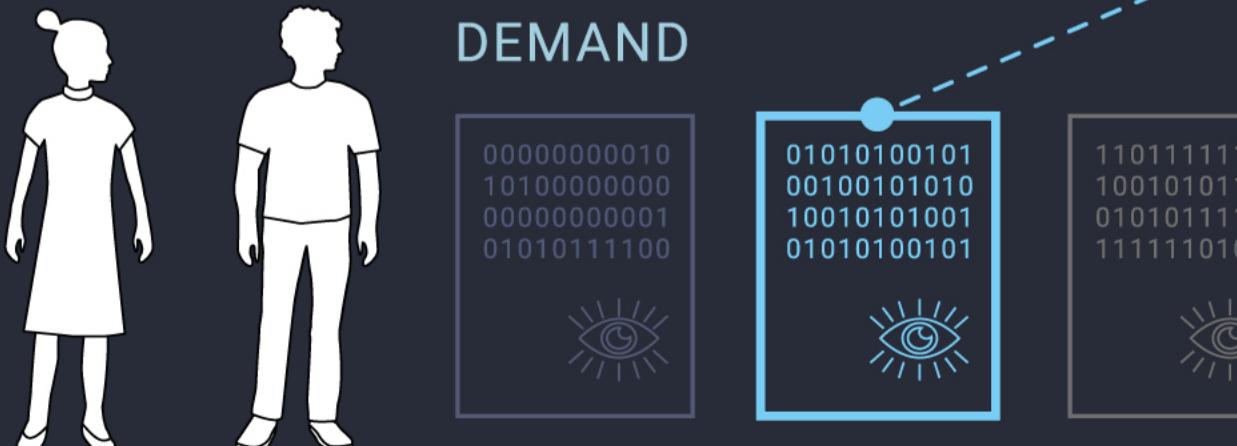


# LIFE CYCLE IN THE ROBONOMICS NETWORK

- Cyber-physical systems (CPSs) publish a variety of offers for services according to the behavioral models that are accessible for their implementation. They attach economically important information: price and existence time of offers. Each offer is signed by the Ethereum Externally Owned Account (EOA).



- Users publish demand, optionally indicating the observing network (ON).



- The lighthouse receives the message in the communication channel and settles the transaction with the Ethereum blockchain.

- After service implementation the CPS sends a message with the IPFS-hash of the transactions log, accompanied due to the service implementation.
- The observing network receives the message with the transactions log, verifies it and makes a decision about the status of the liability (fulfilled or not).
- The observing network signs the CPS's transaction log according to the decision it took, and sends this message to the communication channel.

- As a result of the transaction's settlement the liability contract finalizes
  - >> the commission fee of the observing network releases and is transferred to the account of the observer;
  - >> also, the emission fee of the Robonomics network gets released and is transferred to the account of the lighthouse's provider;
  - >> the CPS gets its' fee.

## SMART CONTRACT

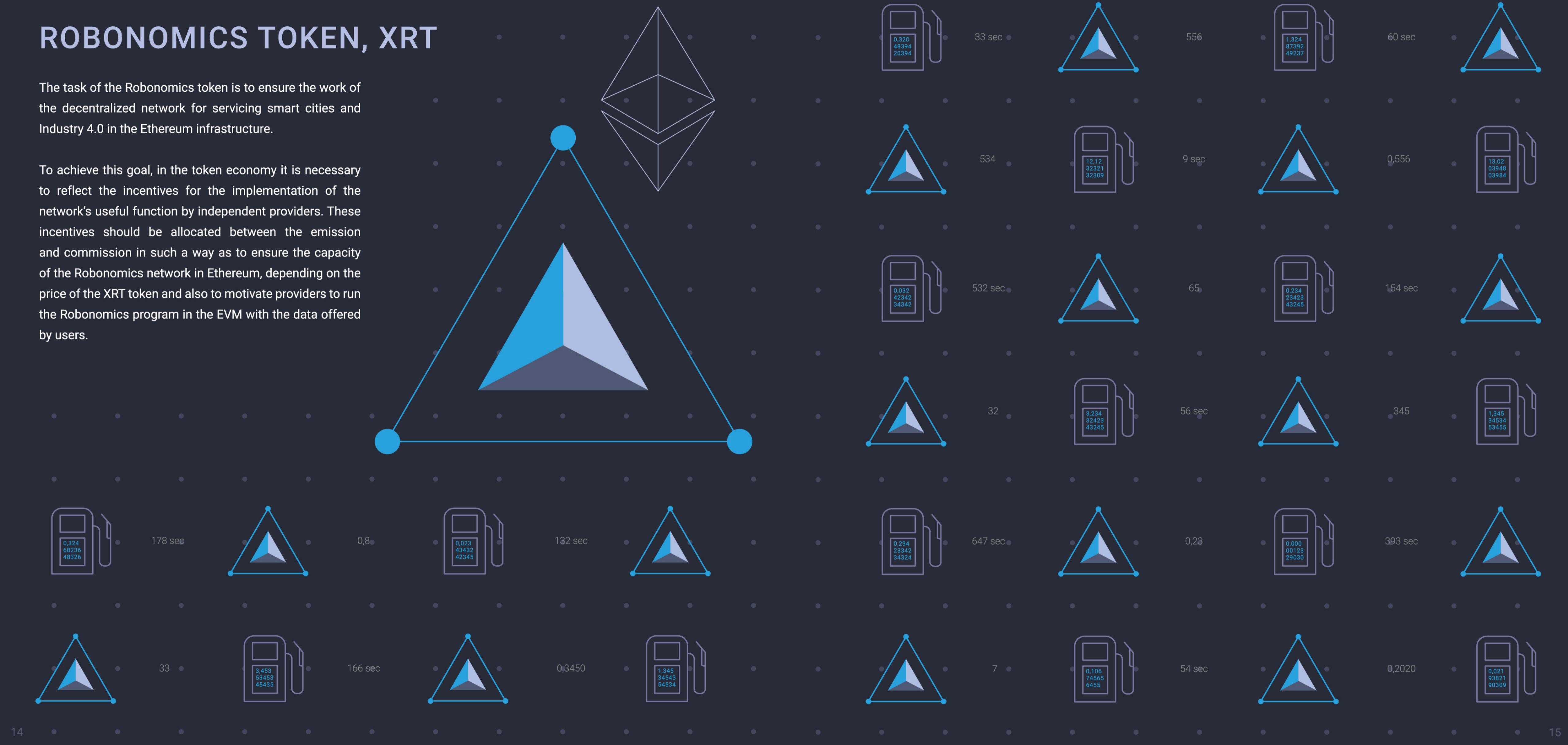


**READY**

# ROBONOMICS TOKEN, XRT

The task of the Robonomics token is to ensure the work of the decentralized network for servicing smart cities and Industry 4.0 in the Ethereum infrastructure.

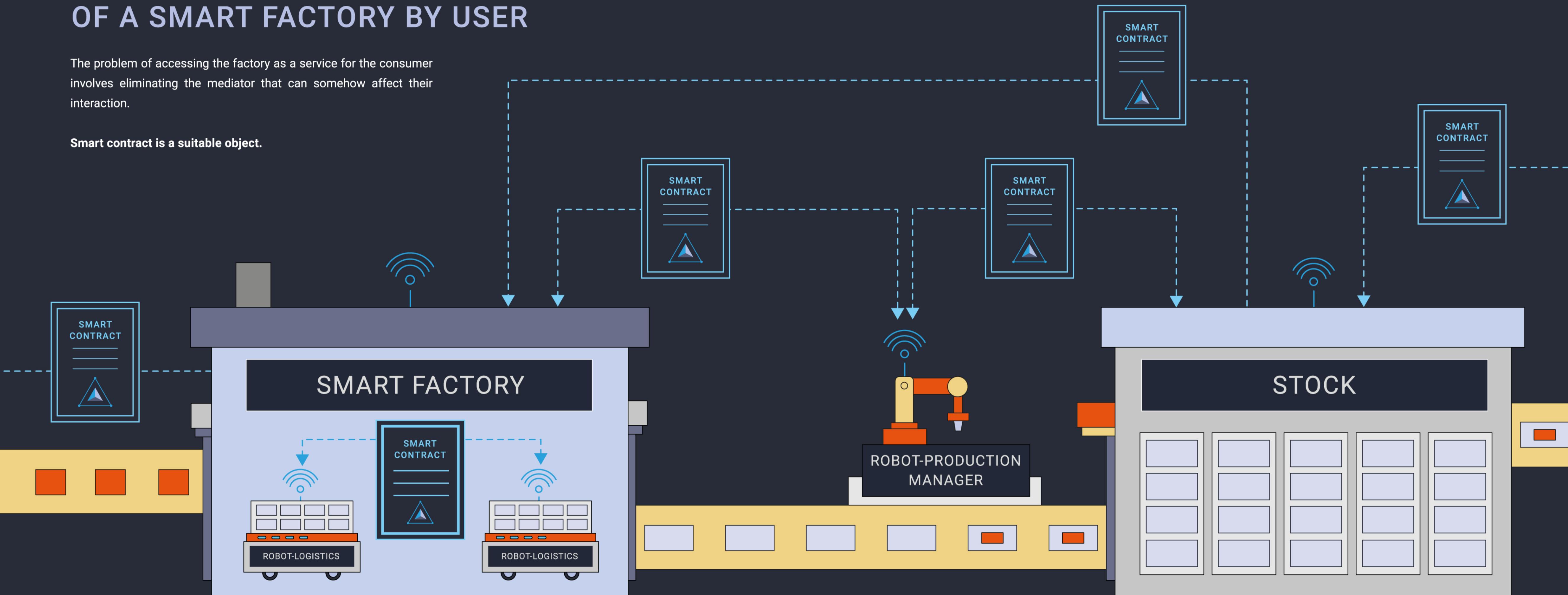
To achieve this goal, in the token economy it is necessary to reflect the incentives for the implementation of the network's useful function by independent providers. These incentives should be allocated between the emission and commission in such a way as to ensure the capacity of the Robonomics network in Ethereum, depending on the price of the XRT token and also to motivate providers to run the Robonomics program in the EVM with the data offered by users.



# THE LAUNCH OF A SMART FACTORY BY USER

The problem of accessing the factory as a service for the consumer involves eliminating the mediator that can somehow affect their interaction.

Smart contract is a suitable object.



# SCALABILITY

Robonomics is designed to represent such large cyber physical systems as a whole factory or city. The current capacity of the Ethereum network is sufficient to enforce over 1,000 contractual obligations per day. This is enough for:

- the organization of daily direct order by car buyers on the sites of several auto groups such as BMW, Porsche and LADA;
- registration of regular routes for unmanned logistics of the current global industrial zones;
- daily publication of reports on the state of the environment from sensory networks of all cities in the world with a population of over 1,000,000 people.

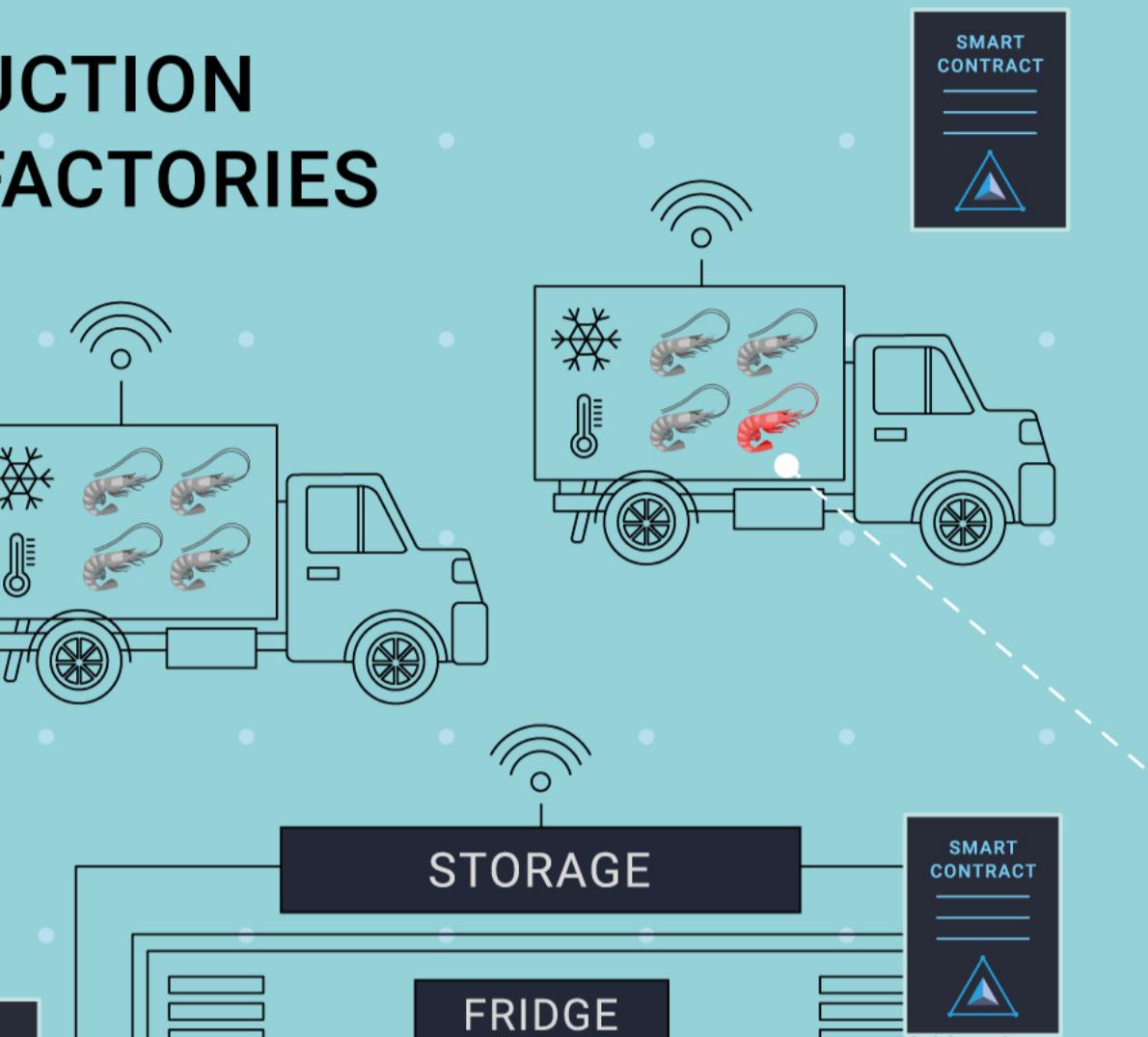
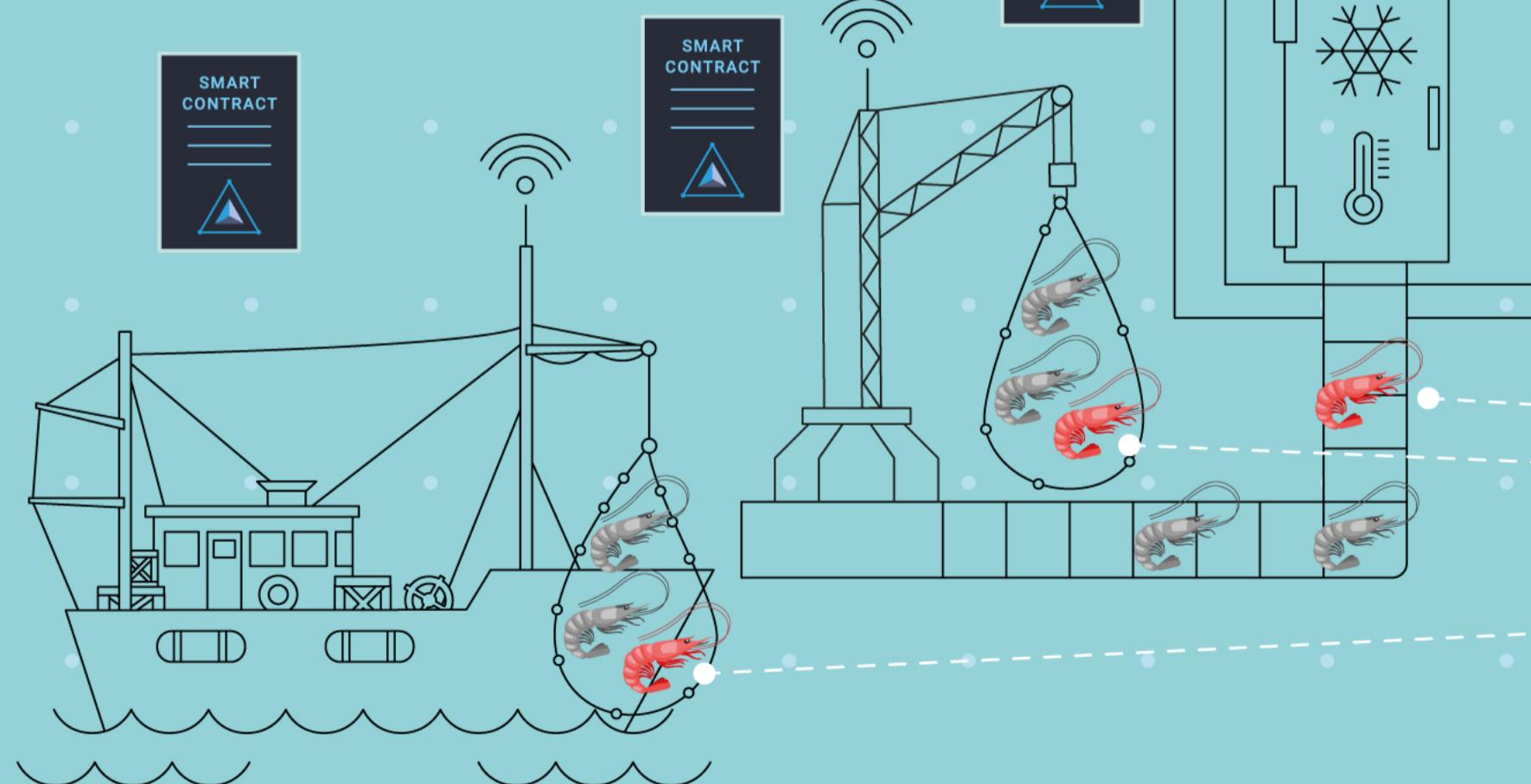


## Robonomics usecase №1

# BUILDING TRUST TO THE PRODUCTION OF SMART CITIES AND SMART FACTORIES

The trust issue between the consumer and the smart factory lies in how the consumer can be sure of the quality of the product produced by the smart factory. The products in the store can be similar, but have a different story of origin. We propose to record the technological process, placing it in a decentralized network. Hash from the log of CPS's operations is saved in the blockchain, giving the history of the product the property of immunity.

**The consumer is confident in the product, since its history cannot be changed in the future.**



*This scenario is implemented by the non-profit organization "Airalab RUS".*

## Robonomics usecase №2

# SMART YARD SAFE ENVIRONMENT

There are many different manufactures located in industrial cities. Their emissions increase the risk of diseases; particularly respiratory diseases, which are dangerous for children. City authorities are still unable to efficiently solve this problem because there are very few stationary observation posts of air pollution, and many of them are already obsolete.

Having a modern automatic sensor installed in the yard, or at the playground, we will be able to monitor the air condition online and thus, we will be able to protect ourselves and our children.

Project "Smart yard. Safe environment" is a system of sensors that monitors the cleanliness of the air in the yard. The use of blockchain technology to store information in the decentralized network in this case will allow the state and its citizens to trust this data and use it along with the data from stationary posts.

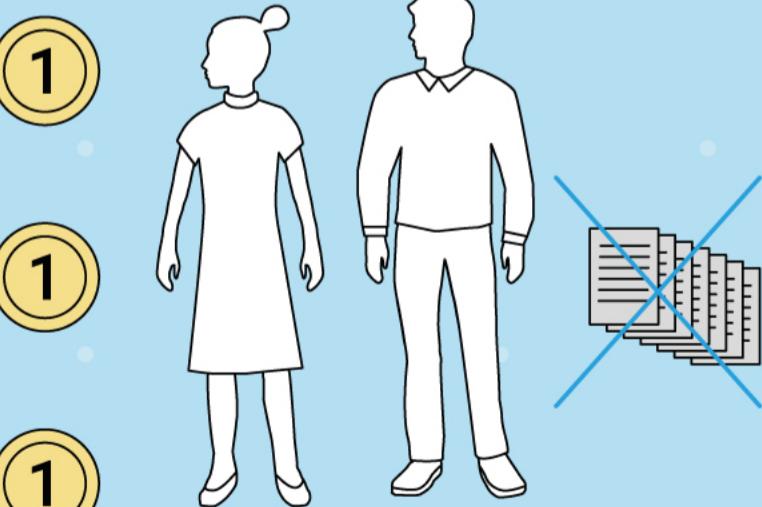
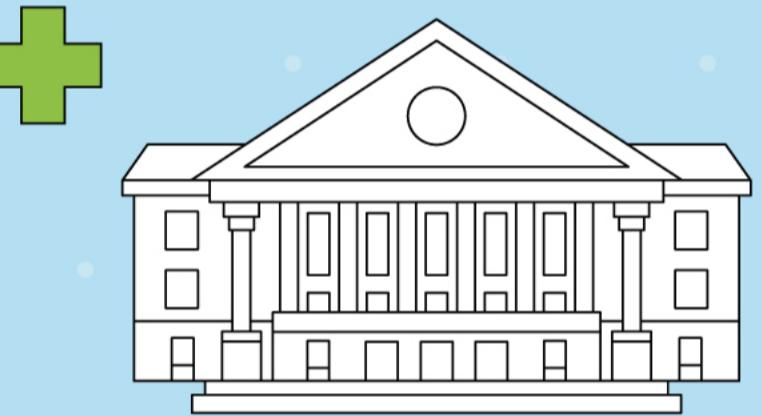
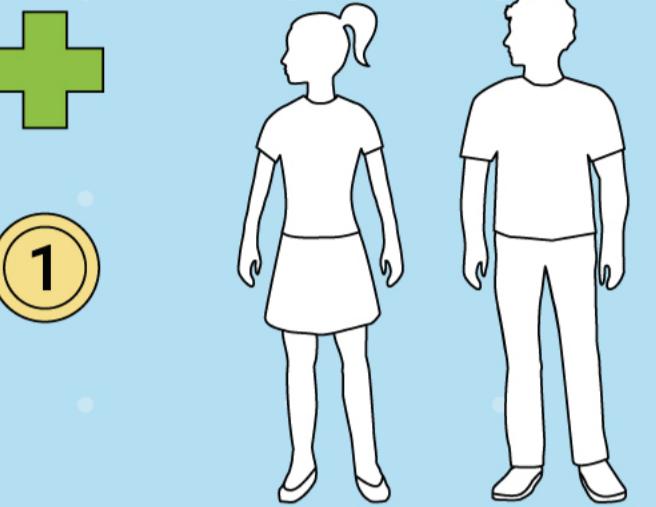
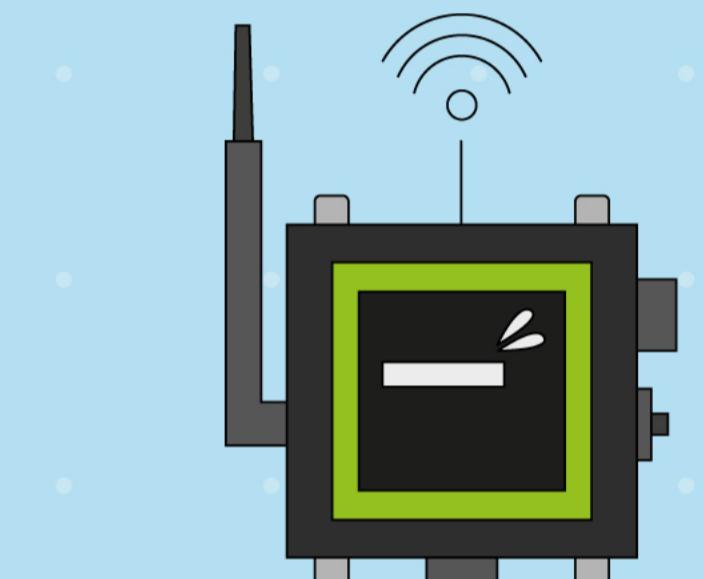
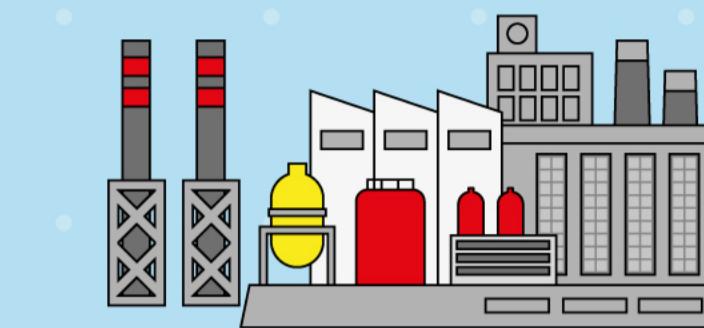


**How is it possible to use the data stored in the decentralized network?**

**Citizens** will be able to sell information about the air quality to the organizations interested in it directly, that is, without any mediator taking part in it. This provides the opportunity to recover the costs associated with installing sensors.

**City administration** will be able to use the information received from the private sensors to improve the quality of citizens' lives.

**Entrepreneurs** will be able to buy data directly from the sensors, bypassing bureaucratic procedures.



*This scenario is implemented by the non-profit organization "Airalab RUS".*

## Robonomics usecase №3

### ROBOT-ARTIST "GAKA-CHU"

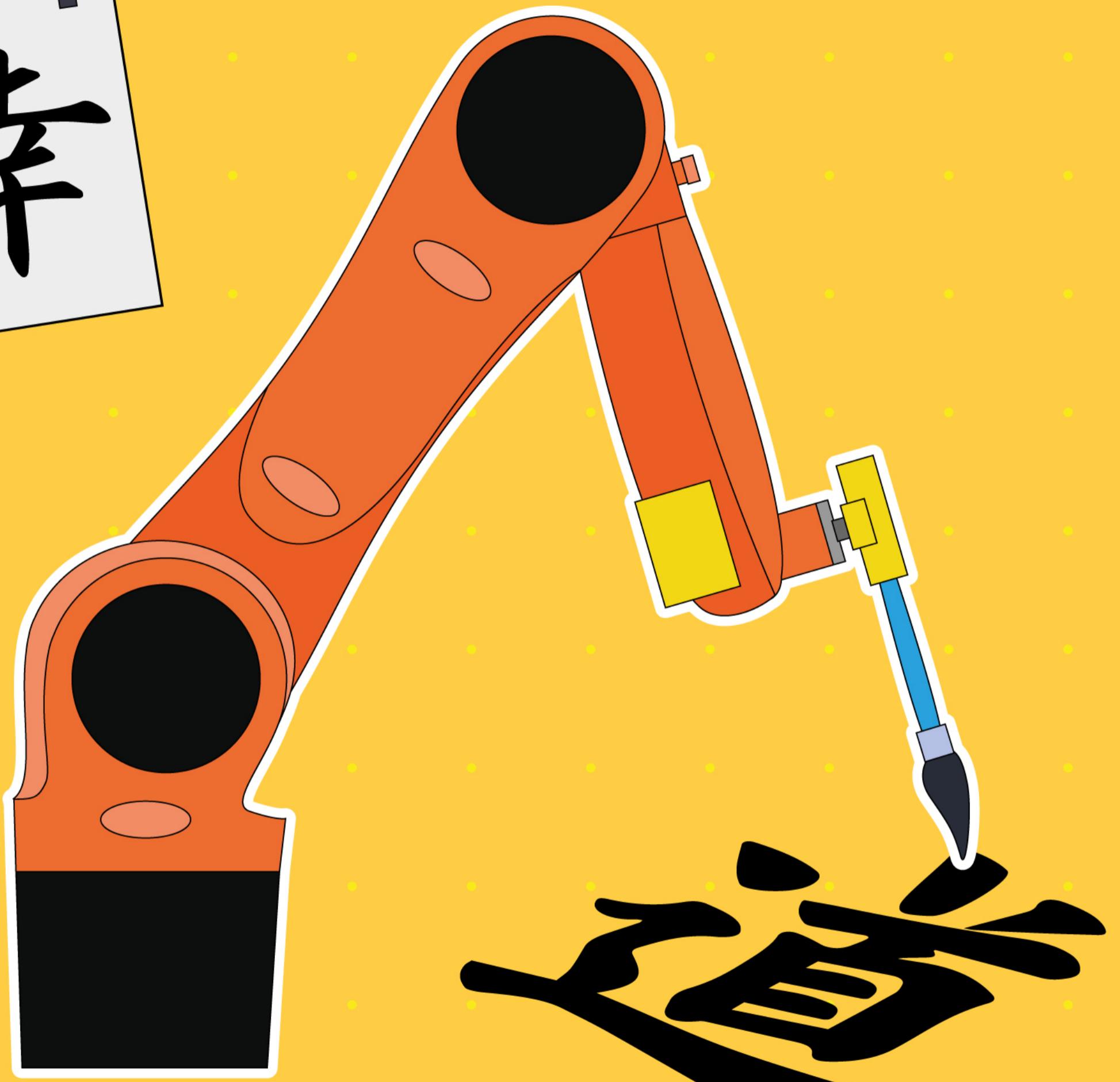
Modern technologies improve the lives of humans, making them more comfortable and fun, freeing up time for thinking and stimulating experimentation. It was a series of thoughts on the subject of the static nature of the industry that led our team of developers to the idea of carrying out an experiment showing an autonomous transformation of production to a specific type of product.

Such an experiment for us is the robot-artist: a small clumsy KUKA manipulator, living in the large world of serious industrial robots. His name is Gaka-chu. Why? "Gaka" in Japanese is an artist, and "chu" was added because of the inexplicable love for Pokemon.

The only earning of the artist was AIR-tokens. For these tokens he could buy some paint, brushes and pay for his dinner; that is, for electricity. Gaka-chu always stays positive and believes in the bright future of art.



In all seriousness, the robot-artist is an example of an adaptive industrial unit that independently performs economic interaction in accordance with the Robonomics protocol. Exploring the environment and image quality monitoring are provided with depth sensors and an RGB-camera. The image itself is synthesized by such cognitive services as Azure. The services analyze information from the social networks by trends and popular hashtags, and process it into a view that can be clearly displayed. This system clearly illustrates the full potential of technology development and the capabilities of the Robonomics protocol.



The scenario is implemented a student from ITMO University: Alexey Ovcharov.

# JOIN US

The Robonomics platform was created in order to solve social and economic issues associated with the total robotization of mass production, urban life and logistics. The main areas of the platform application can be considered the areas related to the solution of such tasks as creating trust in the services and products of smart cities and factories, providing direct user access to autonomous cyber-physical systems and managing multi-agent systems with the help of capital.

The Robonomics platform will allow for the expansion of the infrastructure capabilities of the Ethereum network in the context of Industry 4.0, IoT and smart cities.

## *for SOCIETY >>*

The Robonomics network increases the transparency of goods and services produced by machines, and allows us to track the process of production. Control over the fulfillment of the machines' liabilities is separated from commercial IT-companies that are partners of producers.

With the help of the Robonomics network, verification of the liabilities fulfilled by machines can be performed by Ethereum network validators that are also the decentralized arbitration built on an economic game.

## *for BUSINESS >>*

There is no need to search for such a mediator who can provide reliable information exchange and data storage, and who will be trusted by all participants in the supply chain. The information arising in the chain that is built with the help of the Robonomics network will create added consumer value due to an increase in production transparency.

## *for SCIENCE >>*

We work at ground zero of science, describing the opportunity of managing complex human-machine systems with the help of economic theory. This science is called economic cybernetics. We build our work on the ideas of Norbert Wiener, Ronald Coase and Victor Glushkov. We amplify the ideas of these remarkable scientists with our own experiments on building direct economic relations between humans and machines. Thus, with the help of theory and experiments, we develop a standard of high-level human-to-machine communication.

## *for DEVELOPERS >>*

- Create an added value through increasing the transparency of technological processes in the production of goods by smart factories;
- Create behavioral models of smart factories and cities on the basis of economically sensitive transactions, settled in the public Ethereum Blockchain;
- Design models of verification and fulfillment of contract liabilities by autonomous factories;
- Create autonomous systems for managing the economic relations of smart factories.



# JOIN + US

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