The Blockchain-Based Model for Professional Growth Data Processing

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***Abstract*—Nowadays, it may be stated that blockchain is a universal technological solution that may be applied to any digital asset. Integration of blockchain technology in business processes allows decentralizing control, implementing safe transaction on the web, fully transforming document circulation into electronic format and automating numerous processes in any sphere of human life. An informative report has been drawn up in order to consider opportunities of using blockchain technology in the public sector and the related legal issues, and to decide on further measures for its promotion in Latvia. The paper presents a blockchain-based model that may be used to promote development of this technology in Latvia and substantiate suggestions for transformation and improvement of data processing on professional development of natural persons.**

***Index Terms*—blockchain, personal data management, structure modeling**

I. Introduction

Latvia has started to follow global development tendencies in the area of blockchain technology. Since 2018, pilot projects and activities have been implemented at the level of state governance on the EU scale with an aim to develop intercompatible blockchain infrastructure [1]. On 12 December 2017, “Latvian Blockchain Association” signed an agreement with the Investment and Development Agency of Latvia (LIAA) on provision of support within the activity “Promotion of International Competitiveness” co-financed by the European Regional Development Fund (ERDF) [2]. All three Baltic States signed a memorandum of understanding [3], agreeing to support development of the capital market, promoting innovations, including blockchain-based solutions. The current global tendencies attest public interest in the blockchain technology and the topicality of the research theme. There is a considerable interest in blockchain technology-related issues in the world, from 2015 to 2019 the number of relevant research papers in Scopus data base was increasing exponentially, growing on average 4.3 times per year. The largest number of research papers or more than a half address network security (59%) and smart contract issues (52%), somewhat smaller proportion of papers consider data confidentiality (47%) or Internet-of-Things (34%), one fifth (23%) are dedicated to cryptocurrencies and only 14% cover blockchain-related data management issues.

In the second section, the problem to be solved and the limitations of the existing solutions are defined. In the third section, the authors provide an overview of the research methods and tools used. In the fourth section, the authors reflect on the related research and existing solutions. The fifth section provides insights into blockchain technology and its concept. In the sixth section, the developed blockchain-based model for the processing of professional growth data is presented and evaluated using quantitative indicators. In the last section, the developed model is compared with the existing system currently used in Latvia.

II. Problem Statement

Qualitative analysis was conducted in order to evaluate the professional growth data processing system and substantiate problem statement. The authors interviewed 2 respondent groups: Latvian employers and representatives of the Latvian universities. Large, medium-sized and small enterprises that have an in-house personnel department or employ HR specialists were selected to participate in the employer survey. The authors addressed 645 company representatives; however, the total number of respondents was 80.

The university survey covered public and private educational establishments. The authors addressed 21 representatives of the Latvian universities and academies; feedback was received from 11 institutions.

Based on the employer survey results, it was concluded:

- The data on education and professional experience are the most important information on the potential employee that influences decisions of a recruitment specialist;
- Employers only partially trust the information provided by the candidates;
- The majority of respondents identified cases when candidate’s CV contained false or exaggerated information;
- Employers often detect false or exaggerated information on candidates’ work experience;
- The process of verifying candidate’s data normally lasts from 1 hour to 3 business days;
- Many enterprises still store and/or duplicate in the paper format personal files of the candidates in the locked cabinet/on the shelf;

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- The majority of respondents are not familiar with the blockchain technology, but are ready to use a blockchain tool to verify candidate data and record information on employee work experience in their company.

The following conclusions were made on the basis of the university survey results:

- The largest Latvian universities receive more than 100 diploma verification inquiries from employers a year;
- Verifying diplomas, universities sometimes detect cases of diploma forgery;
- The majority of surveyed universities note that student/alumni files are stored and/or duplicated in the paper format in the locked cabinet/on the shelf;
- The majority of respondents are not familiar with the blockchain technology, but are ready to use a blockchain tool to verify the current information and record data on students, alumni and candidates for enrolment.

The factors that substantiate problem statement:

- Reliability of the data processing system;
- Data verification period and process complexity;
- Professional growth data are stored in several ledgers, which leads to duplication of certain activities and complicates data management;
- Readiness of potential users to reorganize processes;
- Opportunity to forge data in the existing professional growth data processing system;
- Data processing in the paper format, which limits process transparency and data availability;

Reduction of proportion of inefficient elements in the system and their replacement with blockchain elements may be one of the solutions for professional growth data processing.

The following hypothesis was put forward in the course of development of the blockchain-based model: "Making structural changes in professional growth data processing procedures allows increasing security of the system, and considerably reducing time recourses for verifying natural person data."

III. Materials and Methods

In order to investigate the research object and substantiate the problem statement, in the third section the authors summarize the results of the target group survey and consider the factors, which substantiate the necessity to reorganize data exchange in the existing system.

The structural modeling approach [4] was adopted for further investigation of the existing professional growth data processing system and development of the new model, it gives opportunity:

- To consider the research object in its totality;
- To understand its structure and significance of its elements;
- To develop visual, clear models of the structure;
- To conduct experiments with element replacement, not exposing the existing system to risk;
- To compare the systems and make conclusions whether it is better to develop the existing system or introduce a new solution.

Intelligent IFS version 1.0 developed by Ieva Zeltmane [5] was used in the modelling and analysis of the system structure. This tool allowed developing automatic model generation based on the acquired knowledge base.

Taking into consideration that security and efficiency are the main requirements in data processing, the following quantitative indicators were selected to compare the model developed in the paper with the existing professional growth data processing model:

- Dispersion of element ranks (**D**)
- Functional Load Dispersion (**FLD**)

IV. Blockchain Technology

The authors summarized information presented in numerous sources [6]-[10] and adopted the following definitions of blockchain and its core elements. Block is a secured digital data set that is stored on numerous servers and computers. Each block contains information about all network user transactions. A transaction normally contains a record of the fact of digital asset transfer:

- Transaction ID;
- Time of transfer;
- Type of digital asset (a sum of money, copyright, license, diploma, etc.).
- Owner of the asset (who transfers?);
- Recipient of the asset (who receives?).

This record is stored on several servers and computers.

Blocks are interconnected both chronologically with a timestamp and cryptographically using complex mathematical algorithms. Block coding process is called hash function or hash algorithm. This algorithm transforms input data of various length (file, text, image) into a range of letters and numerical symbols of the fixed length called hash. Each new block is connected sequentially and contains a reference to the previous block, thus creating a blockchain. Each computer in the network has a built-in program that ensures synchronization of transactions with other devices or so-called network nodes. Once transaction is approved and inserted in the blockchain, it is not possible to change or delete its contents. Thus, blockchain may be defined as a decentralized chronological data ledger, where the list of all transactions performed in the network is reflected and renewed in real time, making transaction history inspectable. In essence, it is an open and autonomous distributed ledger, which ensures special protection against changes. This specific feature of blockchain is particularly important for professional growth data processing, which should be protected against forgery and should be easily identifiable and verifiable. In addition, each network transaction is coded with cryptographic functions and allows working in the network not disclosing own core data.

Each network participant should download software or a so-called blockchain wallet, which ensures access to the network and stores cryptographic key pair. Public key is used to identify the user and digitally sign transactions in the network, each public key has an attached private key, which can be called a password, it is known only to the owner of the wallet.

Network operations are maintained by validators or miners, solving computing tasks of growing complexity, investing computing power and electric energy of one's own equipment in order to gain reward. In the peer-to-peer network, each computer acts both as a client and a server and is able to communicate with other computers without the help of the central server.

First, unconfirmed transactions are added to the transaction pool, where they are checked in queue one at a time. Verification process is implemented simultaneously on a large number of computers, which work in the same network. Then the miner who first solves the task should present Proof of Work (PoW), which can be used by the other validators to easily verify the transaction and reach consensus. The register recognized as valid by more than a half of the total number of users is set as the official ledger of transactions. Network logic and settings are fixed by the smart contract, which ensures their automatic implementation.

The network where anyone can create a node and immediately perform transactions is called the public blockchain network. However, if the device is connected to the intranet and transactions occur among a selected group of persons who have access to this network, it is a private blockchain network.

It may be concluded that nowadays blockchain technology paves the way for new IT solutions and business models, changing the existing procedures for cooperation and processing of big amounts of data.

V. Related Work

To appreciate the topicality of the research object and the contribution of other authors, quantitative analysis of scientific literature has been performed.

1) Block.co [11] is application software developed by the University of Nicosia, Greece, which allows submitting/revoking pdf. certificates in a blockchain. The University of Nicosia is a pioneer in the blockchain-based certification. Block.co solution may be used by the academic institutions, scientific research centers, state departments, educational professional organizations, insurance companies and other entities willing to issue protected certificates.

2) OpenCerts [12] is a Singaporean solution, which allows educational establishments to issue certificates, whereas employers may use this solution to verify contents and check whether the certificate has been issued by a recognized institution. Each certificate is ascribed a unique digital code, which together with the abridged certificate information is stored in the blockchain.

3) Gradbase [13] is a platform developed in the UK for verifying academic and professional qualifications. The platform allows creating a profile and further update it with professional development data. Each entry should be supplied with a verification code, which is sent by the data issuer to the data recipient by e-mail. Developers of the platform have created and marked Gradcode-QR code, which can be easily attached to CV, LinkedIn and online profiles.

4) EduCTX [14] is a decentralized extended blockchain platform developed in Slovenia, which facilitates certificate management. This platform is based on the concept of the European Credit Transfer and Accumulation System (ECTS). It offers a global reliable decentralized system of higher education credits and assessment, which promotes unified understanding of the processes among students, universities and other potential stakeholders, for example, enterprises, institutions and organizations. Each student has a blockchain wallet, where they collect ECTX tokens for each study course that are equivalent to credit points.

5) Certifaction [15] is application software for verification of diplomas issued by educational establishments developed in Switzerland. Certifaction API may be easily integrated in any university administration e-system environment, which allows educational establishments to fight against diploma forgery, and students – to share their newly obtained diplomas in the social networks. Certifaction gives employers the opportunity to answer candidates much quicker and hire only the candidates with the verified qualification.

6) APPII [16] is an online verification, career management and recruitment platform developed in the UK. It allows job applicants to create a CV and require verification of the information included in the CV from educational establishments and employers. Verifications are received and stored in the user profile. This profile (CV) may be exported and shared with employers while applying for a job.

7) Curriculum Vitae Chain [17] is a blockchain recruitment application software project developed in Asia. When the candidate submits the basic profile data, selected educational establishments and former employers should verify the submitted information. Then the system automatically adjusts the verified CV data to work requirements. When the CV attracts attention, the company may require a CV owner to gain access to their data for a definite fee.

8) BlockchainCV [18] is Ethereum based in the blockchain, which allows creating a CV in pdf format with digital signature (hash or so-called CV ID) and store it in Ethereum network for a fee of 1$. Applying for a job, a CV owner should send a CV ID and home page address www.blockchaincv.com to the employer.

9) Aversafe [19] is a Singaporean platform that provides educational establishments and other issuers of certificates with the opportunity to develop, upload, issue, verify and revoke their digital certificates. Creating their profiles, users may exchange and verify each other's

information. These verifications are recorded in the blockchain, allowing anyone in the network to verify the data of any other user. Natural persons and certificate issuers may use the platform free of charge, but entrepreneurs should pay for using the service.

10) ODEM [20] is a Swiss solution that directly connects educational establishments, employers, students and specialists, creating a supply-based ecosystem. ODEM gives students insights into skills and qualifications sought for by employers and offers courses from a wide range of adjustable programs. Upon completion of the program, ODEM connects alumni with employers. Smart contract solution allows educational establishments to automatically receive funds after completion of the course or receive a fee for course content used by other educators.

VI. Proposed Model for Personal Data Management

The authors of the present article have developed a personal data management model based on the blockchain technology and its concepts, suggesting a new blockchain-based model for processing of professional growth data of natural persons. Visually IFS systems represent a structural model as objects, functionality and interconnections between them (see Fig. 1).

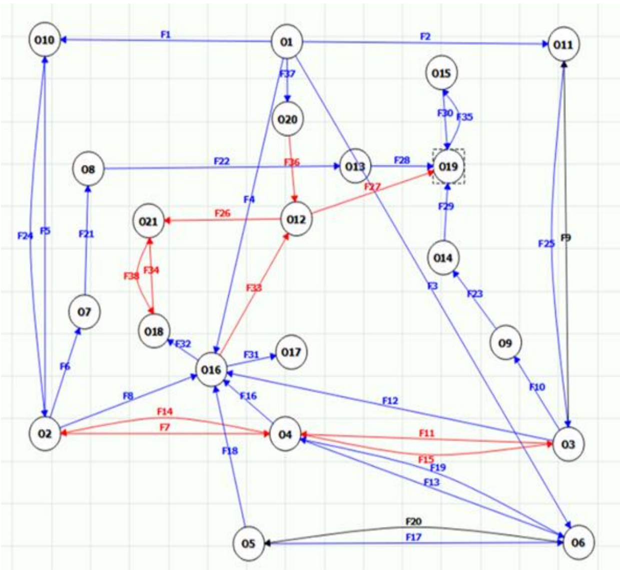

Figure 1. Structural model of blockchain-based model for personal data management.

A data processing system in education and labor market may be described using several elements that were categorized into three groups according to their nature. Each element was ascribed a designator:

Physical elements – data subject, data analyst or data processor who ensures data transfer and data processing. Elements are designated with **P{P_0, P_1, ..., P_n}**.

Control elements – data in the paper or electronic format, which ensure identification, data processing, security and protection of the natural person. Elements are designated with **C{C_0, C_1, ..., C_n}**.

Blockchain elements – elements that ensure highly secure data and asset exchange and protection against forgery. Elements are designated with **B{B_0, B_1, .., B_n}**.

In the IFS system, the elements are designated with letter **O** + order number of the element (Table I).

TABLE I. Description of Elements

	Element	Designation	Object number
Physical elements	Country	P_0	O1
	University	P_1	O2
	Employer	P_2	O3
	Natural person	P_3	O4
	Validator	P_4	O5
Control elements	Personal identification document (passport or ID card)	C_0	O6
	Student/alumnus file	C_1	O7
	Diploma ledger	C_2	O8
	Employee file	C_3	O9
	Accreditation document	C_4	O10
	Legal status	C_5	O11
Blockchain elements	Blockchain network	B_0	O12
	Transaction on higher education of a natural person	B_1	O13
	Transaction on employment history of a natural person	B_2	O14
	Transaction ID	B_3	O15
	Blockchain wallet	B_4	O16
	Blockchain CV profile	B_5	O17
	Monetary account	B_6	O18
	Public ledger	B_7	O19
	Smart contract	B_8	O20
	Virtual currency	B_9	O21

Object functions are described in Table II.

TABLE II. Object Functions

Nr.	Output node	Input node	Description
F1	O1	O10	Grants rights to issue diplomas recognized by the state
F2	O1	O11	Grants rights to conduct business and employ wage labor
F3	O1	O6	Identifies a natural person
F4	O1	O16	Stores user's key pair
F5	O2	O10	Confirms rights to issue diplomas recognized by the state
F6	O2	O7	Student/alumni data processing
F7	O2	O4	Ensures natural person employment
F8	O2	O16	Stores user's key pair
F9	O3	O11	Confirms rights to conduct business and employ wage labor
F10	O3	O9	Employee data processing
F11	O3	O4	Ensures natural person employment
F12	O3	O16	Stores user's key pair
F13	O4	O6	Identifies a natural person
F14	O4	O2	Implements own rights and duties
F15	O4	O3	Implements own rights and duties
F16	O4	O16	Stores user's key pair
F17	O5	O6	Identifies a natural person
F18	O5	O16	Stores user's key pair
F19	O6	O4	Identifies a natural person
F20	O6	O5	Identifies a natural person
F21	O7	O8	Registers records on issued

			diplomas
F22	O8	O13	Reports on education of a natural person
F23	O9	O14	Reports on employment history of a natural person and insurance coverage periods
F24	O10	O2	Confirms rights to issue diplomas recognized by the state
F25	O11	O3	Confirms rights to conduct business and employ wage labor
F26	O12	O21	Generates virtual currency
F27	O12	O19	Allows creating transactions
F28	O13	O19	Stores blocks with records on all transactions in the network
F29	O14	O19	Stores blocks with records on all transactions in the network
F30	O15	O19	Fixes transaction (confirmed transaction) in the network
F31	O16	O17	Stores professional development data
F32	O16	O18	Stores virtual currency
F33	O16	O12	Provides access to blockchain network
F34	O18	O21	Serves as exchange medium in the network
F35	O19	O15	Fixes (confirmed transaction) in the network
F36	O20	O12	Fixes and fulfills network requirements
F37	O1	O20	Develops network requirements and settings
F38	O21	O18	Serves as exchange medium in the network

Blockchain-based professional growth data processing model contains:

- 21 objects,
- 38 object links,
- 1 input node O1,
- 1 output node **O17**.

Taking into consideration that in case of failure of any system element or error, the system may break down, thus it is important to recognize significance of each element. Element ranking allows getting aware of significance of every element and its impact on system operation.

Three ranks may be calculated for each system object:

- $\mathbf{R_{(Local)}}$ indicator, which is an estimate of output and input links. The larger the total number of links, the higher the element ranking is.
- $\mathbf{R_{(Reach)}}$ indicator, which is an estimate of reachable objects. The larger the total number of reachable objects, the more significant the element is.
- $\mathbf{R_{(Path)}}$ indicator, which is an estimate of paths and cycles, which include a chart node. The larger the total number of paths and cycles, which include a node, the higher the rank of the element is.

In order to evaluate structural significance of each object S_{Nj} in the system, full rank of system objects R_{kj} was used. Its value was ascribed based on the following principle: the lower R_{sum} value, the higher the full rank of the object is. The following formula was used to determine structural significance of objects:

$$S_{Nj} = 1 + ((1 - R_{kj})/R_{max})$$

where R_{max} is a maximum full rank value.

Ranks of all objects are summarized in Table III.

TABLE III. RANKS OF SYSTEM'S OBJECTS

	$R_{(Local)}$	$R_{(Path)}$	$R_{(Reach)}$	R_{sum}	R_{kj}	S_{Nj}
O1	4	1	1	6	1	1
O2	3	2	2	7	2	0.92
O3	3	2	2	7	2	0.92
O4	2	2	2	6	1	1
O5	6	4	2	12	4	0.75
O6	4	4	2	10	3	0.83
O7	7	5	5	17	8	0.42
O8	7	5	6	18	9	0.33
O9	7	5	6	18	9	0.33
O10	6	5	2	13	5	0.67
O11	6	5	2	13	5	0.67
O12	5	4	5	14	6	0.58
O13	7	5	7	19	10	0.25
O14	7	5	7	19	10	0.25
O15	7	5	8	20	11	0.17
O16	1	3	3	7	2	0.92
O17	8	6	9	23	12	0.08
O18	6	5	8	19	10	0.25
O19	4	5	8	17	8	0.42
O20	7	5	4	16	7	0.50
O21	6	5	8	19	10	0.25

The chart of element significance levels of the blockchain professional growth data processing model was drawn (see Fig. 2). The results show that $\mathbf{P_0}$ (State) and $\mathbf{P_3}$ (Natural person) are two most significant system elements. It has a logical explanation as it results from the functions and aims of the elements – the state determines the systems, requirements and controls their fulfilment in order to ensure data processing of natural persons. The same refers to elements $\mathbf{P_1}$ (University) and $\mathbf{P_2}$ (Employer).

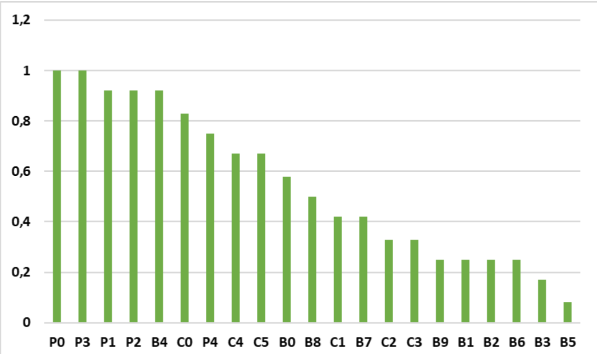

Figure 2. Chart of element significance levels.

Then a new element $\mathbf{B_4}$ (Blockchain wallet) appears, which currently is not included in the existing professional growth data processing system in Latvia. It is a key pair that provides each user with an access to the blockchain network. It is followed by $\mathbf{C_0}$ (Personal identification document) and another new element $\mathbf{P_4}$ (Validator), which should maintain operation of the blockchain network, investing computing power and electric energy of one's own equipment in order to receive reward. Similar to the existing structure, in the newly developed blockchain data processing model the following matching elements are of high significance: $\mathbf{C_5}$ (Legal status) and $\mathbf{C_4}$ (Accreditation document). They are followed by two new blockchain technology elements: $\mathbf{B_0}$

(Blockchain network) and **B₈** (Smart contract). Blockchain network allows elements to intercommunicate and process professional growth data in a secure way, whereas smart contract fixes network requirements and ensures their automatic fulfillment. **B_7** (Public ledger) is another new element, where records of all transactions in the network are stored. This ledger in terms of its significance is comparable with **C_1** (Student/alumnus file) element. In the developed model, elements **C_2** (Diploma ledger) and **C_3** (Employee file) have smaller weight than in the existing structure and in future they may possibly be dropped out, since the information stored in these registers duplicates information in the blockchain ledger – the public ledger. The following blockchain model elements are less significant: **B_9** (Virtual currency), **B_1** (Transaction on higher education of a natural person), **B_2** (Transaction on employment history of a natural person) and **B_6** (Monetary account). Two of them report on education or employment history of natural persons, one of them stores virtual currency generated by the network in accordance with the code written in the smart contract, which serves as an exchange medium in the network. Elements with the lowest significance are **B_3** (Transaction ID), which fixes transactions in the network and public ledger, and system output node **B_5** (Blockchain CV profile), which presents the verified and reliable professional development data of a natural person.

Security of the professional growth data processing system may be assessed using the indicator of potential structure security – dispersion rank **D**, using the formula:

$$D=\frac{1}{w}\sum_{i=1}^{w} R_i^2-\left(\frac{n}{w}\right)\left(\frac{n}{w}\right) \quad (1)$$

where

D = dispersion rank,
w – total number of different full rank values,
n – number of elements in the system,
Ri – elements with the i-th full rank.

Identically with functionally loaded elements, rank dispersion value is equal to 0, therefore, the closer dispersion value is to 0, the more secure the system is. Calculating rank dispersion for a professional development data processing system, where n =18 and w =9, we obtain:

D*=1/9 (22+22+12+12+42+82+12+12+42)-182/92=1.33*

In addition, functional load dispersion FLD was calculated for the system, which demonstrates how uniformly system elements are loaded:

$$FLD=\frac{1}{n}\sum_{v=1}^{n} m_v^2-\left(\frac{cc}{n}\right)\left(\frac{cc}{n}\right) \quad (2)$$

where

FLD = functional load dispersion,
n – number of nodes in the system,
cc – number of paths and cycles in the system,
m_v – number of paths and cycles that contain node v.

The set of all paths between input and output nodes is the following:

1. O1-O17-O2-O9-O11-O10-O6
2. O1-O17-O2-O9-O10-O6
3. O1-O17-O2-O9-O12-O10-O6
4. O1-O18-O3-O4-O2-O9-O11-O10- O6
5. O1-O18-O3-O4-O2-O9-O10- O6
6. O1-O18-O3-O4-O2-O9-O12-O10- O6
7. O1-O12-O10-O6
8. O1-O5-O4-O2-O9-O11-O10- O6
9. O1-O5-O4-O2-O9 -O10- O6
10. O1-O5-O4-O2-O9-O12-O10- O6
11. O1-O17-O2-O4-O3-O13-O14-O15- O8
12. O1-O18- O3-O13-O14-O15- O8
13. O1-O5-O4 -O3-O13-O14-O15- O8
14. O1- O15- O8
15. O1-O17-O2-O4-O7
16. O1-O18-O3-O4-O3
17. O1-O5- O4-O7
18. O1-O17-O2-O4-O3-O13-O16
19. O1-O18 -O3-O13-O16
20. O1-O5-O4-O3-O13-O16

FLD=1/18(202+122+92+132+62+102+32+42+92+102+32+42+62+32+42+32+62+62)-202/182=71.15432

The more uniformly functionally loaded elements are, the more secure the system is in its operations (overloaded elements fail quicker). This indicator should be lower in a better structure.

VII. Comparision of the Blockchain-Based Model with Existing Model for Professional Growth Data Processing in Latvia

Before developing the model within this paper, the existing professional growth data processing model currently used in Latvia was described using the same approach and the IFS tool. The results of analysis of two systems are summarized in Table IV. The obtained results demonstrate that 'state', which is the system's output node, and 'a natural person' are the most significant elements within both systems. In the existing system, numerous ledgers and archives, where professional growth data are registered, are elements of average significance. Not infrequently information is duplicated and stored in the paper format, which causes repetition of certain activities, complicates data management and limits data accessibility. In turn, in the developed model such registers as 'diploma ledger' and 'employee file' are ascribed smaller weight than in the original structure and theoretically in future it will be possible to drop them out, as the information that is stored in numerous ledgers duplicates the information stored in the blockchain ledger – public ledger.

In the existing personal data management system, four output elements – 'diploma', 'CV', 'SSIA (State Social Insurance Agency) statement' and 'personnel document archive' – have the lowest weight. In the developed model, 'blockchain CV profile' is an output node, which presents verified and reliable data on professional growth of a natural person.

Analysis of rank and functional load dispersion demonstrates that the blockchain-based system is more secure, as system elements are uniformly functionally loaded and full ranks differ less. Introduction of a blockchain-based solution in data processing may increase security of personal data of the natural persons, reducing the impact of existing risks on data subjects and data analysist reputations.

Comparison of reliability of the systems demonstrates that the developed blockchain model is fully reliable and may ensure higher level of user satisfaction and trust than the existing data processing model.

TABLE IV. COMPARISON OF THE SYSTEMS

	Existing model	Blockchain model
Number of elements	18	21
Number of links	31	38
Number of input elements	1	1
Number of output elements	4	1
Number of paths	20	13
Number of cycles	0	0
Most significant elements	P_0 and P_3	P_0 and P_3
Data verification period	From 1 hour to 3 business days	From 20 seconds to 1-2 minutes
Dispersion value	1.36	0.854167
Functional load dispersion value	71.15432	34.71202

VIII. CONCLUSION

The model developed helps solve professional growth data process organization issues, allowing to digitalize document circulation and shorten data processing periods. Introduction of blockchain technology in data processing:

- Allows using cryptography that solves the issues pertaining to user confidentiality and data security;
- Allows tracking transactions in real time and increasing data reliability, as all transactions will be digitally signed and marked with the timestamp;
- Allows increasing efficiency, reducing resource consumption;
- Allows mitigating malicious interference risks, thanks to peer-to-peer connections and widespread consensus;
- Allows ensuring system's sustainability in case of attack thanks to presence of numerous ledger copies;
- Allows data owner to transform their data into the source of revenue.

The developed model has been compared with the existing professional growth data processing system in Latvia. As a result, it has been concluded that the structure of the developed model is more secure than the existing one, as system elements are uniformly functionally loaded and full ranks differ to a lesser degree (rank and functional load dispersion indicators near 0).

The above-mentioned criterion allows confirming the hypothesis set forth in the paper: "Making structural changes in professional growth data processing procedures allows increasing security of the system, and considerably reducing time recourses for verifying natural person data." Based on the research results, in future it is planned to present a general software description, which would promote awareness regarding the context of use of the developed model, the main system processes and applications.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

V. Stepanova conceived of the presented idea and performed the computations. I. Eriņš verified the analytical methods and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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