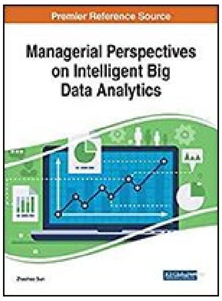

Managerial Perspectives on Intelligent Big Data Analytics

by Zhaohao Sun
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Chapter 6: Optimizing and Enhancing Digital Marketing Techniques in Intellectual Big Data Analytics

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ABSTRACT

The authors in this chapter show the essence, dignity, current state, and development prospects of avatar-based management using blockchain technology for improving implementation of economic solutions in the digital economy of Russia. The purpose of this chapter is not to review the existing published work on avatar-based models for policy advice, but to try an assessment of the merits and problems of avatar-based models as a solid basis for economic policy advice that is mainly based on the work and experience within the recently finished projects Triple H Avatar, an avatar-based software platform for HHH University, Sydney, Australia. The agenda of this project was to develop an avatar-based closed model with strong empirical grounding and micro-foundations that provides a uniform platform to address issues in different areas of digital economic and creating new tools to improve blockchain technology using the intelligent visualization techniques for big data analytic.

INTRODUCTION

Management in Digital Economy is concerned with the design, execution, monitoring, and improvement of business processes. Systems that support the enactment and execution of processes have extensively been used by companies to streamline and automate intra-organizational processes. Yet, for inter-organizational processes, challenges of joint design and a lack of mutual trust have hampered a broader uptake. Emerging blockchain technology has the potential to drastically change the environment in which inter-organizational processes are able to operate. Blockchains offer a way to execute processes in a trustworthy manner even in a network without any mutual trust between nodes. Key aspects are specific algorithms that lead to consensus among the nodes and market mechanisms that motivate the nodes to progress the network. Through these capabilities, this technology has the potential to shift the discourse in management research about how systems might enable the enactment, execution, monitoring or improvement of business process within or across business networks. By using blockchain technology, untrusted parties can establish trust in the truthful execution of the code. Smart contracts can be used to implement business collaborations in general and inter-organizational business processes in particular. The potential of blockchain-based distributed ledgers to enable collaboration in open environments has been successfully tested in diverse fields ranging from diamonds trading to securities settlement (Mendling, J. et al, 2018).

But at this stage, it has to be noted that blockchain technology still faces numerous general technological challenges. In this article, we describe what we believe are the main new challenges and opportunities of blockchain technology for Digital Economy in Russia. A our study in Russia by found that a majority of these challenges have not been addressed by the Russian research community, albeit we note that blockchain developer communities actively discuss some of these challenges and suggest a myriad of potential solutions. Some of them can be addressed by using private or consortium blockchain instead of a fully open network. In general, the technological challenges are limited at this point, in terms of both developer support (lack of adequate tooling) and end-user support (hard to use and understand). Our recent advances on developer support include efforts by of the towards model-driven development of blockchain applications sliding mode in intellectual control and communication, help the technological challenges and created tools (Mkrttchian & Aleshina, 2017).

BACKGROUND

We are the first to identify the application potential of blockchain technology to sliding mode in intellectual control and communication, for help the technological challenges and created tools. A our proposal to support inter-organizational processes through blockchain technology is described by: large parts of the control flow and business logic of inter-organizational business processes can be compiled from process models into smart contracts which ensure the joint process is

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correctly executed. So-called trigger components allow connecting these inter-organizational process implementations to Web services and internal process implementations. These triggers serve as a bridge between the blockchain and enterprise applications. The concept enables the optional implementation of intellectual control and built-in escrow management at defined points within the process, where this is desired and feasible (Mendling, et al, 2018).

The engineering realization of this advance is still nascent at this stage, although some early efforts can be found in our previous works. For example, intelligent visualization techniques that enforce a process execution in a trustworthy way can be generated from sliding mode process models (Mkrttchian & Aleshina, 2017).

Our study show that blockchain technology and its application to digital economy in Russia are at an important crossroads: engineering realization issues blend with promising application scenarios; early implementations mix with unanticipated challenges. It is timely, therefore, to discuss in broad and encompassing ways where open questions lie that the scholarly community should be interested in addressing. We do so in the sections that follows.

MAIN FOCUS OF THE CHAPTER

Issues, Controversies, Problems, Solutions and Recommendations

In this section, we discuss blockchain in relation to the visualization lifecycle including the following phases: identification, discovery, analysis, redesign, implementation, execution, monitoring, and adaptation. Using this lifecycle as a framework of reference allows us to discuss many incremental changes that blockchains might provide.

Process identification is concerned with the high-level description and evaluation of a company from a process-oriented perspective, thus connecting strategic alignment with process improvement. Currently, identification is mostly approached from an inward-looking perspective [Dumas et al. 2018]. Blockchain technology adds another relevant perspective for evaluating high-level processes in terms of the implied strengths, weaknesses, opportunities, and threats. For example, how can a company systematically identify the most suitable processes for blockchains or the most threatened ones? Research is needed into how this perspective can be integrated into the identification phase. Because blockchains have affinity with the support of inter-organizational processes, process identification may need to encompass not only the needs of one organization, but broader known and even unknown partners.

Process discovery refers to the collection of information about the current way a process operates and its representation as an as-is process model. Currently, methods for process discovery are largely based on interviews, walkthroughs and documentation analysis, complemented with auto-mated process discovery techniques over non-encrypted event logs generated by process-aware information systems [van der Aalst 2016]. Blockchain technology defines new challenges for pro-cess discovery techniques: the information may be fragmented and encrypted; accounts and keys can change frequently; and payload data may be stored partly on-chain and partly off-chain. For example, how can a company discover an overall process from blockchain transactions when these might not be logically related to a process identifier? This fragmentation might require a repeated alignment of information from all relevant parties operating on the blockchain. Work on matching could represent a promising starting point to solve this problem [Cayoglu et al. 2014; Euzenat and Shvaiko 2013; Gal 2011]. There is both the risk and opportunity of conducting process mining on blockchain data. An opportunity could involve establishing trust in how a process or a prospective business partner operates, while a risk is that other parties might be able to understand operational characteristics from blockchain transactions. There are also opportunities for reverse engineering business processes, among others, from smart contracts.

Process analysis refers to obtaining insights into issues relating to the way a business process currently operates. Currently, the analysis of processes mostly builds on data that is available inside of organizations or from perceptions shared by internal and external process stakeholders (Mendling, J. et al, 2018). Records of processes executed on the blockchain yield valuable information that can help to assess the case load, durations, frequencies of paths, parties involved, and correlations between unencrypted data items. These pieces of information can be used to discover processes, detect deviations, and conduct root cause analysis (Mendling, J. et al, 2018), ranging from small groups of companies to an entire industry at large. The question is which effort is required to bring the available blockchain transaction data into a format that permits such analysis.

Process redesign deals with the systematic improvement of a process. Currently, approaches like redesign heuristics build on the assumption that there are recurring patterns of how a process can be improved (Mendling, J. et al, 2018). Blockchain technology offers novel ways of improving specific business processes or resolving specific problems. For instance, instead of involving a trustee to release a payment if an agreed condition is met, a buyer and a seller of a house might agree on a smart contract instead. The question is where blockchains can be applied for optimizing existing interactions and where new interaction patterns without a trusted central party can be established, potentially drawing on insights from related research on Web service interaction. A promising direction for developing blockchain-appropriate abstractions and heuristics may come from data-aware workflows and diagrams. Both techniques combine two primary ingredients of blockchain, namely data and

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process, in a holistic manner that is well-suited for top-down design of cross-organizational processes. It might also be beneficial to formulate blockchain-specific redesign heuristics that could mimic how Incoterms define standardized interactions in international trade. Specific challenges for redesign include the joint engineering of blockchain processes between all parties involved, an ongoing problem for design (Mendling, J. et al, 2018).

Process implementation refers to the procedure of transforming a to-be model into software components executing the digital economy process. Currently, same processes are often implemented using process-aware information systems or business process management systems inside single organizations. In this context, the question is how the involved parties can make sure that the implementation that they deploy on the blockchain supports their process as desired. Some of the challenges regarding the transformation of a process model to blockchain artifacts are discussed by (Mendling, J. et al, 2018). It has to be noted that choreographies have not been adopted by industry to a large extent yet. Despite this, they are especially helpful in inter-organizational settings, where it is not possible to control and monitor a complete process in a centralized fashion because of organizational borders (Mendling, J. et al, 2018). To verify that contracts between choreography stakeholders have been fulfilled, a trust basis, which is not under control of a particular party, needs to be established. Blockchains may serve to establish this kind of trust between stakeholders.

An important engineering challenge on the implementation level is the identification and definition of abstractions for the design of blockchain-based business process execution. Libraries and operations for engines are required, accompanied by modeling primitives and language extensions of digital economy process·· Software patterns and anti-patterns will be of good help to engineers designing blockchain-based processes. There is also a need for new approaches for quality assurance, correctness, and verification, as well as for new corresponding correctness criteria. These can build on existing notions of compliance the more, dynamic partner binding and rebinding is a challenge that requires attention. Process participants will have to find partners, either manually or automatically on dedicated marketplaces using dedicated look-up services. The property of inhabiting a certain role in a process might itself be a tradable asset. For example, a supplier might auction off the role of shipper to the highest bidder as part of the process. Finally, as more and more companies use blockchain, there will be a proliferation of smart contract templates available for use. Tools for finding templates appropriate for a given style of collaboration will be essential. All these characteristics emphasize the need for specific testing and verification approaches.

Execution refers to the instantiation of individual cases and their information-technological processing. Currently, such execution is facilitated by process-aware information systems or digital economy process management systems. For the actual execution of a process deployed on a blockchain following the method of (Mendling, J. et al, 2018), several differences with the traditional ways exist. During the execution of an instance, messages between participants need to be passed as blockchain transactions to the smart contract; resulting messages need to be observed from the blocks in the blockchain. Both of these can be achieved by integrating blockchain technology directly with existing enterprise systems or through the use of dedicated integration components, such as the triggers suggested by (Mendling, J. et al, 2018). The main challenge here involves ensuring correctness and security, especially when monetary assets are transferred using this technology.

Process monitoring refers to collecting events of process executions, displaying them in an under-stand able way, and triggering alerts and escalation in cases where undesired behavior is observed. Currently, such process execution data is recorded by systems that support process execution (Mendling, J. et al, 2018). First, we face issues in terms of data fragmentation and encryption as in the analysis phase. For example, the data on the blockchain alone will likely not be enough to monitor the process, but require integration with local off-chain data. Once such tracing in place, the global view of the process can be monitored independently by each involved party. This provides a suitable basis for continuous conformance and compliance checking and monitoring of service-level agreements. Second, based on monitoring data exchanged via the blockchain, it is possible to verify if a process instance meets the original process model and the contractual obligations of all involved process stakeholders. For this, blockchain technology can be exploited to store the process execution data and handoffs between process participants. Notably, this is even possible without the usage of smart contracts, i.e., in a first-generation blockchain like the one operated by digital economy (Mendling, J. et al, 2018).

Runtime adaptation refers to the concept of changing the process during execution. In traditional approaches, this can for instance be achieved by allowing participants in a process to change the model during its execution. Interacting partners might take a defensive stance in order to avoid certain types of adaptation. As discussed by (Mendling, J. et al, 2018), blockchain can be used to enforce conformance with the model, so that participants can rely on the joint model being followed. In such a setting, adaptation is by default something to be avoided: if a participant can change the model, this could be used to gain an unfair advantage over the other participants. For instance, the rules of retrieving digital process from an escrow account could be changed or the terms of payment. In this setting, process adaptation must strictly adhere to defined paths for it, e.g., any change to a deployed smart contract may require a transaction signed by all participants. In contrast, the method proposed by (Mendling, J. et al, 2018) allows runtime adaptation, but assumes that relevant participants monitor the execution and react if a change is undesired. If smart contracts enforce the process, there are also problems arising in relation to evolution: new smart contracts need to be deployed to reflect changes to a new version of the process model. Porting running instances from an old version to a new one would require effective coordination mechanisms involving all participants ((Mendling, J. et al, 2018).

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There are also challenges and opportunities for digital economy process and blockchain technology beyond the classical lifecycle. We refer to the capability areas beyond the methodological support we reflected above, including strategy, governance, information technology, people, and culture.

Strategic alignment refers to the active management of connections between organizational priori-ties and business processes, which aims at facilitating effective actions to improve business performance. Currently, various approaches to digital economy process assume that the corporate strategy is defined first and business processes are aligned with the respective strategic imperatives (Mendling, J. et al, 2018). Blockchain technology challenges these approaches to strategic alignment. For many companies, blockchains define a potential threat to their core digital economy processes. For instance, the banking industry could see a major disintermediation based on blockchain-based payment services. Also lock-in effects might deteriorate when, for example, the banking service is not the banking network itself anymore, but only the interface to it. These developments could lead to business processes and business models being under strong influence of technological innovations outside of companies (Mendling, J. et al, 2018).

The digital economy process governance refers to appropriate and transparent accountability in terms of roles, responsibilities, and decision processes for different digital economy-related programs, projects, and operations (Mendling, J. et al, 2018). Currently, digital economy processes as a management approach builds on the explicit definition of digital economy processes management-related roles and responsibilities with a focus on the internal operations of a company. Blockchain technology might change governance towards a more externally oriented model of self-governance based on smart contracts. Research on corporate governance investigates agency problems and mechanisms to provide effective incentives for intended behavior (Mendling, J. et al, 2018). Smart contracts can be used to establish new governance models as exemplified by (Mendling, J. et al, 2018). It is an important question in how far this idea of Mendling (2018) can be extended towards reducing the agency problem of management discretion or eventually eliminate the need for management altogether. Furthermore, the revolutionary change suggested by Mendling, (2018) for organization shows just how disruptive this technology can be, and whether similarly radical changes could apply to digital economy processes management. (Mendling, J. et al, 2018).

Digital economy processes management-related information technology subsumes all systems that support process execution, such as process-aware information systems and digital economy process management systems. These systems typically assume central control over the process. Blockchain technology enables novel ways of process execution, but several challenges in terms of security and privacy have to be considered. While the visibility of encrypted data on a blockchain is restricted, it is up to the participants in the process to ensure that these mechanisms are used according to their confidentiality requirements. Some of these requirements are currently being investigated in the financial industry. Further challenges can be expected with the introduction of the digital economy in Russian Federation. It is also not clear, which new attack scenarios on blockchain networks might emerge. Therefore, guidelines for using private, public, or consortium-based blockchains are required.

A person in this context refers to all individuals, possibly in different roles, who engage with digital economy processes management. Currently, these are people who work as process analyst, process manager, process owner or in other process-related roles. The roles of these individuals are shaped by skills in the area of management, business analysis and requirements engineering. In this capability area, the use of blockchain technology requires extensions of their skill sets. New required skills relate to partner and contract management, software engineering and big data analysts. Also, people have to be willing to design blockchain-based collaborations within the frame of existing regulations to enable adoption. This implies that research into blockchain-specific technology acceptance is needed, extending the established technology acceptance model (Mendling, J. et al, 2018).

Organizational culture is defined by the collective values of a group of people in an organization. Currently, digital economy processes management is discussed in relation to organizational culture from a perspective that emphasizes an affinity with clan and hierarchy culture (Mendling, J. et al, 2018)]. These cultural types are often found in the many companies that use digital economy processes management as an approach for documentation. Blockchains are likely to influence organizational culture towards a stronger emphasis on flexibility and an outward-looking perspective. In the competing values framework by (Mendling et al, 2018), these aspects are associated with an adhocracy organizational culture. Furthermore, not only consequences of blockchain adoption have to be studied, but also antecedents'. These include organizational factors that facilitate early and successful adoption.

By itself, stored data does not generate business value, and this is true of traditional databases, data warehouses, and the new technologies for storing big data. Once the data is appropriately stored, however, it can be analyzed, which can create tremendous value. A variety of analysis technologies, approaches, and products have emerged that are especially applicable to big data, such as in-memory analytics, in-database analytics, and appliances. In our study we are using Intelligent Visualization Techniques for Big Data Analytic, or business intelligence (Mkrttchian et al, 2011-2017). It is helpful to recognize that the term analytics is not used consistently; it is used in at least three different yet related ways. A starting point for understanding analytics is to explore its roots. Decision support systems (DSS) in the 1970s were the first systems to support decision making. DSS came to be used as a description for an application and an academic discipline. Over time, additional

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decision support applications such as executive information systems, online analytical processing (OLAP), and dashboards/scorecards became popular (Watson, 2014). Then in the 1990s, Howard Dresner, an analyst at Gartner (Watson, 2014), popularized the term business intelligence (BI). A typical definition is that "BI is a broad category of applications, technologies, and processes for gathering, storing, accessing, and analyzing data to help business users make better decisions" (Watson, 2014). With this definition, BI can be viewed as an umbrella term for all applications that support decision making, and this is how it is interpreted in industry and, increasingly, in academia. BI evolved from DSS, and one could argue that analytics evolved from BI (at least in terms of terminology). Thus, analytics is an umbrella term for data analysis applications. BI can also be viewed as "getting data in" (to a data mart or warehouse) and "getting data out" (analyzing the data that is stored). A second interpretation of analytics is that it is the "getting data out" part of BI. The third interpretation is that analytics is the use of "rocket science" algorithms (e.g., machine learning, neural networks) to analyze data. These different takes on analytics do not normally cause much confusion, because the context usually makes the meaning clear (Mkrttchian et al, 2011-2017). It is useful to distinguish between three kinds of analytics because the differences have implications for the technologies and architectures used for big data analytics. Some types of analytics are better performed on some platforms than on others (Watson, 2014). Descriptive analytics, such as reporting/OLAP, dashboards/scorecards, and data visualization, have been widely used for some time, and are the core applications of traditional BI. Descriptive analytics are backward looking (like a car's rear view mirror) and reveal what has occurred. One trend, however, is to include the findings from predictive analytics, such as forecasts of future sales, on dashboards/scorecards (Watson, 2014). Predictive analytics suggest what will occur in the future (like looking through a car's windshield). The methods and algorithms for predictive analytics such as regression analysis, machine learning, and neural networks have existed for some time. Recently, however, software products such as SAS Enterprise Miner have made them much easier to understand and use. They have also been integrated into specific applications, such as for campaign management. Marketing is the target for many predictive analytics applications; here the goal is to better understand customers and their needs and preferences (Watson, 2014). Some people also refer to exploratory or discovery analytics, although these are just other names for predictive analytics. When these terms are used, they normally refer to finding relationships in big data that were not previously known. The ability to analyze new data sources —that is, big data—creates additional opportunities for insights and is especially important for firms with massive amounts of customer data. Golden path analysis is a new and interesting predictive or discovery analytics technique. It involves the analysis of large quantities of behavioral data (i.e., data associated with the activities or actions of people) to identify patterns of events or activities that foretell customer actions such as not renewing a cell phone contract, closing a checking account, or abandoning an electronic shopping cart. When a company can predict a behavior, it can intercede, perhaps with an offer, and possibly change the anticipated behavior (Watson, 2014). Whereas predictive analytics tells you what will happen, prescriptive analytics suggests what to do (like a car's GPS instructions). Prescriptive analytics can identify optimal solutions, often for the allocation of scarce resources. It, too, has been researched in academia for a long time but is now finding wider use in practice. For example, the use of mathematical programming for revenue management is increasingly common for organizations that have "perishable" goods such as rental cars, hotel rooms, and airline seats. For example, Harrah's Entertainment, a leader in the use of analytics, has been using revenue management for hotel room pricing for many years (Watson, 2014). Organizations typically move from descriptive to predictive to prescriptive analytics. Another way of describing this progression is: What happened? Why did it happen? What will happen? How can we make it happen? This progression is normally seen in various BI and analytics maturity models (Watson, 2014). There is no formula for choosing the right platforms; however, the most important considerations include the volume, velocity, and variety of data; the applications that will use the platform; that the users are; and whether the required processing is batch or real time. Some work may require the integrated use of multiple platforms. The final choices ultimately come down to where the required work can be done at the lowest cost (Watson, 2014). For our goal is good Triple H Avatar an Avatar-based Software Platform for HHH University, Sydney, Australia (Mkrttchian et al, 2011-2017).

FUTURE RESEARCH DIRECTION AND CONCLUSIONS

- Blockchains will fundamentally shift how we deal with transactions in general, and therefore how organizations manage their business processes within their network.
- Discussion of challenges in relation to the digital economy processes management lifecycle and beyond points to seven major future research directions. For some of them we expect viable insights to emerge sooner, for others later. The order loosely reflects how soon such insights might appear.
- The digital economy processes management and the Information Systems community have a unique opportunity to help shape this fundamental shift towards a distributed, trustworthy infrastructure to promote inter-organizational processes.

With this article we aim to provide clarity, focus, and impetus for the research challenges in future that are upon us.

1. Developing a diverse set of execution and monitoring systems on blockchain. Research in this area will have to demonstrate the feasibility of using blockchains for process-aware information systems. Among others, design science and algorithm engineering will be required here. Insights from software engineering and distributed systems will be

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informative.

2. Devising new methods for analysis and engineering business processes based on blockchain technology. Research in this topic area will have to investigate how blockchain-based pro-cesses can be efficiently specified and deployed. Among others, formal research methods and design science will be required to study this topic. Insights from software engineering and database research will be informative here.

3. Redesigning processes to leverage the opportunities granted by blockchain. Research in this context will have to investigate how blockchain may allow re-imagining specific processes and the collaboration with external stakeholders. The whole area of choreographies may be re-vitalized by this technology. Among others, design science will be required here. Insights from operations management and organizational science will be informative.

4. Defining appropriate methods for evolution and adaptation. Research in this area will have to investigate the potential guarantees that can be made for certain types of evolution and adaptation. Among others, formal research methods will be required here. Insights from theoretical computer science and verification will be informative.

5. Developing techniques for identifying, discovering, and analyzing relevant processes for the adoption of blockchain technology. Research on this topic will have to investigate which characteristics of blockchain as a technology best meet requirements of specific processes. Among others, empirical research methods and design science will be required. Insights from management science and innovation research will be informative here.

6. Understanding the impact on strategy and governance of blockchains, in particular regarding new business and governance models enabled by revolutionary innovation based on blockchain. Research in this topic area will have to study which processes in an enterprise setting could be onoverganized differently using blockchain and which consequences this brings. Among others, empirical research methods will be required to investigate this topic. Insights from organizational science and business research will be informative.

7. Investigating the culture shift towards openness in the management and execution of business processes, and on hiring as well as upskilling people as needed. Research in this topic area will have to investigate how corporate culture changes with the introduction of blockchains, and in how far this differs from the adoption of other technologies. Among others, empirical methods will be required for research in this area. Insights from organizational science and business research will be informative.

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