From Bitcoin to Decentralized Autonomous Corporations
Extending the Application Scope of Decentralized Peer-to-Peer Networks and Blockchains

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Abstract: Inspired by the new technological advancements and the groundbreaking technology at the foundation of cryptocurrencies, organizational structures are expected to evolve and new corporate structures to emerge, based on full decentralization. We posit that the blockchain, i.e., the technology, system and protocol behind and beyond the most popular digital crypto-currencies, will introduce decentralization in many manifestations of our everyday life, especially in cases where an independent trusted third party is needed to ensure and verify operations and transactions. This paper builds upon the blockchain technology and discusses how it could enable fully decentralized forms of business structures to emerge; decentralized autonomous corporations (DACs) are business entities totally based on code; running on the cloud, providing certain services and creating value for their customers. Thus, we argue that DACs could prove a means of decentralizing and automating decision making in organizations.

1 INTRODUCTION

The need of modern organizations to automate and integrate tasks and processes so as to effectively operate in the increasingly competitive environment, is more than obvious in our era. Information Technology enables the introduction of advanced solutions to perform such tasks. Business structures have also evolved over time, from hierarchical and autocratic structures to more wide and open to innovation models, to facilitate the way businesses thrive towards effectiveness and productivity, making enterprise architecture and structure a key decision for the modern enterprise.

Important technological advancements of our time may enable the invention and conception of new and innovative business structures. More specifically, the pioneering state-of-the-art technology at the foundation of what is today known as digital cryptocurrencies, namely the blockchain, could act as the keystone for the decentralization of anything that runs today under the support or surveillance of a trusted third party to ensure its effective and proper operation. This technology is still at its infancy and the implications deriving from its implementation are

hard to overstate (Giaglis and Kypriotaki, 2014). However, it has already been conceived as able to support the invention of a new and fully decentralized enterprise architecture; "Decentralized Autonomous Corporations" are envisioned as open source entities running on the cloud by themselves, once coded and released, introducing notable opportunities for competitive advantages.

In what follows, we provide a brief overview of the way enterprise architecture has been conceived and evolved over time. Next, we discuss the Bitcoin technology, its disruptive nature and potential. This allows us to discuss decentralization as its most prominent and promising characteristic. Finally, Decentralized Autonomous corporations and their characteristics are introduced, igniting a discussion about the competitive advantages as well as the limitations accompanying this form of business.

2 ENTERPRISE ARCHITECTURE OVER TIME

Enterprise architecture refers to "the fundamental structures of a company (or government agency)" and

seeks to "bridg[e] the gap between business and information technology" (Aier et al., 2011). As a result, it can offer support for the overall design (Dietz, 2006) and the development of the organisational capabilities and assets (Ahlemann et al., 2012).

At the same time, enterprise architecture can be a useful tool towards responding to a range of needs and challenges that contemporary organisations face today (Greefhorst and Proper, 2011). In the following section, these challenges are briefly outlined.

2.1 Current Organisational Needs and Pressures

Contemporary organizations are faced with an ever-increasing complexity and the need to effectively use their technical resources (Shah and Kourdi, 2007). Generally, most of the pressures they experience are extra-organizational and the challenges they need to respond to originate from outside the organizational environment.

On a more abstract level, Greefhorst and Proper (Greefhorst and Proper, 2011) have identified several challenges. To begin with, they argue that, due to globalisation, organisations need to position themselves within the global marketplace and offer products and services that either respond to the needs of global consumers or are built on a differentiation basis. Next, they discuss the need for aligning with the service-oriented economy, which requires organisations to become service providers, even when they are in fact product providers, in the form of offering integrated services. In relation to this, they further identify "the shift of powers in the value chain". This refers to consumers and clients who are today more demanding and powerful. Last but not least, they refer to the changing role and capabilities of Information Technology (IT); while previously IT was used primarily for automating processes and procedures, today it offers a range of opportunities and has transformed entirely the landscape by nesting within the core of the organisation. Most importantly, it can be the instrument for the transformation of the organisation towards responding to contemporary needs.

On a more practical level, the aforementioned issues are interpreted into specific needs of the modern organisation (or business). As it has been highlighted, markets today are integrated, consumers and customers are quite more demanding and competition remains strong. Therefore, the aforementioned issues "change the conditions for control in companies" (Nilsson and Lindvall, 2014).

In more detail, organisations today, particularly those that are small or medium sized, need a series of skills, ranging from IS, business, and general management skills to specific organizational processes for the exploitation of these skills (Cragg et al., 2011). Further, all organisations need a way to integrate their various functions and link all the stages within the supply chain. This can result into information integration (e.g., financial and accounting information, human resources information, customer information) and to the best management practices (Momoh et al., 2010). Most often, these needs are met, completely or partially, through the use of Enterprise Resource Planning information systems. In larger organisations, there is an additional need; modern organisations experience the decentralisation of their resources, among their individual departments, but also between their various business partners. As a result, there is a great need for information exchange and sharing across heterogeneous applications environments (Wang and Xu, 2011). The most common solution that addresses this need is IT, as it can enable the integration and the automation of information, while supporting the integration and automation of processes, despite that there is weak evidence that IT solutions can improve the supply chain integration (Marra et al., 2012).

2.2 Different Enterprise Structures and Their Development over Time

To date, several enterprise structures have emerged, ranging from the brick and mortar paradigm, to e-commerce and mobile commerce, which, supported by ubiquitous internet access, are gaining increasing adoption nowadays.

To begin with, the brick and mortar paradigm refers to the traditional paradigm of doing business from a physical location (e.g., store, offices). Naturally, this structure has not been replaced entirely by other forms. However, it is quite evident that the internet in general has transformed significantly "the way of doing business [...] and commerce" (Maamar, 2003). First of all, consumers have greater power on the web, as they have the opportunity to send and receive information from multiple sources for multiple products and services (Madhavi and Akbar, 2011). As a result, there is great demand for supporting the aforementioned processes through IT and for maintaining business processes that are aligned with consumers' needs (Maamar, 2003), through e-commerce. As a result, there are several brick and mortar businesses that have moved into the internet era, maintaining both an electronic and

physical presence, while others have completely transferred their activities to the web.

Nevertheless, we are witnessing today yet another transformation of commerce. The advent of mobile technologies, supported by the great availability of wireless networks and easy to use handled devices has given way for the rise of mobile commerce (m-commerce). This type of activity is basically "an important step towards achieving an anywhere, anytime paradigm" since it is possible to buy and sell products and services at all times from all locations, i.e., these two dimensions no longer constrain business activities (Maamar, 2003).

Junglas and Watson argue that these two paradigms, e-commerce and m-commerce, exhibit some features, which differentiate them entirely from one another. Specifically, the authors argue that m-commerce and e-commerce exhibits significant differences along the concepts of reachability, accessibility, localization and portability (Junglas and Watson, 2003). Indeed, while it may be said that both paradigms provide to a certain extent all of the above, the former, i.e., m-commerce, subject to other variables (e.g., network availability) manages to provide them in an unrestricted fashion, without setting limits to e.g., reachability and portability.

Following m-commerce, it is posited that yet another paradigm is about to emerge, that of ultimate commerce (u-commerce) (Junglas and Watson, 2003). Weiser has introduced ubiquitous information systems in his seminal paper (Weiser, 1991). In it, he described a world where the boundaries between everyday life and technology blur together as information systems weave themselves into our everyday activities. Based on this, Watson et al. have defined u-commerce as "the use of ubiquitous networks to support personalized and uninterrupted communications and transactions between a firm and its various stakeholders to provide a level of value over, above, and beyond traditional commerce" (Watson et al., 2002). In other words, u-commerce, supported by ubiquitous networks and universal devices, will help commerce become independent from space and time, and extend itself beyond the traditional paradigms (Junglas and Watson, 2003).

At the same time, beyond the transformations that commerce has been undergoing recently, businesses are yet again faced with more changes. It has been noted that the structure of a typical business has been changing recently as well, and that the typical hierarchical structure has slowly but steadily shifted into a pancake design. These two examples, the pyramid and the pancake, occupy the two opposing extremes of a spectrum (Schneckenberg, 2009), while

in between them there are several variations and combinations of the two. To elaborate further, the traditional pyramid reflects the "hierarchical culture, in which leadership makes centralized decisions at the top of the organization and pushes these decisions vertically down to lower-level employees for execution" (Schneckenberg, 2009). In contrast, the pancake design places all employees on the same level, as they are rather autonomous and make their own decisions, drawing from their experience and expertise. In these cases, the employees do not necessarily need the authorization of central management, but they can rely on their own judgment.

These changes have been facilitated by two different features. First of all, studies reveal that currently there is a shift of demand from goods to services. Therefore, contemporary businesses are in need to deliver a service even in cases where they are in fact produce a specific product (Greefhorst and Proper, 2011). Secondly, recent advances have allowed the decrease of costs for information and communication technologies within a given enterprise and there are those who posit that this is in fact the primary reason for the organisational transformation we witness today (Schneckenberg, 2009, Malone, 2004). What is important however, is that this organizational transformation, from the pyramid to the pancake, has led to the introduction of decentralization of decision-making in modern business; (Schneckenberg, 2009).

Lately, the trend towards lean and open to innovation models of operation is increasing; Google allows their employees to spend a significant percent of their time in projects they initiate and conceive, whereas GitHub, the developers' online community, has adopted the "open allocation" mode of operation. The latter is the model of operation which enables employees self-organize and deal with the problems they think as important, without top management guidelines or formal business structures at all. GitHub team members, inspired by a common vision and maintaining an advanced level of communication and collaboration, have proved that this decentralized approach is workable; it counts at least one effective application, as GitHub ranks as a very popular tool and repository for developers nowadays.

In the following paragraphs, the blockchain technology is defined and briefly explained, including insights to its main characteristics.

3 DAC - A NEW BUSINESS STRUCTURE UNDER DEVELOPMENT

Corporations are a way that people use to organize towards a common goal; this means to design and implement a business idea, create and offer a product or service in order to generate added value and thus, *raise profits*. It has been widely argued that corporations are people (The Economist, 2014), meaning that their successful establishment and daily operation are based on the team of people that "runs" the business. Are there types of businesses, though, that offer specific products or services and can be coded into making decisions and generating profit, with just (or even without) human lead and guidance?

As previously discussed, a constantly increasing percentage of big corporations faces the need to re-adjust or even re-engineer their business processes, in order to operate effectively and sustain their competitive advantage. The integration and use of advanced technology in already established businesses, typically provides sophisticated solutions for integration or automation of tasks, thus tackling the aforementioned issue.

At the same time, start-up entrepreneurship is promoted and supported a lot in our era; lean methodologies act catalytically in the development of new business ventures, and arguably require flexible, open-to-innovation business models and operation plans in order for startups to launch and find their way to success.

We suggest that both modern corporations and new business ventures about to flourish, need to consider and exploit innovative technological breakthroughs, and more specifically to examine whether their infrastructure could be improved to facilitate effectiveness and productivity. The blockchain technology is proposed as an infrastructure of such high-calibre and promising potential.

3.1 Blockchain Technology – Introducing a New Alternative?

Based on decades of scientific research results in diverse, multidisciplinary fields, a revolutionary technological invention has quite recently emerged; digital currencies and the blockchain infrastructure.

The blockchain is an online, global, publicly available, distributed registry (ledger) that can be updated by all nodes of a peer to peer (P2P) distributed network, based on their consensus, ensured by the use of a proof-of-work algorithm (Antonopoulos, 2014). The blockchain technology provides the users of a P2P network, previously unknown to each other, with the opportunity, for the first time in history, to reach a decision on the next "block" to be added in the "chain", without the need of a trusted third party.

To date, Bitcoin is the most popular private, decentralized, digital crypto-currency, and the first widely accepted application of the blockchain technology. The original white paper (Nakamoto, 2008), written and distributed by Satoshi Nakamoto, re-introduced the concept of currency as a decentralized means of exchange and store of value, which until then relied solely on trusted third parties, i.e., banks.

Bitcoin as a concept, according to Antonopoulos (2014), refers to all of the following:

- a de-centralized peer-to-peer network (the bitcoin protocol);
- a public transaction ledger (the blockchain);
- a de-centralized mathematical and deterministic currency issuance mechanism; and
- a transaction verification mechanism (Proof-of-Work and mining).

A moment's thought would enable the reader realise that the blockchain technology can ignite applications of decentralized public records, like land titles, vote or criminal records, private records like wills and trusts, while it will probably be met in medical records or issuance of certifications in the near future. A plethora of innovative ideas, based on the blockchain technology, has already flourished; attempts to disrupt the nature of products or services offered by a central sovereign, by enabling a user driven changing process of change of ownership, vary among meta-coins and asset registration ledgers, issuance of certificates of any kind, smart contracts (contractual agreements implemented using software), etc. Could, the very same technology possibly enable the invention of a new form of corporations, a dynamic and decentralized business structure?

3.2 What Is a DAC?

As already discussed, corporations and their structure have substantially developed over the last decades. The aforementioned blockchain technology is believed to be the base for the next potential unfolding with regards to business structures of the future. Corporations that are code on the cloud, based on an algorithm, set up to perform a certain function

that creates value; this is the most simplistic description of decentralized autonomous corporations (DACs), an expression of decentralization that will disrupt the way businesses are organized, to an extent much greater than Bitcoin has affected the way we think about currency.

In fact, Bitcoin has been considered as the first decentralized autonomous corporation by some pioneers in the field; its code runs in the nodes of the network, whereas everyone who owns bitcoins is actually a part of the "company's" shareholders. "Dividends" are distributed proportionately, based on a rationale implemented in the algorithm running on top of the blockchain – by this we refer to mining rewards, distributed to the miner effectively solving a block every ten minutes, whereas decisions are reached over the blockchain – by this we refer to proof of work scheme, with the use of which, consensus is achieved and decisions are reached at large scale, via a voting system that enables shareholders gain control over the system to the extent they contribute to it, without the need or the presence of a trusted third party to ensure the validity of transactions.

The engaged reader would probably argue that Bitcoin, the currency, could not be considered a corporation itself, in the sense that it does not perform a function that creates value for its customers and thus generates revenues and profits; it is just code, that does not interact with the broader environment and it is up to its users to adopt it, make full use of it and enjoy all the benefits that can derive from it as a decentralized form of currency.

Decentralized Autonomous Corporations (DACs) however are envisaged as forms of new and innovative corporate structures, that will enable new venture ideas become established and incorporated into business entities - autonomously running over the blockchain - most importantly, with a very specific goal: *to generate revenues*.

In more detail, a DAC is a company that lives in the cloud, performing functions valuable for its customers. Its customers are automatically charged and have to pay the respective fees for the services they receive. All the operations that are to be performed, will be accomplished by the code, the implementation of the DAC's business logic within the algorithm and over the blockchain. This is the first time in history that technology would allow such a business structure to evolve and exist.

More specifically, DACs will be programmed to divide its tasks into two different categories; repetitive, trivial tasks which can be automated with the use of software and tasks that require creative

thinking, innovation, responsibility or crisis management, tasks that cannot easily be fulfilled by a computer. For this latter category of tasks, human engagement will be required, which will be attracted by certain incentives - again offered by the code that governs the operation of the business.

DACs are also characterized by the fact that no one will be able to change or manipulate their code, once it becomes available, and their software once it's released; no one, including its creators, will be able to change its "content", "business logic" or way of operation, unless the majority of the users/ shareholders agrees and reaches consensus for such action to be taken. Furthermore, DACs are, by nature, based on open source code, enhancing their transparency and trustworthiness in a trustless environment; their source code will obviously be publicly available to any involved or interested party or individual, who would like to access, review it and even propose changes or amendments.

3.3 Decentralization; Does It Always Work?

As already stated, the blockchain technology could enable the establishment of virtual business entities and the launch of their operations, by encoding the mission to be accomplished into software. However, we should consider whether such an innovative business structure could find applications in all different and diverse business sectors. We suggest that such a structure could, indeed, enable the decentralization of service provision *in certain sectors*, like election processes, charities or donations. Other examples of autonomous corporations could deal with content management, domain names and online marketing campaigns management, filling for patents or copyright, or specific financial services, as well as smart contracts and the capabilities they offer for the decentralization of contractual services.

On the contrary, decision making in a production line of a factory, especially when the production process is in progress, is an example that vividly highlights circumstances under which decentralization in the decision making process would probably not be a wise action to be taken.

Furthermore, we should consider whether this technology could be employed to implement and support parts of business processes that could algorithmically be addressed, assigning the most complex and managerial tasks to senior level executives. In other words, such technologies could alternatively enable partial decentralization of certain

business processes of existing businesses (for instance, decentralization on the way a market research project is conducted) or even the decentralization of a certain portion of their business units or departments to a certain extend. For instance, are there cases where customer service could be facilitated or partially automated?

3.4 What Could This New Enterprise Architecture Offer?

The introduction of DACs can be correlated with positive characteristics and changes into the way business is taking place today, but also with significant risks that will have to be confronted.

To begin with, numerous advantages can be identified. Firstly, DACs could be thought as a way to reduce barriers to entry for players that want to enter to existing markets or create new ones, due to no geographical, regulatory or political constraints. The only prerequisite for such a form of business entity to be established is internet connection, and the only thing its further development depends on is adoption rate of its users/ customers. Cryptography is employed to ensure the validity of transactions and cryptocurrencies like Bitcoin are the prominent way to complete related financial transactions, fully decentralizing operation and avoiding the need to depend on a trusted third party.

Moreover, no board of directors or high level executives will have to be hired or occupied for the formulation of a DAC, which results into a generous amount of money that would be attributed to their remuneration (salaries, bonuses, etc.), which now can be attributed to the shareholders of the corporation (i.e. distributed as dividends).

More effective time management and immediate response to customers' requests is (expected to be considered as) granted, since every possible "reaction" to a customers' action or call will correspond to a pre-programmed reciprocation script.

Furthermore, DACs encode, thus explicitly set imperishable business processes, rules and guidelines for their operation, in open source code, thus reviewable by everyone interested and not easily modified or manipulated once the software is released; this leads us to a business structure that is built to prevent corruption and manipulation.

Most importantly, as already explained, DACs' incorporation will support the automation of repetitive tasks that drain the creativity and waste the energy of the human brain; immediately, more space will be provided for humans to employ creative

thinking and innovation, and envision and create new business opportunities.

On the other side, DACs carry some risks which should be identified, so as proper mitigation actions are designed and put in place. First of all, the blockchain technology is in its infancy. This means that it needs time to breathe; we, humans, also need time to understand and conceive its different aspects and manifestations and realize its potential, thus the risk of misinterpretation or manipulation of the term DAC is prominent.

Secondly, in order to form and establish a DAC, we need to trust and rely on code and software; as in early stages of development of every new type or kind of software products, the first attempts run the risk to be vulnerable to malevolent attacks. However, the fact that there are no central points of control or failure to be attacked makes this risk less dangerous. Additionally, the short Bitcoin history has proved that this can be turned into an opportunity form adjustments and overall improvement so that the next software editions to be released are more robust and resilient to malwares or cyber-attacks.

4 SUMMARY AND CONCLUSIONS

Enterprises are the way that people are organized so as to achieve common goals towards commercialization and provision of services and products. The way they are structured is of vital importance for their effective every day operation and management. Radical changes in the way businesses are structured have taken place the last decades, enabling their evolution from hierarchical and strict structures to more horizontal and circular forms.

A promising technological breakthrough, the blockchain, has emerged, enabling the achievement of consensus and trust among previously unknown nodes of a peer to peer network. This newly introduced, groundbreaking technology has inspired humans to perceive a totally disrupting form of operation for modern businesses, which they namely refer to as 'decentralized autonomous corporations' (DACs).

DACs, this potential unfolding and application of the blockchain technology, will empower people encode business processes that create value, into software that will automatically and autonomously run in the cloud, resulting in productive, transparent and effective, profit-making business entities. Not all business sectors and fields may find appropriate

applications, at least in the near future; sky is the limit, however, when it comes to entrepreneurial innovation.

The way decentralized autonomous corporations are going to be organized and structured is under the process of design thinking in our era; this new business structure, with a "politically correct" use, can result into opportunities for cost minimization or differentiation, thus for competitive advantages and adding value services or products.

It is evident that, more time is required for the effective development of this newly formed type of enterprise architecture, DACs, and their actual mode of operation is in need of a more accurate and detailed definition. Last but not least, significant challenges yet remain and have to be addressed for such business structures to become viable and sustainable in the future.

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