The State of the Art for Blockchain-Enabled Smart-Contract Applications in the Organization

Chibuzor Udokwu, Aleksandr Kormiltsyn, Kondwani Thangalimodzi, Alex Norta

Tallinn University of Technology, Blockchain Research Group
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Agenda

- Background information
- State of the art
- The current gap and research questions
- Literature review method
- Analysis of results
- Discussions
Background information

- **Blockchain** – a distributed ledger that allows participants to write and update records on the ledger

- **Nodes and virtual machines** – nodes that are connected in peers and each participating node has a copy of the ledger

- **Consensus mechanism** - agreed method for adding new records to the blockchain by the participating nodes (voting- and proof-based)

- **Programming smart contracts** – are stored and executed in blockchain nodes
State of the art

- **Organizations face new challenges**
  - information security
  - trust and transparency
  - decentralization of working processes

- **Blockchain and Smart Contracts new opportunities**
  - security
  - transparency
  - no involvement of a third-party

- **Early Adoption phase**
  - Scientific researches
  - Business projects
  - ICOs

- **Over 1600 Cryptocurrencies**
The current gap and research questions

• **Current gap:**
  • Little is known about the adoption of smart contracts in organizations

• **Research questions:**
  • How to successfully adopt smart contracts in modern organizations?
  
  • What are the domains of smart-contract applications in established organizations?

  • What are the main benefits of smart-contract applications in these organization domains?

  • What are the issues limiting the gains of smart contract usage in the organizations?
Literature review method

- Systematic literature review method
- 4 phases
  - **Phase 1:** Review of the purpose and protocol of the study
  - **Phase 2:** Searching the literature and practical screening
  - **Phase 3:** The quality appraisal and data extraction is presented
  - **Phase 4:** Analyze the findings
Literature review method: Phase 1

Planning:
• Keywords
• Date period
Literature review method: Phase 2

Search criteria:
• Google scholar, academic articles
• Journal papers, conference papers, white papers
• 2013 – 2018 years
• Keywords:
  • Smart contract + business
  • Smart contract + organization
  • Smart contract + enterprise
  • Distributed autonomous organization + business
  • Decentralized autonomous organization + enterprise
  • Problem + blockchain
  • Problem + decentralized autonomous organization
  • Problem + smart contract
Literature review method: Phase 2

Exclusion criteria:

- First step:
  - Not relevant to the study
  - Duplicates
  - No full text available

- Second step:
  - High quality white paper?
  - Journal paper?
  - Peer-reviewed conference paper?
  - Article on smart-contract application in an organization?
Literature review method: Phase 2

- **Initial search**: N = 469
- **Exclusion by exclusion criteria**: N = 421
- **Review and the analysis**: N = 48
Literature review method: Phase 3

- **Data extraction** from eligible papers based on the research questions
- **Information collection** from articles to serve as a raw material for the analyses
Literature review method: Phase 4

- **Extraction and combination** of essential facts using quantitative techniques

- **Data analysis**

- **At the final stage:**
  - 81% are peer-reviewed publication
  - 2017 – 59%, 2017 and after – 75%
Analysis of results

Analysis is based on

- Year of publication
- Type of publication
- Subcategories to identify the properties of the smart contract

Statistics

- **66.67%** of projects are prototyped in Ethereum
- **87.5%** - projects for private organizations
- **75%** of implemented projects are for private organizations
- **62.5%** working or prototype projects
- **37.5%** theoretical description and proposed frameworks
- **50%** of projects are hosted on Ethereum and Hyperledger Fabrik
The domains adopting smart-contract applications

- Supply change management (SCM), Finance, Healthcare, Information security, Smart city, Internet of Things (IoT)
- Business process management (BPM), Enterprise collaboration, Cloud computing, Organizational governance, E-Voting
The domains with implemented smart-contract applications
The main benefits of smart-contract applications in these organization domains:

- Transparency, trust: 44%
- Tamper proof: 12.12%
- Interoperability: 9.1%
- Reduce costs: 9.1%
- Privacy: 6.1%
The issues limiting the gains of smart contract usage in the organizations

Limitations affecting blockchain technologies

- Digital signature: 55.6
- Consensus: 50
- Solidity: 38.9
- Nodes: 27.8
- Consensus (PoW): 27.8
The issues limiting the gains of smart contract usage in the organizations
Public and private blockchain networks challenges and limitations

- 50% public blockchain
- 75% of implemented projects in private blockchains
The severity of limitations of blockchain

- **Usability**, complexity, and design architecture issues, standardization, lack of testing and practical experience

- **Scalability** – storage, regulation, soundness of smart contracts, security flaws and bugs, privacy leakage and smart contract lifecycle management, non-tested consensus methods

- **Anonimity**, scalability – time, transaction cost, cryptocurrency unpredictability, unsustainable consensus method, trusted third party involvement, liquidity problem
Discussions

- The idea of smart contracts was first presented in 1994 but serious effort to develop organization-blockchain application start in 2017
- Military applications are usually classified and not available in public domains (1200 results in Google Scholar for “military blockchain applications”)
- Switch to Proof of Stake consensus mechanism to solve time scalability and resource wastage issue (QTUM, Ethereum)
- No fault injection frameworks for testing blockchain implementations
- Choose appropriate consensus to support business requirements
- Overregulation stifles innovation
- Researches of smart contract lifecycle management
- Blockchain cloud platforms (BaaS)
Questions?