

A Blockchain-Based platform for the e-Procurement management in the Public Sector

Hasna ELALAOUI ELABDALLAOUI, Abdelaziz ELFAZZIKI, Mohamed SADGAL

*Computer Science Department, Faculty of Sciences Semlalia
Cadi Ayyad University, Marrakech, Morocco*

h.elalaoui@edu.uca.ac.ma

MEDI 2021
Tallinn, Estonia, 21 – 23 June 2021

Plan

- Introduction
 - **Problematics**
 - **Motivations**
 - **Objectives**
- Literature review
- The proposed solution: A blockchain-based platform
 - **The infrastructure components**
 - **The proposed procurement management process**
 - **The smart contracts**
- A Decentralized Application ‘Dapp’ for the public procurement
 - **Case study: Moroccan Process of awarding open tenders**
 - **Overall presentation**
 - **Implementation & Results**
- Conclusion
 - **Contributions**
 - **Limits**

Introduction

Problematics

Public procurement sector in Morocco

- Public procurement in Morocco represents around 160 billion dirhams, or 17% of GDP.
- The construction sector generates 70% of its turnover through public procurement.
- The engineering sector generates 80% of its turnover in the same field.
- The public procurement sector suffers from **corruption**
- Small startups never have their chances against big enterprises



Socio-economic impacts beyond the efforts of all decision makers

Introduction

Motivations

The blockchain technology



- Permanent and tamper-proof record-keeping, real-time audibility, and automated “smart contracts”.
- Increases uniformity, objectivity, and transparency.
- Makes it difficult to delete records or to modify offers once submitted.
- Improves oversight, and record-keeping transparency, and delegates power to authorities who may be prone to corruption.

Introduction

Objectives

- A platform that allows authorities and bidders to conduct bidding and evaluation processes automatically.
- A platform allowing third parties such as decision-makers and citizens to monitor and report risky activities in real-time.
- To take into account key success parameters in public procurement using Morocco as a case study.
- The platform elaboration crops a set of concrete recommendations as a concept study.

Literature review

- According to [R. Weissbarth et al.], blockchain technology has great potential to dramatically improve procurement systems, especially concerning data integration between business functions.

Country	Authors	Problematic	Solution
Russia	N.G. Kosyan (2019)	poor quality public procurement management problems	<ul style="list-style-type: none">• Creating reputation lists accessible to all participants in this process.• The use of a smart contract to minimize the number of intermediaries in public contracts.
Nigeria	T.I. Akaba, A. Norta, C. Udokwu, D. Draheim (2020)	Lack of trust and transparency among stakeholders in the procurement process.	A blockchain-based framework to increase citizen and reporting of more transparent projects.
Indonesia	S.N. Yutia, B. Rahardjo (2019)	the bid selection process in Indonesia is full of competition	<ul style="list-style-type: none">• Adopting a blockchain to reduce the source of fraud.• To explore the process of developing a blockchain-based system.

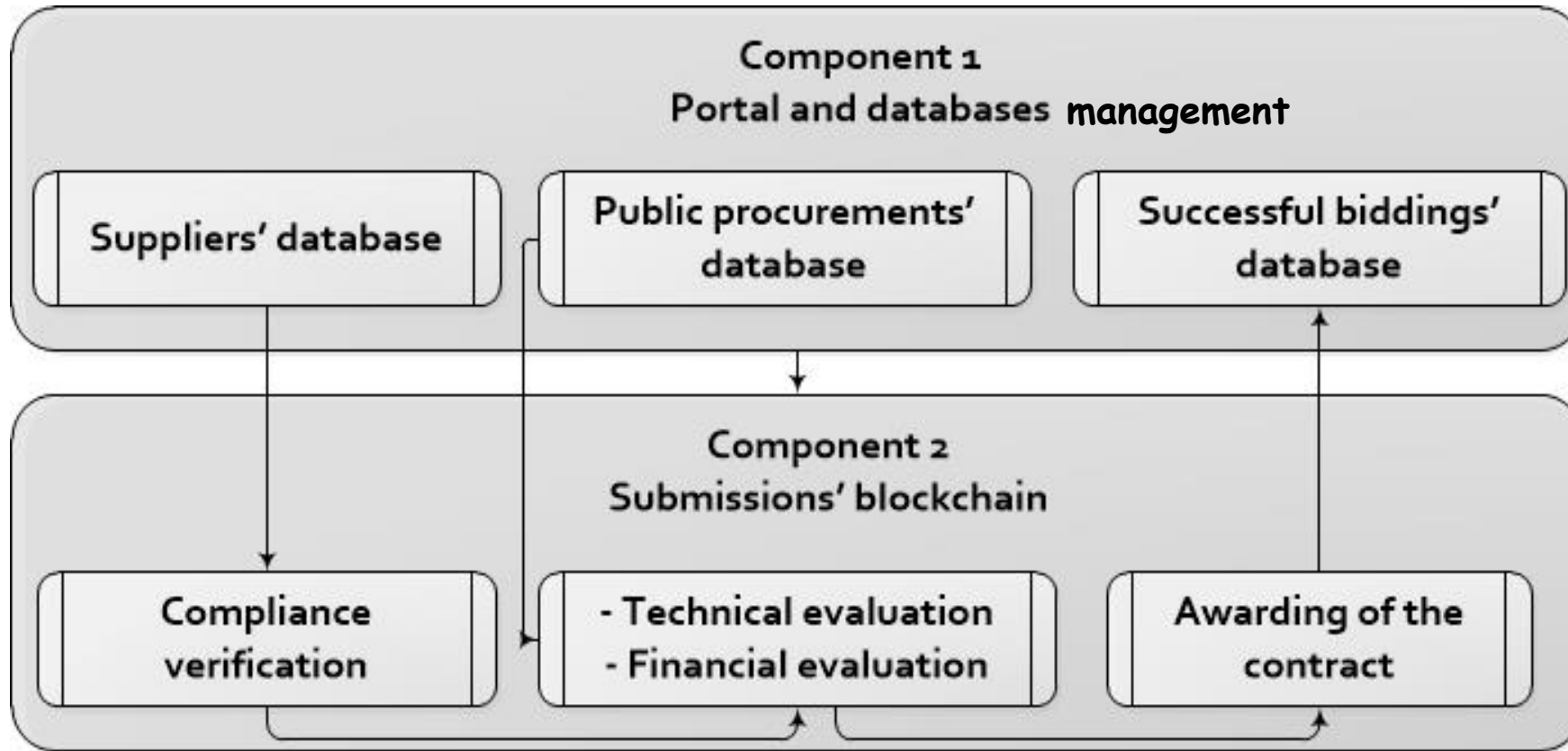
The proposed blockchain-based platform

Alignment of the traditional procedure vs. blockchain procedure

Traditional activity	Dematerialized Activity	Implementation
Registration	Registration of suppliers and administrators.	Accounts with private/public key pair.
Folds sending	Submission of the offer	Preparation of the transaction
Fold reception	Deadline Verification and Receipt of bids	'isOnDelay' function : 'Register_Submission' contract
		'Register' function : 'Register-Submission' contract.
Opening of bids in public session	Verification of compliance	'compliance_review' function : 'Assess_offer' contract.
Review and evaluation of bids	Review and evaluation of bids	'OF_OT_assessment' function : 'Assess_offer' contract
Choice of the offer	Awarding of the contract	'Attribution' function : the 'Assess_offer' contract
Publication of results	Insertion in the database of successful bids	Launch of the verification_confirmed event of the second contract.

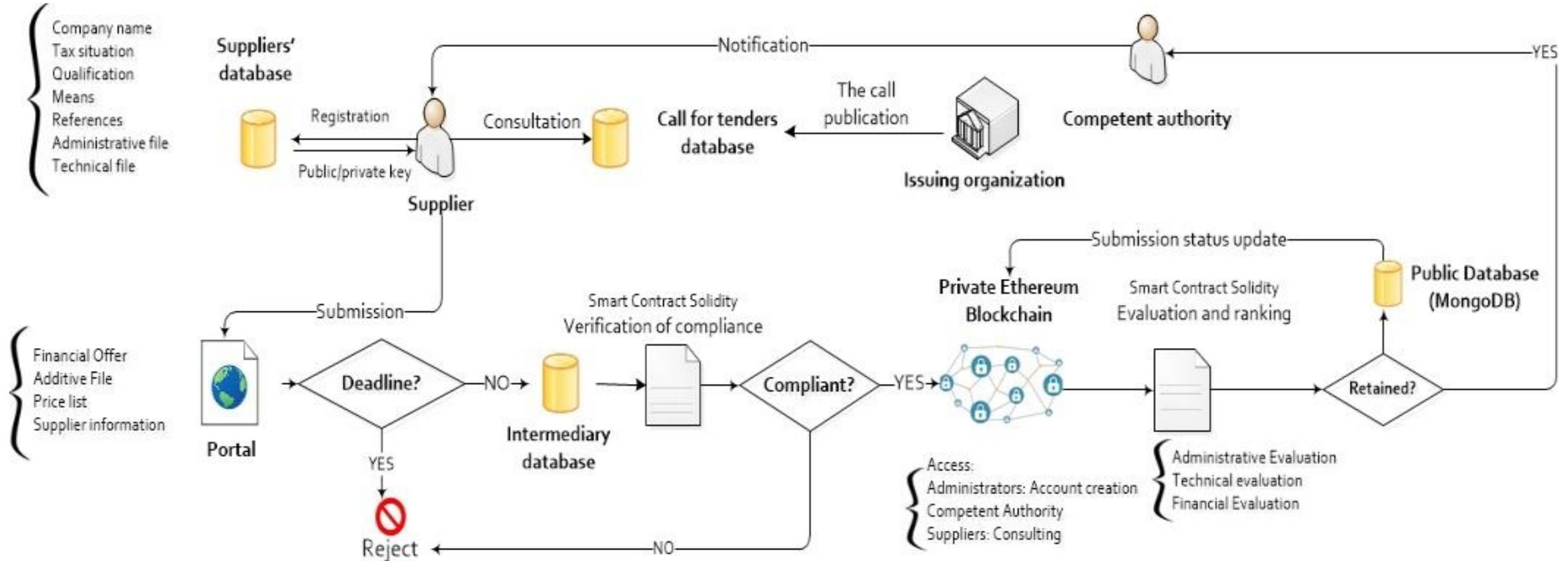
The proposed blockchain-based platform

The infrastructure components



The proposed blockchain-based platform

The proposed procurement management process



The proposed blockchain-based platform

The smart contracts - 1

Attributs	address public bidder;	Bidder's address
	Uint startTime ;	Attribute to store the submission date.
Modifiers	isOnDelay(uint time)	A modifier to verify if the submission was made on time
Events	Launch_verification(address from, address to)	Event launched when the transaction is recorded.
Functions	Register_Submission() public;	A constructor generating a quote by assigning its bidder's address and initiating the submission date.
	Register(address receiver) isOnDelay(date)	This function allows to store the submission in the blockchain.

The 'Register_Submission' contract's parameters

The proposed blockchain-based platform

The smart contracts - 2

Attributs	Struct submission { Address bidder; Uint score;}	A structure of a submission details
	mapping (address => Submission) submissions	A mapping to associate an address of a submission with its information.
Functions	Assess_Offer() public;	Constructor initiating the verification process.
	Compliance_review() public returns (bool)	A function to check the bids conformity and increments the evaluation score of each bid
	OF_OT_assessment () public isReviewed()	Function that assigns a score to the technical offer and one to the financial offer.
	Attribution () public returns (address[]) isAssessed()	A function to recognize the contract awarder according to the ranking of scores.
Modifiers	isReviewed()	A modifier to verify if the submission has passed the compliance verification phase.
	isAssessed()	A modifier to verify if the bid has successfully passed the technical and financial evaluations.
Events	Verification_confirmed (address from, address to, uint amount)	Event launched at the end of the evaluation process to publish the results.

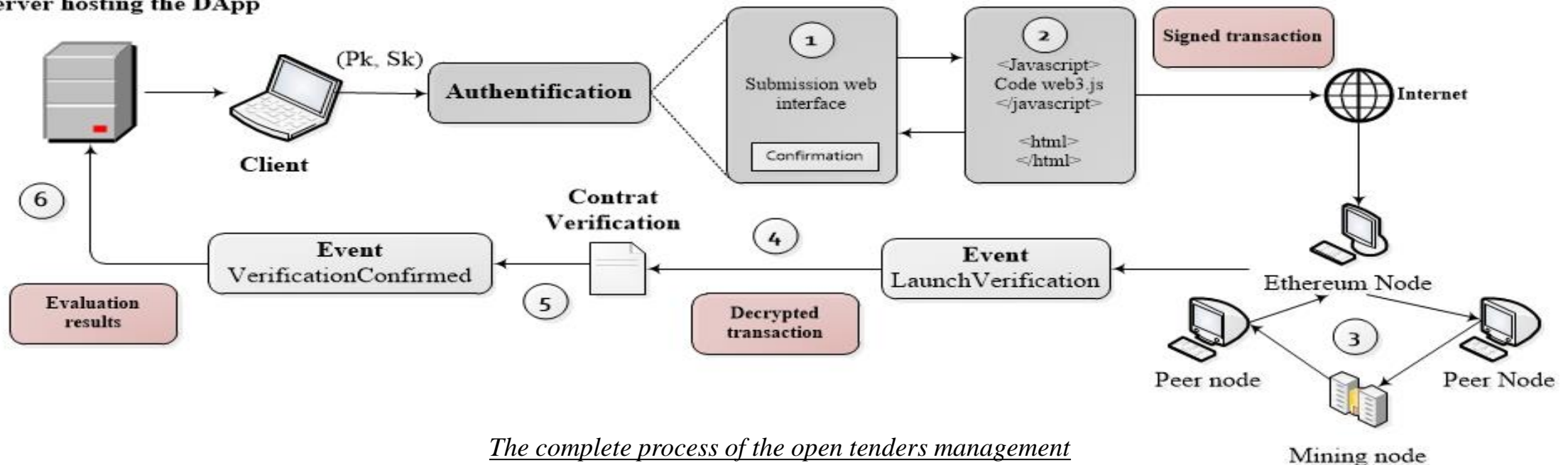
The 'Assess_Offer' contract's parameters

A DApp for the public procurement

Overall presentation

- A decentralized application (DApp) manages all data stored in a blockchain.
- It controls the access to the blockchain thanks to the unique public/private keys associated to each account.

Web server hosting the DApp

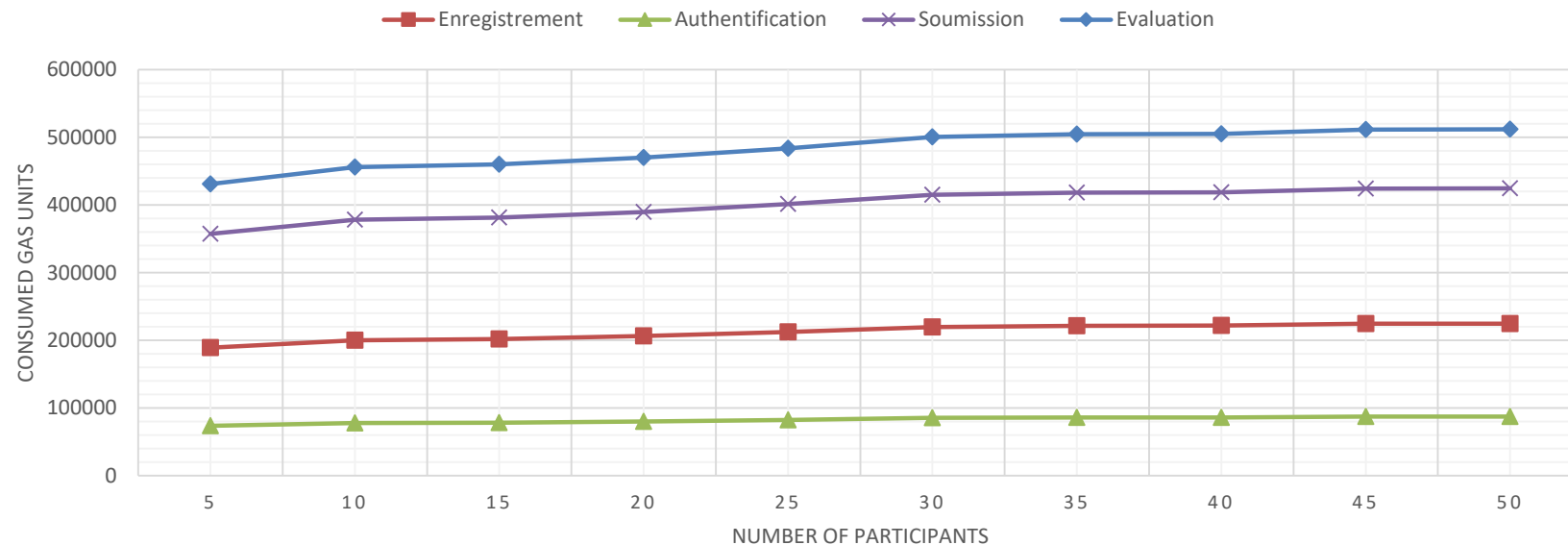


The complete process of the open tenders management

A DApp for the public procurement

Implementation & Results - 1

- The decentralized application was deployed on an Ethereum test network.
- We sent about 100 transactions to simulate candidate bids participating.
- Each block had a maximum capacity of approximately 3,000,000 gas units.
- The storage in a block is divided with 22% of the capacity allocated to the 'Register_Submission' contract, 54% to the second smart contract, and the rest for the storage of hashed data.



Units of gas consumed for each phase of the process according to the number of bidders

A DApp for the public procurement

Implementation & Results - 2

Contract	Name of the operation	Cost of the transaction	Cost of execution	Total gas consumed
Register_Submission	Contract creation	219 535	124 371	343 906
	Constructor	62 279	41 007	103 286
	Deadline checking	22 299	1027	85 605
	Submission storage	71 745	10 650	82 395
Assess_Offer	Contract creation	222 546	139 401	361 947
	Constructor	74 120	45 125	119245
	Compliance verification	18 523	2001	20 524
	Offers' evaluation	21 744	3250	24 994
	Awarding of the contract	65 478	11 450	76 928
Total				1 218 839

Conclusion

Contributions

- A prototype of a public procurement management solution and : the open tendering process
- The use of Ethereum blockchain and solidity smart contracts as a means of recording and verifying submitted bids.

Limitations

- No empirical study of the domain.
- Lack of real data.
- Very limited human and financial resources
- Complexity of the subject

THANK YOU