



Prototype of Non-Genetically Modified Soybean Tracking System Using Blockchain Technology

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Today's agenda

Introduction

Blockchain

Non-GMO Soybean Tracking System

Results

Conclusion

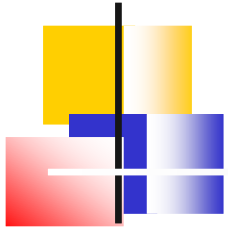
Introduction

Market for non-GMO soybean

Difficulties to produce non-GMO soybean


- Crop isolation
- Controls to avoid contamination
- Low non-GMO seeds availability

The aim of this work



This work proposes Non-GMO Soybeans Tracking System using Blockchain to trace samples tests and information from planting, passing through controls on cultivation, harvesting, and transportation to market delivery.

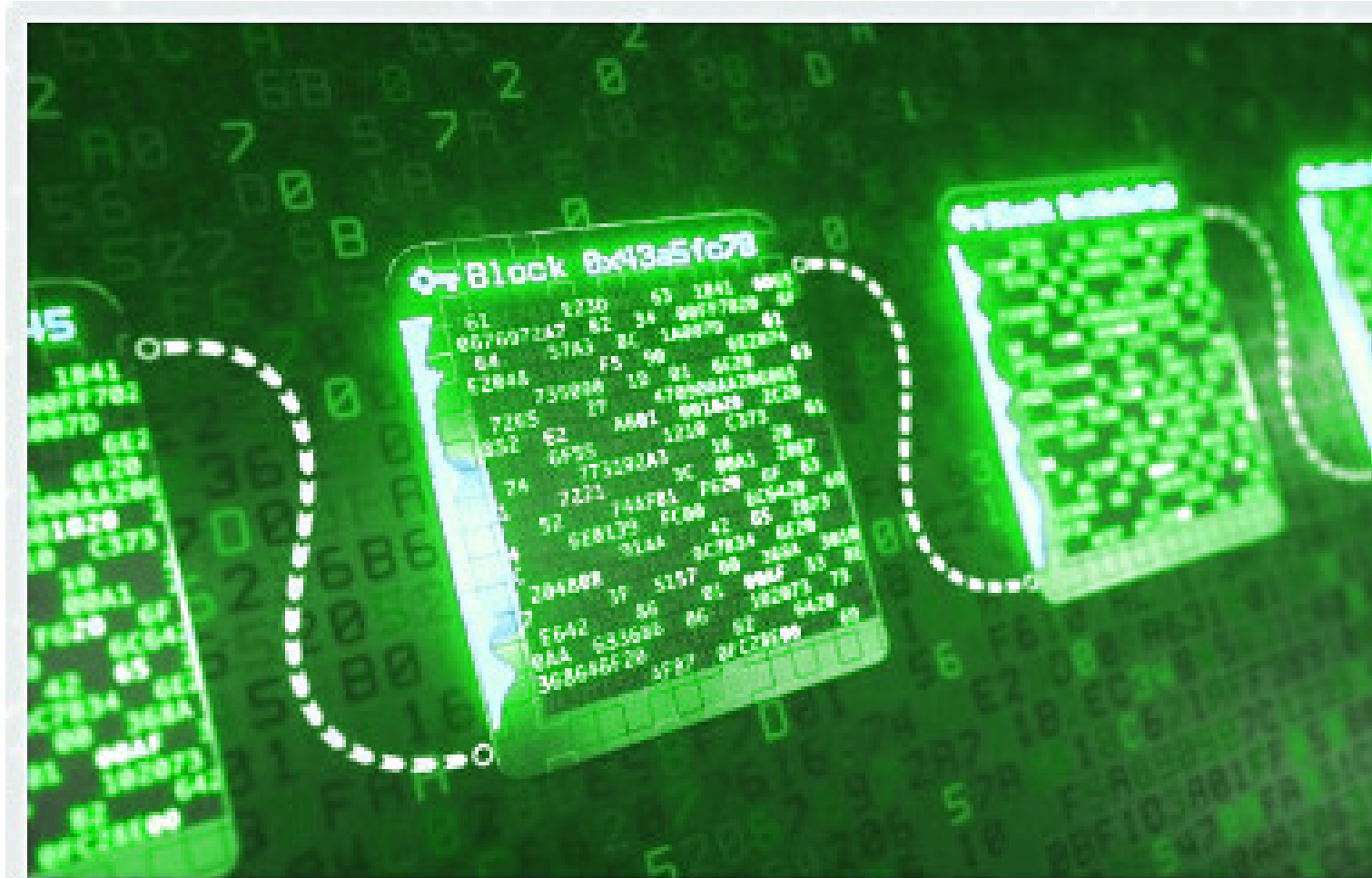
Blockchain



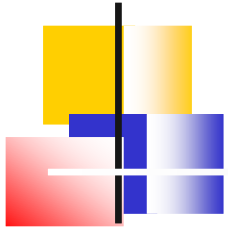
Blockchain is a system in which a record of transactions, especially those made in a cryptocurrency, is maintained across computers that are linked in a peer-to-peer network.



Blockchain



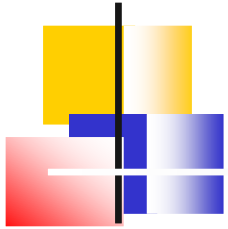
Smart Contract



Smart contracts are digital contracts stored on a blockchain that are automatically executed when predetermined terms and conditions are met.

Smart contracts can help reduce document forgery and increase accessibility.

Smart Contract



Smart contracts are suitable for use in area such as:

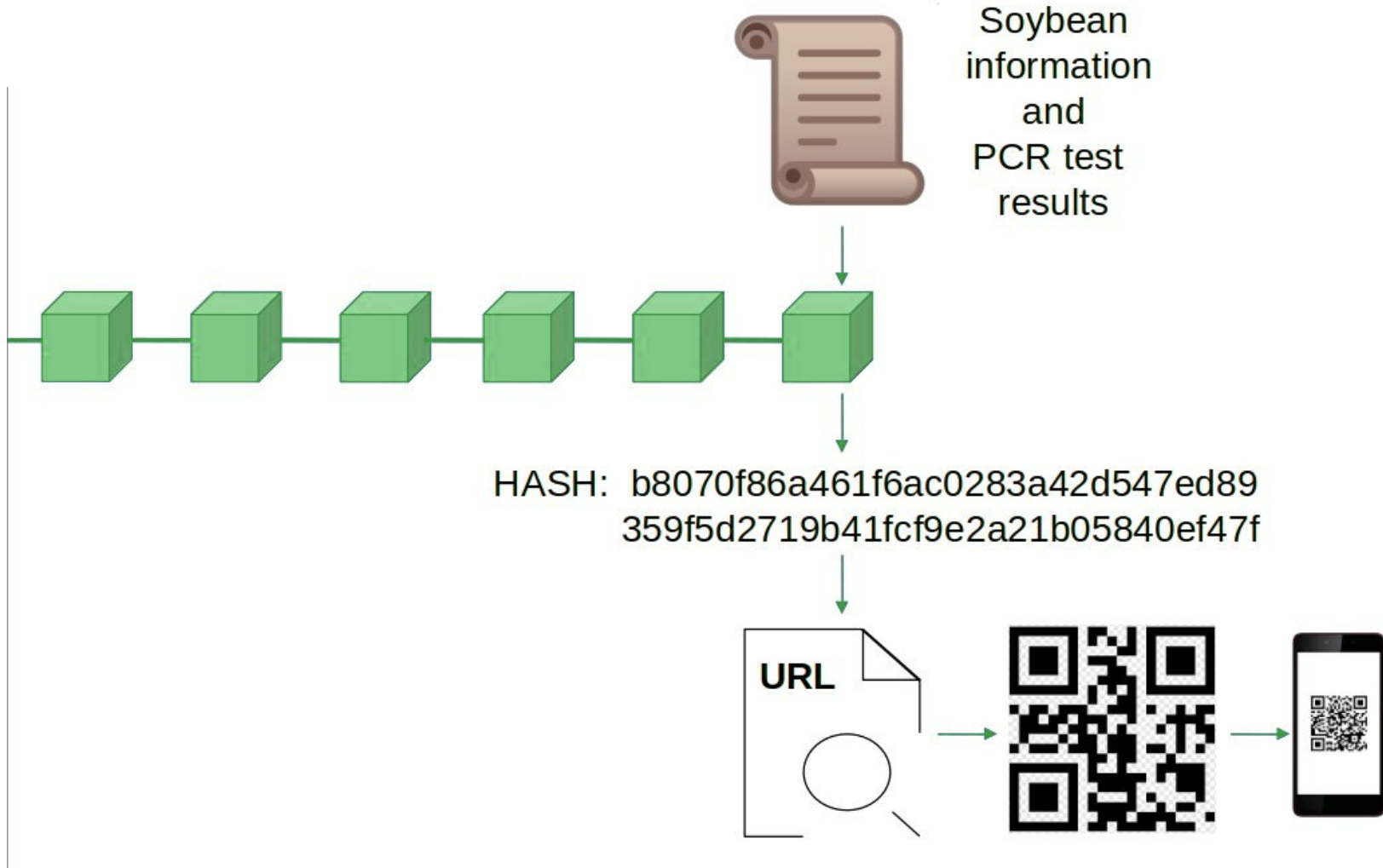
- Supply chain
- Ecommerce
- Tracking systems
- Internet of Things
- Data science and machine learning
- Legal contracts
- and many others

Non-GMO Soybean Tracking System

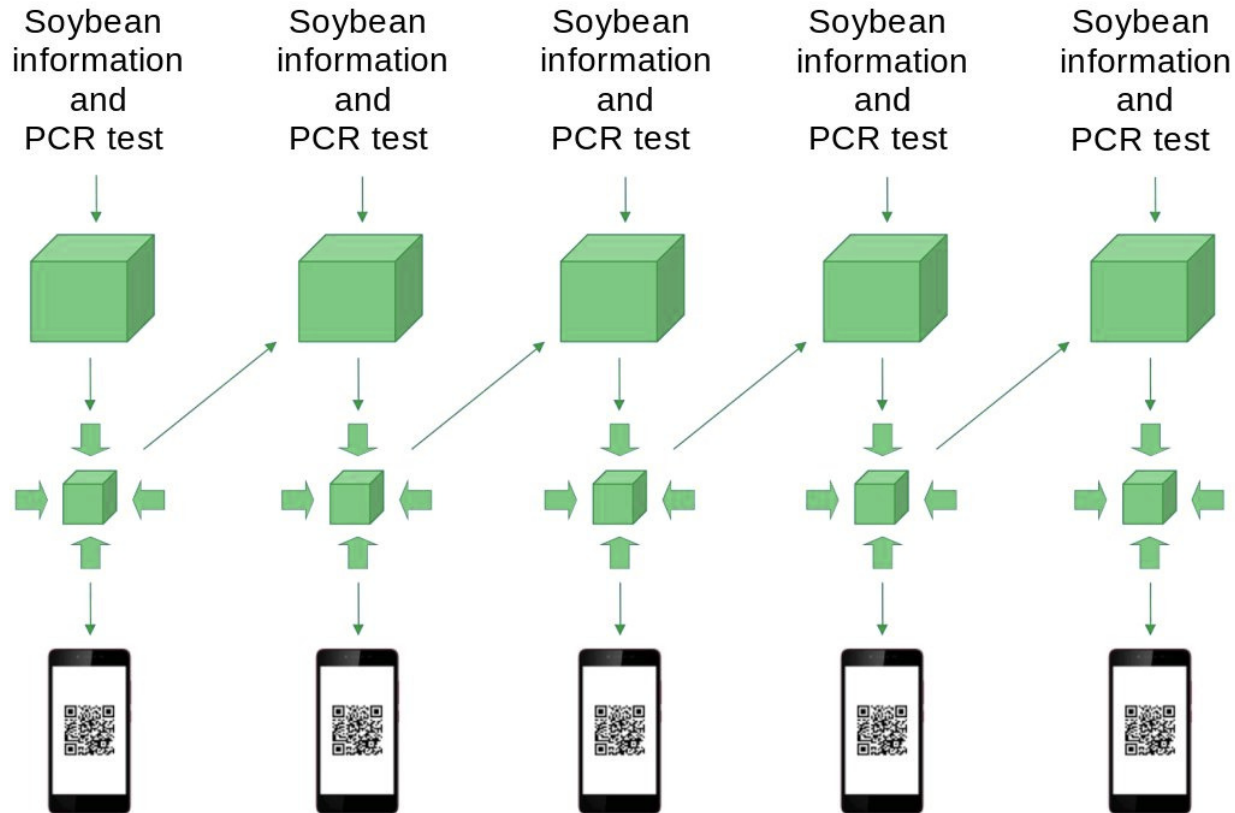


- The system uses blockchain because it is secure against tampering, generating reliability for auditors and consumers.
- Tracking system data flow
- Work Breakdown Structure – WBS
- Smart Contract

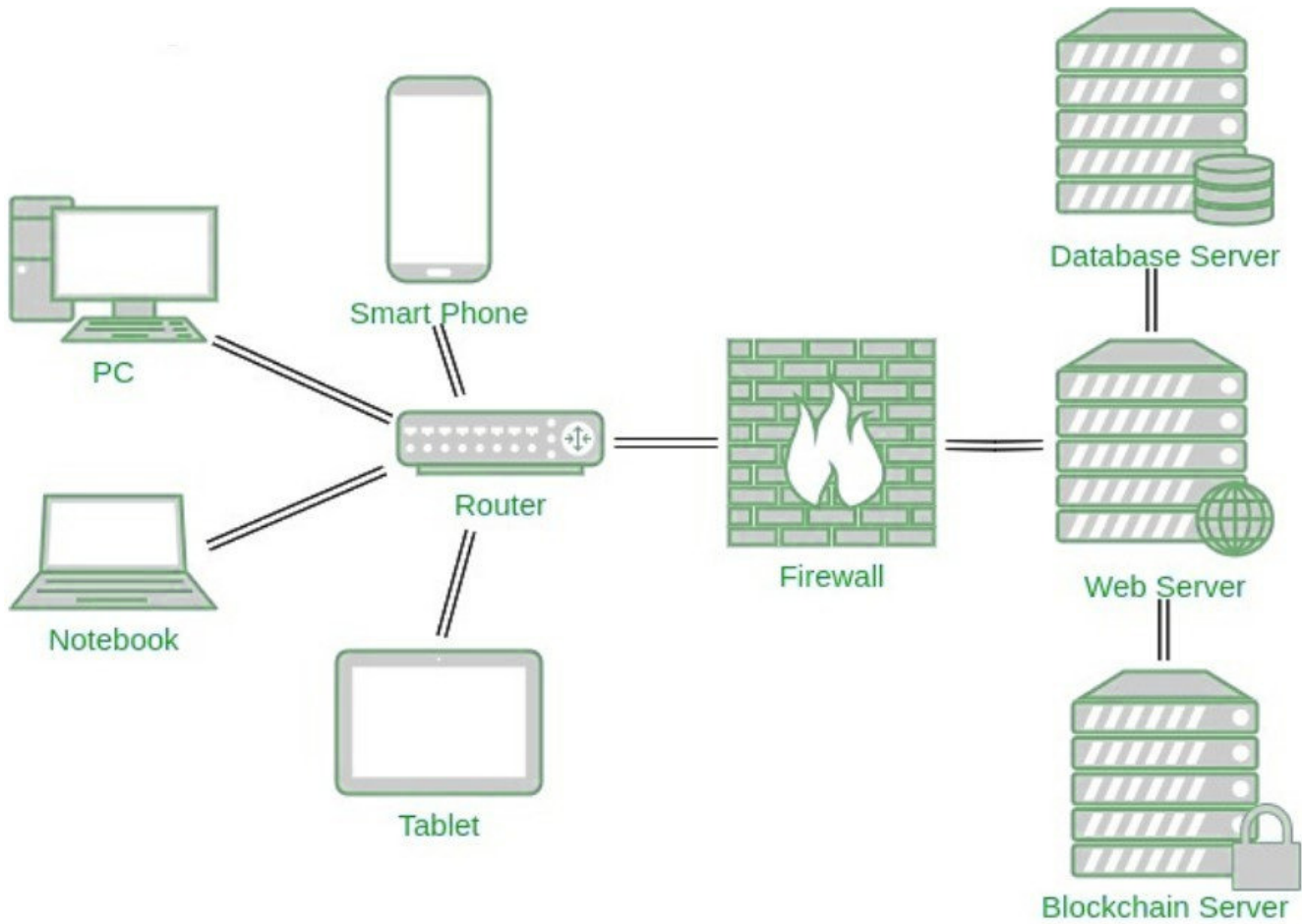
Tracking System Data Flow



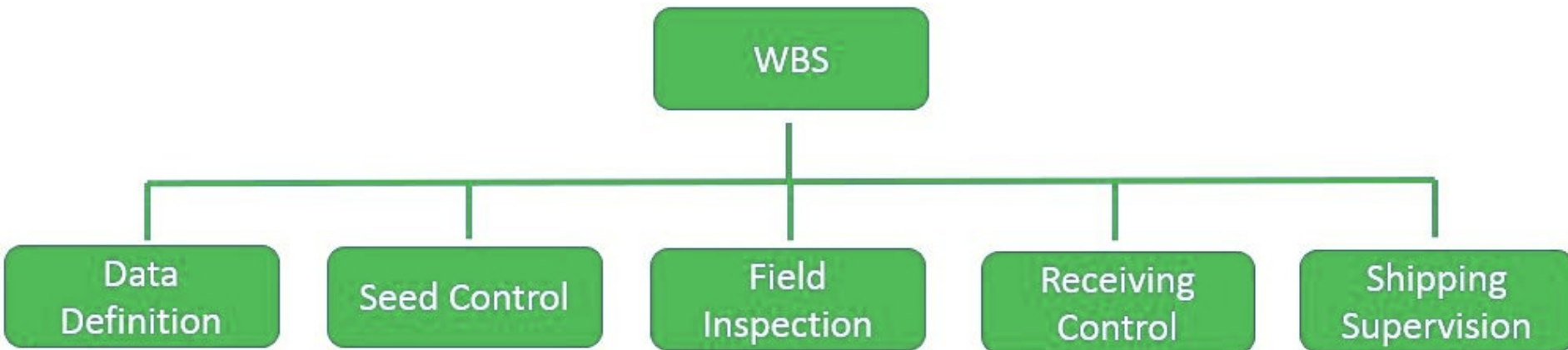
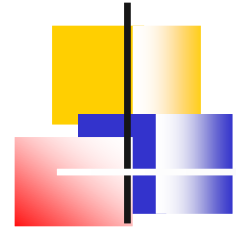
Soybean Tracking System



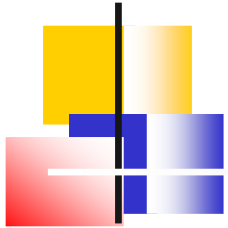
Network Diagram



WBS of the Non-GMO Soybean Tracking System

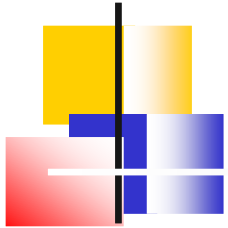


Data Definition



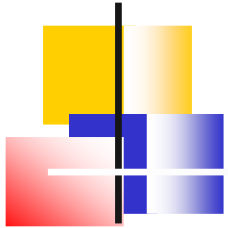
Data Definition is the first procedure, in which the variables to be written to the smart contract were defined.

Seed Control



This step seeks to identify the presence of transgenic soybean variety to avoid contamination of production fields, to ensure non-GMO soybean production.

Field Inspection

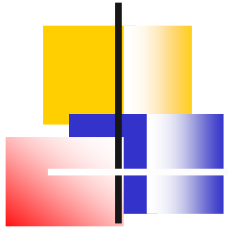


This procedure is to ensure that no varieties of transgenic soybeans are being cultivated by producers to avoid contamination with varieties of other origin.

The stages of this procedure are:

- sampling during the growing season;
- visits with cooperative technician and auditor;
- leaf test with SDI Trait

Receiving Control



The aim of this procedure is to ensure that vehicles containing transgenic soybeans are unloaded at the receiving units, thus avoiding contamination.

In this procedure PCR (Polymerase Chain Reaction) test is performed to sampling of all vehicles; the evidence will be stored for 90 days.

Shipping Supervision

The purpose of this procedure is to ensure that no contamination can occur in the vehicles during the shipment and product delivery. This stage includes a visual inspection of all vehicles, inspection records, and monthly record audits.

Smart Contract Development

remix.ethereum.org/#appVersion=0.7.7&optimize=false&version=soljson-v0.4.2+commit.af6afb...



browser/SoyTracking.sol



Compile

Run

Analysis

Testing

Debugger

Settings

Support

```
1 pragma solidity ^0.4.2;
2
3 contract SoyTracking {
4
5     uint public _lot_number;
6     bool public _seed_control_status;
7     uint public _seed_control_sample;
8     uint256 public _seed_control_date;
9     bool public _field_inspection_status;
10    uint public _field_inspection_sample;
11    uint256 public _field_inspection_date;
12    bool public _receiving_control_status;
13    uint public _receiving_control_sample;
14    uint256 public _receiving_control_date;
15    bool public _shipping_supervision_status;
16    uint public _shipping_supervision_sample;
17    uint256 public _shipping_supervision_date;
18
```

Switch to the new interface!

Current

version:0.4.2+commit.af6afb04.mod.Emscripten.clang

Select new compiler version

Auto compile

Enable Optimization

Hide warnings


Start to compile (Ctrl-S)

Smart Contract (Data Definition)

browser/SoyTracking.sol

```
116 struct SoyInf {
117     address sender;
118     uint lot_number;
119     bool seed_control_status;
120     uint seed_control_sample;
121     uint256 seed_control_date;
122     bool field_inspection_status;
123     uint field_inspection_sample;
124     uint256 field_inspection_date;
125     bool receiving_control_status;
126     uint receiving_control_sample;
127     uint256 receiving_control_date;
128     bool shipping_supervision_status;
129     uint shipping_supervision_sample;
130     uint256 shipping_supervision_date;
131 }
132
133 mapping(uint => SoyInf) public msi;
```

Smart Contract (Seed Control)



```
browser/SoyTracking.sol x
144 event LogSeedControl(address sender, uint lot_number, bool l
145
146 function SeedControl () public returns(bool success) {
147     if (_lot_number==0) throw;
148     if (_seed_control_sample ==0) throw;
149     if (_seed_control_date < 20190101) throw;
150     lotCounter = lotCounter + 1;
151     lotKey = _lot_number;
152     msi[lotKey].sender = msg.sender;
153     msi[lotKey].lot_number = _lot_number;
154     msi[lotKey].seed_control_status = _seed_control_status;
155     msi[lotKey].seed_control_sample = _seed_control_sample;
156     msi[lotKey].seed_control_date = _seed_control_date;
157     mlc[lotCounter].lotCount = _lot_number;
158     LogSeedControl(msg.sender, _lot_number, _seed_control_sta
159
160     return true;
161 }
```



Results

Software Simulation

Compile **Run** Analysis Testing Debugger Settings Support

Environment JavaScript VM VM (-)

Account **0xca3...a733c (100 ether)**

Gas limit

Value

0xca3...a733c (100 ether)

0x147...c160c (100 ether)

0x4b0...4d2db (100 ether)

0x583...40225 (100 ether)

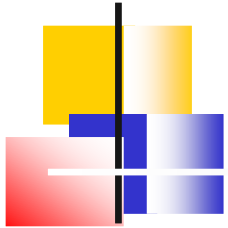
0xdd8...92148 (100 ether)

Deploy

or

At Address

Results



Smart Control Simulation – Seed Control

set_seed_control_date 20191112



set_seed_control_sample 15



set_seed_control_status 1



SeedControl

Data Stored in Blockchain

```
[vm] from:0xca3...a733c  
to:SoyTracking.SeedControl() 0x692...77b3a  
value:0 wei data:0x85c...612f5 logs:1  
hash:0x694...2e447
```

status	0x1 Transaction mined and execution succeed
transaction hash	0x694ff3c650dd72b534ee9a77498eaea7af8ebdf7051f4c1a077dfbb0a1c2e447 
from	0xca35b7d915458ef540ade6068dfe2f44e8fa733c 
to	SoyTracking.SeedControl() 0x692a70d2e424a56d2c6c27aa97d1a86395877b3a 
gas	3000000 gas 
transaction cost	189422 gas 
execution cost	168150 gas 
hash	0x694ff3c650dd72b534ee9a77498eaea7af8ebdf7051f4c1a077dfbb0a1c2e447 

Data Stored in Blockchain

logs

```
[
  {
    "from": "0x692a70d2e424a56d2c6c27aa97d1a86395877b3a",
    "topic": "0x06dcee28f10347f26afb2b0a3b433176ebb010f34497d6865ae1f78692f7c30b",
    "event": "LogSeedControl",
    "args": {
      "0": "0xCA35b7d915458EF540aDe6068dFe2F44E8fa733c",
      "1": "789",
      "2": true,
      "3": "15",
      "4": "20191112",
      "sender": "0xCA35b7d915458EF540aDe6068dFe2F44E8fa733c",
    }
  }
]
```

Smart Control Simulation

Field Inspection

set_field_inspectio
n_date

20191113



set_field_inspectio
n_sample

25



set_field_inspectio
n_status

1



FieldInspection

Smart Control Simulation

Receiving Control

set_receiving_control_date 20191114

set_receiving_control_sample 33

set_receiving_control_status 1

ReceivingControl



Smart Control Simulation

Shipping Supervision



set_shipping_supervision_date	20191115	∨
set_shipping_supervision_sample	55	∨
set_shipping_supervision_status	1	∨
ShippingSupervision		

Smart Control Simulation



Compile Run Analysis Testing Debugger Settings

msi 789

0: address: sender
0xCA35b7d915458EF540aDe6068dFe2F44E8fa733c

1: uint256: lot_number 789

2: bool: seed_control_status true

3: uint256: seed_control_sample 15

4: uint256: seed_control_date 20191112

5: bool: field_inspection_status true

6: uint256: field_inspection_sample 25

7: uint256: field_inspection_date 20191113

8: bool: receiving_control_status true

9: uint256: receiving_control_sample 33

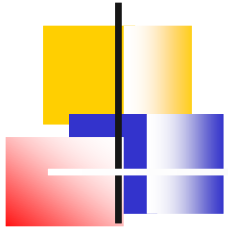
10: uint256: receiving_control_date 20191114

11: bool: shipping_supervision_status true

12: uint256: shipping_supervision_sample 55

13: uint256: shipping_supervision_date 20191115

Conclusion



Blockchain is a reality and suitable for applications in which the available information needs to provide security to partners and consumers.

The traceability system prototype was developed only on the smart contract, still missing the interfaces, but it is possible to notice its effectiveness.



Thank you

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