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Smart budget concept

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Summary

The role and scope of public services provided by the state has been changing since its establishment. The different stages of formulation resulted in different public administration systems reflecting mainly the citizens' expectations.

This paper presents the evolution of public finance management and state accounting systems and the background of the changes based on international and Hungarian examples. Subsequently, the measurements of domestic public finances in the recent decades are analysed focusing on the evergreen problems faced. Finally a disruptive blockchain-based-solution is presented emphasising the potentials lying in applicability for public finance.

Keywords: Public Financial Management, public accounting, Treasury, blockchain, distributed ledger, system design

JEL: H11, C81

The New Public Management (NPM) doctrine emerged during the second half of the 20th century and has been gaining ground ever since. Parallel to this, public administration systems are changing, having the focus on efficiency and 'productivity' in order to have a better public service rendition. According to mainstream (Jenei, 2005) researchers, efficiency can be approached on a financial basis rather than on 'productivity', which has a political context. Having the two concurring concepts, the goal is dual also: to render services to the satisfaction of the citizens ('productivity') minimising the costs of these services (efficiency).

NPM has an influence on budgeting and accounting systems as the measurements needed can only be served adequately with sophisticated accrual based accounting records. Modernisation needs are also raised by the technical developments, considering that the performance of IT tools is evolving in a never-seen rapidity. Centralisation of information opens up with the opportunity to control and synchronize decentralised decision making as a means of consistent and high value public service provision while it also provides the basis of sound and transparent audit procedures. This study also presents examples and problems of public financial management by examining international and Hungarian aspects with a special focus on the quality of accounting data.

The paper analyses the problems and information needs of PFM and introduces the nature of distributed ledgers in order to find evidence for applicability. As a conclusion, a possible structure is identified, specifying how such blockchain could be used for PFM, resulting in less human work, cost efficiency and transparency at the same time.

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1. Current issues

According to Fukuyama (Fukuyama, 1995), trust is a key driver of economic growth. Not surprisingly, when researchers observed (Musgrave, 1999) the connection between trust and individual economic situation it was proven that more wealth results in expressing more trust for governments. On the other hand when redistribution was examined, Anderson found it less supported by those having a higher income than those having lower (Anderson, 2015). Though Anderson also concludes that economic crises did not change trust patterns towards institutions, several studies show that inequality is increasing (Deaton, 2013) (Piketty, 2014) also having mathematically backed reasons presented by Barabási as „the rich comes richer" (Barabási, 2002).

Interesting proceeding was offered by a publication (Ligthart & Oudheusden, 2011). Researchers analysed the links between trust towards government and fiscal decentralization. The long-term repeated survey data of the period 1994-2007 showed a positive effect of decentralisation on trust across the countries examined.

Having the fact that trust is really important for a stable economic evolution, governments also need to work transparently when managing public finances. Studies of World Bank experts (Hashim, 2014) show the experiences of designing PFM systems and how to create them but the question is left open: what can be done if a country does not have these ideal conditions.

2. Budgetary framework in general

Government spending has a huge impact on a national economy by pushing forward or pulling back economic growth, even though there is only a weak correlation[1] between the happiness factor (Helliwell, Layard, & Sachs, 2015) and even the expenditure towards individual citizens.

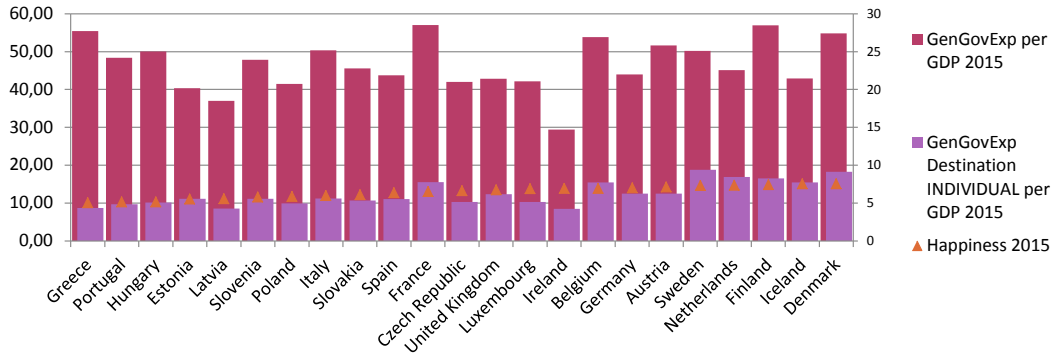

Figure 1. *general government expenditure, that of in individual destination and value of happiness indicator in 2015*

When taking a closer look at the role of government spending in the production of GDP[2] and economic growth, the observer may find it crucial to have a detailed budgetary accounting system. As the spending should not be considered only as an amount of money, given that it is also important that the money properly used, good and applicable

[1] According to data of EU countries of 2015 calculated correlation 0.059 for the general government expenditure, and 0.734 for general government expenditure towards individuals.

[2] C + I + G + (Ex – Im)

classification is essential, backed by a user-friendly regulation also. Though these criteria sound fairly simple, in fact some major obstacles may set back the realization process.

Firstly, difficult regulation and classification may result in a different practice provided an easier solution exists for recording the same event. This causes a bias of data analysis, which may no longer support decision makers' work. Secondly, an unsophisticated classification may end up with the same outcome as poor data cannot be used at all on a macroeconomic level. Thirdly, reporting – as a means of getting correctly classified data – possibly is not the best way of getting information unless it is handed in immediately (at the moment of each and every transaction) and is not suitable for enforcement of execution of the current rules of accounting.

2.1. Trends of PFM development

Public Financial Management (PFM) systems have been thoroughly studied and monitored by the World Bank Group (WBG), mainly as a part of its aids and operations in developing countries. WBG finances several projects aimed at the development of PFM systems. Not only are the financed countries in the focus of observance, but WBG also keeps track of other nations' activities in this field[3]. Moreover professionals have worked out an evaluation scheme in order to make these systems comparable, and published their experiences of PFM development (Hashim, 2014).

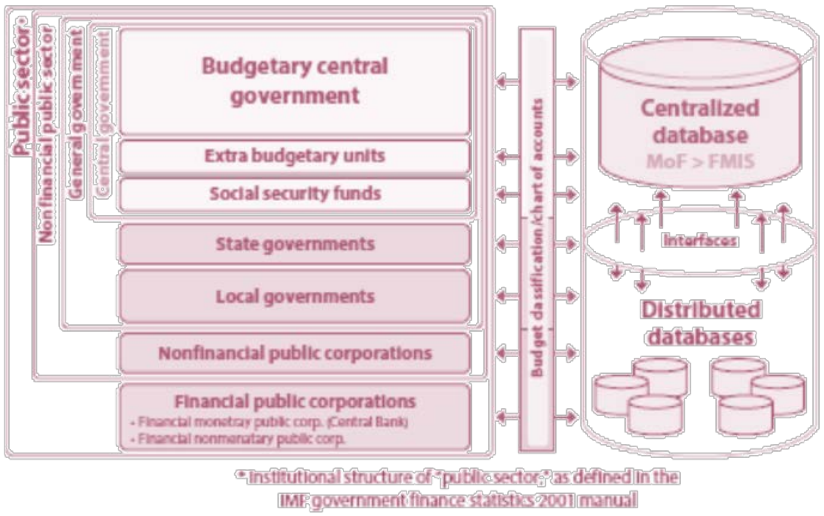

Figure 2. *origin and scope of public financial data (Dener & Min, Financial Management Information Systems and Open Budget Data – Do Governments Report on Where the Money Goes?, 2013, p. 134)*

The analysis of different systems led to a grouping of functions (Dener & Min, Financial Management Information Systems and Open Budget Data – Do Governments Report on Where the Money Goes?, 2013). The eight function groups represent various fields of public administration not equally developed or supported by integrated IT solutions. It is clear that state revenues and liquidity are two key elements of financing public expenditures. Hence it is no surprise that TSA and Tax/ Customs Management Information Systems

[3] Find out more: http://www.worldbank.org/en/topic/governance/brief/financial-management-information-systems-fmis

(MIS) were the first to spread. Since the late 2000's, FMIS penetration has gradually taken the lead[4] (ITU, 2016, p. 187).

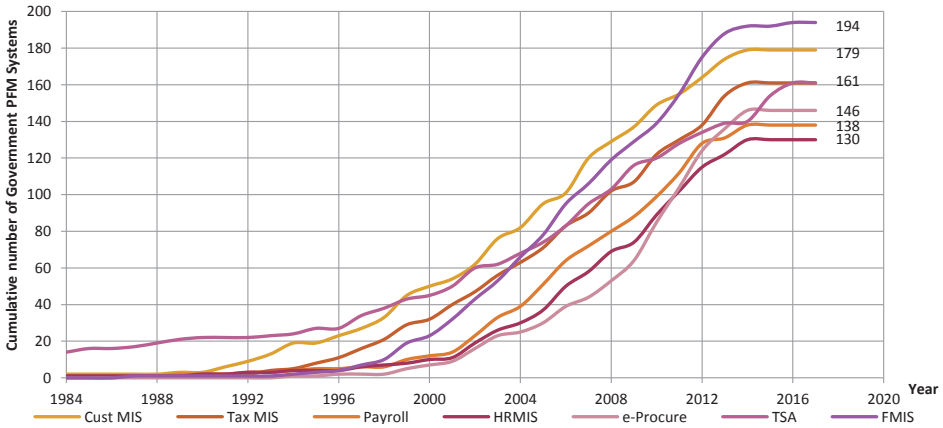

Figure 3. *services of PFM systems (World Bank Group, 2017)*

In another study, researchers reveal (Dener, Watkins, & Dorotinsky, 2011) that usage of off-the-shelf systems comes out more or less in the same proportion as local developments (though the latter are much older, given that new solutions give a complex answer to governments' needs).

2.2. Concept & design

Among the various functions of FMISs, the topmost purpose is to cover all relevant procedures and to serve with a timely database to give a crutch to fiscal (and other) policy- and decision-makers. The budgetary cycle starts with budget preparation that constitutes the aggregate numbers of a law (or other legislative act) on state budget. The breakdown is made by the Spending Units (SPUs), which is applicable for the execution of budget and the calculation of cash-flows and define other financial needs of the government.

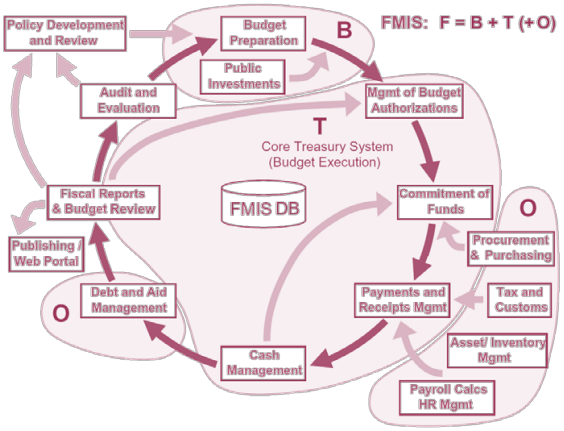

Figure 4. *a modular approach for building FMIS (Dener, Watkins, & Dorotinsky, 2011, p. 2)*

[4] Consider the fact that by this time internet penetration reached 40 % of in developed countries according to ITU.

More diffuse processes follow planning: the breakdown goes into the real everyday life of SPUs. They are handling commitments, financing expenditures and collecting revenues. Naturally different types of costs have their own regulation so it is nearly always unique what requirements to be fulfilled in the specific case. On the other hand, these types can be organised to groups like simple purchasing, procurement, payroll, subsidies and transfers on the expenditure side. Revenues and expenditures do not cover and fluctuations have to be tackled by cash and debt management. In the end of the process reporting to the public and to official authorities are to be a subject of performance evaluation of the budget and the work of the government. Finally, an audit framework guarantees e.g. the validity of all the data produced.

The large number of SPUs, the modifications made within the budgetary year, market impacts on nominal revenue, and the overlap of cycles of different budgetary years ends up in a complex system. Thanks to modern IT solutions and the growth of machine capacities, it is coming easier to handle all these factors at the same time. Robust integrated software are the most suitable to meet all these needs. The WBG and other similar projects' experience show (Dener, Watkins, & Dorotinsky, 2011) that such development takes 6-7 years. According to the abovementioned research, there are modular systems which come from business environment and adapted to public finance specialities (e.g. Oracle, SAP) and have an extended world-wide advisory network. Though these are proven solutions for a business ERP, they mainly focus on manufacturing which is not a characteristic in public finances. In the recent decades, a few new-wave answers emerged on the market also. These systems (e.g. Freebalance, Unit 4) are focusing on the services branch or merely on public financial management. However, off-the-shelf software can be tempting as they promise to be ready for use with a little bit of fine tuning. Nonetheless this can also be a pitfall as accurate planning cannot be carried out without a good understanding of current and future procedures. Referring to the legendary reply of Euclid to King Ptolemy '*there is no Royal Road*'.

As a consequence, research shows that governments are not changing the actual system used for PFM even though new technologies may offer a great progress in efficiency.

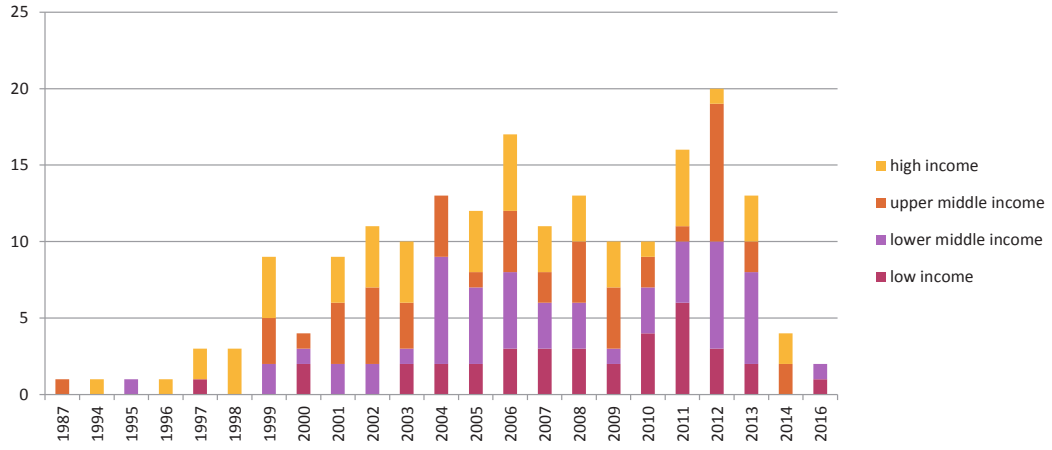

Figure 5. *year of implementation of FMIS solution in use vs. category of GNI per capita (World Bank Group, 2017)*

2.3. FMIS history in Hungary

As stated earlier, WBG[5] had an operation in Hungary for public financial management in 1996. The project documentation shows that the main goal of the USD 7.7 million project[6] was to reform PFM system, lay down the basis of TSA and establish the Hungarian State Treasury (HST) (Bokros & Dethier, 1998). The concept comprised a proposition for information centralisation to handle all public financial accounting transactions of the budget (Country Operations Division, 1996).

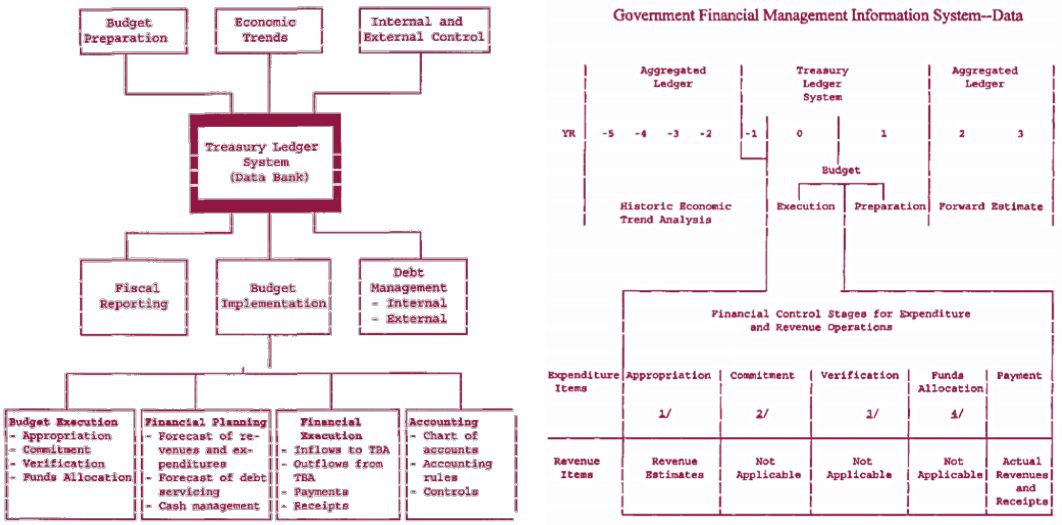

Figure 6. *vision drawn up by project documentation in 1996 for Hungarian State Treasury (Bokros & Dethier, 1998, pp. 28, 30)*

The Hungarian State Treasury was founded for the goals laid down by government resolutions in the mid 1990's (1128/1994. (XII.30.) és a 2189/1995. (VII.4.) – www.njt.hu) and started its operations with a predominantly banking approach. Consecutively the State Audit Office carried out an audit (State Audit Office of Hungary, 1996, p. 58) that found that planning phase was not adequately prepared compared to the complexity of control procedures, institutional workflows, and safety need of such system. Thus – as the mentioned report says – IT system realised differed fundamentally from the immature system design.

In reality the evolution of PFM in Hungary yielded a very fragmented structure in the past two decades. Local SPU accounting systems and the core treasury IT is connected primarily by the means of human interactions though the level of ICT would enable to have a much more automatized scheme. Thus it is very expensive to provide human capacity to supervise data correctness and the number of transactions is increasing. Nonetheless supervision is producing errors come into light that can be also revised by human interaction. Last but not least consolidated data production – that shows general government performance on macroeconomic level – is also challenging with a diffuse structure of system.

[5] Projects of WBG: http://www.worldbank.org/projects/search?lang=en&searchTerm=&themecode_exact=27

[6] Hungary – Public Finance Management Project (English) project site: http://www.worldbank.org/projects/P043446/public-finance-management-project?lang=en

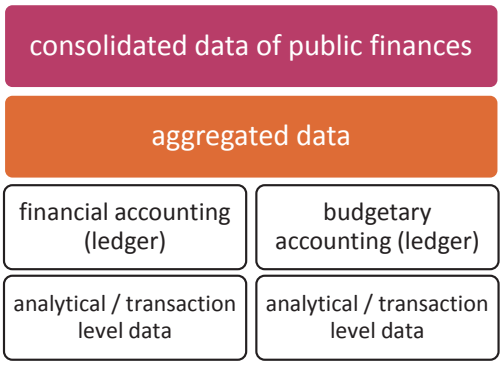

Figure 7. *data tree and storage according to present state – white background shows locally stored data (by the author)*

Issues faced leads us back to basics: the formulation of the so called Treasury Ledger System (TLS as shown on Fig. 6) is essential to gain proper, timely, coherent data framework in public financial accounting.

3. Accounting

An integrated PFM system should be based on a unified classification and regulatory environment in order to be sound, easily cumulated and comparable. The importance of these expectations were highlighted by the struggle following the sovereign debt crisis of 2008 (Szablics, 2016, p. 150). The Council of the European Union adopted a directive[7] with regard to the budgetary frameworks of the Member States and addressed the Commission to assess the suitability of IPSAS (International Public Sector Accounting Standards) for the Member States. (According to the latest updates this framework may be altered by the various interests of the different Member States (Russell, 2017).)

The elaboration is being coordinated by EUROSTAT, which has studied the public accounting and auditing practices (Ernst & Young, 2012) and the potential impact and sustainability of accrual accounting (PwC EPSAS Team, 2014), but the working group has not come to a conclusion so far.

The execution of the law on central government budget has a firm legislative background in Hungary. As of 2014, a new regulation entered into force that created a unique system of a combined budgetary (cash flow based) and financial (accrual) accounting, which is obligatory for all SPUs and other public sector entities. One of the main achievements was the unified chart of accounts and the detailed accounting standards set up by government decree[8]. Unfortunately, the everyday practice is more complex, since the fragmented structure consists of separately installed accounting software which are deployed in line with the specific SPU order and not controlled centrally at all. Consequently, developments were not settled by unified methods and sometimes the procurer orders procedures or constraints in them that may differ from the actual regulation. This does not mean that SPUs are not following the rules, but the chance of flexible interpretation lay in the systems.

Hungarian State Treasury – that is also functioning as the body responsible for SPU reporting – made a survey on the systems in use by SPUs.

[7] COUNCIL DIRECTIVE 2011/85/EU of 8 November 2011 on requirements for budgetary frameworks of the Member States – http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0085

[8] As a reference to the survey of WBG cited above only the third of the countries apply a unified chart of accounts or accounting principles for all segments of budget execution (World Bank Group, 2017)-Q14.

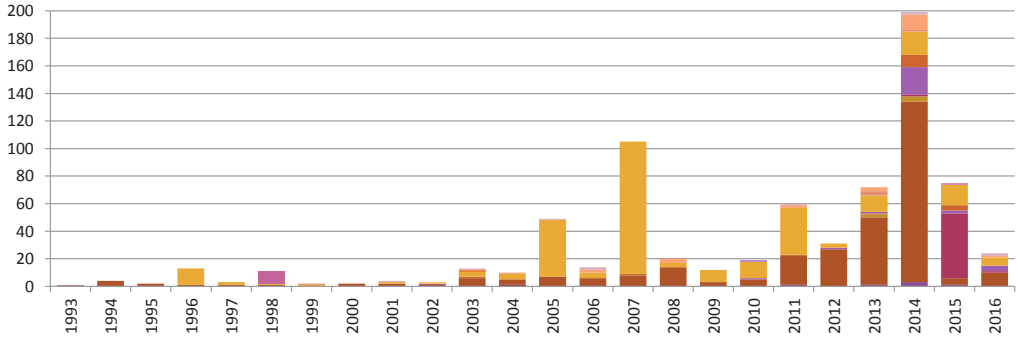

Figure 8. *year of implementation of accounting software in use (by the author, on the basis of survey made by Hungarian State Treasury 2016)*

The 748 SPUs of the central government gave the feedback on the practice of the legislative changes. It was surprising that many of them chose not to develop the current software but to change it to another, while no new supplier appeared on the market and all providers made the follow-up needed to measure up to the new rules. The experiment was also interesting from the aspect of the timeliness of the developments because it took very much time to carry out the specification, procurement, development, etc. phases. Finally the following conclusions can be made:

- As there are only 19 suppliers, the taken administrative measurements were multiplied by parallelism;
- Collateral development – given that every SPU has to follow the same accounting standards, classifications, and rules – hinder cost efficiency;
- Not coordinated developments result in heterogeneity in everyday accounting and the application of law.

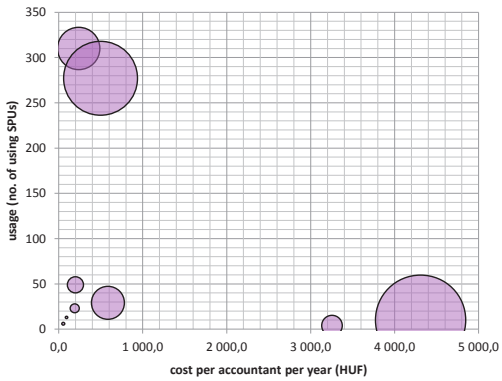

Figure 9. *usage and cost of accounting software in central government (by the author, on the basis of survey made by Hungarian State Treasury 2016)*

As a consequence, decentralised accounting systems provide an opportunity for evasion of basic principles that should be taboo: commitment ought not to succeed appropriation even as payments should must not be in excess of commitments. But the accompaniment of debt of SPUs is always present[9]. This phenomenon can be construed by a collision of interests turning up in different laws when those who make commitments are responsible for the assurance of realization of a fundamental right, such as the right for health and life. For instance, a doctor in a hospital [hospitals are SPUs in Hungary] is

[9] On the basis of HST data: http://www.allamkincstar.gov.hu/hu/koltsegvetesi-informaciok/aktualis-informaciok

making a commitment when using a surgery tool (that is not a property of the hospital already) and is also saving life with it. But the doctor is never taking the legislative rules into consideration (for making commitments) during the life-saving work.

Another aspect of the problem is that, even though the Treasury is making the double coverage check (liquidity in cash and sufficiency of appropriation), it does not have the opportunity to do so on the individual transaction level. It is only up to the single SPU if its activities are in compliance with the rules.

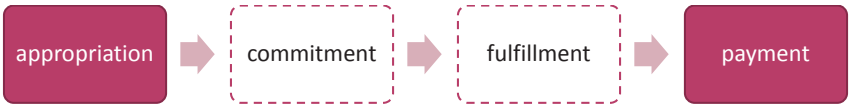

Figure 10. *simplified workflow of expenditure in public finance in Hungary (by the author)*

The software and machines were not the only ones facing a new challenge caused by the inevitable legislative reforms. The numerous (cca. 15k) sector of public accountants and financial professionals had to learn new methods in a relatively short period of time, while the age structure shows that this sector is ageing. We also have to face the side effect of our technology era: young adults priorities are much different when searching for job: they are looking for creativity based works and interesting challenges (Deloitte, 2015), while these factors are not so typical in the (perception of) public administration. (The demand for earnings of an entrant – cca. EUR 10k/year – is much higher than the average EUR 6,2k/year in this sector.) Summing it up lack of newly graduated professionals is evolving.

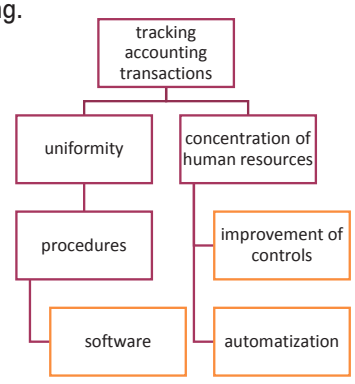

Figure 11. *schematic problem analysis (by the author)*

Questions raised are underlining that the legislative framework is only one (key) element of a sound system, hence the laws, human and IT capacities and everyday practice has to be in harmony.

4. Can a budget be smart?

Establishment and maintenance of the shortly presented PFM IT systems operate in an ordinary structure and they need huge financial resources on account of their massive sizes and solidity. This may cause a nearly invincible hindrance on the way to realisation. Alternatively, a novel (and also hyped) solution can be more cost-effective and scalable for a more coherent and stable system with the help of blockchain technology.

Sharing economy took a very big step forward again by the upheaval of Bitcoin. In their everyday meaning, it is sometimes confusing to grasp the difference between Bitcoin and blockchain, though this is crucial. The first is the name of a cryptocurrency while the second is the representation of the technology behind it. Though Bitcoin is not the one suitable to meet the needs of a country's PFM system, it has several valuable experiences worth describing.

Bitcoin itself started its expansion with a publication in 2009 by the author Satoshi

Nakamoto (Nakamoto, 2009). This study revealed the technical description of how the cryptocurrency is being created and transacted between network peers and miners.

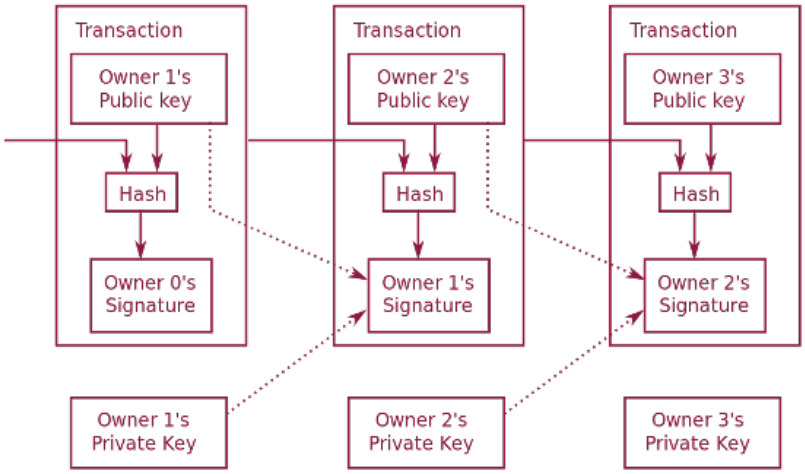

Figure 12. *verification of transactions on the blockchain (Nakamoto, 2009, p. 2)*

ad.1. The units of the cryptocurrency are transacted in a peer-to-peer manner so they do not need an authority, a bank or a national bank, to be transferred electronically (they do not even exist in a material way). It is also ensured that a piece of the money cannot be spent by different peers, the order of the transactions is carefully and safely recorded. All participants acknowledge all transactions.

ad.2. The algorithm behind manages the distributed ledger that is fully transparent to the internet users. Miners – as verifiers of the transactions – are responsible for making hashes from the blocks of several transactions between peers. This hash uniquely representing the inherent transactions as no part can be modified without the modification of the hash itself.

ad.3. The network is operated by the actors (peers and miners), so no central IT capacity is needed for sustainability and the growth needed is also provided by the newcomers in the system which provides scalability. The miners – encoding the transactions – are completing difficult calculations in order to produce the hashes for which work they are being paid by the algorithm as new units of the cryptocurrency is given to those fulfilling the encoding process. (The gives the task to have the hash in a specific end-format so it is more and more difficult to be produced.)

ad.4. The algorithm itself determines the quantity of the cryptocurrency in an expansive but slowing way but the value of a unit is changing according to the market situation: supply and demand for it.

From our prospective the outlined scheme has several consequences: strengths and weaknesses as well. First it is a great achievement that consensus basis results in the fact all the transactions are transparent, thus recorded in an exactly same way by all

the actors. Blocks can be tailored only to the predecessor and the order (or an earlier transaction) cannot be changed by any means. It follows that a piece of the cryptocurrency can be owned only by one peer in a specific moment. Finally the chain itself is merely a distributed ledger[10] so the bookkeeping work is done automatically and the books are kept by numerous miners and changes could only be made in a democratic way when the changer controls more than the half of the computing capacity.

On the other hand, Bitcoin raises doubts as well. Its opponents argue that despite the transparency the users are anonymous as the wallets representing them are only codes and nobody guarantees their personality. Namelessness is a huge virtue for misuse and illegal activities nonetheless for financing terrorism or drug trafficking. Criticisms also mention as a enormous disadvantage that the value of the cryptocurrency is not controlled by any authority or backed by a national economy subsequently it is a field ideal for speculative transactions. Last but not least the ever-growing usage generate ever-growing need for capacities which are only provided till it earns more than the cost. (Once the exchange rate against e.g. USD drops heavily or the growth caused by new emission ceases in 2033 when the hardcoded algorithm ends up with the maximal BTC 21M the miners will no longer have the motivation for operating the network.)

On the whole, this disruptive technology (blockchain) attracts attention of big firms and prominent decision makers all over the world[11] and in Europe as well. European Parliament published an in-depth analysis in early 2017 (Boucher, 2017) that considers the potential options of application not surprisingly mentioning public administration. As national governments are working already on blockchain-based projects a few examples can be listed as follows:

- With the editorial lead of Sir Mark Walport (Government Chief Scientific Adviser in the United Kingdom) a study was published in 2016-ban (Dr. Peplow, 2016) on the blockchain technology and its potential. The document reveals that the government of the United Kingdom is fostering it and in the preface two of its ministers stated their commitment.
- Banque de France started to inquire into the possible introduction of blockchain in 2016. The first tests of the established system took place in the end of 2016, that aimed the identification process within SEPA (Single Euro Payments Area) system applicable for international bank transfers.
- Estonia is a kind of a flagship in public administration modernisation process in Europe. The government is examining the blockchain technology from 2015. For example, with the help of e-residency program one can apply for Estonian habitation from all over the world. Inhabitants get digital ID card that are appropriate for digital signature of official documents in favour of administrative actions without physical presence. Moreover, Estonian citizens can track their health services and data even having the possibility to keep an eye on those who have also got access to their data. All by means of blockchain technology.

It seems that the execution of budget does not hold a speciality that a blockchain could not have a solution to. In order to create a schema, a few analogies have to be found and clarified before completing the model. First we have to consider appropriation as a type of public contract[12] between the State

[10] For ledger of bitcoin transactions see: https://blockchain.info/

[11] See also: http://letstalkpayments.com/an-overview-of-blockchain-technology/ ; https://www.sibos.com/

[12] The blockchain technology gives the basis of smart contracts concept.

(as the provider of the budget) and the SPU on the future right of spending money up to a definite point in time (the end of the budgetary year). This contract obliges the Treasury (as the authority repesenting the State) to provide the money needed to carry out the payment. The blockchain itself here is representing the complete regime that refers to the SPUs while breaking down or modifying their own budget and also the spending and bookkeeping rules. Finally, it is evident that the maintenance of the rules is the task of a central regulating authority or an institution.

Applying these components, the budget lifecycle would comprise the following steps. After passing the law on budget by the Parliament, the Treasury should immediately contract with all the SPUs on the budget dedicated. The SPU itself has to classify the breakdown in line with the regulation (e.g. limits set up by the law on budget or other laws or resolutions) that makes the appropriation usable. Once a modification is initiated, the transaction can only be executed according to the rules laid down in the blockchain and no central measurements have to be taken by the Treasury. The same should be applied to all spending transactions (commitment, fulfilment, payment), when the transactions are recorded directly in the distributed ledger of the blockchain. (Physical fulfilment and the issued invoice can be linked with the commitment id and the rule that no invoices can be accepted or payments can be made without a valid commitment id.) Finally, when payment has to be settled, the smart contract is fully executed in the moment of disbursement so it cannot be used again.

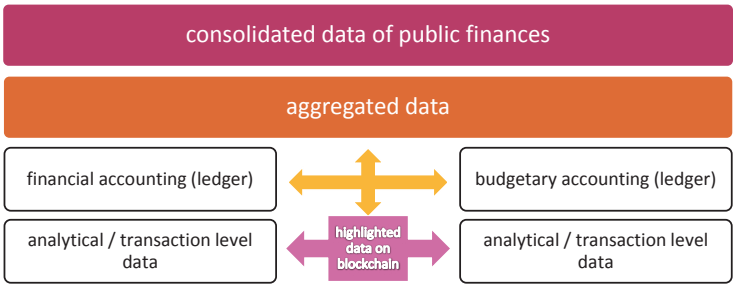

Figure 13. *data tree and storage in the presented blockchain model – white background shows locally stored data (by the author)*

Distributed ledger provides us with an up-to-date record on all transactions made, which is a very good basis for analysis and forecasting using modern BI solutions as well. The quality of valid data can always be available and accessible for the authorized personnel (permissions can be differentiated according to the decision-makers' needs). Finally the vulnerability of the infrastructure is much lower in the decentralised structure of a distributed ledger.

This concept is only a schematic overview of the envisioned appliance of the blockchain in budget execution. There can be several specific cases that are not easily applicable to this simplified model. But the thought experiment is suitable to reflect on the potentials of using an element of the sharing economy (developed originally for business use) in the public administration.

Conclusions

In this paper the improvements were studied on the macro level, which put the accounting IT systems in the spotlight. The budget cycle and key factors of a PFM

system were also examined with an insight on the developments made in the Treasury and accounting system for Hungarian public sector. Finally, the challenges faced were addressed and answered by a potential disruptive solution regarding the actual IT achievements.

Coming to a conclusion, it should be acknowledged that an ordinary integrated system (e.g. IFMIS) is a key factor of prudence and transparency of procedures and financial data of public finances. On the other hand, the centralisation of infrastructure is not a necessary condition any longer, considering that the emerging new technologies and accomplishments of the sharing economy are pushing the public administration towards efficient solutions. But these changes mean a big challenge in change management for decision makers and civil servants with regard to reshaping the working culture, which may be a slower process. As for business life or any other field of an economy, IT disrupts public administration procedures and it only depends on us if we can take the advantage of it.

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