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DISIM
Dipartimento di Ingegneria
e Scienze dell'Informazione
e Matematica

Case Studies of Distributed Ledger Technology in Construction and Agriculture

7th DLT Working Group Meeting 2025

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DLT in IoT scenarios

Distributed Ledger Technologies are emerging as trustworthy infrastructures for real-world Internet of Things systems, ensuring transparency, traceability, and data immutability.

- 1  **Decentralized security** (no single point of failure)
- 2  **Immutable logs** to prevent tampering
- 3  **Cryptographic identity** for devices, improving authentication
- 4  **Decentralized Device Management** secure, distributed device registration

DLT in IoT

Distributed Ledger Technologies enable decentralized, tamper-proof, and auditable management of data in cyber-physical environments. Beyond financial use, these technologies have matured into enabling infrastructures for digital trust in public administration, engineering, and agriculture.

Introduction – DLTW 2025

Case Studies of Distributed Ledger Technology in Construction and Agriculture

Dissemination Work

Two independent case studies that demonstrate the applicability of the technology in distinct operational domains:

1

Constructions & Building documentation:

Building Ledger Dossier (BLD) for digital documentation and seismic-damage mitigation in construction.

2

Agriculture:

IOTA-based smart agriculture system for secure real-time monitoring.

Applications: Trackability in Constructions – DLTW 2025

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Practical Application

Distributed and verifiable framework for managing building documentation and post-event reconstruction evidence.



- Digital Twin models, implemented on **OpenSees**, for simulating structural behavior and documenting updates;
- **IPFS** decentralized storage for long-term archival of official documents;
- NFT-based certification to uniquely identify dossiers and related interventions, and visible on **Opensea** public repository;
- **DAO-governed** workflows involving Installers, Engineers, and Directors of Works.



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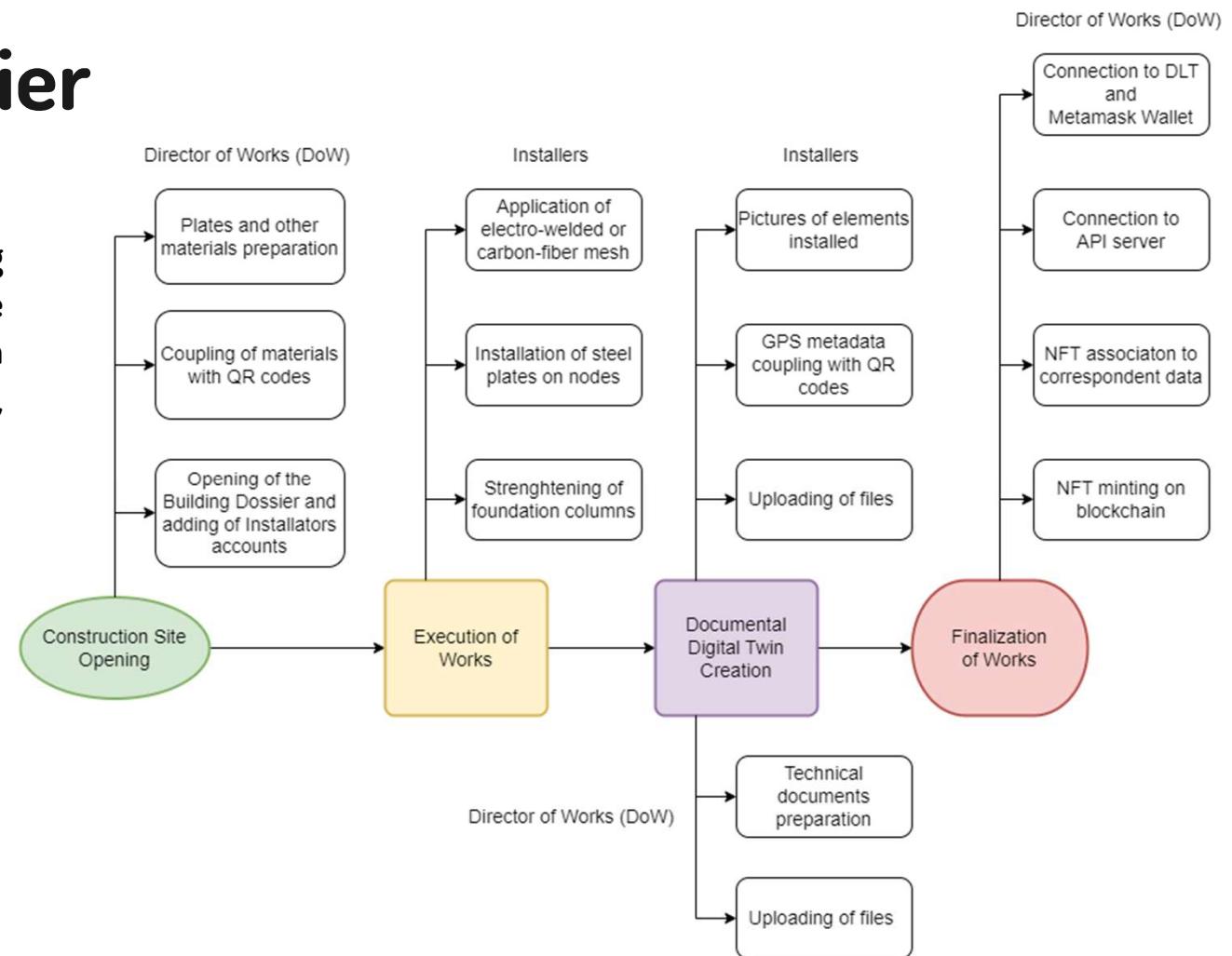
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Building Ledger Dossier

G. De Gasperis, S. D. Facchini, A. Saeed, **Building ledger dossier: Case study of seismic damage mitigation and building documentation tracking through a digital twin approach**, Systems 13 (2025)529.

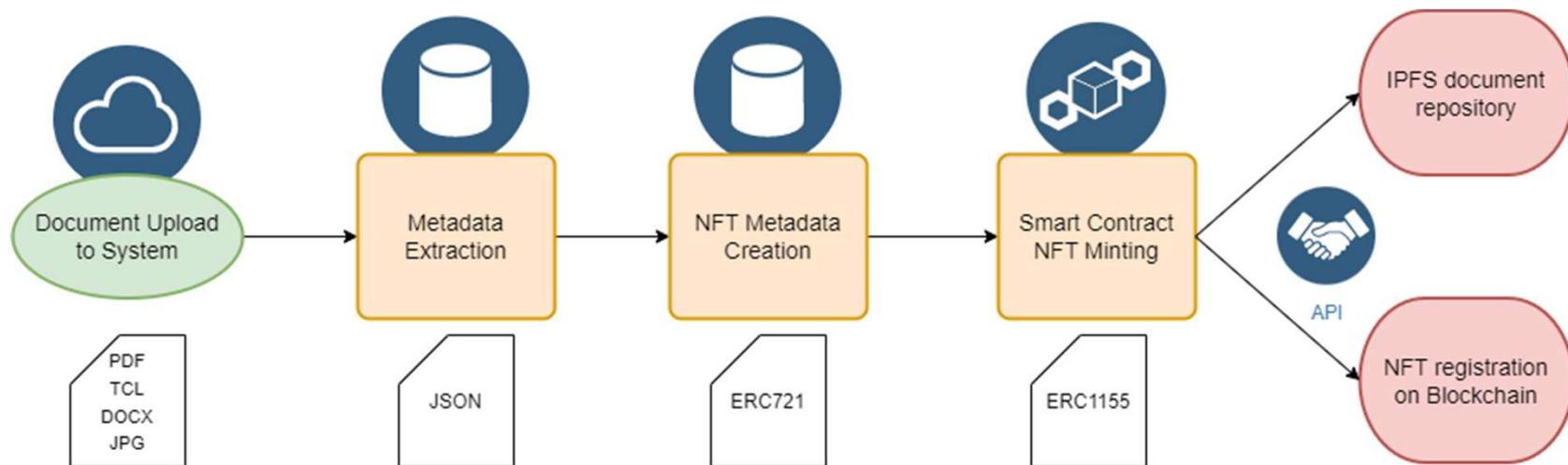


Applications: Trackability in Constructions – DLTW 2025

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Tokenization Progress

Modeling of the tokenization process of Building Dossier's documents.



For each phase is reported the type of document involved and the sub-process (in white) and the medium used (in blue). Once the documents are ready a smart contract provide to interact through API calls with DLT.

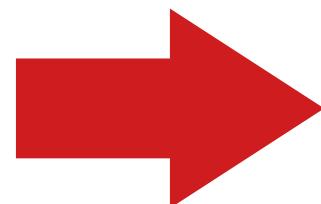


Applications: IoT in Agriculture – DLTW 2025

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RT monitoring with IOTA

"Monitoring Real-Time Data for Smart Agriculture using IOTA and IoT" (in publication EEE BCCA 2025 proceedings)



High Scalability

High Throughput

Low Latency

Feeless



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Why we chose Move

Security & Formal Verification: Move provides strong safety through resource-oriented programming, preventing bugs like double-spending or data loss.

Efficiency & Parallelism: Move's modular design allows fast, parallel execution of smart contracts, improving IOTA's scalability.

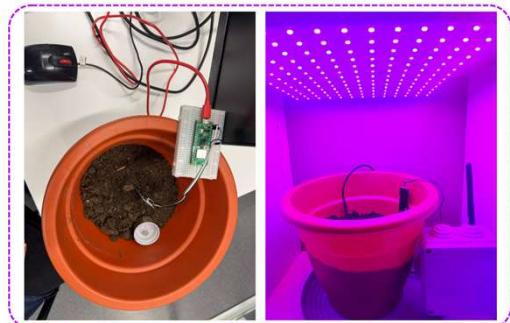
Asset-Native Model: Move treats digital assets as first-class objects, fitting perfectly with IOTA's object-based ledger.

Cross-Chain Interoperability: Using Move aligns IOTA with other Move-based ecosystems (Aptos, Sui), enabling easier cross-chain decentralized application development.

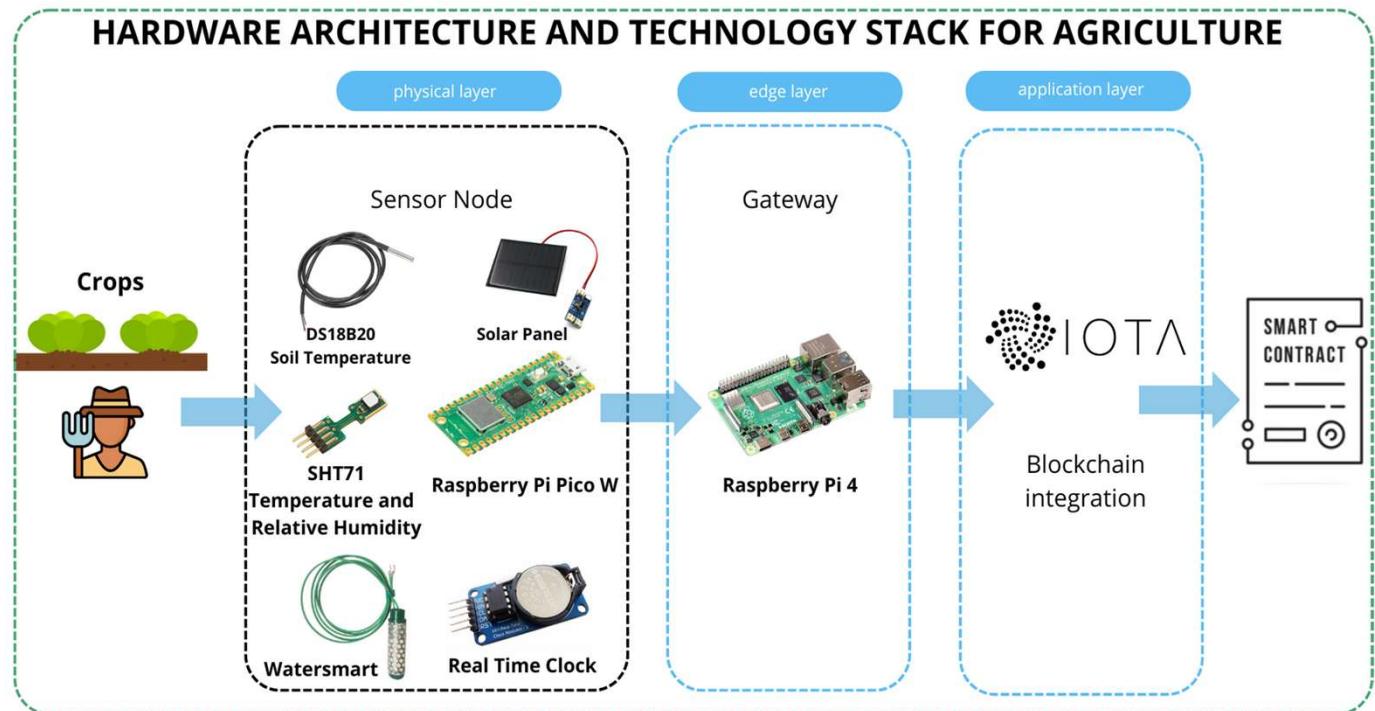
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Technology Stack



| Component | Current (mA) | Voltage (V) | Power (mW) | Description |
|---------------------------------|--------------|-------------|------------|--------------------------------------|
| Raspberry Pi Pico W | 130 - 150 | 3.3 | 429 - 495 | Data transmission |
| SHT71 Sensor | 0.55 - 1.0 | 3.3 | 1.8 - 3.3 | Brief consumption during measurement |
| DS18B20 Sensor | 1.5 | 3.3 | 4.95 | Low consumption per reading |
| Capacitive Soil Moisture Sensor | 10 - 20 | 3.3 | 33 - 66 | Consumption |



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Results

| Functions | IOTA gas cost | USD gas cost |
|--------------------------------|---------------|--------------|
| log_sensor_data | .001 IOTA | 0.00023\$ |
| is_within_range | .001 IOTA | 0.00023\$ |
| is_time_in_range | .001 IOTA | 0.00023\$ |
| verify_sensor_data_with_ranges | .001 IOTA | 0.00023\$ |

```
shahid@Shahid:~/dev/Iota/first_package/sources$ python execute_smart_contract.py
Connected to port /dev/ttyACM0. Receiving data...
Data received: Sensor ID: 1; Temperatura ambiente: 20.96 C; Humedad del suelo: 72.00%; Temperatura del suelo: 20.67 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.96 C; Humedad del suelo: 72.00%; Temperatura del suelo: 17.22 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.96 C; Humedad del suelo: 72.00%; Temperatura del suelo: 21.77 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 33.80 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.96 C; Humedad del suelo: 72.00%; Temperatura del suelo: 22.57 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 16.11 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 19.55 C; Humedad del suelo: 72.00%; Temperatura del suelo: 24.88 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.02 C; Humedad del suelo: 72.00%; Temperatura del suelo: 16.53 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 31.83 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 32.86 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 25.53 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 18.76 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 20.49 C; Humedad del suelo: 72.00%; Temperatura del suelo: 29.23 C
Sensor data logged successfully!
Data received: Sensor ID: 1; Temperatura ambiente: 21.43 C; Humedad del suelo: 72.00%; Temperatura del suelo: 30.74 C
```

| Type | Activity Details | Activity With | Gas Fee | Age |
|-----------------|---------------------|---------------------|------------------------------|--------|
| log_sensor_data | 95THY4pB***Ajmk7U21 | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 8m |
| log_sensor_data | 3hXVsZf***DsQrpXbA | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 9m |
| log_sensor_data | Dc2UvCrK***Zq48ySds | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 10m |
| log_sensor_data | 6FUmshbQ***n4kM1tMh | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 11m |
| log_sensor_data | Aoww2i4Y***xXtnDYY | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 12m |
| log_sensor_data | 9tLAhVHG***XpFhAjQ1 | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 13m |
| log_sensor_data | 28Crk9Bx***dPjwduu2 | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 14m |
| log_sensor_data | 2EYhHwK7***80MmQ75P | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 15m |
| log_sensor_data | HkhyAerJ***hMBUVQpd | 0xb8f5a3***acb29acc | 0.001 IOTA 1,000,000 NANO | 1h 16m |



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Thanks for you Attention!

DLT Workshop 2025

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