Tools for Analytics and Cognition for Crowd Journalism Application

Natasa Paunkoska(✉), Atanas Hristov, Aleksandar Karadimce, Ninoslav Marina, and Mirsat Sefidanoski

University of Information Science and Technology, 6000 Ohrid, Macedonia
{natasa.paunkoska,atanas.hristov,aleksandar.karadimce}@uist.edu.mk,
mirsat.sefidanoski@cse.uist.edu.mk
http://www.uist.edu.mk

Abstract. Businesses and service consumers should take advantage of social media's ability to adapt their marketing campaigns to achieve a long-term strategic advantage. Setting quantitative and attainable expectations is critical to the progress of every marketing or business endeavour. The development of tools for analytics and cognition (TAC) is essential for customers and providers to increase productivity and inject intelligent insights into operational and mission-critical social media businesses through driven analytics. In this paper, the developed tools provide guided analytics software for intelligent aggregation, cognition and interactive visualization with a monitoring dashboard for concrete crowd journalism use cases. The provider receives an approach to a guided analytic dashboard filled with meaningful business visualization predictions. Among the other things, he can inspect the quantitative metrics for a sharing economy and estimate stakeholders' channel monetization as a new innovative quantified value by engaging users with trusted content. TAC uses this principle of engagement rate measurements and provides visualization insights for stakeholders to choose the right track for boosting their business.

Keywords: Social media · Guided analytics · Sharing economy · Engagement rate · Crowd journalism

1 Introduction

Today's most popular social networks, such as Facebook, Twitter, etc., are centralised platforms owned by private corporations that unilaterally control the respective networks. International project "smART socIal media eCOsystem in a blockchaiN Federated environment (ARTICONF)" is devoted to researching and developing a series of trustworthy, resilient and globally sustainable decentralised social network platforms [1]. Today, social media platforms are vital technologies that connect and inform people to global networks. They can create new forms

Y. H. Sheikh et al. (Eds.): AFRICOMM 2021, LNICST 443, pp. 252–263, 2022.
https://doi.org/10.1007/978-3-031-06374-9_16

of communication and bring about significant changes in mobilisation, business practices, the journalism process and the acquisition of public knowledge. Media publishing companies currently carry significant social responsibility for transparent, independent and trustworthy news sharing.

ARTICONF seeks to build a decentralised and federated social media network supported by an underlying blockchain platform that is seamlessly combined with optimised trust-based measures in an anonymised environment, making it easier to track bad actors and remove malicious content such as malicious content as fake news. Moreover, its novel socio-cognitive and smart matching practices integrate relevant users with common interests into an orchestrated networked community world without de-anonymising them. According to the concept, such a design would unite a variety of social media actors (individuals, startups, and SMEs) under a single institutional umbrella, allowing them to participate in incentivised collective decision-making and the sharing economy. ARTICONF offers a fresh perspective in an age when data breaches and undemocratic practices at the hands of centralised intermediaries are commonplace through establishing an open and transparent crowd journalism ecosystem. Each anonymous user has control over their data, with options for individual or collaborative monetisation.

In this paper, we promote the Tool for Analytics and Cognition (TAC) [2], a fundamental part of the ARTICONF platform used to collect and aggregate data and to produce meaningful business insights for the crowd journalism scenario[1]. For this purpose, the TAC tool develops six separate microservices given in Fig. 1. The crowd journalism provider delivers an adequate data set to the general ARTICONF platform gathered from their use case functioning. Then, that data proceeds in a manner that the Trust and Integration Controller (TIC) tool adds trustiness, anonymity and security of the content [3], the Co-located and Orchestrated Network Fabric (CONF) tool reliably stores the data in a decentralized way [4], the Semantic Model with self-adaptive Autonomous Relevant Technology (SMART) identifies users with multiple fake profiles [5], and the TAC collects the finial input pre-processed it, analyses and provides insights to the crowd journalism provider as shown in Fig. 1. The main tasks of TAC are to handles the aggregation microservices for geospatial and temporal data to be visualized in a guided analytics dashboard, expanded with intelligent business revenue predictions concerning the Return on Investment (ROI) and Return on Collaboration (ROC).

The remainder of the paper is organised as follows. Section 2 provides an overview of the state-of-the-art. Section 3 gives an overview of the crowd journalism use-case in the context of TAC ARTICONF framework. Section 4 explains the TAC microservices for crowd journalism, providing details for the geospatial, temporal, visualization, guided analytic, return on investment and collaboration microservices. Section 5 describes TAC implementation for a crowd journalism scenario, and Sect. 6 concludes the paper and provides future directions.

[1] https://articonf.eu/crowd-journalism-use-case/.

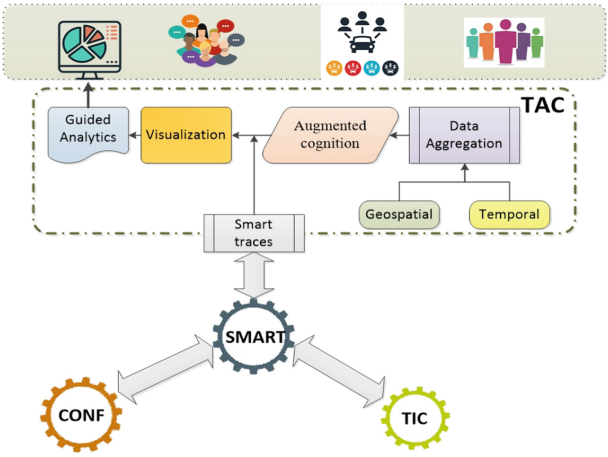

Fig. 1. The ARTICONF data flow architecture model

2 Related Work

The TAC tool develops multiple microservices working as a single solution for the social application provider. This means that the provider can benefit by using one decentralized platform and still accessing a variety of information. These days, social applications should use multiple centralized solutions offering single services such as aggregation data management, GPS solution, business-related software, etc., to have all advantages offered by TAC. In continuation are elaborated the existing centralized solutions.

A social media network is an umbrella term encompassing all web-based applications that let individuals generate content [6]. Social media has the potential to foster active collaboration, participation and exchange of information. Another aspect of social media is its ability to bring people with common interests together [7]. Particularly, it allows an individual to create a personal or a professional profile, follow or link to other people, author content and share it. The existence of different social media services leads to the production of heterogeneous data. The data has various formats such as images, videos, maps, and geolocation data; hence, they come from various data sources and have inconsistent file formats. Thus, managing the process of aggregation is a difficult task. One alternative for effective data management is providing large-scale storage and multidimensional data management in one integrated system [8–10].

Geospatial analysis can essentially be described as the gathering, displaying, and manipulating imagery, Global Positioning System (GPS), satellite photography, and historical data. This information is usually represented in geographic coordinates or implicitly in terms of a street address, postal code, or forest stand identifier as they are applied to geographic models. There are various use cases where geospatial analysis is applicable, such as crisis management, weather monitoring, climate change modelling, sales analysis, human population forecasting,

and many more. Regarding the crowd journalism scenario, the geospatial data are significant for on-time crisis information by providing a medium for citizens to communicate and seek for help victims (e.g. Nepal earthquake). The benefits of affected peoples are immediate information sharing and visualization of dire and urgent events [11]. Therefore, crowdsourcing geospatial data has a key role in such situations. Traditional mapping is nearly exclusively coordinated and often also carried out by large organisations, while crowdsourcing geospatial data refers to generating a map using informal social networks and Web 2.0 technologies [12].

Communities are not static. Like living organisms, they evolve because of cultural, environmental, economic, or political trends, external interventions, or unexpected events. Technological developments also have substantial impacts on social changes, a phenomenon that has become influential with the arrival of mobile communications devices and social networking services [13]. Temporal data usage and analysis are crucial to all ARTICONF use cases for successful sustainability and revenue growth. In the crowd journalism scenario, the geospatial temporal analysis is significant for anomaly detection, correlation of events, prediction over time series data and event stream [14]. It allows tracking of verified active accounts, enabling the system to push notifications to proven contributors, and tracking and increasing user engagement. Both active posters and likers are almost twice as likely to return to the site when they have received an alert [15].

Modern applications produce large amounts of data in the form of logs and events to facilitate quick failure diagnosis and mitigation, stored in special big data database systems. Through such a system, the data is used to query different events and trace down issues in the application. There are several software and tools available today which assist with the utilisation of time-series data in population research [16,17].

Another aspect for businesses related to social networks is understanding and calculating the potential revenue. Many researchers [18–20] work on collecting meaningful information for providing an appropriate Social Return on Investment (SROI) analysis and calculation. Usually, they set some principles and guidelines to follow, define organisations, stakeholders, skills, and requirements necessary for the undergoing process.

3 Crowd Journalism in the Context of TAC ARTICONF Framework

Crowd journalism enables media content production through a cooperative process that supports both ordinary citizens and journalists. Citizens use a mobile phone application to capture and share live video feeds. This use-case includes other components, such as the media engine, the central viewing platform, the storage, and the marketplace. Independent journalists and the news broadcasting industry gather the crowdsourced news with public participation to create content outside the mainstream media.

The necessity of crowd journalism mainly appears from the increased number of breaking news, such as a terrorist attack, an earthquake, or a nuclear plant failure in a restricted geographical location. To facilitate this coverage, ordinary citizens empowered with the necessary tools can provide live video coverage of the event in a participatory way [21]. The use-case focuses on mobile live media capture by the crowd using mobile phones that play a large part in human routines and are the best device to use in extreme news situations, where dedicated cameras are not present. However, validating the crowdsourced news content is crucial for the providers to determine whether the news is fake or real. Hence, anonymity and data privacy are significant concerns among crowd participants since social media platforms controlled by proprietary organisations are non-transparent and affected by data breaches. ARTICONF enables users to share, visualise, and buy media content with anonymised identities in a decentralised social media platform, ensuring users' control over their data and content ownership.

This section presents the crowd journalism use case in the context of the TAC, which is responsible for aggregating, integrate, and analysing the data knowledge extracted from the SMART. The TAC supports the analytic system and injects additional information to improve operational tasks, planning, and providers management through visualisation, geospatial, social-contextual, and temporal data mapping and aggregation microservices. These TAC interconnected microservices are organised in modules, as shown in Fig. 1. Each microservice produces specific insights for providers to expand and strengthen the crowd journalism business activities and profits and for consumers to improve their experience and earn additional income.

4 TAC Microservices for Crowd Journalism

This section goes deeper into the context of explaining the components depicted in Fig. 1. The TAC tool carefully develops the various microservices to fit and work best for the concrete crowd journalism use case. In continuation, descriptions for six separate microservices are given: geospatial, temporal, visualisation, guided analytic, return on investment and return on collaboration.

4.1 Geospatial

Crowd journalism is an application for independent journalists and the news broadcasting industry to create content outside mainstream media by gathering crowdsourced info with public participation. Validation of the crowdsourced news content is crucial for the application providers. Therefore, provisioning time-critical infrastructure resources closer to the news location is very important. The TAC tool offers providers meaningful insights based on the geospatial information for the crowdsourced news location. The analysis applies an algorithm that creates a so-called validation region that predicts the exciting areas in

a breaking news event location. Diverse news coming with coordinates matching the specific region are considered valid. Otherwise, the system will observe the content as fake news.

4.2 Temporal

The crowd journalism use case aims to publish the news as fast as possible after an event occurs. On the other side, the provider must be cautious of the content going to bring out. Thus, the TAC models detailed analysis and insights about the creator and video profiles to make correct decisions connected with concrete news. From the available temporal crowd journalism aggregated data, TAC follows the rating of the video to learn about how trustworthy it is. This insight is associated with the video's creator, marked as a fake or successful journalist after several bad or good rating iterations. The output later is considered in the validation process for videos and creators classification.

4.3 Visualization

Journalists and citizens using the crowd journalism application produce data related to the video news. The TAC tool performs a specific content analysis on the aggregated content, enabling valuable visual information for the providers and users. The outputs strengthen the trust in the platform and help the process of news validation that better rates the provider's business.

Some of the crowd journalism visualisation insights that TAC enables are: a heat map showing the most common places of recording videos; a gauge that gives information about the average satisfaction rating attributed to the video; a pie chart that differentiates the various events by the popularity rating; a pie chart showing the most popular video creators and buyers divided per different event types; timeline chart following the average purchasing price per videos; a tag cloud words based on importance indicates the most frequently used tags associated with a video; bar charts for the most popular video creators in terms of rating and trustiness, and bar chart for the top valuable buyers of videos; charts based on the different communities following the informative, impact and trustiness rating; timelines tracking the return on investment and return on collaboration progress over periods; and etc.

4.4 Guided Analytic

Guided analytics microservices process, integrate, and analyse cognitive knowledge extracted through the SMART aggregated data. Hence, they recommend the use-case applications and social media providers to improve their revenue growth with pattern prediction and risk analysis.

The TAC uses an interactive dashboard to visualise the knowledge gained through the guided analytics approach. It extracts valuable insights from the data and organises, filters, analyses, and visualises them as part of the data

storyline. TAC guided analytics dashboard visualises focused areas where the consumers most utilise a specific application. The dashboards deal with the visualisation part and translate aggregated diverse data into a visually understandable format.

Generally, the crowd journalism dashboard is divided into three subgroups:

- The sub-dashboard covers guided geospatial and temporal data analysis conducted from the crowd journalism use case through the SMART tool.
- The sub-dashboard represents insights provided by using machine learning techniques over the predefined communities.
- The sub-dashboard tracking the trend of the business revenues progress.

The TAC dashboards provide interactive features to the providers, including: selecting a specific time frame from date ranges, selecting specific values from data fields, and filtering values from data fields.

4.5 Return on Investment

The ROI (Return on Investment) measurement produces meaningful insights that help social media application operators determine whether their investment will improve their businesses and profits. Besides, it allows users to enhance their experience and earn extra revenues. In TAC, the ROI monitoring microservice measures the business financial concept to help providers make better resource allocation decisions. Tracking the revenue and investment for service utilisation is a crucial TAC requirement. The third sub-dashboard guides the crowd journalism applications and social media providers in improving their revenue growth with pattern prediction and risk analysis.

The calculation for the concrete crowd journalism ROI depends on the video price (current price of the video in tokens defined by the video creator) and the purchase video price (number of tokens spent in the purchase by the buyers):

$$ROI[Crowd\ Journalism] = \frac{Video\ Price - Purchase\ Video\ Price}{Purchase\ Video\ Price} \cdot 100. \quad (1)$$

4.6 Return on Collaboration

ARTICONF, as a social media platform, is a decentralised ecosystem that allows diverse providers to create, discover, perform, and analyse various social media events involving different social media actors. More precisely, the social media ecosystem involves multiple individuals and organisations referred to as stakeholders who join the triggered events and monetise their channels by creating and engaging users with trusted content. Each trigger for an event or activity happening in a social network that increases the users' collaboration is a potential revenue for the stakeholder. This claim introduces the new ROC (Return on Collaboration) microservice that provides innovative quantified values representing revenues relative to each functional area's invested capital. Measuring

ROC enables users with real-time cost per engagement analyses and defines their specific business application success indicators.

The ROC metrics are mainly related to the users' engagement rate when using certain application services; this paper is precisely about the crowd journalism application. The engagement rate often tracks user involvement with the service and the offered service promotion's effectiveness. Translated in our use case, that would be in terms of successfully created news videos. Following the ARTICONF platform, any voluntary user activity opens the perspective for gaining rewards as tokens for various application tasks. Generally, the user savings and earrings made with the accumulated rewards are essential for calculating and visualising the ROC.

The calculation of the crowd journalism engagement rate is the ratio between the video price (represents the current price in tokens of the video) and total price (aggregated price in tokens of all video purchases):

$$ROC[Engagement\ Rate] = \frac{Video\ Price}{Total\ Price} \cdot 100. \tag{2}$$

5 TAC Implementation for Crowd Journalism

TAC creates an interactive interface to support social media consumers and providers in injecting intelligent insights into data aggregation and cognition. This approach towards crowd journalism guided analytics goes beyond a straightforward analysis of revenue figures developments by recognising revenue-enhancing strategies and forecasting potential results for an enhanced collaborative economy. The TAC implementation uses interactive dashboards to visualise the knowledge gained through the crowd journalism applications used to pilot and validate the developed tool.

The dashboard enables better predictive analytics, planning, and observing social media marketing strategy's effect on the audience. It also allows providers to determine the impact of integrating social media services and the overall application performance.

The ARTICONF data flow architecture model describes the interaction with the other ARTICONF tools (see Fig. 1) and allows visualisation of geospatial and temporal data in a guided analytics dashboard, part of the TAC interface. TAC retrieves the data flow from the SMART API to the final dashboards through Logstash, an open-source data processing pipeline, part of the Elastic Stack. TAC carefully filters, processes, and stores it on its server once the data flow passes through the Logstash using the HTTP poller plugin. TAC carefully analyses and aggregates this data and finally visualises it on interactive dashboards, as shown in the following section. TAC uses the Kibana open-source data visualisation tool for Elasticsearch using various data presentation diagrams, such as bar charts, gouge visualisation, line charts, area chart, pie chart, and tables.

TAC uses visualisations, including various widgets, such as line charts to find trends and pie charts to compare analytical findings. The validation of the visualisation diagrams takes place in three steps:

– TAC developers provide application visualisations using carefully simulated sample datasets.
– Providers deliver real datasets, which undergo specific processing and manipulations for obtaining the same visualisation insights.
– TAC testers compare both sets' output to validate data flows, applications, and visualisation changes.

5.1 Visualisation Results

The visualisations provided in this section are part of the interactive dashboard developed for the crowd journalism application. The dashboard provides guided analytics of the crowd journalism qualitative data obtained from SMART by applying filtering rules to select the most relevant parameters of interest specific to the crowd journalism application. Currently, the TAC tool uses simulated data for the visualisations presented in this section.

The crowd journalism guided analytics dashboard is divided into three subgroups, as presented in Sect. 4.4. The most meaningful insights for crowd journalism providers were created and presented in the form of a visualisation dashboard depicted in Fig. 2. The visualisations shown in the figure represents part of the complete dashboard. Several other visualisations to improve the guided analytics and allow a different user perspective over data are included in the complete dashboard.

Fig. 2. Crowd journalism dashboard

– Fig. 2.1 uses a pie chart visualisation showing the users with the highest number of created videos, and for each user, it shows the type of event published in the video. It gives an overview of potential influencers in the crowd journalism social network.

- The bar chart visualisation in Fig. 2.2 represents how the impact rating differs for a specific event and which type of event has the most/least impact on the application.
- Fig. 2.3 shows coordinate map visualisation of interesting geographical areas in a breaking news event location.
- Fig. 2.4 is a scatter plot visualisation showing the relationship between trust and impact rating of specific event types. It will help in the identification of successful news video creators in terms of ratings.
- Fig. 2.5 uses a line chart visualisation that depicts the crowd journalism engagement rate depending on the current price of the video and the total price of all video purchases, as presented in Sect. 4.6.
- The line chart visualisation in Fig. 2.6 represents the crowd journalism ROI depending on the current price of the video and the purchase video price, as presented in Sect. 4.5.

6 Conclusion and Future Directions

The ARTICONF ecosystem has developed a comprehensive analytics and cognition (TAC) monitoring tool for a crowd journalism use case. The proposed tool key contribution has provided social media users with analytics dashboard data from the crowd journalism scenario's collective participation. This way, the qualitative support the analytic system, injecting additional information to enhance the crowd journalism communities' operational tasks, planning, and management. TAC uses visualisations to measure the user's engagement rate and monitor the ROI, diagnose investment risks for social media journalist providers, and improve collaboration and revenue. The ROI measures are still evolving for social networking capability. Still, there are methods that the teams can use to determine their progress and collaboration. The innovative ROC metric, implemented by a ROC microservice, helps crowd journalism providers track the application network's spread with new active users engaged with the ARTICONF platform. TAC visualisation insights for ROC can bring extra revenue to businesses and determine the right track for further capital investments.

ARTICONF, together with the four tools (TIC, CONF, SMART, TAC), addresses issues of trust, time-criticality and democratization for a new generation of federated infrastructure to fulfil the privacy, robustness, and autonomy related promises that proprietary social media platforms have failed to deliver so far. It means that diverse social applications from different countries (especially the developing countries) can join in such a decentralized platform and enjoy the offered advantages of using virtual infrastructure, blockchain for increasing autonomy and data privacy, the trustiness derived by applying the smart-context algorithms and customize guided analytics dashboard for driving the economy in the right direction.

Acknowledgement. This research is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 825134, the ARTICONF Project (https://articonf.eu/).

References

1. Prodan, R., et al.: ARTICONF: towards a smart social media ecosystem in a blockchain federated environment. In: Schwardmann, U., et al. (eds.) Euro-Par 2019. LNCS, vol. 11997, pp. 417–428. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-48340-1_32
2. Karadimce, A., Paunkoska (Dimoska), N., Capeska Bogatinoska, D., Marina, N., Nandal, A.: Guided analytics software for smart aggregation, cognition, and interactive visualisation. In: Sharma, M.K., Dhaka, V.S., Perumal, T., Dey, N., Tavares, J.M.R.S. (eds.) Innovations in Computational Intelligence and Computer Vision. AISC, vol. 1189, pp. 521–528. Springer, Singapore (2021). https://doi.org/10.1007/978-981-15-6067-5_59
3. BitYoga: Blockchain for social media - Blockchain as a Service (BaaS). ARTICONF Blog, 30 March 2021. https://articonf.eu/blockchain-for-social-media/
4. Shi, Z., Zhou, H., Hu, Y., Koulouzis, S., Rubia, C., Zhao, Z.: Co-located and orchestrated network fabric (CONF): an automated cloud virtual infrastructure for social network applications. Presented at the Large Scale Distributed Virtual Environments, EuroPar 2019, August 2019. https://doi.org/10.5281/ZENODO.3679385
5. Saurabh, N., et al.: The ARTICONF approach to decentralized car-sharing. Blockchain: Res. Appl. **1**(1–2), 100013 (2021). https://doi.org/10.1016/j.bcra.2021.100013. ISSN 2096-7209
6. Waters, J., Lester, L.: The Everything Guide to Social Media: All You Need to Know About Participating in Today's Most Popular Online Communities. Karen Cooper (2010)
7. Harrin, H.: Social media for project managers. Project Management Institute (2010)
8. Herbreteau, V., Salem, G., Souris, M., Hugot, J.-P., Gonzalez, J.-P.: Thirty years of use and improvement of remote sensing, applied to epidemiology: from early promises to lasting frustration. Health Place **13**(2), 400–403 (2007). https://doi.org/10.1016/j.healthplace.2006.03.003
9. Boulil, K., Bimonte, S., Pinet, F.: Conceptual model for spatial data cubes: a UML profile and its automatic implementation. Comput. Stand. Interfaces **38**, 113–132 (2015). https://doi.org/10.1016/j.csi.2014.06.004
10. Sarwat, M.: Interactive and scalable exploration of big spatial data - a data management perspective. In: 2015 16th IEEE International Conference on Mobile Data Management, Pittsburgh, PA, USA, pp. 263–270 (2015). https://doi.org/10.1109/MDM.2015.67
11. Brandusescu, A., Sieber, R.E., Jochems, S.: Confronting the hype: the use of crisis mapping for community development. Converg.: Int. J. Res. New Media Technol. **22**(6), 616–632 (2016). https://doi.org/10.1177/1354856515584320
12. Heipke, C.: Crowdsourcing geospatial data. ISPRS J. Photogramm. Remote. Sens. **65**(6), 550–557 (2010). https://doi.org/10.1016/j.isprsjprs.2010.06.005
13. Ahn, J., Taieb-Maimon, M., Sopan, A., Plaisant, C., Shneiderman, B.: Temporal visualization of social network dynamics: prototypes for nation of neighbors. In: Salerno, J., Yang, S.J., Nau, D., Chai, S.-K. (eds.) SBP 2011. LNCS, vol. 6589, pp. 309–316. Springer, Heidelberg (2011). https://doi.org/10.1007/978-3-642-19656-0_43
14. Zaslavsky, A., Jayaraman, P.P., Krishnaswamy, S.: ShareLikesCrowd: mobile analytics for participatory sensing and crowd-sourcing applications. In: 2013 IEEE 29th International Conference on Data Engineering Workshops (ICDEW), pp. 128–135 (2013). https://doi.org/10.1109/ICDEW.2013.6547440

15. Millen, D.R., Patterson, J.F.: Stimulating social engagement in a community network. In: Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work, New York, NY, USA, pp. 306–313 (2002). https://doi.org/10.1145/587078.587121
16. Fedak, V.: Top 4 popular big data visualization tools. Towards Data Science (2018). https://towardsdatascience.com/top-4-popular-big-data-visualization-tools-4ee945fe207d. Accessed 11 Apr 2019
17. Akshaya, H.L., Nisarga, J.S., Vidya, J., Veena, K.: A basic introduction to DevOps tools. Int. J. Comput. Sci. Inf. Technol. **6**(3), 2349–2353 (2015)
18. Iyer, R., Agrawal, P.: Social return on investment - measuring the impact. Int. Res. J. Bus. Manage. **VIII**(10) (2015)
19. Salverda, M.: Social Return on Investment (2016). https://www.betterevaluation.org/approach/SROI
20. Nicholls, J., Lawlor, E., Neitzert, E., Goodspeed, T: A guide to social return on investment (revised). The SROI Network (UK) (2012). https://www.socialvalueuk.org/resources/sroi-guide/
21. Teixeira, L., Amorim, I., Ulisses Silva, A., Correia Lopes, J., Filipe, V.: A new approach to crowd journalism using a blockchain-based infrastructure. In: Proceedings of the 18th International Conference on Advances in Mobile Computing & Multimedia (MoMM 2020), pp. 170–178. Association for Computing Machinery, New York (2020). https://doi.org/10.1145/3428690.3429159