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Critical Perspectives on Blockchain for humanitarian aid

How does the technology impact procedural fairness and beneficiary data protection?

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Chapter 1: Introduction

1.1: The Origins of Humanitarian Aid

The concept of philanthropy or charity as a means of alleviating human suffering has been rooted in the archetype of morality since the early onsets of ancient civilizations. At first, the mandate to lend aid to the less fortunate was primarily expressed through religious beliefs and the scriptures of a multitude of religions. The pious would be encouraged to show gratefulness towards God by sharing their wealth or food with those members of the community that were not as blessed as them.

Towards the end of the 19th century, however, the increasing traction of human rights theories removed the notion of humanitarianism from the exclusive grasp of the church and the opinion was formulated that one should help others not because God demands it, but rather because it is our obligation as an intelligent and empathetic species to mitigate the hardships of those suffering by sheer happenstance. The idea that a "common humanity" existed was a philosophical recognition that led to localized humanitarian efforts.

The foundation of the International Committee of the Red Cross (ICRC) in 1864 in Switzerland is considered a pivotal point in the history of humanitarian aid, as the Red Cross movement was the first to pursue truly international aspirations.[1] The foundation of the Red Cross and the standards it set for humanitarian effort worked as a basis for several other aid organizations, such as Save the Children (1919) and Oxfam (1942).

While the stage for modern humanitarian aid was set in the late 19th century, it was not until the end of World War II that the effort became systematized and secularized.[2] The number of humanitarian organizations, most of them operating under the United Nations, grew rapidly in the decades following the War. Some examples include the UN Disaster Relief Office (1971), the World Food Programme and the World Health Organization (1974-75) and the UN High Commissioner for Refugees (1980).[3] While previous attempts were centered primarily in relief efforts for the victims and soldiers of the First World War, the United Nations takes a turn for a more inclusive, global agenda that aims to alleviate the

[1] Claudena Skran and Carla N Daughtry, 'The Study of Refugees before "Refugee Studies"' (2007) 26 Refugee Survey Quarterly 15.
[2] Johannes Paulmann, 'Conjunctures in the History of International Humanitarian Aid during the Twentieth Century' (2013) 4 Humanity: An International Journal of Human Rights, Humanitarianism, and Development 215 <http://muse.jhu.edu/content/crossref/journals/humanity/v004/4.2.paulmann.html>.
[3] ibid.

problems created by colonialism and the subsequent collapse of empires in Europe, including the Ottoman Empire. [4]

This new approach also reflects an important change in the way the global community views humanitarian aid. From the Catholics of Central Europe to the first humanitarian efforts of the Red Cross, aid was defined as a response to a specific disaster or emergency. In the late 20th century however, as the UN and other NGOs take up missions of international humanitarianism, the scope of the effort broadens to include advocation for long – term policies and sociopolitical change. Save the Children NGO offers a very illustrating example for this point: while their main goal in the 1930s was to provide relief to children suffering from war and its aftermath, by late 1950s they had developed an expert international organization concerned with the long-term welfare of children worldwide.[5]

This gradual evolution of the scope and the mandates of humanitarian organizations has led to the creation of a gargantuan global community of volunteers, NGOs, international organizations and regulatory bodies that work in tandem to continuously develop new tools for more efficient and systematized humanitarian aid.

1.2: Technology in Aid: Blockchain

When it comes to short-term projects that ameliorate conditions for vulnerable groups such as the victims of natural disasters or refugees on the first steps of fleeing persecution or conflict, the implementation of novel delivery methods and innovative solutions can make a tangible difference. The tracking of data through the aftermath of the 2004 tsunami in the Indian Ocean showed that while the relief efforts were seriously lacking in technological expertise and logistics, the implementation of simple vehicle routing algorithms for the delivery of aid (for organizations that performed ground-delivery of food and first-aid supplies such as FOCUS and Humanity First) increased the aggregate weight of supplies carried by 6.7% and decreased delivery times by a minimum of 16.3% within the first month of implementation.[6] That slight change incurred an 4.3% increase in cost, but led to 11% more people having aid timely delivered.. While this data displays that technology can greatly assist with the management of assets in humanitarian aid it does not provide for a detailed account of the ways in which a new system can be transformative for the delivery of aid and the non-economic benefits that beneficiaries can reap from these implementations. As will be clarified later in the introduction, the research contained in this thesis is largely based on the position that relief effort performance cannot be measured solely on grounds of financial gain: promoting

[4] Skran and Daughtry (n 1).
[5] Dominique Marshall, 'Children's Rights in Imperial Political Cultures: Missionary and Humanitarian Contributions to the Conference on the African Child of 1931', *International Journal of Children's Rights* (2004).
[6] Ann Melissa Campbell, Dieter Vandenbussche and William Hermann, 'Routing for Relief Efforts' (2008) 42 Transportation Science 127 <http://pubsonline.informs.org/doi/abs/10.1287/trsc.1070.0209>.

equality, transparency and actively combatting discrimination should be considered as central performance objectives.[7]

The leaping progress of information technology in these first decades of the 21st century has naturally sparked the eagerness of NGOs and governments to find innovative solutions to long-standing problems. One of the various technologies that are being researched and experimented on for use in humanitarian efforts is the blockchain.

Just like the vast majority of novel and complex technologies, blockchain has surfaced in the modern world of technological, financial and social development with a promise of omnipotence and infallibility. Almost ten years after the first commercially available applications of the cryptographic technology, the adopters and the evangelists of blockchain have come a long way from simple payment systems and transactions, to creating complex algorithms which offer solutions varying from record-keeping databases to autonomously enforceable agreements. As institutions all around the globe contemplate the use of blockchain technologies to facilitate their activities, be it governments seeking digital-identity solutions, banks migrating their ledgers on the blockchain or international organizations working towards more transparent donation mechanisms, this is a pivotal moment to critically reflect on the technology.

1.3 Research State of the Art

The body of literature on blockchain is as of now quite limited due to the combination of two factors: the technology is largely untested outside the bounds of financial applications and it has been very closely linked to cryptocurrencies, a sector that inadvertently moves the discussion away from the record-keeping potential of the technology and into the stock exchange. The enthusiasm surrounding cryptocurrencies has led to a bulk of one-sided research: economic journals are usually overstating the capabilities of the technology while underplaying the obstacles in its adoption.[8] Blockchain technologies can offer innovative solutions in the realm of databases, they are, however, difficult and costly to implement, and they introduce an increased complexity due to their decentralized nature. One of the biggest hurdles that such technologies face is of regulatory nature: controlling access to personal data and layers of encryption that are naturally untested. [9]A point of consensus in the blockchain literature is that the technology can offer increased guarantees of trust, due to its decentralized nature and the fact that databases cannot be tampered with. Increased transparency in transactions is a huge point for humanitarian aid, as especially

[7] Amiya K Chakravarty, 'Humanitarian Relief Chain: Rapid Response under Uncertainty' (2014) 151 International Journal of Production Economics 146.
[8] Michael Pisa, 'Reassessing Expectations for Blockchain and Development' (2018) 12 Blockchain for Global Development 80 <https://www.mitpressjournals.org/doi/pdf/10.1162/inov_a_00269>.
[9] ibid.

for cash donations, losing funds to facilitators and middlemen constitutes a central concern. [10] In the current value chain of international development funds travel from donors to a system of implementation partners (usually NGOs) and local organizations. This system is characterized as opaque and, at times, inefficient. [11] Proponents of the blockchain would rush to claim that the technology can offer a panacea to this problem with the use of peer-to-peer networks. While it is true that blockchain presents strong security solutions, the idea that it can fully substitute a trustful relationship is misguided: human agency is still necessary to oversee the inputs of digital assets. [12]

1.4 The Thesis Approach

The few research attempts centered around blockchain and Distributed Ledger Technologies in the humanitarian sector have focused much more on how the technology works, rather than how it can address both organizational and practical issues of transparency and fairness in aid.[13] Through this thesis the aim is to explore not only the facilitation of back-end processes within humanitarian organizations, but to analyze how existing and future projects involving blockchain can transform the experience for end-users- mostly aid beneficiaries. The research will largely follow hypothetical stages of implementation and assess how DLTs can transform the humanitarian supply chain in terms of procedural fairness. The reason why this research objective is considered crucial is the necessity for new technological systems to translate humanitarian principles into their very architecture, catering to the problems of people in need both by default and by design. The thesis aims primarily at separating the hype that accompanies a new technology from the realistic expectations of what exactly it can deliver. The central topic of discussion is **whether the implementation of blockchain technologies can increase transparency and fairness in projects of humanitarian relief activities and how it can impact the processing of personal data for beneficiaries.** While "performance" in relief chains was presented earlier in the introduction as a simple metric of resource input to output, it is important to highlight that the example was meant to illustrate the quantifiability of some of the variants of performance. When it comes to the delivery of humanitarian aid, performance is also measured in terms of maintaining human

[10] Hristos Doucouliagos and Martin Paldam, 'THE AID EFFECTIVENESS LITERATURE: THE SAD RESULTS OF 40 YEARS OF RESEARCH - Doucouliagos - 2009 - Journal of Economic Surveys - Wiley Online Library' <http://onlinelibrary.wiley.com/doi/10.1111/j.1467-6419.2008.00568.x/pdf>.
[11] Walter J Gutjahr and Pamela C Nolz, 'Multicriteria Optimization in Humanitarian Aid' (2016) 252 European Journal of Operational Research 351.
[12] Lana Swartz, 'Blockchain Dreams: Imagining Techno-Economic Alternatives After Bitcoin' 82 <http://llaannaa.com/papers/Swartz_Blockchain_Dreams.pdf>.
[13] Giulio Coppi and Larissa Fast, 'Blockchain and Distributed Ledger Technologies in the Humanitarian Sector' [2019] Humanitarian Policy Group 46 <https://www.odi.org/sites/odi.org.uk/files/resource-documents/12605.pdf>.

dignity in a fair and transparent process.[14] Contrary to activities in the for-profit sector, humanitarian activities should be measured also in terms of procedural and distributive justice: achieving non-discrimination and actively promoting human rights. A good example in that regard would be the usage of SMS-based and data connectivity based solutions; while these technologies provide quicker response in aid, they segregate recipients of aid on the basis of who has access to a certain technology or device, making the solutions less impactful than initially thought.[15] The issue of promoting fairness in humanitarian operations will be examined through the lens of a supply-chain model. Each link in the humanitarian supply chain will be evaluated in terms of how blockchain could impact the way it functions and the capability to monitor the procedure.

Because of the limited real-life applications of the cryptographic technology for humanitarian purposes, a case study will be used in order to identify how this new technology works in the realm of humanitarian aid, the solutions it seems likely to provide and the obstacles it has encountered. The case study chosen is a project of the World Food Programme called "Building Blocks", where the WFP's Innovation Accelerator used a blockchain application to match people with their entitlement to aid in the Azraq refugee camp in Jordan. This particular project was chosen for the study because - relief projects offer more controlled environments in which a specific variant of performance can be examined.
The thesis will contain a review of technological literature which will provide insight on how blockchain works in general and the applications that are relevant for humanitarian aid. Technical information will be mostly descriptive, with the aim to allow understanding of the nuances of these applications by non-technical experts. By drawing information and empirical data from other cases of implementation of both blockchain and more traditional databases in humanitarian aid donation and distribution, a comparative analysis will follow. In this way, a clear distinction will be made between the barriers that blockchain has the potential to overcome by introducing truly novel changes and the areas where it is implemented simply by virtue of its popularity and traction.
The fact that blockchain is largely untested – from a regulatory perspective- leaves room for multiple questions pertaining to both its compliance with global human rights frameworks and its suitability for meaningful social development and financial inclusion. Through doctrinal legal research, the qualities and function of this novel technology will be evaluated through the prism of international humanitarian law and human rights frameworks.

[14] Benita M Beamon and Burcu Balcik, 'Performance Measurement in Humanitarian Relief Chains' (2008) 21 International Journal of Public Sector Management 4.
[15] Kevin P Donovan and Aaron K Martin, 'The Rise of African Sim Registration: The Emerging Dynamics of Regulatory Change' (2014) 19 First Monday 1.

1.5 Research Questions and Methodology

Main Question: To what extent does blockchain have an impact on the performance and transparency of humanitarian efforts and what are the regulatory and political risks the technology faces?

Sub-Question #1: How do blockchain enabled smart-contracts work for humanitarian efforts?

This question will be answered mainly through the review of technical literature and on the basis of the "Building Blocks" case study. The aim of answering this question is not to analyze the technical specifications of different blockchains but rather to provide a basis of communication for the rest of the analysis of the thesis.

Sub-Question #2: Does its implementation of blockchains lead to more empowered aid recipients?

This question will be answered through a comparative and descriptive review between the new technologies and the ones traditionally employed by humanitarian agencies. Drawing from literature in the realms of humanitarian aid and sociological studies the thesis will analyze the impact blockchain has both on quantifiable results but also in combatting long-lasting problems of corruption, discrimination and distributional injustice.

Sub-Question #3: What are the regulatory pitfalls of distributed ledger technologies, in particular regarding data protection of vulnerable groups?

This question will be answered through doctrinal legal research. As the regulatory framework currently stands, the UN and other NGOs are bound only by a set of vague international rules when it comes to handling personal data. Within the next few years, many of those organizations will most probably have to abide by the "adequacy decisions" of GDPR Art. 45. The answer to this question will examine not only the blockchain's compliance with current frameworks but also whether these regulations are fit to control the use of such an untested technology. The UN Global Pulse principles for data protection and privacy will be extensively discussed through their codification into the WFP Guide to Personal Data Protection.

Chapter 2: Aspects of the Technology and Presentation of the Case Study

2.1: Foundations of Blockchains and Smart Contracts

What is a blockchain?

The blockchain is an endless public ledger of transactions which uses cryptographic algorithms to "pseudonymize" the entry data and instead of being kept in a centralized database the ledger is "distributed" among peers who each confirm the validity of every new transaction, creating a "decentralized" database.[16] For anyone not familiar with the technology and its recent uses -most notably cryptocurrency and smart contracts- this definition calls for further elaboration.

The aforementioned ledger functions in much the same way as traditional bank account ledgers. For a traditional bank account, the financial institution would keep records on the account's information, credit, debit, transaction history and all other elements required to establish a real-time tracking of the account balance in monetary units. Such a document would be kept in the bank's database and its validity would be guaranteed by the trust between the account holder and the financial institution, which is backed by a combination of national and international law. In the case of blockchain technologies, the process of record-keeping is fundamentally different. As its name implies, this technology is a linear progression – a "chain" – of pieces of information – "blocks". When a new transaction takes place on the blockchain, a new "block", containing the information of that transaction is added to the chain which follows a strictly linear, chronological order.[17] Adding the information to the blockchain though is more complicated than adding it to a centralized ledger. Whereas in the latter the information would be handled by a single employee or piece of software that is verifying and recording transactions, the former requires the combined computing power of the users of the blockchain. Specifically, when a transaction takes place, encrypted bits of this information are processed by a network of users – the peers- and then added to the blockchain in a linear process. Each computer which is part of the network has a full copy – a "full node"- of the transaction history of that blockchain platform. That, in essence, means that when a transaction takes place, all these computers cross-check the validity of the transaction simultaneously, based on previous information input on the blockchain.[18] The word "endless" is added to the definition because in

[16] Joseph Lubin, Mally Anderson and Bobbi Thomason, 'Blockchain for Global Development' (2018) 12 Innovations, Technology, Governance, Globalization 10 <https://www.mitpressjournals.org/doi/pdf/10.1162/inov_a_00263>.

[17] Jesse Yli-Huumo and others, 'Where Is Current Research on Blockchain Technology?-A Systematic Review.' e0163477 <http://www.ncbi.nlm.nih.gov/pubmed/27695049%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5047482>.

[18] Melanie Swan, *Blockchain - Blueprint for a New Economy* (2015).

order for a blockchain to function properly, all transactions made on it should be assessed whenever a new one takes place. To go back to the comparison example, when transferring money to another account, the bank's software would cross-check with previous inputs and outputs of currency that the account was part of, to verify that it has the balance the user claims. It would then transfer the money and calculate a new balance. On the blockchain, this process takes place simultaneously across the network, essentially ensuring that every new transaction is based on the previous ones. As is evident from the example above, the key innovation of the blockchain does not actually lie in the way record-keeping is executed, but in *who* does the record-keeping. The blockchain has been defined as a means of "*decentralized trustless transactions"*.[19] This definition attempts to clarify that by using blockchain for transactions one does not need to have trust in the counter-party or in the intermediary (financial institution). The users, however, should put their trust in the algorithms and the databases used. Throughout the paper this definition of "trustlessness" will be challenged, as the blockchain may not be easily modified, it is still dependent on the human agent who inputs the initial information.[20]

Notably, the most popular use of blockchain technology lies in the development of cryptocurrencies, such as Bitcoin. Bitcoin was created as a form of digital cash in 2009 by an unknown person or entity nicknamed Satoshi Nakamoto. Although it is recognized as a digital currency, Bitcoin has fundamental differences from fiat currencies that states use. An officially used and accepted fiat currency has a value contingent on federal reserves, exchange rates on the stock market and other factors which are beyond my expertise and the scope of this thesis.[21]

Although the use of blockchain for digital currencies has been at the epicenter of the blockchain discussion for many years, the uses of this technology expand far beyond simple payments and trading. One should think of blockchain technology as a software platform or web protocol. It provides a toolkit and a certain infrastructure for security and transparency, but the application that is built on top is up to the user to determine.[22] For the sake of organization and convenience, the different potential applications of blockchain technology have been divided by the research community into blockchain 1.0 and 2.0. Blockchain 1.0 is the use of blockchain for the creation of cryptocurrencies and for peer-to-peer payments, as illustrated in the third paragraph with the Bitcoin example. Blockchain 2.0, also known as "smart contracts", utilizes the distributed ledger infrastructure for purposes that go beyond simple

[19] ibid.
[20] Michael Pisa and Matt Juden, 'Blockchain and Economic Development : Hype vs. Reality' [2017] Center for Global Development Policy Paper (107) 1 <https://www.cgdev.org/sites/default/files/blockchain-and-economic-development-hype-vs-reality_0.pdf>.
[21] Swartz (n 17).
[22] Danushka Jayasinghe and others, 'Philanthropy on the Blockchain' (2018) 10741 LNCS Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 25.

payments and could include any document such as property titles, medical records and loans. Implementation of such technologies began in 2014, and is still in an immature stage.[23]

What is a smart-contract?

The innovation that blockchain 2.0 brings to the table is the ability to form and execute agreements between two or more parties on the blockchain, thus the name "smart contracts"; although they do not necessarily constitute legally- binding, bilateral agreements.[24] These agreements are autonomous and self sufficient, because once their code is uploaded on the blockchain, the initiating agent no longer needs to track their completion and because they manage and allocate resources automatically, depending on their source code and their specifications.[25] A good example of such use can be found in farmer's insurance. A smart contract specifying the agreement is uploaded on the blockchain with various variables: one of which is weather. If the farmers agreed with the insurance company to be covered in case of heavy rain, then the smart contract will automatically deliver the agreed-upon funds to the farmers, whenever precipitation reaches the specified threshold.[26] Blockchain 2.0 applications move away from decentralization of payments, to decentralization of markets. Once an agreement has been uploaded on the blockchain, trust between the contracting parties is unnecessary, as the system is built to deliver when the specifications are met and will do so regardless of the parties' relationship.[27]

Notably, the most popular smart contract platform is the Ethereum blockchain. Different blockchains in this sense function similarly to software platforms, where a creator introduces a parameter -based system that others can use to build their own agreement. Ethereum was created in 2014 and it contains a programming language toolkit and a platform that allows the user to create an infinite variety of agreements, self-executable depending on the variants they specify.[28] It is exactly this flexibility that makes the Ethereum blockchain so appealing for building simple smart-contracts.

The most important take-away to be had from this presentation of "smart-contracts" is that they only resemble contracts in name. This has been a mishap in naming the technology and has led to a high degree of confusion, especially among legal experts who are used to the word "contract" as denominating an agreement that abides by the law of torts. "Smart-contracts" built on the blockchain are actually more

[23] Swan (n 23).
[24] Eliza Mik, 'Smart Contracts: Terminology, Technical Limitations and Real World Complexity' (2017) 9 Law, Innovation and Technology 269.
[25] Swan (n 23).
[26] Sam Haveson, Alan Lau and Vince Wong, 'Protecting Farmers in Emerging Markets with Blockchain' [2017] Cornell Tech 16 <https://www.johnson.cornell.edu/Portals/32/EMI Docu/Fellows/Blockchain Article.v2.pdf>.
[27] Swartz (n 17).
[28] Pisa and Juden (n 25).

akin to self-executable scripts and are only capable of transferring funds under certain conditions.[29] These scripts cannot take into account any change in the transacting parties' circumstances, and they have no actual negotiated terms, as legal contracts do.[30]

How do smart-contracts know when to execute?

A very central question concerning such automated payments on the blockchain is how the script gets the data necessary to execute the fund transfer it has been programmed to make. As was presented in the first section of this Chapter: "What is a blockchain?", the increased reliability of such decentralized databases is largely based on the fact that the only information stored in the chain is the information required to validate transactions. [31] If people were simply allowed to upload any sort of information to the blockchain then the database would be compromised. This is where oracle software comes in.

An oracle software is a piece of code that gathers data from third sources and provides a go/no-go decision to the "smart contract" running on the blockchain.[32] In the example for farmer's insurance presented in the previous section, the oracle software is linked to a meteorological tracker that has been decided upon by both parties of the agreement for its reliability and impartialness. Without constantly feeding information to the "smart contract", the oracle tracks the precipitation levels and when they reach the point that warrants compensation, only then do they "communicate" with the blockchain agreement to issue a command to execute.[33]

As one would naturally conclude, "smart-contract" reliability is directly contingent to the reliability of the oracle software connected to it. The agreement itself might be nigh immutable in the conditions under which it has been programmed and have guarantees of trust because of the blockchain protocol underlying its architecture, but it obviously cannot differentiate false input of data from an accidentally bugged or fraudulently corrupted oracle software.[34] This gap in effectiveness has been referred to in blockchain research as "the oracle problem". The more variants are added to the effectiveness of a certain technology, the more likely accidents are to happen or foul-play to be employed.

[29] Mik (n 29).
[30] ibid.
[31] Lubin, Anderson and Thomason (n 21).
[32] Massimo Bartoletti and Livio Pompianu, 'An Empirical Analysis of Smart Contracts: Platforms, Applications, and Design Patterns' (2017) <http://link.springer.com/10.1007/978-3-319-70278-0_31> accessed 6 February 2019.
[33] Haveson, Lau and Wong (n 31).
[34] Bartoletti and Pompianu (n 37).

2.2 The "Building Blocks" Project

The World Food Programme is the UN's food assistance branch and the largest international organization dealing with world hunger. As cash-assistance was implemented more and more in its humanitarian efforts, the organization identified a rising problem with lack of transparency, misuse of funds and mismanagement of data among the intermediaries it used to deliver aid.[35] Recognizing the potential of blockchain technology in dealing with such issues, the Innovation Accelerator (WFP's branch for innovative technologies) created Building Blocks, a project that uses asset management and authentication applications built on blockchain to deliver humanitarian aid.

The pilot of the project was performed in January 2017 in the Sindh province of Pakistan. It used the Ethereum blockchain to introduce a "proof of concept" system and test the blockchain's capability to authenticate and register transactions. What this essentially means, is that the Innovation Accelerator built a simple smart contract system which matches the identity of a person with the aid they are entitled to. The algorithm then makes a log of the transaction and by comparing disbursements to entitlements, calculates the new balance. [36]

Utilizing the lessons learned with the pilot in Pakistan, WFP rolled out a larger application of "Building Blocks" at the Azraq refugee camp in Jordan. Starting out with only 10.000 Syrian refugees in early 2017, the system coverage reached 100.000 refugees as of October 2018.[37] The application allows refugees to redeem their cash transfers through a biometric identification system (iris scans) that the WFP already had put in place in the camp. By scanning their irises at one of the various locations across the camp the refugees can get cash or food, and the algorithm itself crosschecks all variables including the identity of the person, their family situation, the amount of aid they are entitled to, the time-frame throughout which the aid should be distributed and creates a ledger of all transactions taking place in the camp.[38]

The Innovation Accelerator has reported that the use of blockchain technology has tackled the issue of misuse of funds considerably, by creating an "immutable source of information without third-party oversight." Both the organizations of the UN and independent parties can rely on this information, and the ledger can also be used for tracking donations in a transparent manner. The Accelerator also reported that they managed to save 98% in banking fees, a figure amounting to approximately 4.000$ a month for the

[35] 'What Is "Blockchain" and How Is It Connected to Fighting Hunger?' <https://insight.wfp.org/what-is-blockchain-and-how-is-it-connected-to-fighting-hunger-7f1b42da9fe> accessed 11 February 2019.
[36] 'United Nations World Food Programme Innovation Accelerator' <https://innovation.wfp.org/year-review-2017/docs/WFP-innovation-accelerator-2017-annual-report.pdf> accessed 16 May 2019.
[37] ibid.
[38] 'UN Blockchain – Multi-UN Agency Platform' <https://un-blockchain.org/> accessed 26 November 2018.

Azraq refugee camp. They intend to scale-up the system to cover all 500.000 refugees residing in the camp as well as two new country offices by 2019. [39]

2.3 Particulars of the Technology Employed

The Blockchain: WFP used a **permissioned** version of the Ethereum blockchain. The distinction between permissioned (private) and permission-less (public) blockchains is central in understanding the function of the technology. In a public blockchain, as the name implies, there are no limitations to who can access the blockchain and its information, the only requirement is downloading a version of it and whoever has a version becomes a peer.[40] Public blockchains are by far the most popular for commercial applications and are the ones that can support currencies (such as Bitcoin). A permissioned blockchain on the other hand is controlled by an organization or legal entity (in this case WFP) and only agents who have been granted permission gain access to the chain and its information.[41] Currently the only other entity that has a working node for "Building Blocks" is UN Women through a partnership with the WFP, although the agency is not involved with the disbursement system of the Azraq camp. This begs the question of what are the differences between a permissioned blockchain and a traditional, secure database. The most important differences are highlighted below:

- Administrator Privilege: A traditional database features at least one user (usually the architect of the database) who resides at the top of the user hierarchy: the administrator. An administrator of a database has access to increased functionality compared to other users, including the ability to create, modify and delete records as well as concede or share some of these privileges with other users.[42] A permissioned blockchain on the other hand retains its decentralized nature and has no administrator. All peers are equal in the sense that they all have the same copy of the chain and they all work together to verify every single transaction.[43] It is, of course, not open for public use, but no single actor can modify a record: be it the amount of an entitlement, the date that aid was provided to a refugee or the sum of said aid.
- Recursive Storage: This difference is maybe evident from the administrator example but should also be highlighted on its own. A traditional database is recursive: an administrator can go back and purge

[39] 'Blockchain for Zero Hunger | WFP Innovation' <https://innovation.wfp.org/project/building-blocks> accessed 11 February 2019.
[40] Leslie Lamport and others, *Blockchain for Dummies, IBM Limited Edition*, vol 9 (2017) <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85028525259&doi=10.1109%2FTEMSCON.2017.7998367&partnerID=40&md5=9594448ba6ddc6febd97d6317d65c46b%0Ahttp://ieeexplore.ieee.org/document/8321932/%0Ahttp://portal.acm.org/citation.cfm?doid=357172.357176>.
[41] ibid.
[42] Roman Beck and others, 'Blockchain – the Gateway To Trustfree Cryptographic Transactions' [2016] Research Papers 153 <http://aisel.aisnet.org/ecis2016_rphttp://aisel.aisnet.org/ecis2016_rp/153>.
[43] ibid.

old records in order to optimize database processing performance. Blockchain ledgers offer no such options. Once a record has been verified on the chain, it stays there for as long as the blockchain is in use.[44] While this is a central characteristic of blockchains and offers the guarantees of "immutability" that its proponents claim, it also constitutes one of the greatest barriers in large-scale implementation of such technologies. The more transactions happen on a certain blockchain, especially if it uses "smart-contract" applications, the larger the data file of the blockchain becomes, eventually reaching hundreds of gigabytes in size. [45] Therefore, unless specific technologies are invented that can compress the size of a blockchain effectively or in some other way considerably reduce the size of an ever-growing chain, the large-scale implementation of the technology remains a theoretical question.

The Biometric Oracle and the Cash Disbursements: As far as the software is concerned, there is no need to go into the specifics of the code, but it is important to list the resources the Innovation Accelerator used to realize the project, as each of them may raise different concerns. The entire system was built with a simple programming toolkit called Parity, that is user-friendly to create "smart-contracts" on the Ethereum blockchain. The "smart-contract" is linked to a validation oracle. This essentially constitutes a simple piece of software that validates the identity of a certain user with "off-chain" information. This oracle is connected to UNHCR's BIMS (Biometric Identification Management System) platform, a database of iris-scans and fingerprints for refugees that is widely used across a number of refugee camps. When a refugee presents their iris to the scanner, the validation oracle commands the "smart-contract" to execute, which then proceeds to move funds to or from the entitled person's wallet, registering the transaction.[46] For the purposes of the analysis on the handling of personal data in Chapter 4 it is important to clarify the notion of **"zero-knowledge proof"**. When such an oracle "communicates" with the application to initiate execution, the data itself does not flow into the blockchain. By design choice in "Building Blocks" and in many other systems that employ "smart-contracts", the oracle connects to the system in a binary way by providing a yes/no answer to whether the conditions set have been met.

2.4 Observations on the Project

The initial observations on the "Building Blocks" case study will be divided in two groups: material and procedural. As mentioned in the introductory chapter, multiple criteria need to be taken into account when measuring the performance of a new technology in the realm of aid.

From a strictly financial perspective, if we consider the WFP's data to be valid and reliable, the benefits of the new technology are undeniable. By introducing this system of autonomously-operating algorithms

[44] Pisa and Juden (n 25).
[45] Pisa (n 13).
[46] 'United Nations World Food Programme Innovation Accelerator' (n 41).

to disburse cash donations, the "travel-distance" of said donations has been considerably reduced. The Ethereum client "smart-contract" has replaced the financial institutions handling the funds and has led to reported savings of 98% by eliminating banking fees. [47] Refugees in the camp also report significant reductions in queue waiting times and more efficient identification of family members entitled to common packages of aid.

From a procedural aspect, the WFP is reporting a generic "increase in transparency", with the removal of third-parties from the equation having a positive impact on combatting fund mishandling and preventing fraud.[48] A more careful look into the procedure, however, could raise some alarming concerns. First of all, as of the time this thesis is being written, refugees do not have individual access to their digital-wallets. The system keeps virtual track of them, but there is no effective way for a person to see their balance, view the history of their transactions or monitor the procedure itself. The primary concern however stems from the use of identification biometrics in a permissioned electronic ledger. The collection, by the UNHCR, of refugee biometric data has been increasing at an exponential rate. After the BIM system's pilot in Thailand in 2015, the program expanded to cover 120.000 in Southeastern Asia and has been growing ever since, with plans for a global roll-out.[49] Publicly-disclosed information is scarce, but it is safe to assume that the 100.000 refugees participating in the blockchain program in Jordan are also biometrically identified since the WFP is using UNHCR's identification system. Identification of vulnerable groups of people, especially when biometrics are employed cannot be a simple question of efficiency. Biometric technology, even when yielded by the UN, calls for questions of democratic accountability and ethical scrutiny. The fact that the UN is only truly bound by internal policy and the decrees of the Security Council makes it imperative that such systems do not function under "black box" conditions but are rather open to monitoring by stakeholder groups and watchdog NGOs. When paired with an immutable and automated source code of decision making, the issues of data ownership, participatory decision making, sharing of sensitive data and capacity for erasure become crucial – and potentially dangerous.[50] Taking into consideration the lack, on the UN's part, of a clearly articulated and public set of rules for the collection and use of this data, a multi-disciplinary analysis of the risks associated with such new technologies is of paramount importance.

[47] 'What Is "Blockchain" and How Is It Connected to Fighting Hunger?' (n 40).
[48] 'Blockchain for Zero Hunger | WFP Innovation' (n 44).
[49] 'UNHCR - Biometric Identity Management System' <https://www.unhcr.org/protection/basic/550c304c9/biometric-identity-management-system.html> accessed 11 February 2019.
[50] Anna Lodinová, 'Application of Biometrics as a Means of Refugee Registration: Focusing on UNHCR's Strategy' (2016) 2 Development, Environment and Foresight 91.

Blockchain shows promise in creating efficient models for no-intermediary donations. The question of whether it can deliver on its promises for transparency and beneficiary agency, however, remain unanswered. The following chapter will analyze how blockchain applications can affect transparency in the realm of aid, and what are the novel changes it introduces for the organizations and the people involved.

Chapter 3: Blockchain for Fairness in Humanitarian Relief

3.1 Defining Humanitarian Fairness: Transparency and Distributive Justice

As mentioned previously in the introduction of the thesis, humanitarian aid activities differ quintessentially from those in the for-profit sector. Apart from the obvious difference in objectives: the former being relief of vulnerable populations in post- conflict or post-disaster situations and the former being profit for shareholders, there is also a pivotal difference in scope and the way that performance is measured.[51] A humanitarian project needs to always be gauged not only on its efficiency (the capability of transforming capital into aid) but also on its "fairness".[52] Although this requirement is ethical in nature it is by no means philosophical. When attempting to provide sanctuary for ethnic or religious groups that have been targeted by oppressive power-holders, when deploying relief operations for disaster victims and trying to mitigate human suffering, translating the principles of fairness into policies and systems is a pragmatic necessity to create impactful change.[53] As nature and conflict push people to the brink, establishing trust in organizations and projects that function fairly is the cornerstone not only for relief but for the rehabilitation process that follows.

"Fairness" can be a slippery concept to narrowly define. It is encountered in phrases of many disciplines: from business, to political science, to sociological studies and law. According to Rawls, fairness is based on the belief that "each person has an inviolability founded on justice that even the welfare of society as a whole cannot override".[54] In order to facilitate examining fairness in the context of humanitarian aid and for the research purposes of this thesis, the term should be broken down further in two principles: transparency and distributive justice- or impartiality. Each of these terms contains its own set of values and ideals and the objective function of all these principles shall build a comprehensive model of fairness as a dynamic term. Transparency, for example, is the mandate for organizations to "be open in the clear disclosure of information, rules, plans, processes and actions" according to Transparency International.[55] It is conceptually linked not only to visibility and understandability but also to accountability: an organization that functions in a transparent manner should be able to easily allow third parties to perceive actions taken and demonstrate compliance with ethical and statutory rules.[56] Distributive justice in this context should also be broadened from the purely Rawlsian and Aristotelic definitions of "duty of assistance" into a more grounded approach. Distributive justice in aid should be about distributing socio-

[51] Beamon and Balcik (n 19).
[52] ibid.
[53] Gutjahr and Nolz (n 16).
[54] John Rawls, *Theory of Justice. Revised Edition* (1999).
[55] Transparency International, 'Transparency International - What Is Corruption?' (*Transparency International*, 2017) <https://www.transparency.org/what-is-corruption>.
[56] ibid.

economic goods on the basis of individual need in an impartial and systematic manner. Thus, it encapsulates the notions of non-discrimination and equity.[57]

As has been described in the previous chapter, the proponents of blockchain fully endorse the claim that the technology is capable of increasing transparency and building systems that promote objective distribution criteria without human intervention.[58] This chapter will explore the validity of the claim by identifying a "pipeline" through which aid travels from donors to beneficiaries, the areas that pose a high risk for corruption and unfair practices and examining how the implementation of a blockchain or a distributed ledger technology could impact these areas.

3.2 Corruption and Unfair Practices

According to Transparency International's glossary, corruption is "the abuse of entrusted power for private gain".[59] Corruption embodies the antithesis of fairness, it is however important to state that while all instances of corruption constitute non-transparent practices, not all instances of non-transparency are caused by corruption. In many cases of humanitarian aid projects the requirement to act as fast as possible to mitigate a disaster can lead to sub-optimal decisions on implementation which usually lead to trade-offs in transparency to gain efficiency; especially when employing local intermediaries to carry out work on the ground.[60] When assessing the areas of risk concerning unfair practices, the instances of systematic abuse and the situations that create contingencies for poor decision making will be viewed together as threats to transparency and distributive justice. This holistic approach is useful in building a clearer image of how a technological system can or cannot facilitate change in problem areas of aid disbursement.

Corruption and non-transparent practices in humanitarian aid are not an unknown phenomenon, the literature, however, does not feature a great volume of research on the subject. Potential causes of this gap in research have been codified as "*the reluctance hypothesis".*[61] According to this hypothesis, when studying empirical questions such as "*How effective is foreign aid*?" or "*How does non-transparency impact aid-effectiveness*" researchers have strong priors which affect incentives for research. The belief that humanitarian aid projects are governed by the ethical principles of altruistic humanitarianism has led to a reluctance to publish negative results. In a meta study by Doucouliagos and Paldam (2006) it was found that, specifically in Aid Effectiveness Literature, while the average effect of aid is found to be

[57] Helena De Bres, 'The Many, Not the Few: Pluralism About Global Distributive Justice' (2012) 20 Journal of Political Philosophy 314.
[58] Nir Kshetri, 'Will Blockchain Emerge as a Tool to Break the Poverty Chain in the Global South?' (2017) 38 Third World Quarterly 1710 <http://doi.org/10.1080/01436597.2017.1298438>.
[59] Transparency International, 'Transparency International - What Is Corruption?' (n 60).
[60] Daniel Maxwell and others, 'Preventing Corruption in Humanitarian Assistance: Perceptions, Gaps and Challenges' (2011) 36 Disasters 140.
[61] Doucouliagos and Paldam (n 15).

positive, the results worsen with the accumulation of data and the independent replication of the models used.[62] This lack of vigilance and open conversation about the pitfalls of aid has created a norm where only the most scandalous and severe abuses gain publicity.

In order to critically assess the effects of blockchain on the top-down, fair distribution of aid, a risk map will be employed. The map chosen is the one developed by Ewins et al. (2006) for the comprehensiveness of the model and the clear mapping of the processes of humanitarian action that are vulnerable to corruption and unfair practices.[63] The analysis that follows applies to the "pipeline" of aid in key sectors such as shelter, food, healthcare and refugee assistance. A similar map will be employed in the fourth chapter of the thesis following the trail of personal and biometric data through similar processes. These "maps" are necessarily simplified representations of an archetypal humanitarian response. In practice there will be discrepancies among different organizations depending on their size, the type and scope of the project.[64] In both instances, blockchain applications will be juxtaposed to traditional technologies in each problem area, creating an understanding of the specific solutions brought to the table.

3.3 Problematic Areas in Assistance and the Effects of Blockchain

Initial Assessment and Program Design

At this stage of humanitarian relief, the emergency is identified and policies are put in place to build an effective program that answers the needs of beneficiaries. The main risk at this stage is falsifying the assessment, either under pressure of a third-party or by exaggerating the need of providing aid to increase reputation and publicity of the project. Not all cases of false assessment fall under the scope of corruption, but any analysis and program design that does not take the needs of beneficiaries as a foremost criterion poses a threat to the fairness of the project.[65] Research by Transparency International Bangladesh for example, reveals that in the past decade of humanitarian assistance in the country both national and local governmental officials have been applying pressure for particular affiliated groups to be included in beneficiary lists, or withholding information in exchange for bribes.[66]

The stage of the initial assessment and its importance for the efficacy of a humanitarian program highlights one of the most crucial limitations of blockchain – and any other technological solution: the system cannot counter false input of data. The databases built on a blockchain can be highly secure, but they all start from a "first block". If information on the first block is false, then all subsequent blocks

[62] ibid.
[63] Pete Ewins, 'Mapping the Risks of Corruption in Humanitarian Action' (2006) <http://www.u4.no/document/literature/mapping-risks-corruption-humanitarian-action-1.pdf>.
[64] ibid.
[65] Maxwell and others (n 65).
[66] Transparency International, 'Preventing Corruption in Humanitarian Operations' [2010] Handbook of Good Practices.

which linearly verify data according to previous ones are going to follow.[67] Blockchain cannot compensate for the lack of non-transparent governance at the design stage.

Fundraising and Allocation of Funding

When raising funds for a specific program, humanitarian agents usually have both public funding (donations) and institutional funding (governmental or NGO based).[68] The risk of unfairness in this case is linked to both transparency and distributive justice. Placing overheads on the agency's budget, using ear-marked donations for purposes other than the ones intended or internal fund mishandling by NGO managers can be rooted in the pursuit of personal gain or poor governance.[69]

Institutional funding is made through a proposal-acceptance procedure, similar to that of public procurement. Its transparency lies in the enforceability of the applicable statutory law and not as much in the systems employed. Public funding however is quite dependent on systems (fundraising platforms/events, charity marathons etc.) and constitutes an area where blockchain technologies show promising results.[70] Creating a fundraising platform based on peer-to-peer donations on a public blockchain instead of a "private person to bank account" model can allow for real time visibility of all funds transferred, in a distributed ledger accessible by all donors.[71] The technology is still immature to allow for a quantification of possible financial gains, even though the Innovation Accelerator clearly stated that "Building Blocks" saved 94% in banking fees when it comes to fund allocation, which is a tangible result that should be taken into consideration.[72] From the donor's perspective, this participatory procedure of fundraising increases visibility of the process, and since every block (in this case every donation) is visible to all users, accountability of the organization is also ensured.

Blockchain donor applications also offer other utilities which can ameliorate tracking of donations and elimination of intermediaries, such as the direct translation of funds into commodities. The South-African startup Bankymoon created a donor platform for schools that automatically loads the affiliated schools' electricity meters according to donor payments through the use of a "smart-meter".[73] The process of getting electricity for these schools was heavily bureaucratic and this model of pre-payment of electric bills in real time gained traction for its efficiency and transparency.

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[67] Katherine Heires, 'The Risks and Rewards of Blockchain Technology' [2016] Risk Management 4.
[68] John Hudson, 'Consequences of Aid Volatility for Macroeconomic Management and Aid Effectiveness' (2015) 69 World Development 62 <http://dx.doi.org/10.1016/j.worlddev.2013.12.010>.
[69] ibid.
[70] Beck and others (n 47).
[71] ibid.
[72] 'Blockchain for Zero Hunger | WFP Innovation' (n 44).
[73] Bankymoon, 'Social Projects - Bankymoon' (2016) <http://bankymoon.co.za/social-projects/>.

Working with Partners

It is not uncommon for humanitarian organizations to work together or fund localized organizations to carry out part of the relief process.[74] Risks of unfairness and corruption at this stage can be identified either in the selection and evaluation process of partners or in the additional step created on the delivery of relief to beneficiaries.[75]

Naturally, a blockchain cannot help with poor selection criteria for partners. Open, roundtable discussions with senior staff of the local organization, joint decision-making and auditing of the internal processes of the partner are considered best practices, oftentimes however, especially in disaster response, time does not allow for extensive partner screening.[76] In the wake of the 2005 tsunami in Sri-Lanka local NGOs were flooded with money, some of them faced with an overnight increase in their annual budget by a factor of ten or more.[77] Management problems and fund mishandling in this case were a common occurrence. At this stage, an Ethereum- based blockchain client such as the one used by the WFP in "Building Blocks" could have provided remedy to the issue of fund mishandling. Considering each of the localized NGOs employed their own systems of distribution and budgeting after receiving the funds, (some of them potentially granted limited access to resources and databases of the bigger organizations) this fragmentation of processes leaves lots of room for "blind-spots" where corruption may take place. If organizations were working with a private blockchain client with the total of the funds recorded into the ledger, and they allowed the local NGOs to use the funds only through the application of the platform, then the process would not only be more secure but also auditable in case of a fault.[78] Another benefit of private Ethereum clients is their capability for offline storage and migration, allowing for use of the database from partners even in remote areas with no mobile connectivity. Surely, corrupt officials and local power-brokers could potentially find ways to diverge funding for personal gain. The inability, however, to alter blockchain records on a permissioned chain would have made it very difficult to hide the losses at the stage of monitoring and evaluation and would have held the partners accountable to a much higher standard compared to traditional databases.[79]

[74] Maxwell and others (n 65).
[75] ibid.
[76] Homi Kharas and Johannes F Linn, 'BETTER AID RESPONDING TO GAPS IN EFFECTIVENESS' [2008] Policy Brief 2008-06 1 <https://www.brookings.edu/wp-content/uploads/2016/06/11_aid_effectiveness_linn.pdf> accessed 4 February 2019.
[77] Timothy Russell, 'The Humanitarian Relief Supply Chain: Analysis of the 2004 South East Asia Earthquake and Tsunami' (2005) <citeulike-article-id:1525949>.
[78] Ahmed Kosba and others, 'Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts', *Proceedings - 2016 IEEE Symposium on Security and Privacy, SP 2016* (2016).
[79] Scott Brett, 'How Can Cryptocurrency and Blockchain Technology Play a Role in Building Social and Solidarity Finance?' (2016) 1 United Nations Research Institute for Social Development 26.

Procurement and Logistics

The stage of procurement of in-kind goods and the particular methods of transporting these goods to the targeted beneficiaries pose some of the greatest risks of non-transparency and non-equity at the expense of people in need. The large sums of money involved and the multiple stakeholders especially in capital intensive sectors such as water and shelter place procurement very high in the areas with a risk of corruption.[80]

Organizations which are active in humanitarian projects almost always have a procurement procedure in place which follows industry practices: the proposal is made by the agency, tenders from potential suppliers/contractors are made and the decision of what entity signs the procurement agreement is made publicly and on objective criteria of need and value/price efficiency.[81] This seems fair in theory; reality however is infinitely more complex especially in cases of emergency procurement. Rules for international tendering are difficult to implement, and the differences in pricing and expertise may lead to exclusion of local contractors and suppliers.[82] Inflating budget proposals, bribing of officials or agency staff to gain a better standing within the procurement process, or even supply of in-kind goods that are of sub-optimal specifications are common in humanitarian procurement.[83] Attempting to avoid these pitfalls, some NGOs engage in more complex, multi-criteria international procurement procedures that follow tendering standards of competitive for-profit markets. An example from Iraq, according to the Governor of Basra, shows that such practices of international tendering led to the refurbishment of 20 police stations in the region for 25$ million by international contractors; a project that could have been completed by locals for 5$ million.[84] The system seemed fair on paper but in practice the complexity of the procedure and the limited administrative expertise of local contractors made the procedure opaque and rigid. On the other hand, when working in remote regions under pressure of time and resources, local contractors who have a much better understanding of market prices and practices can collude to forge fake tenders and share the profit of the highest bidder after the project.[85]

In the realm of logistics, things are more straightforward: the only necessary check is to make sure that the same amount of goods have been received as the amount of goods dispatched. Some agents of humanitarian aid view the area of logistics as relatively safe, while others propose that documentation of

[80] Jessica Schultz and Tina Søreide, 'Corruption in Emergency Procurement' (2008) 32 Disasters 516.
[81] Richard Oloruntoba and Gyöngyi Kovács, 'A Commentary on Agility in Humanitarian Aid Supply Chains' (2015) 20 Supply Chain Management 708.
[82] Ewins (n 68).
[83] ibid.
[84] Transparency International, 'Preventing Corruption in Humanitarian Operations' (n 71).
[85] Oloruntoba and Kovács (n 86).

goods can be falsified.[86] Especially in food aid, some interviewees by Transparency International point out that while the number of food containers received might agree with the number dispatched, it is not uncommon for the containers to be underweight.[87] Records show that transporters of relief goods, especially when they are private local contractors, commonly experience pressure from armed factions or corrupt authorities to handover an in-kind "tax" for safe passage.

Blockchain for procurement procedures shows incredible promise in the for-profit sector. Especially public blockchains offer utilities of verifying the truthfulness of data provided by suppliers, keeping open records and an accessible and inexpensive procedure for everyone involved.[88] Strengthening such a process with smart-contract applications could ensure not only the transparency of the procurement process but also the timely and unfalsifiable delivery of the agreed-upon goods or services. The requirement for publicity of profiles on the blockchain allows the organization in charge of the procurement to cross-check the validity of any claims the potential contractor makes, simply by taking a look at the public profile of the user.[89]

Sadly, while these utilities can offer a lower-cost, trust-based system for B2B tender transactions, it does not seem to provide a solution to the core problems of humanitarian procurement. As explained some paragraphs prior, the main obstacles to an equitable and transparent procurement process in aid are: the lack of information agencies oftentimes have for local market practices, price inflation/sub-optimal goods, the complexity and opaqueness of procedures and the arbitrary exclusion of potentially good contractors or suppliers on the bases of collusion, bribery, military roadblocks and lack of technical literacy. By deploying a nascent and experimental distributed ledger technology instead of a traditional correspondence-based system none of these pitfalls would be effectively combatted. Best practices show that the hiring of specialized procurement management staff, prior market research of local economies, simplification and understandability of tender proposals and the clear definition of on-the-ground objectives before the procurement begins can increase the visibility of different suppliers and provide a level playing field where decisions can be made for the best interest of the beneficiary.[90] A new technology can expedite processes in business relationships that are already stable (such as for-profit B2B) but when deployed hastily in unstable power dynamics it can broaden the gap between those

[86] Russell (n 82).
[87] Transparency International, 'Transparency International - The Global Anti-Corruption Coalition' (*Transparency International*, 2016) <https://www.transparency.org/about>.
[88] Bertrand Maltaverne, 'Blockchain: What Are the Opportunities for Procurement?' (*Medium*, 2017) <https://medium.com/procurement-tidbits/blockchain-what-are-the-opportunities-for-procurement-d38cfd5446fa>.
[89] ibid.
[90] Maxwell and others (n 65).

businesses with access to technology and those without, increasing the risks of uncertainty and subsequently foul play.

As far as logistics are concerned, blockchain could potentially provide increased security in terms of document verification and handling of goods.[91] By migrating the logistics agreements on a private blockchain that is controlled by the agency distributing the aid, forgery and untruthful statements on part of the companies delivering the goods could be curbed by not allowing contractors to make their own records outside of the blockchain at any stage of delivery.[92] Theoretically, a weight or volume calculating oracle at the end point of distribution could be used to verify the accuracy of the statements of the partners. These technical measures could increase accountability of the partners and visibility of the delivery route (most probably by a low margin), they do not however answer important problems of roadblocks, warehousing theft and unlawful diversion of resources due to blackmail or violence.[93] Studies in humanitarian supply-chains show that maintaining and securing truck fleets, studying the safety of different routes, physical security at warehousing level and the cultivation of an ethical exchange between agency staff and the people in charge of delivery can have a much larger impact on the quality of aid.[94] It is also important to note that especially in cases of emergency relief efforts, in-kind goods, medicine and sanitation supplies, as well as cash can be diverted at the logistics/supply-chain stage to meet needs of populations that were previously unaccounted for. Flexibility and fast-reflexes in such relief projects can be of lifechanging difference to beneficiaries and promotes equity under the condition that decisions are made with transparency and based on objective criteria.[95] Migrating logistics onto an immutable and complex database could be hurtful for the purposes of impartiality and distributive justice in emergency relief, by excluding the needs of people that arise in the field.

Targeting and Registration of Beneficiaries

Determining who is in need of how much aid and proceeding to build a record of the aid recipients can be a daunting task for humanitarian organizations. The assessments that have to be made in order to create a complete and trustworthy list of targeted recipients of aid is a lengthy process, and it entails help and information from local authorities who are not always willing to provide it for free.[96] Establishing a system of comprehensive and objective criteria that accounts for the needs of different groups within a population in a manner that promotes transparency on the side of the agency and equity and impartiality among the recipients is notoriously difficult. It becomes nigh impossible in rural parts of the developing

[91] Jayasinghe and others (n 27).
[92] Coppi and Fast (n 18).
[93] Campbell, Vandenbussche and Hermann (n 11).
[94] ibid.
[95] Ewins (n 68).
[96] Maxwell and others (n 65).

world where local enforcers and self-proclaimed gate-keepers hold the supervisory role of a dysfunctional state. In multiple field studies by Save the Children in Sierra Leone, Southern Pakistan, Liberia and Burundi it was found that the registration and targeting phase was consistently sabotaged with corrupt practices of local power-holders who ended up controlling who went on the beneficiary lists through bribery, blackmail and harassment.[97] Local groups would hoard big parts of the aid or exert control over the registration process and would demand bribes or sexual favors to allow individuals or families to have access to relief goods. [98]

Targeting of beneficiaries is a governance-level process and it represents that stage in every humanitarian project where the on-paper plan meets the people it was created to aid. It is a crucial administrative process where resource managers, researchers and project planners come together with the communities to determine the scale of need of each group and individual. Blockchain as a record-keeping technology seems irrelevant at this phase of humanitarian assistance.

Registration, however, is possibly the phase where blockchain solutions can truly make a difference in humanitarian aid. Once an agency has finalized the list of targeted beneficiaries, using a blockchain instead of a traditional database can make the process more transparent and secure. In the case of "Building Blocks", the WFP used the iris scans of refugees in Jordan to create an immutable database of registered beneficiaries that adapts in real time to supply and demand of aid.[99] As explained in the technical analysis of Chapter 2, a "smart-contract" application is deployed on the Ethereum blockchain which calculates automatically the balance of every registered refugee depending on the aid they have received and the aid they are entitled to. The inability of human agents to make changes to that ledger considerably reduces or eliminates the possibility that certain beneficiaries receive an incorrect amount of aid due to administrative errors or external pressure.[100] All this, under the condition of course, that the initial targeting list inputted in the system is reliable and correct. In the case of "Building Blocks" one could argue against the inventiveness of the blockchain on the basis that the WFP not only had to deal with a controllable population of beneficiaries (the residents of the Azraq camp) but also had the infrastructure of the BIMS UN platform to access the biometric identities it needed for the recipients of aid. Taking a look at more case studies of blockchain deployed for humanitarian purposes however allows for the discovery of a common thread in the registration process. In May 2018, the IFRC in collaboration with the Kenya Red Cross Society (KRCS) used a blockchain-based registration platform called the

[97] Elizabeth G Ferris, 'Abuse of Power: Sexual Exploitation of Refugee Women and Girls' (2007) 32 Signs: Journal of Women in Culture and Society 584.
[98] ibid.
[99] 'Blockchain for Zero Hunger | WFP Innovation' (n 44).
[100] Jayasinghe and others (n 27).

Blockchain Open Loop Payment Pilot Project for the assistance of drought-affected households in Isiolo County, Kenya. For lack of a pre-established identification platform such as BIMS, volunteers from the KRCS visited the communities to register people's mobile phones and explain participation in the program.[101] The authentication mechanisms uploaded encrypted data of beneficiaries on the blockchain platform in which both the IFRC and KRCS participated as peers, alongside with Red Rose: the technology provider who built the platform.[102] The presence of the peers on the blockchain ensured that no single-entity could amend the results of registration. According to KRCS the pilot demonstrated that this integrated solution for aid disbursements could maintain high levels of transparency even when any one of the participating entities was offline and provided significant protection against fraud: both on first- and third-party levels.

Distribution

The stage of implementation and distribution of aid is, in essence, the culmination of the efforts made in all previous stages and -in terms of transparency and distributive justice- a direct reflection of the project up to that point.[103] Provided all other phases have been designed and executed with fairness, handing out supplies or cash to the beneficiaries should be the most straightforward and least complex process of the entire project. Secure blockchain applications have shown potential in curbing the diversion of resources in precarious situations where distributors have limited discretion in the selection of what beneficiary gets what aid and in cases where supervision is challenging.[104]

Regrettably, the phase of distribution is in fact the point in the relief supply-chain where the risk of non-transparency and corruption is by far the greatest.[105] While the distribution by the organization in charge can be at times problematic, the true issue is what happens to the aid after it has been handed out. Interviews and field research by Transparency International identified significant difficulties in exerting control over the resources post-distribution and the risks of theft, diversion by local elites/authorities, extortion, preferential treatment of groups within the communities and -oftentimes- redistribution by the locals are common.[106]

[101] IFRC, 'Blockchain Open Loop Cash Transfer Pilot Project' [2018] Learning Review 9.
[102] ibid.
[103] Paulmann (n 2).
[104] Nir Kshetri, 'Blockchain's Roles in Strengthening Cybersecurity and Protecting Privacy' [2017] Telecommunications Policy.
[105] Benita M Beamon, 'Measuring Supply Chain Performance' (1999) 19 International Journal of Operations and Production Management 275.
[106] Sarah Collinson and others, 'Power, Livelihoods and Conflict: Case Studies in Political Economy Analysis for Humanitarian Action' (2003) 13 Humanitarian Policy Group Report 1.

This information is gathered by researchers and NGOs primarily through interviews and the lack of quantitative data highlights the severity of non-transparency and inequality in humanitarian efforts as a whole.[107] The very nature of the practices employed to divert aid after it has been distributed make it very challenging to gather insight on what exactly takes place and to find ways to combat it. It is also difficult to draw the line between corrupt unfair practices and legitimate sharing of the relief goods with other deserving – yet untargeted- people within the communities. Addressing this issue without deploying surveillance-type measures is a challenge that is yet to be solved. Using any type of blockchain application to track resources after they have been disbursed to the recipients would be a clear affront not only to privacy but to human dignity and would most certainly create more issues of non-transparency than it would solve.

Monitoring and Evaluation

Although not directly part of the assistance supply-chain, the capacity of a project for clear monitoring, evaluation and reporting mechanisms is crucial for a fair procedure. The main risk that monitoring and evaluation are faced with is that of falsified reports or buried evidence of diverted aid packages.[108] The limitations that an organization can face in establishing field offices, make visits to local NGOs or create effective and independent audit mechanisms are restricting their capacity to control the entire pipeline of aid.

Lack of large-scale blockchain operations and the experimental nature of the technology does not allow for conclusive remarks on how it can impact monitoring and evaluation. On a theoretical level, auditability and security against forgery are some of the qualities that blockchain boasts above all others but tangible results for humanitarian assistance are yet to be seen. The WFP claims that "Building Blocks" allows for constant monitoring of the process, greatly increasing the transparency of the project.[109] The case, however, with a permissioned blockchain that has only one entity as a peer, such as the one used by WFP, is of very limited scope to allow for extrapolation of these results in larger efforts. In practice, a big breakthrough for monitoring in aid that blockchain brought to the table is the ability it offers to donors to track their donations on the chain in real time (as explained under "Fundraising"), increasing trust in organizations that the donated funds reach their destination.[110] The results could be interesting if more UN agencies and humanitarian actors in general collaborated to build an interoperable blockchain in which every agency acts as a peer and all information is cross-checked and verified

[107] François Bourguignon and Mark Sundberg, 'Aid Effectiveness - Opening the Black Box' (2007) 97 American Economic Review 316.
[108] Ana María Anaya-Arenas, Angel Ruiz and Jacques Renaud, 'Importance of Fairness in Humanitarian Relief Distribution' (2018) 29 Production Planning and Control 1145 <https://doi.org/10.1080/09537287.2018.1542157>.
[109] 'What Is "Blockchain" and How Is It Connected to Fighting Hunger?' (n 40).
[110] Beck and others (n 47).

autonomously. As has been discussed, the strength and immutability of any blockchain is increased exponentially when used by more peers and a sharing of best practices and information between agencies could have breakthrough innovations for the evaluation of projects.

3.4 Observations on the Analysis

The primary observation to be made following this examination of different risks in the humanitarian supply chain is that there is a disconnect between the hype accompanying the technology and the effects that evidence suggests. While the claims that blockchain introduces systems with increased transparency and security are proven to be valid, the difference it makes in practice seems marginal. This may be in part due to the "Bitcoin effect": the inextricable linkage of blockchain to cryptocurrencies which creates the tendency to measure the performance of the technology in economic terms.[111] As it turns out the impact of blockchain is considerable in cutting costs, especially by eliminating intermediaries such as banking institutions, but when seen under the prism of ameliorating procedural fairness it is difficult to justify the use of the technology compared to other alternatives. In certain stages of humanitarian assistance, particularly fundraising, registration of beneficiaries and monitoring of projects, blockchain presents utilities that increase transparency and equity for the benefit of the people receiving the aid. In other pivotal stages however, the technology seems unable to provide solutions. That being said, the technology is largely new and untested and the promise it shows is certainly worth investigating.

Another observation is linked to the publicity effect of technological innovations in humanitarian aid. The realm of aid is not immune to the mimicking tendencies of other sectors and many of the piloted projects that run on blockchain today are a result of an organizational desire "to not be left behind".[112] "Building Blocks" is a relatively big and ambitious project developed by the WFP: one of the largest humanitarian agencies in the world. Not all agencies possess the infrastructure or the resources that allow for a project of such scale, which results in numerous small projects being developed behind closed doors and executed in circumstances too narrow to allow for quantifiable results.

The third observation, and potentially the most pessimistic, is that the risks of unfair practices that a relief effort project would run into do not seem easily rectifiable by a change in the technology used. While it is true, as displayed extensively above, that some technologies are more secure and promote fairness in the system in comparison to others, it has been found that almost all organizations focus on solutions for finance and procurement with human resources receiving less attention even though research shows that staffing is a vital point in increasing transparency and preventing corruption.[113] To achieve fairness on the

[111] Heires (n 72).
[112] Pisa (n 13).
[113] Maxwell and others (n 65).

entire length of a project, the values of transparency and distributive justice need to permeate the system as a whole. Modern humanitarian aid literature highlights the need for a holistic approach, where these values are codified and applied systematically from policy making, to program design, to implementation and evaluation. The collaboration of multiple international agencies in drafting codes of conduct and sets of binding rules, the clear segregation of duties among the staff, the establishment of effective whistleblower and complaint mechanisms are some of the measures that are gaining traction in the aid community for their overall effectiveness in performance and fairness. In a study on the effects of different information technology solutions in humanitarian aid an anonymous interviewee from the ICRC stated *"(…) People need to focus less on the technology and more to the people. I've never met a technical problem that wasn't a people problem in the first place."*[114] This phrase adequately sums up the effects of blockchain on procedural fairness for humanitarian aid.

[114] ICRC and Privacy International, 'The Humanitarian Metadata Problem: "Doing No Harm" in the Digital Era' (2018).

Chapter 4: Handling Personal Data on Blockchain for Relief

4.1: The Age of Profiling and the Unique Case of Humanitarian Data

As information technology permeates every aspect of individual and group behavior, devices become more accessible and everything is reengineered to connect to the internet, collected data has become an invaluable asset for organizations of all industries and sizes and humanitarian actors are no exception. Public discourse is nowadays riddled with conversations and debates about "big data", the way corporations monitor and analyze the behavior of citizens and the ways in which public bodies should regulate and scrutinize these processes. Despite the good will of many academics and activists to raise consciousness about the fact that the seemingly unlimited and unmonitored processing of personal data can pose serious threats to individual and group freedoms and rights, practical solutions are yet to be seen.[115] The newly voted and implemented GDPR in the European Union has been vocally celebrated as a pioneering legislative text that bridges the gap between corporate innovation and the peoples' right to privacy but upon closer examination has caused minimal changes in how big organizations, both public and private, conduct their everyday business. The right to privacy and its natural contemporary extension, the right to data protection, are not only featured in EU legislation but are also enshrined in the Universal Declaration of Human Rights[116], the UN Global Pulse Rules and numerous other national and international legal frameworks.

This chapter, however, does not aim to view blockchain through the prism of enforcement of data protection rights *stricto sensu*. While the safeguards and the rules for processing of data are indeed linked to the human right to privacy, analyzing these nuances only as an issue of legal compliance would not address important issues that arise in the humanitarian sector. Most recent regulatory attempts for the protection of personal data tunnel-vision in markets and consumers, focusing on the exchange of an individual's data for a service or commodity. Rules are made with Western societies in mind and, in great part, the debate on privacy circles around the use of social media platforms, targeted advertising, geolocation and consumer profiling.[117]

These are all extremely important issues for contemporary societies both developed and developing. It is important however to highlight that in cases of vulnerable populations such as the recipients of humanitarian aid, personal data oftentimes equates to much more than consumer habits and view-to-click

[115] Payal Arora, 'Bottom of the Data Pyramid: Big Data and the Global South (3)' (2016) 10 International Journal of Communication 19 <http://ijoc.org/index.php/ijoc/article/view/4297>.
[116] United Nations, 'United Nations Universal Declaration of Human Rights 1948' [1948] Office of the High Comissioner for Human Rights.
[117] Arora (n 120).

ratios. For a political dissident, a refugee on the run, a victim of domestic or sexual violence, information as simple as transaction records paired with real-time location can be a death warrant should the data fall into the wrong hands. When sensitive data enters the picture, there is no statement too hyperbolic about the catastrophic potential a single data set could have. If collecting information on ethnic and religious origin, medical records, sexual preferences and gender identity is considered precarious in the developed world then it is critically perilous in its developing parts.

The dangers posed by a potential data breach or fault in security are not the only parameters that set personal data collected in humanitarian action apart from others. While data processed in the context of for-profit activities is usually based on a bilateral agreement or contract between the subject and the organization, the circumstances under which beneficiary data is collected can be infinitely more complex; especially in emergency assistance.[118] Asking for someone's fingerprint when they are waiting in line for rationed food cannot be compared to giving away a print for a gym membership, no matter the good intentions and the mechanisms of humanitarian actors at play. The fact that aid beneficiaries are oftentimes under duress, the discrepancies in technological literacy, the disorganized and scattered nature of groups within communities all lead to a power asymmetry that is difficult to curb.[119]

Considering this asymmetry, as well as the life-and-death significance of data collected in aid and relief efforts it becomes clear that the protection of data of beneficiaries features not only the necessity for comprehensive legal frameworks but also requires the designing of systems that embody political and ethical values. When looking at blockchain -or any other technology- as a tool for collecting and storing beneficiary data the analysis should include how the system can or cannot empower individuals and groups to own their narrative and partake in the decision-making processes that this data facilitates.

4.2: Blockchain Capabilities for Data Protection in Humanitarian Efforts

In order to build an organized outline of the potential effects of blockchain on data protection a rules framework must be used as a basic axis on which the new technology can be applied. For the purposes of this subsection this set of rules will be the WFP Guide to Data Protection and Privacy.[120] The Guide is a good fit because it codifies both legal and ethical principles drawing from various legislative texts and

[118] ALNAP, 'Participation by Crisis-Affected Populations in Humanitarian Action A Handbook for Practitioners' [2000] Evaluation.
[119] Kim Scriven, 'Innovations in International Humanitarian Action - Background Paper' [2009] 25th ALNAP Meeting on Innovations in International Humanitarian Action 1.
[120] WFP, 'WFP Guide to Personal Data Protection and Privacy' <https://docs.wfp.org/api/documents/e8d24e70cc11448383495caca154cb97/download/>.

treaties. It will be used solely to provide a structure for the examination of blockchain for humanitarian purposes but the analysis will expand – mainly with the provisions of the GDPR which have extensively analyzed by think tanks and public bodies- to cover concepts and ideas that are not necessarily included in the guidelines. The Guide is also linked to the "Building Blocks" case study that is highlighted throughout the thesis so the findings can also be viewed through the lens of real-world applications.

Before venturing into the specifics of the data and the technologies at hand it is pivotal to clarify that "blockchain" as a term can cover – as was also described in Chapter 2- a wide array of different architectures, each with their own parameters and internal governance systems. Minute changes on the back-end code of a particular system can have considerable impact on how it handles personal data and, consequently, how it should be interpreted in the humanitarian context. Some characteristics such as "trustlessness" and "immutability" have been heralded as being intrinsic to the blockchain but they ultimately constitute design choices and not unmodifiable traits.[121] Throughout the next paragraphs an attempt will be made to take into consideration some different architectures of the technology to identify whether some provide a better fit in certain humanitarian circumstances than others. Bearing in mind, however, the constant evolution and innovation of such technologies it would be impossible to account for all conceivable modifications of a blockchain.

Does data stored on a DLT constitute personal data?

The entire attempt to evaluate blockchain as a tool for personal data protection would be void without first establishing that data stored in a decentralized manner actually constitutes personal data. The WFP Guide defines personal data as:

> *Personal data is any information relating to an individual that identifies the individual or can be used to identify them. – WFP Guide, p.2*

Which is concurrent with the GDPR's definition under Article 4 (1)[122]:

> ***personal data**' means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person;*

[121] Paul Nelson, 'Primer on Blockchain: How to Assess the Relevance of Distributed Ledger' [2018] US Agency for international Development 1 <https://www.usaid.gov/digital-development/digital-finance/blockchain-primer>.
[122] Regulation (EU) 2016/679 (GDPR) 2016 (Official Journal of the European Union).

These definitions have been drafted with traditional, centralized databases in mind and might not, at first glance, reflect the reality of fragmented and encrypted data stored on distributed ledgers. The name and address of a beneficiary would clearly constitute personal data in an Excel file on an agency's server; but is this the case with a 12-digit key scattered across several nodes? A closer look at the definitions of "identifiability" and "anonymization/pseudonymization" shows that the architecture of blockchain does not preclude that data stored on the chain is personal data.

In both the WFP's Guide and the GDPR, identifiability is part of the definition of personal data: "*can be used to identify*", "*identifiable*". When deploying a transaction-facilitating blockchain, such as the one used by WFP in "Building Blocks", every user has a key, a code used to identify them in the network. Even when this key is not public and not directly related to a certain individual it can still lead to the user's identification with the help of other pieces of data (name, time and location of transaction, transaction history etc.). Even in cases of zero-knowledge applications similar to the "smart contract" developed in the case of "Building Blocks", the identifiability of the data subject does not change. The CJEU has clearly stated in the "*Breyer v Germany*" case (regarding the identifiability of users of dynamic IP addresses) that an address linked to a computing device constitutes personal data even if the data relevant to identify that person is held by a third party.[123] In the present case study, not only does the WFP hold a record of all transactions in its permissioned ledger, but the UN is in possession of biometric data linked to the users of these devices. The answer to whether a refugee is identifiable in the system is therefore positive.

That being said, rules on data protection and privacy do not apply to anonymous data. Were all the different pieces of information on a certain individual to be anonymized, then compliance with stringent data protection rules would not be necessary. In fact, all information stored on a blockchain is encrypted, which is a core characteristic of the technology and not a design choice. Encryption however does not necessarily mean anonymization for the purposes of privacy compliance. The WFP Guide defines anonymizing as: "*Stripping or disguising information that could be used to identify an individual from a data set. Anonymizing is used to prevent identification of the individual either directly or by deduction.".*[124] The GDPR, in Recital 26, adds the notion of irreversibility to this definition : "*data rendered anonymous in such a way that the data subject is not or no longer identifiable*".[125] Anonymization is different from pseudonymization in that the latter allows for backwards identification with a key or additional piece of information while the former is an irreversible process that cannot

[123] M Ilešič and others, 'Breyer v Germany: JUDGMENT OF THE COURT (Second Chamber)' (*InfoCuria - Case-law of the Court of Justice*, 2016).
[124] WFP (n 125).
[125] Regulation (EU) 2016/679 (GDPR).

conceivably lead to the subject. The two terms differ not only in technical definition and scope but also in whether the data resulting from these methods is considered personal or not. Pseudonymized data is personal data while anonymous data is not. The particular encryption method used in blockchain technologies, called "hashing", has been unequivocally defined by the Article 29 Working Party as a pseudonymization technique, unable to rid a data controller of their obligations under data protection rules.[126] Having ascertained that the data stored on DLTs constitutes personal data the analysis can cover the principles of data protection.

Principle 1: Lawful and Fair Collection and Processing

> *WFP shall collect and process personal data by **lawful** and **fair** means with the **informed consent** of the beneficiary. – WFP Guide, p.18 (emphasis mine)*

The first principle documented in the WFP Guide reflects the most common obligations of data controllers under the law: lawful and fair processing and consent. Note that while other frameworks such as the GDPR contain more legal grounds for processing (contract, legal obligation, legitimate interests, vital interests, further processing) the WFP substantiates only consent as a valid ground for the collection and processing of personal data. This makes sense for the purposes of humanitarian assistance and is an ethically sound choice for the WFP mission. As far as lawfulness and fairness are concerned, the WFP follows the model of most UN agencies and international organizations in general referring to their mandate of ending world hunger to define the notions of fairness and lawfulness. These concepts are beyond the scope of the use of a new technological system and are intrinsically linked with WFP's internal governance.

"Informed consent" is a term positioned at the epicenter of data collection and processing irrespective of the particular nature of the activities of an organization. In their guidelines the WFP does not include a full definition of consent apart from listing that prior to giving her permission, a beneficiary should know the type of data collected, the purposes of collection, the parties accessing the data and a point of contact for communication of concerns.[127] In data protection legislation, however, the notion of informed consent has been codified as:

> *Consent should be given by a clear affirmative act establishing a freely given, specific, informed and unambiguous indication of the data subject's agreement to the processing of personal data relating to him or her, such as by a written statement, including by electronic means, or an oral statement*. – GDPR, Recital 32

[126] Article 29 Data Protection Working Party, 'Opinion 05/2014 on Anonymisation Techniques'.
[127] WFP (n 125).

With the further expansion by the Article 29 Working Party[128]:

> *Consent can only be valid if the data subject is able to exercise a real choice, and there is no risk of deception, intimidation, coercion or significant negative consequences if he/she does not consent.*

The circumstances under which consent of a beneficiary is acquired in humanitarian assistance projects can be complex and when deciding on the validity of that consent a series of factors regarding the vulnerability of an individual or group should be taken into consideration: technological literacy, location, environmental factors, health status, religious norms and the complexity of the data processing system to name a few.[129] Most international organizations, including the WFP and the Red Cross have extensive handbooks on how staff members should account for these vulnerabilities and have built systems of redress and monitoring that – in absence of proof to the contrary- should be considered adequate.

The use of blockchain, however, creates new parameters that should be openly discussed. First of all, a permission-less blockchain would virtually allow access to anyone that has a node to all data of transactions on that particular chain.[130] How can consent be given for a virtually infinite number of data processors is a question yet to be answered. Permissioned blockchains such as the one employed in "Building Blocks" are simpler in that regard since only a limited number of users have access to transaction data and user keys which are managed in a more centralized manner. Considering the phrase *"(no) … significant negative consequences"* as stated by the WP29, assessing a beneficiary's consent to the processing of their data asks for even further elaboration; not only for blockchain but for any newly implemented data system. When faced with the choice of either accepting an agency's request to migrate a subject's data to a new system that expedites aid disbursement or stay with a traditional distribution scheme that might be more susceptible to long queuing times, complicated paperwork or fraud, an argument that these drawbacks constitute "significant negative consequences" could be formulated. Especially in cases where resources are scarce, or the aid consists of food, medicine and sanitary supplies,

[128] Article 29 Working Party, 'Opinion 15/2011 on the Definition of Consent' 38 <http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2011/wp187_en.pdf>.
[129] Christopher Kuner and Massimo Marelli, 'Handbook on Data Protection in Humanitarian Action' [2017] Geneva: International Committee of the Red Cross 1 <https://shop.icrc.org/e-books/handbook-on-data-protection-in-humanitarian-action.html>.
[130] Lamport and others (n 45).

the duress of a beneficiary should be carefully noted and the staff should make sure that alternatives to data processing are not only adequate but also viable.

Humanitarian agencies have been at the forefront of systematic combat against human suffering for decades and their expertise to inform people and support them through technology should be constantly evaluated on the basis of the solutions in provides. Choices in the field can sometimes be overwhelmingly difficult considering time constraints and emergencies; therefore a certain degree of trust in the staff's good will should be granted in research. Hypothesizing that humanitarian agencies take all steps reasonably necessary to gain "informed consent" prior to collecting and processing a subject's data, there is still a question that has surprisingly not surfaced regarding blockchain applications and most agencies that employ the systems have not commented on: what about withdrawal of consent? The idea of granting a data controller permission to process personal data is necessarily linked with the ability to withdraw said permission whenever the subject deems fit, without having their motives questioned and without adverse consequence.[131] The WFP Guide as well as the ICRC Handbook on Data Protection both state that a beneficiary should be able to withdraw consent for processing, but are naturally drafted with centralized databases in mind. From GDPR Article 7(5):

> *The data subject shall have the right to withdraw his or her consent at any time. The withdrawal of consent shall not affect the lawfulness of processing based on consent before its withdrawal. Prior to giving consent, the data subject shall be informed thereof. It shall be as easy to withdraw as to give consent.*

The much heralded "immutability" of a blockchain, the same characteristic that makes it tamper-proof and anti-censorship might be an insurmountable obstacle for many principles of privacy and data protection, withdrawal of consent being one of them and, as will be analyzed further into the chapter, the right to access and the right to be forgotten.[132] Use cases of blockchain in the humanitarian sector are rife with descriptions of how participants to the programs were briefed on the merits of the technology and gave their consent for processing but, so far, it remains unclear what exactly is to happen should a beneficiary want to withdraw their consent.[133] In principle, withdrawal of consent is not retroactive, meaning that all processing that has taken place on the legal ground of consent up to the point of withdrawal are unaffected.[134] What would happen however if a refugee participating in "Building Blocks" for example, decides they do not want to receive aid in this manner anymore? If the program has achieved critical scale, with all refugees in a particular camp participating, and the beneficiary is used to having the

[131] Article 29 Working Party (n 133).
[132] Michèle Finck, 'Blockchains and Data Protection in the European Union' (2017) 18 Max Planck Institute for Innovation and Competition Research Paper 32.
[133] Coppi and Fast (n 18).
[134] Article 29 Working Party (n 133).

automatic application calculating their entitlements and the aid they receive on the ledger for a long time then it is safe to assume their well-being is now bound to the system. Even if the architecture is built in such a way that makes it legal for the withdrawal process to have some -reasonable- obstacles, this issue goes beyond legal compliance and into the realm of human dignity. In Taylor's views on data justice *"(dis)engagement with a technology"*, as the ability of people to autonomously decide the degree of involvement with a particular system and the free-choice of how their data is collected and processed is a pivotal pillar of the concept.[135]

The ICRC , in its Handbook on Data Protection for Humanitarian Action has recognized the shortcomings of obtaining informed and unambiguous consent from populations that are particularly vulnerable and in dire need of quick and effective assistance. Being physically incapable of gaining information or giving consent, to being part of a big population of violently displaced people or having no alternatives in the field for a specific type of aid that needs to be immediately distributed are some of the conditions that render consent ineffective.[136] In these situations, as the ICRC has accurately observed, a humanitarian agency should rely on different grounds for the processing, rather than on an incomplete form of consent. Best practice would be to base the collection and processing of data on "the vital interests of the subject" until the immediate danger is averted, and then provide a comprehensive layout of options when the population is stabilizing. While blockchain bolsters security, it is also a technology that can scale to permeate entire systems and supply-chains, creating a technological dependency too burdensome for people in need. Humanitarian agents need to take this into very careful consideration and make sure that individuals and groups are given authentically autonomous choices on systems: ones that represent their unique values and needs.

[135] Linnet Taylor, 'What Is Data Justice? The Case for Connecting Digital Rights and Freedoms Globally' (2017) July-Dec Big Data & Society 1.
[136] Kuner and Marelli (n 134).

Principle 2: Specified and Legitimate Purpose

> *WFP shall collect personal data only for specific, explicit and legitimate purposes and shall further process this in a way that is compatible with those purposes. If a secondary purpose arises that is not compatible with the originally-stated purpose, beneficiary consent must be obtained for this secondary purpose.* – WFP Guide, p.24

The principle of purpose limitation is one of the cornerstones of data protection and the WFP has also unambiguously included it in their guidelines. The principle is also codified in GDPR Article 5(1b):

> *(personal data shall be…) collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes; further processing for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes shall, in accordance with Article 89(1), not be considered to be incompatible with the initial purposes ('purpose limitation');*

The purposes of processing for humanitarian action are quite common among different organizations and always linked to a certain degree with the mission of each. While this is a solid safeguard at first glance, the sweeping escalation of big data analytics creates an uncertain ground especially in regards to further processing or "secondary purposes".[137] Big data analytics are defined by the goal of maximizing the volume of data sets, not only through collection of new data but also by merging different data sets. In the "Building Blocks" example, the biometric identification data of BIMS is combined with the transaction data and public keys of the users of the Ethereum platform, allowing analytic algorithms to draw conclusions on groups and individuals based on numerous different characteristics.[138] This could pose great threats to one of the pillars of the data justice framework: nondiscrimination.[139] Allowing automated decision making for the profiling of beneficiaries infringes on one's individual freedom not to be discriminated against and also raises an impenetrable barrier for challenging these machine-driven conclusions.

Blockchain in that regard introduces capabilities that can be very promising when put to good use, especially with the additional layer of "smart contracts". The cryptographic nature of the technology in combination with the automated decision making of applications (such as cash disbursements and identification) can greatly limit the processing activities an entity can make with the data sets it has, even

[137] Arora (n 120).
[138] Coppi and Fast (n 18).
[139] Taylor (n 140).

if they fall under the definition of big data.[140] Referring again to the "Building Blocks" case, all data that is stored on the chain is encrypted, despite being personal data.[141] Should the WFP only use the biometric data it acquired from UN BIMS for the purpose of verifying user identities in a zero-knowledge, proof of concept system (as they currently do according to their papers) then the principle of purpose limitation is met. The organization would not be able to have access to the data itself, or perform analytics on the data that is on chain, apart from ensuring that the algorithms it has built give the correct yes/no answer whenever a beneficiary seeks to collect aid.[142] That is also a very important innovation when working with external partners or third parties. In a traditional database an organization would have to grant access to the data to a third party in order for the latter to be able to build its system on top. In the case of blockchain applications, in particular permissioned ledgers, simply granting a node to another humanitarian entity would not disclose any data in itself, but rather a series of intertwining encrypted values.[143] Permissioned DLTs might have architectural characteristics that curb the inevitable profiling of big data analysis and reignite the essence of purpose limitation in a continuously data-driven environment.

Principles 3 & 4: Data Quality / Participation and Accountability

> **Principle 3: Data Quality**: *WFP shall ensure that personal data sought and obtained is adequate, relevant and not excessive in relation to the specified purpose(s) of data collection and data processing. WFP shall take all reasonable steps to ensure that personal data is accurate and up-to-date.* -WFP Guide, p.25

> **Principle 4: Participation and Accountability:** *WFP shall ensure that beneficiaries are consulted about the processing of their personal data, before and during all stages of such processing. Beneficiaries shall be enabled to access, verify, correct, update and erase their personal data. WFP shall ensure confidentiality of beneficiary personal information and shall take appropriate actions in the event of a data breach.* – WFP Guide, p. 28

These two principles will be examined jointly because the values they codify are deeply interrelated. The principle of data quality in the WFP's text represents the principles of data accuracy and data minimization. The principle of participation and accountability represents the right to access, the right to

[140] Finck (n 137).
[141] Kosba and others (n 83).
[142] ibid.
[143] Coppi and Fast (n 18).

amend and the right to be forgotten. Effectively allowing beneficiaries to exercise their right to access, amend and erase in a transparent manner would be void without the overarching principle of data accuracy and vice versa. The enforcement of these rights can be quite simple in centralized databases and there have been many cases, even before the entry-into-force of the GDPR, where they have been successfully exercised.[144] In systems based on blockchain however some of these rights are not only much more difficult to effectively apply but, under certain circumstances, might be entirely contradictory to the very architecture of the technology.[145]

Data minimization

From GDPR Article 5(1c):

> (personal data shall be:) *adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed ('data minimisation')*

Also linked to the phrase "*not excessive"* in the WFP Guide, the principle of data minimization is not a particularly new concept in the realm of data protection. It is mentioned throughout legal texts as a prerequisite for the lawfulness of processing. It does not only cover the obligation of a data controller to collect only the data that is strictly necessary but also to **delete data when it is no longer necessary for the specified purpose it was collected for.** As explained under "Informed Consent" any subsequent uses of the data would require either a new declaration of consent or a new legal ground to be valid.[146]

The very essence of data minimization is at odds with DLT storage. Distributed ledgers are by definition "ever-growing chains" which perpetually accumulate data to ameliorate their dependability with each additional block.[147] Not only is the architecture of the technology contradicting this principle but the incentive for building a blockchain is also to get as many participants as possible, especially in public blockchains.[148] In certain cases, mainly those that track transactional data like the "Building Blocks" project, some solutions have been theorized but seem still far on the horizon. Migrating past transaction on an off-chain database without affecting the reliability of the blockchain and the live capabilities might

[144] Andrej Zwitter and Mathilde Boisse-Despiaux, 'Blockchain for Humanitarian Action and Development Aid' (2018) 3 Journal of International Humanitarian Action.
[145] Finck (n 137).
[146] Article 29 Working Party, 'Opinion 03 / 2013 on Purpose Limitation' [2013] Weisungen, Guidelines etc 1.
[147] Fatima Arkin, 'What You Need to Know about Blockchain in 2018 | Devex' (*Devex*, 2018) <https://www.devex.com/news/what-you-need-to-know-about-blockchain-in-2018-93007>.
[148] ibid.

be technically possible but it appears like a minute modification in a system that is predominantly non-compliant.[149]

Data Accuracy, the Right to Access, the Right to Amend and the Right to be Forgotten

From GDPR Article 5(1d):

> (personal data shall be:) *accurate and, where necessary, kept up to date; every reasonable step must be taken to ensure that personal data that are inaccurate, having regard to the purposes for which they are processed, are erased or rectified without delay ('accuracy')*.

and Article 16:

> *The data subject shall have the right to obtain from the controller without undue delay the rectification of inaccurate personal data concerning him or her. Taking into account the purposes of the processing, the data subject shall have the right to have incomplete personal data completed, including by means of providing a supplementary statement.*

As far as the principle of data accuracy is concerned, a DLT inarguably provides strong guarantees that data cannot be modified.[150] In the case of third-party partnerships or intermediaries in humanitarian assistance, where the tampering of databases has been a long-standing concern, this is a very important step towards fairness and transparency as also explained in the previous chapter. A blockchain can ensure that a beneficiary's data, whether inbound or outbound, will be shared among partners and entities in the exact same way it was recorded, nullifying chances of fraud and clerical errors.[151] Still, information that is accurate at the moment of collection will not necessarily be relevant forever.

Unfortunately, this inability for modification is absolute, barring even the proprietors of their own personal data from any rectification.[152] This is clearly problematic and is another point where the immutability of a blockchain becomes a hurdle instead of an advantage. Evidently, this limitation also applies to the right to erasure, or the right to be forgotten as it is oftentimes cited in literature. Certain blockchains allow for additional blocks to be added on top of the existing ones, perhaps falling under the scope of the "supplementary statement" of Article 16.[153] Legal frameworks, as well as humanitarian

[149] Michel Rauchs and others, *Distributed Ledger Technology Systems: A Conceptual Framework* (University of Cambridge 2018).
[150] Nelson (n 126).
[151] Rauchs and others (n 154).
[152] Finck (n 137).
[153] ibid.

agency guides always refer to the state of the art: modification and erasure should be technologically neutral as concepts and their interpretation shall take into account the particularities of the technology employed. Erasure is still out of the picture for blockchains as they were specifically designed to be tamper-resistant. Public blockchains also pose the problem of data being fragmented among multiple nodes, oftentimes in numerous jurisdictions, a fact which, combined with the encrypted nature of the data, creates a digital environment where neither the data subject can possibly know who exactly has pieces of the data, nor can the controller of the node know whose data they have.[154] Permissioned blockchains might fare better in this regard as it is may not be entirely impossible for the entity/ies controlling the nodes to make a copy of certain blocks, hand them over to the data subject and then completely anonymize their content leaving only the binary trace that the block was there and its information was valid.

Apart from the detailed technicalities of whether some modifications of the system can lead to legally compliant solutions it is once again important to highlight the uniqueness of beneficiary data in this regard. Having the personal data she has shared as a recipient of aid amended or erased, to fit her new profile or new life is a paramount indication of autonomy and freedom for a current or past beneficiary.[155] Following again the conceptual framework of data justice, the notion of (in)visibility is intrinsically linked with human dignity, the ability to be continuously represented in a manner congruent with one's personal needs and goals; both in people and in data sets.[156] Blockchain in that regard, and especially applications linked to identification seem to trade this autonomy for efficiency and immutable accuracy. Even with more traditional technologies, the stance that opting-out from aid should be discouraged because the benefits of performance outweigh matters of individual personality is widely adopted.[157] The heralded quality of blockchain as a system that maintains records perpetually without room for modification only solidifies this belief. One does not need to wear the foreboding lens of post-modern philosophy to recognize the potential birth of a "caring" panopticon: an endless, immutable record maintaining itself with the promise of future prosperity.

[154] ibid.
[155] Anaya-Arenas, Ruiz and Renaud (n 113).
[156] Taylor (n 140).
[157] Kuner and Marelli (n 134).

Principle 5: Security

> *WFP shall continue to implement appropriate physical, organizational and technological security measures to protect personal data against accidental loss and/or damage, unauthorized access, disclosure, modification and destruction, and to ensure continuous availability of WFP's application programs and data.*

Related to GDPR Article 5(1f):

> *(personal data shall be…) processed in a manner that ensures appropriate security of the personal data, including protection against unauthorized or unlawful processing and against accidental loss, destruction or damage, using appropriate technical or organizational measures ('integrity and confidentiality').*

The legal obligation to ensure the integrity of a subject's data needs no introduction as it is a fundamental pillar upon which the rest of the obligations are essentially built. Distributed ledger databases boast a level of security that, in the current state of the art, seems to be second to none. Blockchain features two very substantial characteristics that make a data breach almost impossible compared to traditional databases. First, the database itself has a physical infrastructure wildly different from any centrally-operated database. A considerable number of hacking attacks exploit a vulnerability of the physical server, exposing the system to malware that can take control of data or source-code in a real-world data center.[158] A DLT is comprised of the processing power of many different devices, across networks and platforms. The second characteristic is intrinsically linked to the first and is essentially the lack of a single target for an attacker who would seek to expose the system remotely. The data of a blockchain is not centrally managed, meaning that a third party does not have an actual network or server whose defenses they need to bypass.[159]

That being said, at the beginning of the rise of Ethereum there was an exploit achieved by an individual which became known as the "DAO hack". In 2016, DAOs (short for distributed autonomous organizations) became some of the first governance mechanisms that functioned through "smart-contracts".[160] The most popular among them, simply named "the DAO" was a virtual venture capital fund that was governed through a blockchain by its investors. Shortly after it went live, a single entity on the

[158] Yli-Huumo and others (n 22).
[159] ibid.
[160] Lubin, Anderson and Thomason (n 21).

chain allegedly retrieved 3.6 million Ether from the DAO by abusing a coding loophole known as a "recursive call exploit". Not to delve into details of technical nature, it soon turned out that the hack was the result of a design flaw rather than hacking ingenuity. The creators of the chain had designed a back-door on the system to ensure that majority stockholders would not oppress the minority, allowing for return of the funds in case the minority made an objection to traded stocks within a week of an investment.[161] The hacker simply found the back-door. The DAO hack has been used as an argument against the security of Ethereum blockchains, while it should be interpreted as a testament to the self-destructive tendencies of corporate avarice.

Even without all its add-ons and functionalities, a dry-hull DLT application used for storage of data seems to be the best available option for beneficiary data especially for sensitive data-sets such as the biometrics collected on the BIMS platform. The security guarantees of a blockchain and its innately cryptographic architecture allows for near-immunity to unauthorized access and a very high standard of data integrity.

[161] Osman Güçlütürk, 'The DAO Hack Explained: Unfortunate Take-off of Smart Contracts' <https://medium.com/@ogucluturk/the-dao-hack-explained-unfortunate-take-off-of-smart-contracts-2bd8c8db3562> accessed 16 May 2019.

Conclusion

A disclaimer that is absolutely necessary at this point is that despite its discouraged tone at many observations within, this thesis is by no means meant to disparage the gargantuan endeavors and contributions of humanitarian agencies towards a more equal, visible and just world. The past two decades have been abundant with innovation in the humanitarian sector and the standard of living in the developing world has been observed higher than ever before. Despite their potential drawbacks and pitfalls, new technologies have indeed enabled people to receive aid in unprecedented volume and efficacy. Blockchain projects for social and humanitarian purposes are still in their very early stages, with 34% having been started in 2017 or later and 74% being still in the pilot stage. 55% of these initiatives are estimated to have a demonstratable impact for beneficiaries within 2019.[162] In the theoretical analysis and the case studies carried out in the thesis it seems that even in this very early stage, blockchain technology can indeed promote procedural fairness in certain links of the humanitarian supply chain; specifically donation visibility, logistics, registration of beneficiaries and monitoring of projects. Whether the new technology can provide long-lasting solutions to the core causes of non-transparency and corruption however, remains to be seen.

Blockchain itself has architectural capabilities which could change the way we interact with data and with each other. The vision of a public ledger where everyone is the owner of their own digital identity is currently central in building models for decentralized governance. The example of Estonia is at the forefront of this futuristic vision: the government has made available 99% of its services through e-Estonia, a system that guarantees security and accessibility through DLTs.[163] This proves that the systematic adoption of the technology at scale can have sizeable and lasting impact for the people involved.

The research contained in this thesis is not without limitations. Firstly, the analysis of the impact of blockchain on fairness in humanitarian aid was largely based on conceptual frameworks and might not reflect the nuances of complex aid-disbursement operations. Academics should work together with international agencies to gather primary data from beneficiaries and staff in order to build a more complete understanding of the effects of the technology in the field. The results should be used to compile real world models of "when, where, who and how exactly?" a certain technology can be exploited to the fullest benefit of vulnerable populations. Secondly, despite best efforts to comprehend and illustrate DLT technologies and "smart – contracts", this thesis does not represent the assessments of a technical expert.

[162] Doug Galen and others, 'Social Impact - Moving Beyond the Hype Blockchain' (2018) 1 Blockchain for Global Impact 1 <https://www.gsb.stanford.edu/sites/gsb/files/publication-pdf/study-blockchain-impact-moving-beyond-hype.pdf>.
[163] ibid.

A fully-fledged multidisciplinary approach in the future should definitely include academics with detailed knowledge on the architecture and capabilities of blockchain so that the discussion can be systematically narrowed down to specific design choices that are uniquely fitted to the needs of humanitarian aid. An overarching limitation that has been mentioned throughout the thesis is the nascent stage of the technology and the lack of a sizeable body of literature from which to draw reliable information. It is certain that with the expanding popularity of blockchain in the aid sector future researchers will have access to a much larger volume of material and be able to extrapolate more complex links between technology and the well-being of beneficiaries.

This thesis should be viewed as a prompt for open collaboration and pluralistic decision making. Instead of working individually on their own projects under “black box” conditions, humanitarian agencies and NGOs should be holding public discussions in sharing best practices, future plans and solutions to long lasting issues. It is inevitable that new technologies will bring forth impasses that are difficult to predict and being silent about the obvious obstacles that lie ahead only contributes to a culture of “data silos” where each organization is alone in both the development of its programs and the facing of their unintended consequences.

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