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AN APPROACH TO BUILD A DECENTRALIZED COLLECTION OF BUSINESS PROCESS MODELS

Abstract. In this study we have proposed the approach to organization of decentralized blockchain-based business process model repository that could be used to provide secure software solution to store and access the business process model collection in a tamper-resistant manner.

Keywords: Business Process Model, Blockchain, Repository, Knowledge Sharing, Smart Contract.

Current trend of the digital transformation encourages large enterprises, medium-size companies, and even small businesses to focus on detection, analysis, and improvement of their business processes by deploying BPM (Business Process Management) suites that automate routine activities. Such approach is known as BPM, while described cycle of continuous process improvement is referred as BPM lifecycle. Business processes are considered as structured sequences of activities performed by employees and other stakeholders in order to transform raw information or materials into products or services valuable for customers, either external or internal. For example, sick leave application is processed to satisfy an internal customer – an employee who requested the sick leave, while order processing serves to an external customer – a company's client or a counter-party organization, which requires order fulfilment. Each of such business scenarios are called as business processes and, traditionally for BPM projects, are represented using graphical models (similar to flowcharts used to describe algorithms) in order to capture, store, and share knowledge about organizational activities. Captured knowledge about ongoing business processes represented in the form of graphical schemes could be used to train new employees (future process participants) or to detect inefficiencies in workflows to improve organizational activities through business process automation (replacing manual routine tasks with scripts) or re-engineering (rebuilding whole business process scenarios from scratch).

Thus, it is natural for big enterprises to have extremely large collections of hundreds or even thousands [1] of business process models. Keeping and accessing such volumes of business process models could be possible with the use of enterprise-level techniques and software solutions. Since availability, integrity, and security are crucial features for enterprise collections of business process models, in this paper we consider usage of a blockchain technology to keep and manage business process models in the secure and stable manner.

According to Yan et al. [1], managing enormous collections of business process models is a complex problem indeed, which requires special software tool to store, search, and manage business process model versions [1]. Such software was called a “business process model repository” [1] and, according to Elias [2], it should correspond to the particular requirements, e.g. support of a standard business process modeling notation, displaying of both graphical and textual process descriptions, provision of multiple model versions for the same process, model search and categorization, model analysis and comparison, support of relationships between business process models etc. However, there are external access and security [2] requirements, which fulfillment is critical for corporate assets. Access control and integrity control features were also mentioned by La Rosa et al. [3], as capabilities of an advanced business process model repository software named “APROMORE” [3]. Also, access, integrity, and, in addition, transaction management features were mentioned as part of the framework for business process model repositories proposed by Yan and Grefen [4]. Researches made in this time period are devoted to efficient querying of business process models, stored in a repositories, using graph-based data structures and indexing approaches similar to search engines [5, 6], and comparison of business process models using various similarity measures based on business process structure and semantic [7, 8]. Nevertheless, all of these studies have mentioned accessibility and security as repository features, but not as their main research objectives.

Since the crypto-boom of 2017, a blockchain technology went far beyond the Bitcoin cryptocurrency, even though it was initially designed to fit digital currency requirements, such as forgery resistance, immutability, and decentralized community-backed governance [9]. Originally created to implement cryptocurrencies, the blockchain technology works with transactions (e.g. containing recipient’s address, number of coins to be sent, and sender’s signature), which are consolidated into blocks that contain hash values of blocks generated before, by which creating a chain of irreversible and immutable blocks [10]. Therefore, data authenticity and consistency could be proven by checking conformity of hash values back to the initial block of the whole blockchain [10]. Thus, blockchain transactions do not need a “trusted entity” for processing, they could be executed fast and at low cost, cannot be tampered, and could be easily traces [11].

Such benefits could not be unnoticed by industry and to support business process execution on top of blockchains, “smart contracts” were introduced as the computer programs that run in the blockchain platform and record results of their execution as immutable transaction into the blockchain [11]. Being a blockchain platform, Ethereum represents a peer-to-peer network of nodes that maintain a distributed ledger of transactions, whereas its main purpose is a “world computer” that runs smart contracts as general-purpose computer programs created using Solidity language similar to JavaScript by means of its syntax [12]. Unlike Bitcoin, Ethereum and other platforms that support smart contracts are called as “programmable blockchains”, which are used to create decentralized applications or “DApps” [12].

DApps use smart contracts as back-end code and blockchains as databases in

contrast to traditional applications backed by centralized servers, whereas the frontend of DApps is usually created with traditional combination of HTML (HyperText Markup Language), CSS (Cascading Style Sheets), and JavaScript together with the “web3.js” library is used to access Ethereum API (Application Programming Interface) [12]. By April 2021, there are five leading smart contract platforms that could be used as “programmable blockchains”: Ethereum, Polkadot, Solana, EOS, and Binance Smart Chain, however, Ethereum is still the major player and its future development may cement it as the dominant smart contract platform once and for all [13].

Considering relatively young age of a blockchain-based BPM, there are mostly proof-of-concept or experimental solutions currently exist (i.e. Caterpillar and others [14]). These solutions consider cross-organizational performance of business processes supported on top of blockchain platforms.

However, for our best knowledge, the enterprise knowledge sharing approach using a blockchain platform and the BPMN (Business Process Model and Notation) process modeling standard was not proposed yet. Hence, using programmable blockchain platforms, such as Ethereum, there could be created a decentralized application to store and manage collections of business process models as part of the inter-organizational repository of corporate knowledge (see Figure 1).

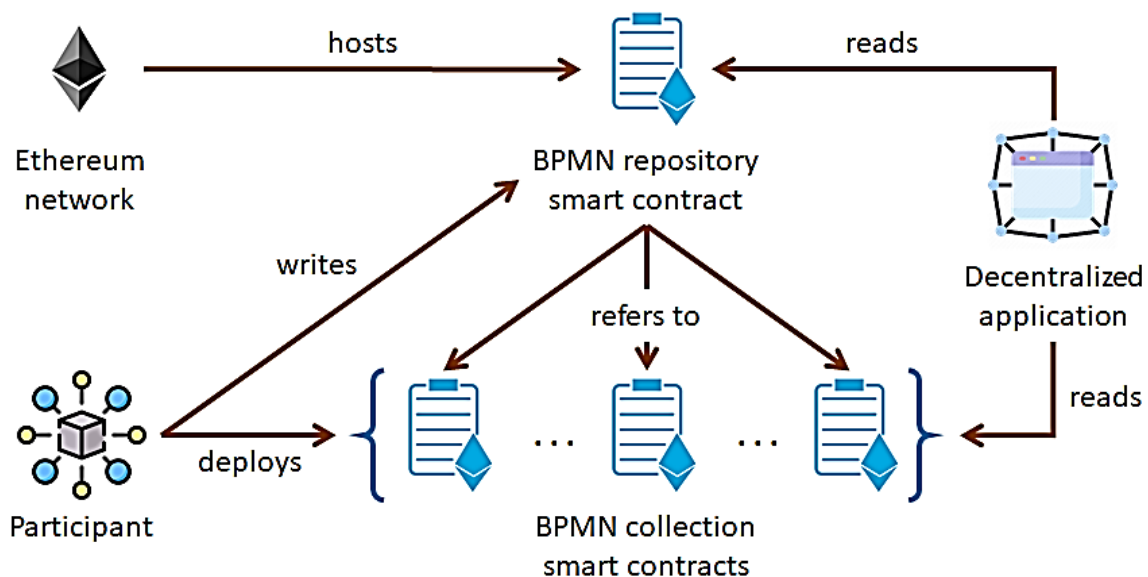


Figure 1 – Conceptual model of a blockchain-based business process model repository

According to the conceptual model shown above in Figure 1, a blockchain-based repository of BPMN models could be implemented as multiple smart contracts: a main smart contract, which addresses one or several smart contracts that represent collections of business process models.

As the frontend should be created a decentralized web application that will get the registry of process model collection from the main smart contract and access respective collections of BPMN models. Therefore, such repository may contain multiple business process models collections owned by different organizations or individuals supporting this enterprise knowledge sharing initiative.

We have selected the Ethereum blockchain platform for smart contract implementation because of its dominance in the area [13], Turing complete programming language Solidity [12], and availability of development tools: Remix IDE (Integrated Development Environment), Ropsten Ethereum test network, MetaMask wallet for interaction with the Ethereum network. Created web application prototype shows a decentralized application that uses HTML, CSS, and JavaScript together with the “web3.js” library to work with the smart contract. The source code of developed decentralized application is available at [15].

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