Social Data Analytics for Enhancing the Collaborative Economy

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Abstract—Focusing on the data-driven analytics and its effects on paid services providers can potentially reverse-engineer break-even rates, expected Return on Investment (ROI), and performance timelines. Traditional centralised social networking analytics and metrics can estimate the expected number of customers using well-established vendor-specific revenue assurance tools. They include a systematic approach of incorporating social, environmental, economic, and other values into standard decision-making processes. The challenge appears when the decentralised social media stakeholders come into the game. Then they need to find unified metrics to measure the achievement of social impact relying on three primary performance indicators: appropriateness, efficiency and effectiveness. This paper presents the idea of adding social collaboration term to increase impact within the industry and the effectiveness of tactics and strategies among multiple people, groups or departments. The decision making process related to the revenues will thus benefit from this newly defined metric called Return on Collaboration (ROC). Measuring the ROC provides users with real-time cost per engagement analyses, allowing them to define their specific business application success indicators. The traditional ROI calculates the gain or loss of a given investment. On the other hand, ROC measures the "improvement" resulting from a monetary expenditure in collaboration and the innovative ROC model facilitates user collaboration and revenue growth. As a result, providers can assess the effect of social media services and technologies.

Index Terms—Return on Collaboration, Return on Investment, Social Media, Data Analytic.

I. INTRODUCTION

This paper is devoted to researching and developing a series of trustworthy, resilient and globally sustainable decentralised social network platforms to form the foundation of next-generation social media connectivity. Social media platforms can shape and mobilise communication patterns, practices of exchange and business, creation, learning and knowledge acquisition. Today, social media platforms are vital technologies that connect people to global networks. They can create new forms of communication and bring about significant changes in mobilisation, business practices under one systemic umbrella

and allow them to be a part of incentivised collaborative decision-making and sharing economy.

In principle, the paper presents a new perspective in the current age when data breaches and undemocratic practices are a regular phenomenon at the hands of centralised intermediaries by creating an open and transparent ecosystem, where control lies in the hands of each anonymous user with provisions for individual or collaborative monetised enhancement. The proposed microservices-based Tool for Analytics and Cognition (TAC) supports an analytic system for decentralised social media applications, injecting additional information to improve operational tasks and providing meaningful insights for application providers to enhance their businesses and profits. The research focuses on developing new critical innovation microservices, designed to measure the user's engagement rate through ROC metric and monitor the ROI, which diagnose performance risks for social media actors to improve collaboration and revenue.

ROI monitoring microservice tests, measures, and evaluates the application's Key Performance Indicators (KPI) and calculates the ecosystem's overall success metric for every use case. It also supports customisations according to the needs of social media providers. ROI is a business financial concept that helps executives make better resource allocation decisions, typically considering varying levels of risks and returns. ROC metric microservice is an innovative quantified value representing revenues relative to each functional area's capital invested. Measuring ROC provides users with real-time cost per engagement analyses and defines their specific business application's success indicators.

Engagement metrics are the most commonly used criteria when measuring the quantity of collaboration, which is tightly related to ROC. Thus, applying correct engagement and conversion strategies to leverage social commerce and convert engagement to sales helps businesses amplify revenue and ROI using digital market platforms. The engagement metrics often tracks user involvement with the service and effectively promote services. It indicates how the application

meets user expectations after they sign up and over time. Retention depends on the value found by the customer in the service. Monitoring the level of engagement helps to determine the level of customer satisfaction and identify potential churn.

Engagement rate metrics for centralised entities is done using a formula that measures the amount of interaction social content earns relative to reach or other audience figures. The reactions, comments, shares, views, followers, likes, impressions are some vanity metrics aligned with the specific application for engagement rate calculation. The main goal of the various engagement metrics is the selling point in the social media environment, bringing more ROI. Calculating the engagement rate is difficult in the absence of a standard metric. There exist multiple ways to measure the engagement depending directly on the social application in use. Some of the most influential centralised social media vendors are using an engagement rate calculation approaches, as follows:

Facebook measures the effectiveness of the posts and their connection with the fans and calculates the engagement metrics based on the number of likes, comments, shares, and clicks generated by the posts [1]:

$$Engagement\ Rate = \frac{Likes + Comments + Shares}{Fans} \cdot 100. \tag{1}$$

Instagram engagement rate per post is the total number of people who saw and liked or commented on a post divided by the total number of Instagram followers [2]:

$$Engagement\ Rate = \frac{Likes + Comments}{Followers} \cdot 100. \tag{2}$$

LinkedIn calculates the engagement rate by adding the number of interactions, clicks, and new followers, divided by the reach of the post [3]:

$$Engagement\ Rate =$$
$$\frac{Comments + Likes + Shares + Mentions + Clicks}{Reach} \cdot 100. \tag{3}$$

Twitter engagement rate considers the number of replies and retweets to the total number of followers [4]:

$$Engagement\ Rate = \frac{Replays + Retweets}{Followers} \cdot 100. \tag{4}$$

Our challenge is to define unified metrics for calculating the engagement rate for diverse, decentralised social media applications that visually represent the ROC to the provider offering users valuable insights for their business track and success.

Section II provides an overview of the state-of-the-art. Section III presents the qualitative metrics for a sharing economy for ROI monitoring and the ROC metric. Section IV shows the visual analytic implementation for the collaborative economy, while Section V provides a discussion and conclusion on the research accomplishments.

II. RELATED WORK

ROI is a widely utilised financial indicator in traditional and social media marketing measured through different tools, especially for short-term returns [5]. Its initial purpose was to compare capital projects with one-time investment and the returns during the following years [6]. In tourism, the marketing ROI measures inform organisations in private and public sectors about the effective allocation of marketing resources and tourism development that best match operators and destination managers' goals. Stakeholders with differing goals focus on different target markets [7]. Fisher [8] states that ROI in social media lacks its purpose because it cannot measure community reactions. They lack of being consistent in the metrics (the calculation formula) in the different social media applications. The impact of community differs from case to case, the community reactions can not follow standard measurements. Therefore, this metric miss the overall picture, and there is no universal system for measuring the effectiveness of the revenue. [9]–[11].

In social networks, users are likely to spread viral videos in a well-designed social media campaign, generate additional brand-related material, tweet about the brand, and write about their interactions. Social metrics that represent these kinds of social media habits are relevant and essential for managers to calculate the ROI of social media efforts [12] in order to determine long-term success. Hence, social networking enables tracking industrial rivalry, emphasising the lead generation, acquiring clients, and retention, promoting real-time conversation to connect with clients [13]. Luan Wise's Lynda.com course [13] describes the social media marketing ROI as "the value an organisation derives from investing in a piece of marketing activity", "a performance measure used to evaluate the efficiency", and "a measure of the profit earned from each investment ."

Calculating ROI for marketplaces operating on a social network is very tricky and challenging. Nowadays, social media tries to integrate new metrics for engagement (user activity and collaboration) and conversion strategies to leverage social commerce and convert engagement to sales to amplify revenue and ROI using digital market platforms.

Cisco Systems made the first attempt to assess ROC and business investment [19] through a framework across three areas: operational ROI by reducing and avoiding costs, productivity ROI through more efficient processes, faster time to market, reduced cycle time, and strategic ROI that leads to business transformation and strategic advantage. Weise [19] proposes one global model for efficient network collaboration and Hootsuite [20] a social analytics approach by breaking down the needed metrics not to miss crucial insights. Works such as [21], [22] concentrate on user engagement in social media marketing as an influential platform for marketers to disseminate marketing messages. Authors in [23], [24] focus on social media engagement, metrics, and advertising. The work in [23] examines how consumers' engagement on social media platforms relates to the advertising embedded

in these platforms and provides additional evaluations of the advertising itself. Authors prove that engagement with social media or advertising is highly context-specific and generates different experiences. Social media engagement metrics' identification factors define social media brands' content strategy performance, as shown in [24]. The authors categorised these metrics and provided future research opportunities and managerial involvement in social media engagement issues. All researches are about finding specific social metrics to calculate the engagement rate for centralised applications. In our paper, we offer unique metrics that will work for more diverse decentralised applications.

III. QUANTITATIVE METRICS FOR COLLABORATIVE ECONOMY

Tool for Analytics and Cognition (TAC) develops critical innovation microservices for the platform within the project called SmART socIal media eCOsytstem in a blockchaiN Federated environment (ARTICONF). The focus is to provide insights into users' engagement rate and the ROC over incentivised and sharing economy through an interactive dashboard.

A. Return on Investment

Social media allows a fast and easy way to communicate private and group messages, and the news spread in seconds [25]. Busines and service prosumers (subjects who are both producers and consumers), exploiting social media's power, can adapt their marketing strategies accordingly to gain a sustainable competitive advantage. Establishing quantitative and attainable goals is crucial for every marketing and business effort success. Focusing on the data-driven content impacts allows providers to theoretically reverse-engineer break-even points and anticipate ROI and timetables for success. Analytics on social media offer metrics that effectively estimate the number of clients influenced during their journey. For instance, the number of views of a Facebook ad may indicate an increase in awareness, while the number of clicks may reflect a product's interest. Similarly, businesses may use the number of fans to reflect their interest in their products. Finally, online sales capture interest in their products [26]. The ROI assessment was possible in traditional marketing by providing direct, tangible activities to assess the advertisement efficiency. User behaviours are not natural in social media and are thus more difficult to quantify. However, some researchers are trying to measure social media behaviour in a quantitative form to allow companies to gain insight into their effectiveness. Metrics like traffic, shares, and time on site can reveal how well the content is resonating with the target audience. One can use this information to set a baseline and monthly or quarterly per cent increase goals to ensure continuous improvement. Marketers usually measure their social media campaigns success at different stages in the mass media consumers experience, such as print ads or television [26]. To explain, social media (e.g., Facebook ads, blogs) help potential customers find products or services, develop an opinion, reinforce beliefs that they respond to customers' particular needs, and decide to buy a

product or service. ROI is the business relationship between the profit and the investment that generates that profit and examines its performance. For most businesses, ROI measures the financial efficiency of an investment. The difference between return and investment divided by investment represents the ROI percentage, as shown in (5)

$$ROI\% = \frac{Return - Investment}{Investment} \cdot 100. \qquad (5)$$

The problem in calculating social media ROI is that, while the investment (i.e., resources put into a particular campaign) may be clear, attaching a currency value to the return is not as simple. Producing content is not always as easy as snapping a nice photo and coming up with a witty caption, and requires a dedicated team to create, curate, and produce content. None of these teams is free. Proving social ROI is a sure-fire way to get management to keep giving access to resources for social media marketing. Measuring the social ROI is necessary to illustrate the possible effect of social media marketing strategy, better understand the audience, and pivot when a particular method does not work as planned. The general formula for calculating the ROI% adopted by TAC is the difference between the user saving and the investment divided by the investment, given in (6)

$$ROI\% = \frac{User\ savings - Investment}{Investment} \cdot 100. \qquad (6)$$

The nature of social media indicates that networking platforms develop and improve people-to-people relationships. It would be a colossal error to calculate the ROI of social media like any other communication medium because its essence is radically different from that of other media outlets [26]. ROI measures are still evolving for social networking capability, but there are methods that the teams can use to determine their progress and collaboration. There are quantitative success measures that can measure networking and cooperation, such as increasing the number of people joining communities.

B. Return on Collaboration

Socialising to achieve a common goal is a definition of social collaboration. This type of collaboration circulates mainly on the Internet because the available technologies make it easy to share, develop, and analyse. Lately, involving the collaboration technology across a broad array of businesses adds value to their functioning. The advantages are supporting complex and distributed teams, improving business activities like customer service and product development, and providing greater reuse and manageability of documents and other content artefacts. 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 trusted content and engaging users. Each trigger for an event or activity

happening in a social network that increases the user collaboration represents a potential revenue for the stakeholder. This claim introduces the new ROC metric that provides innovative quantified values representing revenues relative to each functional area invested capital. Hence, ROC allows providers to determine the impact of integrating social media services and the overall application performance, providing real-time tracking of engagements' true reach and ROI. The ROC metrics qualify the user engagement rate when using certain application services and often tracks their promotion effectiveness. Following the ARTICONF platform, any voluntary user activity opens the perspective for gaining rewards as tokens for various concrete application tasks. For example, the energy marketplace use case uses application tasks for trading, sharing data, or subscribing to reward and gamification schemes. In the car-sharing use case, the owner sets the reward price if the passenger leaves the car in a specific place. Using this principle of engagement rate, measurement on the dashboard provides visualisation insights for stakeholders to choose a better path for growing their business and allows the users to redeem their reward points on their monthly energy bills or other services. The other use cases of the ARTICONF platform similarly gain and reuse rewards earned for accomplished services. Thus, the new ROC metric needs to rely on the user savings and earnings from the accumulated dividends. The new metric must fit all applications that use the new proposed distributed platform. The following generic formula defines the overall engagement rate, ratio between the individual user rewards over the service cost itself, as an eminent part of the ROC metric whose value depends on the user's concrete application:

$$Engagement\ Rate =$$
$$= \frac{Earnings\ per\ User}{Revenue\ per\ Application\ Service} \cdot 100. \quad (7)$$

- **Earnings per user metric** are the reward points based on the social network platform's user activity, which increase the general profit essential from the providers' perspective. These are usually companies engaged in incentivising businesses with social media consumers, providing various software services, and involving diverse social media actors.
- **Revenue per application service metric** depends on the business application's successful functioning in the social network platform.

IV. VISUAL ANALYTIC IMPLEMENTATION

This section provides visualisation insights determined by the TAC to illustrate the ROI and the ROC metrics using two use-cases: car-sharing and energy marketplace. The ROI and the ROC visualisations are part of the guided analytic dashboards for the two use-cases. These dashboards enable better predictive analytics, planning, and observing social media marketing strategy's effect on the audience and impact the overall application performance.

A. Car-sharing

Car-sharing is a social network application that offers user services like sharing trips and renting vehicles. Users act as passengers on a trip, share the final trip price, or rent their car to earn profit. The application is active in a few cities of one country, but the focus is to spread it in many European countries and cities.

TAC performs analytic data calculations and enables visual insights to the stakeholder, including the estimated profit per trip and the earnings upon a successfully finished trip. The result gives the fleet manager awareness of the service's development at an existing location, including the necessity of new investments.

The **car-sharing ROI** depends on the **trip price** as the total trip cost paid by all passengers and the **trip reward** set by the car owner for all passengers, as show in equation (8):

$$ROI[Carsharing] = \frac{Trip\ price\ -\ Trip\ reward}{Trip\ reward} \cdot 100. \quad (8)$$

The visualisation helps users of the car-sharing services receive insights into the travellers' habits and behaviour. This way, providers can anticipate the ROI with the social media metrics that effectively estimate the clients engaged during a journey. Furthermore, the providers can examine an investment's rentability and focus on assessing marketing resources for client's target groups in specific communities.

The area chart visualisation in Figure 1 represents the car-sharing ROI. This chart also shows the total trip price paid by all passengers and the owner's reward over the given timeline. The data set is provided by the car-sharing application [28].
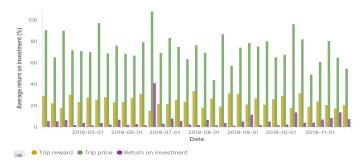

Fig. 1. Area chart visualisation on the carsharing ROI.

We identified several essential metrics for calculating the car-sharing engagement rate.

- **Passenger rewards** represent the rewards points saved by users after a successfully completed trip.
- **Total trip earnings** represent the trip price shared by all passengers calculated either per drive kilometres or travel time.

The **car-sharing engagement rate** quantifies how actively a client uses the car-sharing application, as shown in (9)

$$Engagement\ Rate = \frac{Passenger\ rewards}{Total\ trip\ earnings} \cdot 100. \quad (9)$$

Figure 2 depicts the car-sharing engagement rate depending on the passenger rewards and the total trip earning after a specific time. The passenger rewards reflect the user's activity in the car-sharing application and the full price of a successful trip.
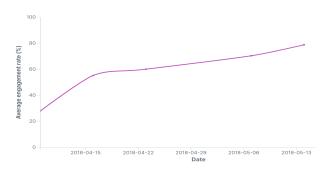

Fig. 2. Engagement rate based on the passenger rewards and total trip earnings per service.

B. Energy Marketplace

The energy marketplace use-case allows utility companies to incentivise customers to log their consumption and production data. The use-case offers a blockchain platform for recording user transactions concerning energy consumption, production, and trading, which stores all the transaction data as references to Cloud storage of locally encrypted user-related sensitive data. Utility companies benefit from an analytics system for performing granular predictions on in-home and community-level energy production and consumption. Additionally, a mobile application is available for users and utility companies. Customers use their mobile applications to register with the platform and store their energy production and consumption data in a locally encrypted database. They also choose to share their data with utility companies and trade their excess energy with their neighbourhood. The grid compensates their energy bills using the tokens generated from sharing the data and trading energy. Utility companies participate in the sharing economy by rewarding users for sharing their data and use it for predictive analytics, planning and trading. ARTICONF platform stores on the blockchain the information related to each transaction.

The **energy marketplace ROI** depends on the **consumed power** as progressive energy or heating consumed by the user in kW and the **produced power** as the advanced solar energy produced by the user in kW, as shown in (10), (11) and (12)

$$ROI[Energy\ consumption] = \frac{Solar\ Production}{Energy\ consumption} \cdot 100,$$
(10)

$$ROI[Heating\ consumption] = \frac{Solar\ Production}{Heating\ consumption} \cdot 100,$$
(11)

$$ROI[Energy\ market] =$$
$$= \frac{Solar\ Production}{Energy\ consumption + Heating\ consumption} \cdot 100.$$
(12)

The visualisation helps the energy marketplace gain insights into the households' energy consumption, production, trading habits, and behaviours. This way, the smart energy providers can anticipate their ROI by performing granular predictions on in-home and community-level energy production and consumption. Furthermore, they can trade their excess energy with their neighbourhood. They compensate their energy bills using the tokens generated from sharing their data and trading energy with target groups of clients in specific communities.

The area chart in Figure 3 represents the different ROI types, including the total ROI, the ROI for energy consumption, and the ROI for heating consumption. This chart shows the critical factors for the energy marketplace long-term success, as the difference between energy and heating consumption ROI. It also gives insights on a business opportunity based on user engagement in heating versus energy consumption. The data set is provided by the energy market application [29].
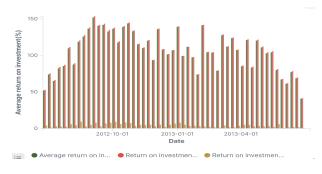

Fig. 3. Area chart visualisation of the energy marketplace ROI.

We identified several essential metrics for calculating the energy marketplace engagement rate.

- **Transferred asset** represents the amount of energy in kW bought or sold.
- **Price per kW** quoted by the energy producer when selling the energy is part of the smart contract between the producer and consumer, who aggregates to the quoted price.
- **Transaction type** is a tag for differentiating buying or selling transaction type.
- **Energy earning** from the energy trading is the difference between the transferred asset multiplied with the price per KW when selling energy and the transferred asset multiplied with cost per kW when buying energy (per transaction after specific time interval).
- **Total energy earning** represents the entire making from the energy trading, calculated as the sum of all **energy earnings** after a specific time interval.

The energy marketplace engagement rate is the ratio between the energy and the total energy earnings, as shown in equation (13)

$$Engagement\ Rate = \frac{Energy\ earnings}{Total\ energy\ earning} \cdot 100.$$
(13)

Figure 4 depicts the energy marketplace engagement rate depending on the user earning from the energy trading and the total resulting energy earning.
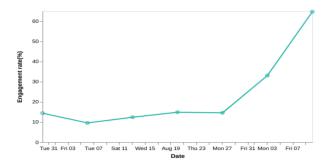

Fig. 4. Engagement rate increase based on energy earnings and total energy earnings per service.

V. DISCUSSION AND CONCLUSION

Business intelligence analyses the financial indicators and tools for revenue tracking. TAC [27] can reveal the quantitative metrics for a sharing economy by calculating the investment to estimate the potential profit. Understanding the new trends of businesses socialising on the Internet and analysing qualitative aspects of social collaboration can bring revenues that bring popularity to this technology.

The newly defined ROC metric, implemented by a ROC microservice that helps 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.It estimates stakeholders' channel monetisation as a new innovative quantified value by engaging users with trusted content. By incrementing the users' collaboration, the stakeholder potentially increases the revenue through the ROC valorisation. TAC uses this principle of engagement rate measurements and provides visualisation insights for stakeholders to choose the appropriate track for boosting their business. ROC represents a significant shift and ensures that providers take advantage of the distributed social media sharing economy.

ACKNOWLEDGMENT

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