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Research Article

Drivers and Barriers for Using Blockchain Technology to Create a Global Fact-Checking Database

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ABSTRACT

A core concept within journalism is the demand for correctness and the ability to double-check news and its sources (Kovach & Rosenstiel, 2014). In this paper, we reflect on the development of a prototype to study the possible use of blockchain technology to create a global secure database of fact-checks that is open to the public. The prototype utilized Hyperledger fabric to create a permissioned blockchain that stores fact-checks created by its users. Through automated processes using smart contracts (chain code applications), we aimed to create a solution that would improve the reliability of fact-checking and keep track of each fact-checking process for digital content, including pictures and videos.

Our conclusion is that it is indeed possible to create a blockchain-based system that allows the establishment of a network of fact-checkers that could collectively build and maintain a globally accessible fact-checking database. However, based on technical developments and the evaluation performed by the professional fact-checkers and data journalists in our study, we conclude that the cost, complexity, and rapid technological changes required in this domain indicate that blockchain technology is not yet ready to be directly applied to fact-checking processes in a real-world scenario.

Keywords: blockchain technology, fact-checking, digital media, journalism, verification

INTRODUCTION: THE IMPORTANCE OF FACT-CHECKING

In today's society, where the flow of information is relentless, fact-checking and verification of news have gained greater significance, especially over the past two decades. A core concept within journalism is the demand for correctness and the ability to double-check news and its sources. In the book *Elements of Journalism*, Kovach and Rosenstiel (2014) argue that verification of facts is the core element of journalism and verification is what makes journalism different from other media work or fiction.

However, verification and fact-checking in journalism are challenged by the demand for greater speed to publication on digital platforms, which in turn might lead to less time to prioritize proper verification processes. Fact-checkers are also challenged by numerous disinformation campaigns circulating through user-generated content on social media (Marwick & Lewis, 2017). Consequently, new methods are needed to safeguard the very core of journalistic professionalism. Fact-checkers need to enhance their methods to become more effective and reliable in order to swiftly limit the spread of disinformation online.

Research on the elections in India, for example, has found that WhatsApp was used widely to propagate false information during critical electoral processes (Resende et al., 2019). This trend was naturally met with an increase in fact-checking efforts. However, the response was mainly in the form of an increase in the

number of isolated fact-checking organizations that generally worked independently from each other and did not share or promote each other's day-to-day findings about claims and sources.

This lack of coordination when publishing fact-checks leads to fragmentation, redundancy, and inefficiency. It also means that, for their fact-checks to have any impact, fact-checkers have to actively expand their reach and compete for space in popular media. Fact-checking organizations that are not affiliated with media outlets or have limited distribution channels would therefore be at a disadvantage.

In this article, we describe, evaluate, and analyze a project conducted in Sweden in 2019 and 2020. The project was entitled source-labeled journalism (SLJ) and utilized *blockchain technology* to create a prototype that had the potential of creating a global database of fact-checks through a decentralized network of fact-checkers and media organizations that collaborated together in efficient ways.

The SLJ was a follow-up project to the fact-check assistant (FCA) project that was developed in 2018 and 2019 (as described in Picha Edwardsson et al., 2021). One of the goals of the FCA project was to explore whether it was possible to build a reliable, secure global database that fact-checkers around the world could build and maintain together without the requirement of a central authority. Upon exploring the different technological solutions, the FCA development team pursued SLJ as a follow-up project, utilizing blockchain to create a prototype that was tested by a panel of professional fact-checkers and data journalists in Sweden, France, and the United States.

The purpose of this paper is to describe, evaluate and analyze the process and findings of the project and answer the research question about whether blockchain technology can possibly enhance the process of fact-checking to better confront the increased proliferation of disinformation online, and what the drivers and barriers are for using blockchain technology to create a global fact-checking database.

BACKGROUND

Fact-Checking in the Journalistic Process

The importance of fact-checking in journalism is constantly growing and has developed into a new genre in news journalism, both within established news organizations and in separate entities such as PolitiFact in the US and Faktiskt.no in Norway (Graves, 2016). The difference between fact-checking and verification, however, is that fact-checking is the process of assessing the validity of claims when they have been published through some form of media, while verification is usually done by the journalist before the publication (cf. Allern, 2019; Wardle, 2018).

Occasionally, political fact-checking and digital content verification overlap, particularly when content circulates in social media. This leads to a demand for technical digital content verification experts and traditional political fact-checkers to work more collaboratively (International Fact-Checking Network, 2020).

Verification is a difficult research field to study, however, and studies show that there is a lack of consensus on how to verify (Hermida, 2015). Journalists often struggle with conflicting values, where the digitalized media landscape has imposed greater demands on speed while at the same time demanding that the facts that are published be verified. Sometimes, as in live-reporting, verification is even done in collaboration with the audience. Thus, facts become less fixed and more fluid (Hermida, 2015).

Many journalists also struggle with increased pressure in their daily work, as they have to produce more content for multiple platforms, which leads to reduced time for critical investigation and verification (Witschge & Nygren, 2009). The ideal of producing accurate content is challenged by the news practices where verification becomes part of the publishing process and not the writing process (cf. Widholm, 2016).

Consequently, we argue that journalists today need better tools for both verification and fact-checking in order to save time and secure more accurate fact-checks. Better fact-checks, in turn, could have a positive impact on the general public's attitude and trust in media, which we also aim to discuss in this study.

Blockchain Technology

Blockchain technology was originally invented by the anonymous developer going under the pseudonym Satoshi Nakamoto who introduced the Bitcoin protocol in a paper entitled *Bitcoin: A peer-to-peer electronic*

cash system (Nakamoto, 2008). Blockchain can be described as a digital network built on top of the Internet to create and maintain a decentralized digital ledger of transactions by individual members of the network to exchange anything of value, including electronic cash, without the need for a central authority, such as a bank or an exchange.

Blockchain uses sophisticated cryptography and incentive mechanisms to ensure the immutability and security of data while simultaneously motivating new members to join to benefit from the financial incentives it has to offer. The idea that no central authority controls the data or ensures consistency is a paradigm shift in the field of digital financing and value sharing online, and it has the potential of changing society in many ways (Al-Saqaf & Seidler, 2017). One of the areas in which blockchain could have a direct impact is tracking provenance and securing factual information, such as database entries of an encyclopedia or records of events.

While blockchain initially emerged from the use of bitcoin as a publicly accessible network that anyone can join without permission, the principles of the technology were adapted to projects that require permission to join, resulting in what is called private and permissioned blockchains. Consequently, a blockchain that requires permission to join is an antithesis of public permissionless blockchains. Additionally, such blockchains suffer from several technical limitations compared to public blockchains (Vukolić, 2017). However, the level of added security that the technology brings to closed networks makes it an appealing choice for experimentation by major global companies around the world for many different uses, such as in the domain of food supply chain traceability (Duan et al., 2020), storing real estate records (Veuger, 2018) and protecting intellectual property rights (Wang et al., 2019).

In the case of food supply chain traceability, the purpose of using blockchain technology is to improve sustainable food supply chain management, thereby preventing people from getting sick from eating contaminated food. According to Duan et al. (2020), blockchain technology could help improve food traceability, information transparency, and recall efficiency. However, the authors also propose five potential challenges, including "lack of deeper understanding of blockchain, technology difficulties, raw data manipulation, difficulties of getting all stakeholders on board, and the deficiency of regulations" (Duan et al., 2020).

Also, Veuger (2018) claims that storing real estate records using blockchain technology has its challenges. He argues that the relationship between blockchain and real estate has not yet been proven in practice, but it is expected to develop further in the form of registering transaction processes and the DNA passport of a real estate object. According to Veuger (2018), "completeness and transparency are the basic ingredients for trust in the system."

Finally, Wang et al. (2019) argue that blockchain technology could be a viable option for protecting intellectual property rights. They claim that "the application of blockchain technology to the field of intellectual property stems from the time-stamping feature of blockchain technology". Furthermore, they argue that even though blockchain has not been used in practical applications yet, this would be conducive to the development of blockchain in relation to copyright protection (Wang et al., 2019).

In this article, we present the development process of a prototype that was built to demonstrate the potential application of a Hyperledger-based permissioned blockchain. The aim was to create and preserve a shared record of fact-checks produced by journalists and fact-checking organizations in return for financial incentives issued in the form of virtual tokens through a mutually beneficial system built around what is often referred to as *cryptoeconomics*. In the methodology section of this paper, we provide a description of the process used by the system and implemented in the prototype.

Development and Diffusion of New Technology

The implications of emerging technologies on journalism are the focus in a wide field of research, and the discourse of technological innovations in media is often dominated by an optimistic view on the role of technology in relation to the development of journalism (cf. Steensen, 2011).

However, research shows that many media companies have been rather slow in utilizing the potential that new technologies offer (Lassila-Merisalo, 2016; Steensen, 2011). Journalists are usually positive to "changes that they believe increase the quality of journalism and are consistent with existing norms and values, while

they resist changes they see as disruptive of journalistic autonomy, damaging to the news product, and communicated poorly by the company leadership", according to Ekdale et al. (2015, p. 939).

Furthermore, journalists in general are reluctant to adopt innovative technical solutions if they view them as a threat to their professional autonomy. At the same time, journalists may choose to adopt new solutions that they perceive will strengthen their autonomy (cf. Deuze, 2007, p. 157; Nygren, 2015, p. 138; Waisbord, 2013).

Other factors determine if digital innovations are successful in newsrooms; for example, the newsroom work culture and how open it is to innovations in general, management support for journalist training and conditions that would facilitate successful implementation, the irrelevance of new technologies, and the absence of innovative individuals all influence the success of digital innovations (cf. Maiden et al., 2019, p. 223; Steensen, 2009).

It is thus interesting to reflect on what factors determine if an innovation is viewed as irrelevant or possible to adopt. Rogers (2003) defines *diffusion* as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 35). He argues that "diffusion is a kind of *social change*, defined as the process by which alternation occurs in the structure and function of a social system" (Rogers, 2003, p. 6). Rogers (2003) distinguishes between three main types of innovation-decisions:

1. *Optional innovation-decisions*, choices to adopt or reject an innovation that are made by an individual independent of the decisions of other members of a system,
2. *Collective innovation-decisions,* choices to adopt or reject an innovation that are made by consensus among the members of a system, and
3. *Authority innovation-decisions*, choices to adopt or reject an innovation that are made by relatively few individuals (in a system) who possess power, status, or technical expertise.

Furthermore, Rogers (2003) describes five innovation attributes, which are useful for understanding why some ideas diffuse more easily than others. These attributes are, as follows:

1. *Relative advantage,* which is "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 229).
2. *Compatibility,* which is "the degree to which innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopter" (Rogers, 2003, p. 240). Compatibility can help the individual give meaning to the new ideas, so they are regarded as more familiar. "An innovation can be compatible or incompatible with (i) sociocultural values and beliefs, (ii) previously introduced ideas, and/or (iii) client needs for the innovation" (Rogers, 2003, p. 240).
3. The *complexity* of an innovation is the degree to which an innovation is perceived as relatively difficult to understand and use. According to Rogers (2013, p. 257), the complexity "is negatively related to its rate of adoption."
4. *Trialability* is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried easily are generally adopted more rapidly than others (Rogers, 2003, p. 258).
5. *Observability* is the degree to which the results of an innovation are visible to others. Some ideas are easily observed and communicated to other people, whereas other innovations are not (Rogers, 2003, p. 258).

As noted by several critics and Rogers (2003) himself, the diffusion of innovation theory is not without limitations. One such limitation is that the theory has a pro-innovation bias, implying that innovations are desirable and should be adopted quickly and without modification (Ekdale et al., 2015; Rogers, 2003). This is interesting in view of Steensen's (2011) conclusions regarding the discourse of technological innovations in media, which is dominated by an optimistic view on the role of technology in relation to the development of journalism. Despite this limitation, we have decided to use the diffusion of innovation theory in our study to discuss and explain our research findings.

Social Construction of Technology

As the aim of our project was to develop a prototype with the potential to create a global database of fact-checks through a decentralized network of fact-checkers and media organizations, we adopt the theory of social construction of technology, meaning that socio-technological objects and technologies operate beyond the editorial department (Royal, 2020; Westlund & Lewis, 2014). We argue that social action is a central element in technological development and there is a "spectrum of possible technological choices, alternatives and branching points" (Winner, 1993, p. 366).

The fundamental argument of social construction of technology is that human action shapes technology (Pinch & Bijker, 1984), and this is an alternative to deterministic views on the development of technology (Williams & Edge, 1996). Social construction of technology in a digital realm views users as technological change agents (van Baalen et al., 2016). Multiple groups of users adopt, apply, and share the meanings of the technology and define the trajectory of the technology development (Klein & Kleinman, 2002). Thus, the development and use of technology is embedded in its social context, which is interesting to reflect on in view of our research results.

METHOD

In this article, we describe, evaluate, and analyze the SLJ project conducted in Sweden in 2019 and 2020. The project utilized *blockchain technology* to create a prototype that had the potential of creating a global database of fact-checks through a decentralized network of fact-checkers and media organizations that collaborated together in efficient ways. The SLJ was a follow-up project to the FCA project that was developed in 2018 and 2019 (described in Picha Edwardsson et al., 2021).

We pursued a novel research project to examine whether blockchain technology could facilitate the process of fact-checking and make it more reliable and secure. The project resulted in the development of an application prototype using a Hyperledger fabric-based private and permissioned blockchain. By creating automated processes executed through smart contracts (chain code applications), we aimed to create a potential solution that would improve the reliability of fact-checking by keeping track of each fact-check of digital content, including pictures and videos.

The Hyperledger fabric blockchain environment was chosen for adaptation beyond financial transactions, and it is available as an open-source project in continuous development. Since distributed ledgers have different requirements depending on the use case, the use case for the project was thoroughly analyzed. This analysis started by defining the fact-checking process, and the involved groups included fact-checkers, media companies and fact-checking service administrators.

The assumption here is that, in order for the permissioned environment to work by enabling a swift consensus algorithm, there must be a high level of trust between these three groups. This is weighed against the other option of using a public permissionless blockchain, such as Bitcoin or Ethereum, which does not require trust between participants but adds delays and costs that could be unpredictable. The research culminated in the development of a logical flow process and algorithm that could then be implemented in coding in a development environment that would use Google Go's programming language, JavaScript, and the Ruby on Rails development framework.

The project to build the SLJ blockchain prototype went through a number of stages as shown here:

1. September 2019: Preliminary research and consultations.
2. December 2019: Development of the Hyperledger code and setup to run the prototype.
3. June 2020: Integration of the FCA and development of an API.
4. September 2020: Expansion of blockchain with new members.
5. December 2020: Testing, evaluation, and optimization of the prototype.

How the SLJ System Works

The prototype was built in such a way that the nodes are the fact-checkers themselves. This allows them to collaborate, enhance the quality of their fact-checks, and achieve greater efficiency. The system requires three groups of users to register, as follows.

Media

The first user group consists of persons who are confronted by claims that need to be fact-checked. The group could for example consist of editors in a newspaper or television newsroom. In the SLJ system, we call this group *media*. For example, let's say that a news media company has come across a viral video of a high-profile politician or celebrity engaged in an act of corruption. Since it is crucial to get the story straight before publishing any news about the video, editors in the media company would register on the SLJ platform and call upon fact-checkers around the world to verify or falsify the video. Media would offer to pay a reward through the blockchain token reward system to those fact-checkers who succeed in fact-checking the claim review given a particular timeframe.

Fact-checkers

The second group in the SLJ system is the *fact-checkers*. Those who register as fact-checkers are notified promptly of the need to fact-check the particular video in the described example. They then conduct fact-checks using the FCA tool, come up with a finding, and describe how they arrived at this finding. For the sake of argument, the video was found to be fake using some of the tools accessible via the FCA. The fact-checker subsequently proceeds to mark the claim as false and provide concrete evidence.

Reviewers

The third group of users is the *reviewers*, who are experts in the field of fact-checking. Typically, they would be veteran journalists, editors, or directors of fact-checking organizations. Their role is to carefully review the process fact-checkers used to arrive at a particular conclusion regarding the claim.

If the reviewers are able to verify the fact-check of a claim or a video using the appropriate tools or methods, they approve it and the reward is automatically split between the fact-checkers and reviewers, preliminarily with 80% of the reward going to the fact-checkers and 20% to the reviewers. If multiple fact-checkers succeed in accurately verifying the validity of the claim, they will split 80% of the reward evenly among them. Fact-checkers who fail to be specific and meet the criteria of the fact-check, and consequently have their fact-checks rejected, will have this failure added to their reputation record. This is meant to incentivize fact-checkers to be prompt but equally diligent when doing the fact-checks.

Once the fact-checks are approved by the reviewers and the rewards distributed, the fact-check becomes a permanent part of the global database. This database can be accessed through an API of any of the websites affiliated with the members of the system. For example, media companies that published a report based on a fact-check could link directly to the API through their website to get the details of how the claim was verified. The overall logic and flow of the process is demonstrated in **Figure 1**.

The Evaluation Process of the Prototype

The first time the prototype was publicly unveiled was during the Global Fact 7 Summit organized online in June 2020. A special workshop to introduce the prototype was put on the agenda of the event, and twenty-eight attendees from twelve countries joined.

In order to evaluate the prototype, we invited the attendees of the workshop to a follow-up testing session to experience the prototype hands on. This had to be done virtually due to the COVID-19 pandemic. Only six of the attendees participated in the evaluation: four from Sweden, one from France, and one from the United States. The participants included both professional fact-checkers and data journalists. Each of them was provided with a video link showing how the prototype is used and asked to simulate the experience of members of different groups, i.e., the media, fact-checkers, and reviewers.

Since the prototype utilizes FCA as the main building block, the feedback on the usability and effectiveness of the tool was obtained through a questionnaire (provided in the **Appendix A**) that the participants were

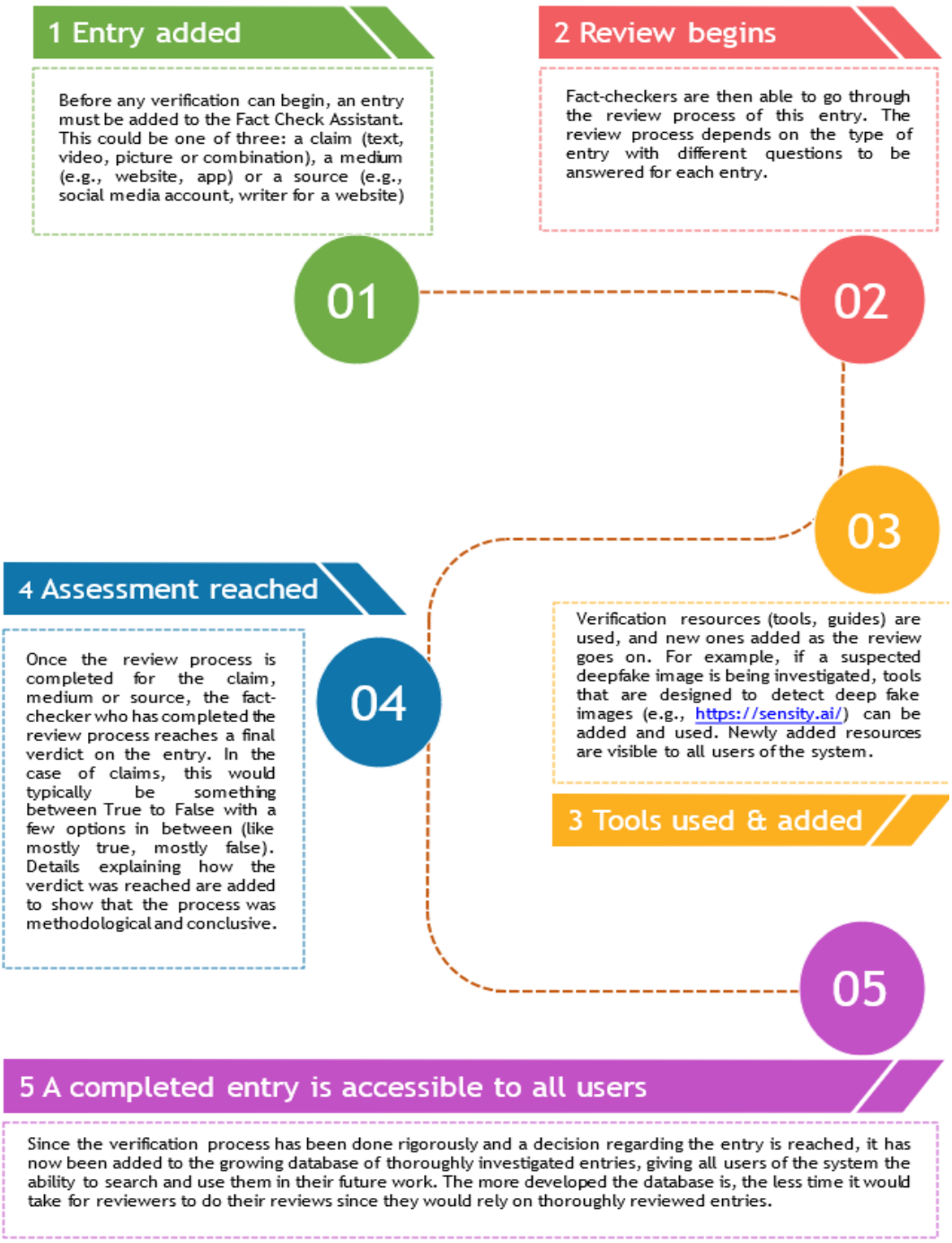

Figure 1. The process of creating fact-check entries in the SLJ system

asked to answer after testing the prototype. The main question that each respondent had to answer was whether implementing blockchain technology into fact-checking, as in the FCA, serves a useful purpose for them. The participants' comments were collected and analyzed with the aim of discerning and organizing emerging patterns and themes in their answers in relation to our research question, which is an analysis method described by McCracken (1988).

RESULTS

The results of this research project could be divided into two parts. The first revolves around reflections on the actual technical implementation of the prototype itself, and the second is based on the feedback received from the participants who tested the prototype.

Reflections on the Technical Implementation

During the coding process, we discovered that running the blockchain was highly complex and resource intensive. Consequently, the ultimate objective of creating a decentralized fact-checking service ought to be valuable to such a degree that the complexity and resource use makes it justifiable. This raised the question of whether it would be viable for SLJ members to install and maintain their blockchain node despite the high cost of doing so, especially if they were not fully equipped with the necessary technical know-how.

The prototype's implementation was completed, and the prototype's code uploaded to the open-source repository GitHub. The challenge was to see not only whether it could be taken and used but also if it could be scaled and expanded efficiently, which was not possible to explore at this stage since it required having the technology installed on many different servers to create a blockchain consortium.

The cost, complexity and the frequent code-breaking changes associated with developing the prototype resulted in the conclusion that it is perhaps not yet time to deploy the prototype in a real-world scenario unless it is in a purely experimental fashion and the consortium members are willing to take the risk to test it on their own servers.

The original idea was to see if this could be done, with the working prototype as a proof of concept, and this has theoretically been proven. However, there is a high cost associated with such a decentralized system and it is difficult to maintain, even though this ultimately can only be proven by actually implementing the step. There may well be extremely valuable outcomes from this system for sustaining fact-checking missions and improving the quality of verification, but it would be necessary to build a complete ecosystem that appreciates, understands, and tolerates the risk of blockchain technology since it is still in the development stage and has not yet reached mainstream acceptance. Unfortunately, this project was not able to go this far.

Summary of the Evaluation by the Test Participants

The evaluation by the test participants showed that many of them found the tool easy to use, but at the same time it seemed to lack an interesting design. The prototype appeared to make a scientific impression, which sometimes felt intimidating to the participants. The main problem seemed to be that the fact-checking process required so many steps. The participants complained about all the clicks, saying this was time-consuming. The threshold was too high when it came to starting the fact-checking process. In the evaluation, they asked if the user interface could become easier, more gamified or in some other way simpler and more straightforward.

The complexity of the fact-checking tool is a hard problem to solve since this complexity is necessary in order to perform a high-quality fact-checking process. However, it might be something that developers and designers can look into in the future, as it has come up repeatedly in the feedback.

Another important point raised in their answers to the questionnaire, and that is connected to the points above, was that the fact-checking process needs to become less time-consuming for the users. Time is of the essence for both journalists and professional fact-checkers; therefore, it is important to consider how the tool could help them to cut the time spent on fact-checking. This is an important aspect, which could also be considered in future development work.

One participant pointed out that the navigation and presentation of claims could become a problem with higher volumes of material. Consequently, developers need to consider how claim doublets will be dealt with and how claims in the system can be synchronized with facts checked by other organizations or in other platforms.

Some participants pointed out that they would appreciate ways to connect with other existing systems in the fact-checking community as well as the inclusion of a function to create fact-checks that are compatible with *ClaimReview*, a Google-supported standard schema to facilitate the sharing of fact-checks on the web. Another participant suggested a tool that provides an audit protocol to help fact-checkers remember everything. "It would be a tool like yours that would guide fact-checking by providing effective tools at each phase. It could be collaborative so that each fact-checker could enrich the audit. It would be an internal tool for an editorial office so that everyone could have access to the fact-checking carried out." The participants

also suggested a standard format for all fact-checks. “Process and incentives are really key. I think this tool is onto something.”

When asked about the general public’s trust in the news media in relation to the fact-checking tool, the participants tended to be hesitant. Some thought this point was unclear and difficult to answer, as they did not understand how the general public would find information about the tool–or if the intention is that the public also will use the tool.

Other participants believed that this tool is a good step towards improving trust in the news media in general. “Yes, independent fact-checking as a part of the publishing cycle could create a deeper trust in news media, of course depending on how the different media outlets handle cases when fact-checkers debunk publications.” “I think it will be increasingly important to develop tools to balance the rise of Synthetic Media/Deepfakes.” “I am curious how the tool can keep up with the possible endless generation of fake stories and media from GPT-3 and other similar algorithms.” “Yes, especially if the traceability of both the method and money pay-outs is 100%.”

Regarding the integration of blockchain in the fact-checking process, it might also be hard to inform the general public about the technology in relation to fact-checking, according to the participants. Once again, we come across the notion of how complicated blockchain technology is to understand and grasp (cf. Rogers, 2003). Blockchain might also be connected to Bitcoin, which is a negative thing in many people’s views. “I think that blockchain is still relatively poorly understood by the public. They might think of Bitcoin in the best-case scenario and that might lead to associations of murky businesses. So, perhaps better to emphasize that the data cannot be tampered with, that it is secure, transparent, etc.?”

Other participants found the blockchain technology interesting and a possible solution. Media organizations in particular might be interested in the concept of integrating blockchain technology in fact-checking, according to one participant.

The economics of the system seemed to be another weak link in the solution, according to the participants, as it is still quite unclear how the incentives and the bonus system for fact-checkers work. This is yet another aspect that needs to be addressed in future research.

DISCUSSION AND CONCLUSIONS

Our conclusion from the project is that the cost, complexity and rapid technological changes in this area indicate that blockchain is not yet ready to be directly applied in fact-checking processes in a real-world scenario.

The specific reasons for why blockchain technology is not yet ready at this stage align well with the theory of diffusion of innovations by Rogers (2003):

1. It is difficult to understand the concept and difficult to explain how it works.
2. It is difficult to use.
3. The technology is not ready for usage by everyone yet.
4. It is not tangible.
5. The users in general fear the unknown.

In addition to these bullet points, blockchain technology is not really meant for dynamic journalistic *content* as everything stored on a blockchain is immutable and impossible to modify or erase. The economic aspect is another weak part of blockchain technology, as it relies on relatively untested and unstable models of cryptoeconomics.

As social action is a central element in technological development, we argue that the development and diffusion of new technology is embedded in its social context (cf. Pinch & Bijker, 1984; Winner, 1993). In the end, human action will shape technology. In this project, we have come a long way in implementing this system as a prototype and idea for the world to benefit from, and for the research community to perhaps examine and use. In order to make the best of it, a longer multi-year project could be initiated as a follow up

to this project with experimental services launched to those who are willing to explore the opportunities that blockchain technology could bring to the journalism space.

Our conclusions from this project also align well with the conclusions drawn in a book chapter by Al-Saqaf and Picha Edwardsson (2019), who studied the doomed CIVIL project and concluded that while blockchain technology has the potential to become useful within journalism, it suffers from key deficiencies that need to be addressed. The learning outcomes of the project we pursued provide valuable knowledge in the domain where journalism and technology intersect, potentially leading to many new research ideas to be developed in the future.

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APPENDIX A

Links Used in the Project

https://github.com/wsaqaf/sljournalism

Short intro: https://play.sh.se/media/Intro+to+Demo+of+SLJ+protytpe/0_zmuymlox

Demo: https://play.sh.se/media/Prototype+demo/0_zaht9yol

Questionnaire Used in the Evaluation

What is your impression of the tool's **efficiency** (navigation, uniformity, and speed)?

What is your impression of the tool's **user friendliness** (self-explanatory, easy/difficult to use)?

What is your impression of the system's **effectiveness** (adds value to your work, easy to learn)?

What needs to be **improved** in the tool in order to increase usability for you and/or for other fact checkers?

As this is still a prototype, we ask in what way a real working tool similar to this one, **would help you** in your daily work as a fact checker? If so, in what way? If not, why?

On a long-term basis, do you think a real working tool like this would benefit **the public's trust** in news media? If so, in what way? If not, why?

Do you think the system of **integrating blockchain technology** into a fact-checking tool is increasing the public's trust in news media? If so, in what way? If not, why?

Any **final comments** that you would like to add?