

Effectiveness of Blockchain in overcoming barriers in Humanitarian Supply Chain

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ABSTRACT

In the era of Industry 4.0 many new technologies are emerging and changing the status quo in many industries and sectors. On the other hand, people around the world are grappling with serious humanitarian issues of hunger, poor infrastructure affecting housing, education, healthcare. These problems are a result of complex causes ranging from natural disasters, environmental causes and human enforced causes such as ill governance, terrorism and forceable displacement of population belonging to certain communities. To address the humanitarian crisis global institutions are tirelessly working to assuage the suffering of people in crisis. Back bone of such initiatives is the Humanitarian Supply Chains which are often a complex linkage of Global non-profit organizations, private players, independent contractors, and local volunteers. This paper aims at identifying the areas in humanitarian supply chain which can be improved by implementation of Blockchain technology. Barriers to humanitarian supply chains are identified from the extensive literature review. Using the responses received from experts in Humanitarian Supply Chains and Blockchain, an exploratory factor analysis was conducted giving us 4 factors in the context of Blockchain Implementation.

Keywords:

Blockchain, Humanitarian, Supply Chain, Barriers, Exploratory factor analysis

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Introduction

The earliest mentions of the blockchain technology is in the whitepaper published in 2008 by Satoshi Nakamoto. The paper mentioned a tamper-proof, decentralized protocol. It was then, Bitcoin - a cryptocurrency was born as an alternative to the conventional banking system. Today a large number of Cryptocurrency networks are based on Blockchain. In 2013, Vitalik Buterin proposed Ethereum, a blockchain-based network on which Turing-complete scripts could be executed. Blockchain has found a wide range of applications in fintech, banking, logistics, international financial transaction, and data security. Over recent years blockchain has seen its application in Humanitarian Supply Chain(HSC),

Healthcare, Insurance, Asset management, and numerous other industries. Humanitarian crisis is on the rise as the world faces challenges in terms of environmental degradation, hatred against communities, terrorism and natural disasters. The world is experiencing a lot of mankind displacement. A large sum of 70.8 million people around the world have been forced out of their home till 2018(UN, n.d.-a). International agencies like the UN are scrambling their specialized agencies to provide relief to refugees and people trapped in crisis within their own national boundaries. The World Food Programme (UNWFP) is actively seeking interest and has implemented pilot programs using Blockchain transactions. The UNWFP has implemented blockchain based cash benefit transfer system for 10,000 Syrian refugees

in Jordan topurchase food using biometrics(UN, 2017).

UN and other global organizations have leveraged private players and Tech startups to assist them in implementation of blockchain enables aid. One such project is being run at Vanuatu, South pacific – one of the world’s remote and hazard-prone locations. OXFAM Australia along with Sempo and Consensys – one of the world’s largest blockchain firms have successfully implemented blockchain based direct cash transfer of Humanitarian aid to the community of people with limited access to internet, smartphones and electricity supply(Lin et al., 2019; Rust, 2019).Blockchain is stipulated to be an evolutionary and game changing technological which may change the status quo of the transactions worldwide. Humanitarian supply chain has a lot of barriers in effective implementation of resources as compared to commercial supply chains. Experts around the world are convinced that blockchain technology will help make humanitarian supply chain more effective. While it is widely agreed upon that blockchain technology will be helpful there is lack of well documented source addressing which barriers in particular could be overcome by application of blockchain based systems. This paper aims at conducting exploratory analysis to group these barriers in the context of blockchain implementation.

The remainder of the paper is organized as follows:Literature review, Methodology, Results,Future scope of research,Conclusion, Acknowledgement.

Literature Review

A lot on research has been done on use cases of blockchain in Supply chain, logistics and humanitarian aid. Researchers have also identified challenges and barriers in Humanitarian Supply Chains(B Balcik & Beamon, 2008; Bremer, 2004; Kala, 2014; Raju & Becker, 2013; Sandwell, 2011). Many of them are due to the inherent nature of

operations in Humanitarian Supply Chains (Gustavsson, 2003).Many technological interventions have come up in Supply Chain and it has also got its application in Humanitarian Supply Chain. Blockchain as a technology can aid organizations in financial trust, integrity verification, data management, privacy, security, and governance(Casino et al., 2019; Drosatos & Kaldoudi, 2019; Mackey & Nayyar, 2017; Mettler & Hsg, 2016; Modgil & Sonwaney, 2019). As listed in table 2, researchers have studied barriers in Humanitarian Supply Chains. Technological barriers pose a great challenge to the supply and management of Humanitarian aid(Feng et al., 2012; Kabra & Ramesh, 2015; Lee & Zbinden, 2003; Maiers et al., 2005; Mbarika et al., 2005; Odedra-Straub, 1993). Political barriers such as regulations and mal practices are also a big hurdle(Kovacs & Spens, 2009; Willner & Zafeiridis, 2013). Organization barriers covers improper organizational structure and, insufficient resources, shortage of skilled workforce(Agostinho, 2013; Burcu Balcik et al., 2010; Fritz Institute, 2005; Gustavsson, 2003; Maiers et al., 2005; Natti & Ojasalo, 2008). Inefficient management also causes lot of uncertainty and pressure on the HSCs (Kovacs & Spens, 2009; Sahebi et al., 2017; Willner & Zafeiridis, 2013). Humanitarian aid often goes beyond the regional and national boundaries, cultural differences among various stakeholders and interacting agencies is a hinderance to efficiently deliver the aid in cash or kind (Burcu Balcik et al., 2010; Fugate et al., 2006; Kovacs & Spens, 2009; Schulz & Alexander, 2010).Financial Barriershave been extensively covered by various UN Humanitarian reports and issues (B Balcik & Beamon, 2008; UN, n.d.-b, 2017). But there was need forresearch which highlights specific barriers which can be removed by implementation of Blockchain. This research is an attempt to identify such barriers and classify then with context to Blockchain technology.

Table 1: Barriers identified in Literature Review

Sr. no.	Barrier	Category
1	Disparity in IT infrastructure among actors	Technological Barriers
2	Lack of time to share knowledge	
3	Lack of accurate information from affected areas	
4	Manual supply chain	
5	Poor IT infrastructure	
6	Poor usage of technologies such as Internet, Digital wallets, GPS, robotics	
7	Weak warehousing and logistics infrastructure	
8	International regulations	Political barriers
9	Unethical issues such as theft, terrors, deception	
10	Fatigue amongst rescue and humanitarian workers	Organizational barriers
11	Ineffective organizational structure to share and enhance knowledge	
12	Insufficient resources to provide knowledge sharing opportunities to workers	
13	Shortage of skilled humanitarian workers	
14	Lack of proper training for humanitarian workers	Managerial barriers
15	Lack of cooperation and coordination amongst interacting organizations	
16	Lack of real-time monitoring of reconstruction activities	

17	Lack of Integrated management system	Financial barriers
18	Unstable managerial and leadership positions in humanitarian organizations	
19	Lack of financial trust in Humanitarian organizations	
20	Traceability of funds and expenditure tracking	Cultural Barriers
21	Cultural difference among actors	
22	Inadequate information sharing among actors	
23	Inefficient trust among actors	
24	Insufficient knowledge creation, enhancement and sharing	

Methodology

3.1. Rationale and purpose of the research

Blockchain technology has been seen as a breakthrough when it comes to establishing amongst transacting organizations/parties, many pilot projects are being conducted by Humanitarian organizations at regional and global levels. As the technology is still in its earlier implementation, we tried to gather expert opinions regarding its effectiveness in overcoming barriers in Humanitarian Supply Chains (HSCs).

3.2. Sampling

As the population sample of experts working in implementation of Blockchain in Humanitarian Supply Chain is very limited. The sampling technique used was Judgmental/Expert sampling. The experts were chosen on the basis of literature review available, reports of blockchain based implementation in Humanitarian Supply Chain and experts from not for profit humanitarian

organizations.

3.3. Procedure

We conducted interviews with these experts with experience in implementation of Blockchain in Humanitarian aid and relief. With the help of the discussion conducted we narrowed the list to 14 barriers as show in Table 2, the list was narrowed by eliminating common or highly correlated barriers as per the response we received from the experts. A questionnaire was prepared to capture expert views on the effectiveness of blockchain in overcoming these barriers. A conscious list of 74 experts was prepared and their responses to the question - Will blockchain be effective in overcoming these barriers? were captured on a Likert scale of 1 to 5. 1 – Strongly Disagree, 2 – Disagree, 3 - Not sure, 4 – Agree and 5 – Strongly Agree. The responses collected between July and September 2020 are used for analysis in this paper.

Table 2: List of Barriers considered for further analysis

Sr. no.	Barrier
1	Disparity in IT infrastructure among actors
2	Lack of time to share knowledge
3	Lack of accurate information from affected areas
4	Poor usage of technologies such as Internet, Digital wallets, GPS, robotics
5	Weak warehousing and logistics infrastructure
6	International regulations
7	Unethical issues such as theft, terrors, deception
8	Lack of cooperation and coordination amongst interacting organizations
9	Lack of real-time monitoring of reconstruction activities
10	Unstable managerial and leadership positions in humanitarian organizations
11	Lack of financial trust in Humanitarian organizations
12	Traceability of funds and expenditure tracking
13	Cultural difference among actors
14	Insufficient knowledge creation, enhancement and sharing

3.2. Statistical analysis

In this paper Exploratory factor analysis (EFA) is used to identify if there is any factor structure in the barriers when it comes to Blockchain's effectiveness. For reliability of statistics we also calculated Cronbach's Alpha of 0.886 which gives We have used principal component factor extraction along with varimax rotation, as it gives clear interpretation of the factor structure by loading a variable highly on a factor there by minimizing loading on other factors(Thoma & Gruber, 2020). The number of factors in this

analysis was determined by the Kaiser rule, extracting factors with an eigenvalue larger than 1(Kaiser, 1960). KMO and Bartlett's test were performed, in this sample the result was 0.594which is above the levels suggested by (Field, 2013) and the Bartlett test created produced a significant result of ($p < 0.001$) which states significant correlations between items (Bartlett, 1954).

To get an unweighted factor score we calculated average of top barriers in each factor and then took average across all the responses.

Results

4.1. Factor loading and unweighted factor scores

The EFA using Principal Component Analysis and Varimax rotation with Kaiser normalization gave 4 factors with satisfactory KMO of 0.594which is above the limit suggested by (Field, 2013)and Bartlett result with $p < 0.001$ (Bartlett, 1954), thus validating the analysis. Factor 1 gave 8 barriers across infrastructure, Technological, cultural and organizational barriers, Factor 2 gave 2 barriers, Factor 3 yielded 2 barriers and Factor 4 yielded 2 barriers as well. Loading of items on factors is shown in Figure 1.

Rotated Component Matrix ^a				
	Component			
	Factor 1	Factor 2	Factor 3	Factor 4
Unstable managerial and leadership positions in humanitarian organizations	0.842			
Unethical issues such as theft, terrors, deception	0.840			
Disparity in IT infrastructure among actors	0.804		0.327	0.303
Insufficient knowledge creation, enhancement and sharing	0.803			
Cultural difference among actors	0.775			
International regulations	0.761	0.387		
Weak warehousing and logistics infrastructure	0.636	0.627		
Poor usage of technologies such as Internet, Digital wallets, GPS, robotics	0.612			0.477
Lack of real-time monitoring of reconstruction activities		0.920		
Lack of cooperation and coordination amongst interacting organizations		0.865		
Lack of time to share knowledge			0.897	
Lack of accurate information from affected areas	0.353		0.819	
Traceability of funds and expenditure tracking				0.875
Lack of financial trust in Humanitarian organizations		0.493		0.727

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Fig.1: Results from the exploratory factor analysis as obtained in the rotated component matrix.

4.2. Factor scores

The unweighted factor scores obtained by calculating average of top barriers(components) in

each factor and then averaging across all the responses are shown in Figure 2.

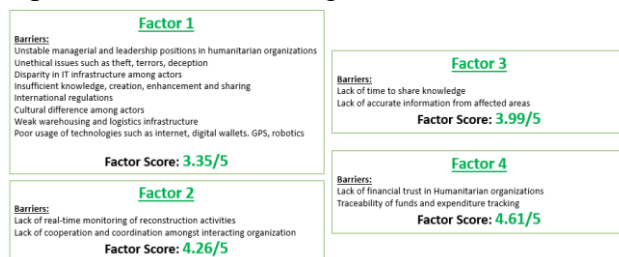


Fig. 2. Unweighted factor scores across all the response collected

4.3. Interpretation of factors and these scores

Factor 1 covers barriers belonging to infrastructure challenges, technological barriers and cultural & organizational issues. As shown in Figure 1, it has got factor score of 3.35 out of 5 (lowest among all the factors). The scores can be interpreted as, blockchain will have the lowest chances of overcoming barriers loaded in this factor.

Factor 2 covers coordination and monitoring barriers in Humanitarian Supply Chain. As shown in Figure 1, it has got factor score of 4.26 out of 5. This means Blockchain will be effective in overcoming barriers identified in this factor.

Factor 3 covers information and knowledge sharing barriers in Humanitarian Supply Chain. It has a factor score of 3.99 out of 5, which is decent meaning blockchain will be fairly effective in overcoming these barriers.

Factor 4 covers financial and traceability barriers in Humanitarian Supply Chain. It has a factor score of 4.61 out of 5, which is the highest meaning blockchain will be most effective in overcoming these barriers.

Some important comments received during the course of interview and data collection are Current blockchain implementations are mainly in the areas where accountability and financial obligations are involved and without multi-party involvement blockchain will not offer value compared to other solutions, Blockchain's effectiveness can be further studies using cost

benefit analysis, Automating complex processes through appropriate use of blockchain applications such as automating manual tracking and logging of supply chain data.

Future Scope

This paper aimed to identify barriers which can be removed or mitigated by deploying blockchain based systems. As part of the future scope we encourage to conduct cost benefit analysis or any other financial study for each barrier and factor. The research was done on the basis of responses and feedback received from the blockchain implementers and Humanitarian Supply Chain operators, a research done by collecting responses from beneficiaries of the blockchain based humanitarian aid program will give new perspective and validate this research.

Conclusion

A lot of research is being conducted in identifying the merits of blockchain as a technology, meanwhile Humanitarian Aid and relief organizations are facing with numerous challenges in the effective delivery of the aid – in cash or kind. With global issues such as refugee crisis, natural disasters and political instability on the rise; it is inevitable that the problems and their scale will also rise. This paper identifies the barriers in the context of Blockchain implementation. This research aims at helping Humanitarian supply chain players to recognize barriers that can be solved by deploying Blockchain and also barriers for which they will have to look beyond blockchain.

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