challenges

Opinion

Theory of Constraints and Bitcoin: Introducing a New Fulcrum

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Abstract: Much of the attention on bitcoin relates to its ability to store value over time or whether you will one day by able to buy a cup of coffee with it. Much less attention is given to bitcoin's potential role as a unit of account. This opinion piece proposes that bitcoin has potential to provide a consistent unit of account for organisations to adopt, but also to assist them in making and measuring meaningful business developments. The paper draws from the business improvement philosophy of Theory of Constraints to propose that unit of account, particularly within high inflation environments, is critical to consider. An illustrative case of a well-known publicly traded company, Microstrategy, provides an example and logic for a company choosing to integrate bitcoin into a business. The paper also gives attention to how the adoption of bitcoin can promote the development of renewable energy infrastructure and provide staff with opportunities for personal development to support their well-being. Opportunities for further research are identified to explore the integration of bitcoin within a business as well as with Theory of Constraints.

Keywords: theory of constraints; bitcoin; inflation; operational improvement; sustainable development

Citation: Matthews, R.L. Theory of Constraints and Bitcoin: Introducing a New Fulcrum. *Challenges* **2024**, *15*, 7. https://doi.org/10.3390/challe15010007

Academic Editors: Murray A. Rudd and Susan Prescott

Received: 5 December 2023
Revised: 24 January 2024
Accepted: 29 January 2024
Published: 30 January 2024

1. Introduction

Eli Goldratt used a range of concepts and ideas to develop a management and improvement philosophy [1] that has impacted practitioners and individuals alike, many becoming committed advocates of the framework. In comparison to other approaches to improvement, such as lean [2] and six sigma [3], Theory of Constraints (TOC) is not grounded upon the application of particular tools, techniques or practices. The result is that performance of a TOC initiative is not measured in terms of how closely an organisation follows a particular framework [4], rather how well the goals of the business were achieved. TOC gives attention to applying simple techniques that are measured in terms of improved customer satisfaction, making financial gains, business growth and employee development (amongst others). This is not done through complex, statistical formulae for increasing the ability of staff to work harder, but a change in mentality related to constraints that prevents a company from making more money (or achieving other business goals).

Rather than attempting to map and understand all processes present within an organisation, TOC begins from a simple premise; there is a single process within an organisation that is preventing it from making more money. Instead of attempting to remove waste from all processes (lean [2]) or reduce variation of key processes (six sigma [3]), TOC focuses attention solely on ensuring that a critical process is operated at full capacity, with all other processes being arranged in such a way as to provide support to this process. The logic is that if the key process produces more products (or services), the system produces more, meaning the organisation makes more money. In comparison to improving every aspect of an organisation that is likely to greatly increase the costs of improvement interventions, benefits can be realised from TOC implementations much more quickly and simply, and demonstrated through clearly defined, objective measures of performance [5].

Taking a broader perspective on the issue of constraints within an organisational system, the ability to be able to measure an improvement is based upon a consistent unit of measurement [2]. For example, if an organisation was able to make 20% more US dollars

this year than last year, that would only represent a 20% improvement if the value of the dollar was consistent over that period. While recent, above target inflation may have caused issues for US based firms [6], imagine measuring performance improvements within an Argentinian organisation, with inflation consistently in triple digits [7]. The consequence is that not only do we need to improve operational processes, but also ensure that we are able to measure the improvement without it being distorted by the unit of measurement (or account).

Ammous [8] provided an insightful critique of the impact of fiat (government backed) currencies on the ability of individuals, organizations, and societies to engage in long-term, meaningful development. Low time preference, enabled by currencies that maintain their value over time, was presented as enabling the pursuit of longer-term, meaningful goals. Such time preferences result from not having to spend all ones' effort on meeting immediate needs. For example, someone who is very thirsty is unable to do anything other than search for water if they are not to die in the short-term, meaning this particular individual would not give attention to learning or personal improvement. While this is a rather extreme example, it illustrates a similar idea to a firm rushing to deliver products, to pay interest on loans or pay staff, with no spare time or resources to innovate their products, promote staff well-being, consider the environmental impact of their business or meet future demands of their customers.

The following paper provides an overview of the TOC improvement philosophy and methodology, to illustrate how bitcoin can be integrated into the framework. Given the inability of the value of bitcoin to be inflated away through central bank monetary policy, the accumulation of bitcoin may provide a useful metric for a company to measure performance against. The work shows that in addition to TOC providing a framework on which to base operational improvement, bitcoin may provide a key target on which to direct improvement towards. The paper concludes by exploring opportunities for further research, related to how businesses could integrate bitcoin within their approach to operational improvement.

2. Literature Review

Originally presented by Satoshi Nakamoto [9], bitcoin (the asset) is a new type of commodity that can be transacted without third party involvement, over long distances, quickly and at low cost, with an enforced supply of 21 million units. Since the release of the software at the beginning of 2009, considerable interest has been directed towards bitcoin, whether in terms of its environmental impact [10], use for illegal purposes [11] or speculation [12]. However, these specific examples appear to be misinformed, outdated or misguided, respectively [13]. On the Scopus (Scopus.com) research database, there are 10,301 publications with bitcoin in their title, abstract or keywords, with 4882 of these being journal articles (as of 16 January 2024). In comparison, there were only 1640 documents referring to "Theory of Constraints" in their title, abstract or keywords (TAK), with 979 being journal articles, showing considerably less academic interest in TOC. Interestingly, no articles referred to both topics in their TAK, nor did any articles refer to either of these terms in their TAK and refer to the other in the rest of the articles, showing a noticeable gap in the overlap of these topics. Finally, only 11 articles referred to both Bitcoin and Theory of Constraints in the whole document, with eight of these focusing upon blockchain technology and five of these related to supply chains, compared to bitcoin and TOC specifically. Given that Ammous [8] (p. 258) stated blockchain technology only made sense for keeping a record of the emission and ownership of a native token, the value of using blockchain technology within other settings is yet to be determined. This is illustrated by the review of Muruganandham et al. [14], where the high energy consumption of blockchain technology created problems when attempting to apply it to different situations.

Given there is so little overlap between bitcoin and Theory of Constraints, the following two sections provide brief introductions to both topics. Given that more in-depth presentations have been given elsewhere, attention will be focused on providing a simple

foundation on which to appreciate how they may contribute to one another. Theory of Constraints will be presented first, to provide a picture of how a business may begin to improve, before covering bitcoin, as a means of making a subtle, yet important change to a business.

2.1. Theory of Constraints

Eli Goldratt's book, The Goal [1], presented the story of Alex Rogo's journey of turning around the performance of a factory through the application of a range of tools, combined with some hard, scientific logic. The fundamental questioning of accepted approaches to managing production, such as total quality management [4] or more generally, mass production [2], have created barriers to the wider adoption of TOC. However, TOC aims not to implement specific practices in a better way, but to think about the whole aim of business differently and manage production processes accordingly. Goldratt's philosophy was that the productive capacity of any system was limited by a single process (the constraint), in the same way that the strength of a chain was determined by its weakest link. Goldratt's logic was that improvements to a system should be focused upon only this constraint, which when improved would improve the entire system.

Within other improvement frameworks (specifically lean), attention is given to removing inventory (work in progress or stock) from the system. In comparison, TOC accepts that having inventory, or more precisely, a buffer, can be useful for ensuring that the constraint is utilised, even if there is a problem somewhere else in the system. In combination with this "buffer", Goldratt devised a production system that defined how many items the constraint needed to produce in a given period (drum), and a process to control the release of inventory into the system (rope). This ensures that only production required by the customer would ever be manufactured, and there was only inventory in the system that was needed, and that non-constraint processes focus production at a rate that ensures the constraint is always utilised.

Following the simplification of the production planning system through this "drum, buffer, rope" approach [1], improvements can be made to the constraint. This is enabled by the extra time that is released from non-constraint processes that are no longer attempting to operate at full capacity. Goldratt outlined "5 steps of on-going improvement", that targeted improvements to the constraint, to initially ensure maximum utilisation by the constraint having a "buffer" and then having other processes removing work from the constraint. Once achieved, improvement activities, whether improvements in quality or machine settings are directed to the constraint, to increase its output. Once completed, the whole system is reviewed to determine whether the identified process was still the constraint. If a different production process was identified, the improvement process would begin again, focusing operational scheduling and then improvement activities upon another process. Gupta and Kline [5] illustrated how this approach enabled improvements in system outputs with little or no net cost of implementation, creating significant returns on investments from TOC improvement activities.

Within this improvement framework, there is an assumption that if improvements are made to the constraints and more products are produced, the customer will be willing to buy them. However, if the customer demand is inelastic, rather than producing more products, the process could instead produce the same number of products in less time, releasing productive capacity for new sources of revenue. What does appear to have been overlooked, is the ability to measure improvement, not only in terms of "throughput" of the constraint, but also the ability to make money, particularly if the value of the money is being inflated away. This problem was well illustrated by Michael Saylor, whose company (Microstrategy) amassed significant capital reserves, did not need to reinvest, or expand, but at the same time did not want to lose the value of what he and his company had worked so hard to accumulate [15]. This suggests that while improvements can be made to operational processes, the units improvements are measured in, also need attention.

2.2. The Hidden Constraint

Theory of Constraints, as well as other improvement frameworks focus primarily upon the improvement of operational processes, with the aim of improving quality, reducing costs and increasing outputs [16]. The ideal impact of this, is that efforts directed toward these improvement activities lead to increases in revenue, greater than the cost of the initiative (return on investment). Interestingly, minimal attention is given to applying these tools within high inflation environments. Recent increases in inflation and reductions in growth, globally [17], mean high inflation environments are increasingly commonplace, raising questions about the relevance of existing approaches to improvement. Unless organisational and operational improvements can outpace the rate of inflation, which in the UK has been over 5% for over a year [18], significant problems are created for business owners attempting to operate, when material, energy, and labour costs are increasing.

While there are many potential causes of inflation, from European war to wedged super tankers to governments' pandemic response to civil unrest in Chinese factories to central bank money printing, it is unlikely to end soon [19]. Given central bank policies to target 2% inflation under the Keynesian logic of promoting consumption and justifying deficit spending [8], it is even less likely that deflation will be allowed to return prices to their original levels. As a result, and consistent with Michael Saylor's analysis [15], there is value in initially adopting bitcoin as a store of value, but also progressing towards using it as a new unit of account within a business. While over its 15-year existence, bitcoin has experienced a number of speculative bubbles resulting in dramatic increases and decreases in its fiat value [12], bitcoin has a very stable monetary policy [9]. The monetary policy is enforced by a network of nodes (Bitcoin the network) confirming transactions and miners expending energy to produce new blocks on the "proof-of-work" chain that only include valid transactions. Put simply, the protocol can only be changed if the majority of these parties reach consensus and implement a new version of the code. Given that much of the value of bitcoin comes from this consistency, those in the system are unlikely to approve any significant changes, meaning the chances of a change in monetary policy are viewed as close to zero.

The impact of consistent monetary policy is that investment into the total supply of bitcoin allows one (an individual or company) to secure a proportion of the total supply, that cannot be diluted overtime through inflation. The dollar (or GBP) value of that portion of the network may change, significantly, in the short to medium term, as a result of changes in demand or speculative bubbles [12], but the proportion of the network will not. Over a longer timeframe, particularly when viewing the 15-year history of the Bitcoin network, the value of each bitcoin has increased. Rather than continually working to accumulate currencies that are losing their value through inflation, so constraining the ability of a business to grow without accessing credit, introducing a unit of account with a fixed supply may be the *fulcrum* upon which businesses can leverage long-term improvements.

The question then arises of how an organisation might begin to apply TOC to their operational processes, and why could integrating this with the asset of bitcoin be beneficial.

3. Saving in a Sound Asset

While bitcoin's fiat value is accepted as being volatile, Nakamoto [9] and the past 15 years illustrates resilience, rather than volatility, is the more important attribute of the network. Even though economists, Cheah and Fry [12], suggested the "*long-term fundamental value is not statistically different from zero*" (p. 35), there has been significant upwards movement in fiat price over the life of the protocol. As a result, although the fiat value of bitcoin accumulated through business improvement activities may be unknown in the short term, on a long enough timeframe, the benefits will likely be positive [20].

For a firm attempting to measure performance in a fiat currency, there are risks that even after particularly successful years or product launches, they will experience a similar situation to that of Michael Saylor, mentioned earlier [15]. Establishing a bitcoin treasury has provided Microstrategy with a means of storing value, without having to (initially)

change their business model or pay for storage of the treasury (which would be the case with gold). Having found a way of utilising the output of a cash generating business, Microstrategy have focused their treasury strategy on the acquisition of additional bitcoin through numerous avenues, including issuing stock, issuing high yield bonds and accessing business loans. For Microstrategy, this approach provided them with significant publicity and interest from investors, that in turn resulted in a significant increase in the value of their stock [21].

In combination with bitcoin representing a means for businesses to store value, as a unit of account, bitcoin also provides a metric for assessing firm performance. Using Theory of Constraints, significant improvements can be made to operational processes, that can result in significant increases in revenue (amongst other measures), as demonstrated by Modi et al. [22]. Rather than accumulating an inflationary, fiat currency, or pursuing expansion to make use of the revenue before it was devalued, firms can simply allocate additional revenue to the accumulation of bitcoin. While the volatility may mean that the fiat value of the treasury assets from one year to the next may vary significantly, by measuring firm value in bitcoin, it is relatively straightforward for a company to determine whether they have been able to increase its bitcoin holdings. Thus, bitcoin as a unit of account, while having volatility when denominated in fiat currency, has consistency in its monetary policy, so in the long term provides the TOC framework with a crucial performance improvement metric.

Importantly, in addition to bitcoin providing a stable and resilient monetary asset that provides benefits for the company, the monetary network characteristics of Bitcoin are also relevant. Multiple, unconnected, legacy banking systems around the world can make it extremely slow and expensive to transact across national borders. The adoption of bitcoin as a *medium of exchange* between supply chain partners could greatly improve ease, speed and cost of transactions, while also removing cross-currency volatility. This particular use of the asset and network then provides motivation for a company to share their understanding of bitcoin with other companies to promote mutually beneficial changes in business practices.

Interestingly, integrating bitcoin into a business also provides avenues for businesses pursuing sustainability related goals. While outside the scope of the current work, new bitcoin are mined when electrical power it put through application specific integrated circuits (ASICs) to add new transactions to the "proof of work" chain for a block reward. By monetising any spare electricity in a business, bitcoin mining incentivizes the integration of inconsistent renewable electricity generation [23]. In combination with Theory of Constraints, a business could explore opportunities for reducing or optimising power usage, not simply to reduce costs, but for the purpose of accumulating bitcoin with excess (or otherwise wasted) energy. By utilising bitcoin mining, a business could both focus on accumulating bitcoin, while simultaneously be incentivized to integrate zero/low carbon energy generations into their business operations [24].

While other improvement frameworks could be applied within a business to make bitcoin related improvements, TOC appears particularly relevant by focusing upon a clear goal. Other improvement initiatives such as Lean [2] or Six Sigma [3] give greater emphasis on demonstrating cost savings, that are most clearly demonstrated by reductions in headcount. In comparison, TOC takes a more developmental approach. This difference means that rather than improvement initiatives being viewed as a vehicle for improving long term sustainability of the business (TOC), other initiatives can be seen as an excuse for redundancies; lean is, after all, an acronym for **L**ess **E**mployees **A**re **N**eeded. This provides an interesting connection with Gupta et al. [25], who states that managers working within TOC need a "*mindset of making money rather than saving money*" (p. 881). By implementing TOC within a business, with the explicit aim being to accelerate the firm's ability to accumulation bitcoin, all employees can orient their behaviours around this goal.

4. Conclusions

In recent years, academic research into bitcoin has increased significantly, whether in terms of its misinformed environmental impact [10] or historical use by criminals [11]. However, much less attention has been given to bitcoin's potential role within business operations. This initial exploration has begun to address this, by presenting bitcoin as a focus of improvement activities, using TOC as the framework for implementation. Bitcoin is presented as a means of storing the value realised from improvement initiatives, with potential for bitcoin mining providing a means of realising benefits from energy saving improvement or investment in renewable energy generation. This process may provide firms aiming to pursue operational improvement with long-term development goals, that move away from short term cost-saving (reducing inventory or headcount). The management guru, Gary Hamel [26], conceptualised this as "denominator management", where focusing upon cost reductions that increase return on investment in the short term, could ultimately lead to a firm losing their competitiveness.

As one of very few publicly listed companies pursuing the accumulation of bitcoin as part of their corporate strategy, reference was made to Microstrategy, as well as the impact bitcoin adoption had on their share price. Further research exploring how organisations integrate bitcoin into their operations would enable the ideas of this work to be explored, assessed, developed and validated. By moving away from a traditional, top down, cost-saving improvement initiative, TOC (and bitcoin) may also provide a means to engage those in the organisation and align individual goals with those of the firm. Not only can the accumulation of bitcoin provide owners and management with a consistent goal to measure firm performance, but there are also opportunities for staff to share in the accumulated bitcoin, promoting further goal alignment. Looking into the future, longitudinal research into the impact of a bitcoin treasury could explore opportunities for more fundamental changes in the business, created if the value of the treasury asset increases dramatically. Given the lack of research exploring the intersection of bitcoin and TOC, but also considering the impact of high inflation environments, the following research questions may inform and guide further research;

What changes need to be made to the TOC improvement framework in order to integrate bitcoin?

What approaches and improvement frameworks do firms in high inflation environments employ?

What challenges and benefits will firms implementing bitcoin and TOC together experience?

How does the implementation of TOC with bitcoin impact the development of long-term sustainable development goals?

How does the implementation of TOC with bitcoin impact employee well-being?

Operating a business within a high inflation environment is likely extremely challenging. Consider the UK for example, with both the spikes in utility prices [27] and the UK mini budget of September 2022 greatly affecting businesses' ability to operate [28], utility costs alone made it near impossible for some firms to operate. Simply adopting traditional improvement strategies may pressure those in the organisations to work longer and harder for inflationary currencies, resulting in a degradation of their well-being. If businesses, whether manufacturing or service-based want to be sustainable both economically and environmentally, new strategies that are not simply cost reduction or outsource focused need to be embraced, to remain competitive in an increasingly digital and global marketplace. Fortunately, this does not mean firms need to embark on increasing the complexity of their business through the integration of blockchain technology [29] or smart contracts [30] through industry 4.0. Instead, by structuring a business around an asset with a known, fixed supply, firms are provided with a foundation of development, insulated from central bank (or energy) policies. TOC may provide a novel and focused mechanism for running a business, particularly if the aim is to accumulate bitcoin, as the selection and organisation

of internal operations becomes laser focused. As the guru of management philosophy, Jonah, in "The Goal" [1] stated:

> *"Alex, I have come to the conclusion that productivity is the act of bringing a company closer to its goal. Every action that brings a company closer to its goal is productive. Every action that does not bring a company closer to its goal is not productive. Do you follow me?"* (p. 34).

Therefore, if the goal of the company is to accumulate money that will not inflate (bitcoin), improvement activities oriented towards this goal can be viewed as exceptionally productive.

Funding: This research received no external funding.

Data Availability Statement: No new data were created or analyzed in this study, URLs for all source data is present within the reference list.

Acknowledgments: I would like to thank Murray Rudd and the editorial staff at Challenges, for facilitating this special issue, seeing potential in an idea, and nudging me to actually write this article. I would also like to thank the three anonymous reviewers, for suggesting valuable additions, subtly broadening the scope, and also testing my understanding of Keynesian economics. Without your voluntary contributions, the process of peer-review would not exist, so thank you.

Conflicts of Interest: The authors declare no conflict of interest.

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