Big Social Network Data and Sustainable Economic Development

Umit Can [1],* and Bilal Alatas [2]

[1]   Computer Engineering Department, Munzur University, 62000 Tunceli, Turkey
[2]   Software Engineering Department, Firat University, 23119 Elazig, Turkey; balatas@firat.edu.tr
*   Correspondence: ucan@munzur.edu.tr; Tel.: +90-555-844-5537

Abstract: New information technologies have led to the rapid and effective growth of social networks. The amount of data produced by social networks has increased the value of the big data concept, which is one of the popular current phenomena. The immediate or unpredictable effects of a wide array of economic activities on large masses and the reactions to them can be measured by using social media platforms and big data methods. Thus, it would be extremely beneficial to analyze the harmful environmental and social impacts that are caused by unsustainable business applications. As social networks and big data are popular realms currently, their efficient use would be an important factor in sustainable economic development. Accurate analysis of people's consumption habits and economic tendencies would provide significant advantages to companies. Moreover, unknown consumption factors that affect the economic preferences of individuals can be discovered and economic efficiency can be increased. This study shows that the numerous solution opportunities that are provided by social networks and big data have become significant tools in dynamic policy creation by companies and states, in solving problems related to women's rights, the environment, and health.

Keywords: social networks; big data; big data analysis; sustainable development

1. Introduction

New information technologies have led to the rapid and effective growth of social networks. Initially aimed at establishing communication between individuals or groups, these platforms are currently used by millions of people to express their political views, personal emotional states, or economic preferences. The data produced by these platforms have reached to an unbelievable magnitude. This large amount of data has increased the value of the big data concept, which is one of the popular and rapidly developing phenomena currently. Big data has started presenting new solutions to the challenges in many areas by helping in the development of new methods. One of these areas is sustainable economic development, which contains solutions to various issues in the world. Even though there are multiple definitions of sustainable economic development, the most frequently used definition is as follows: "a development model that meets the requirements of the present without compromising the ability of future generations to meet their requirements" [1]. In other words, it signifies the planning of present and future life and development, such that it will allow for the requirements of future generations to be met by maintaining a balance between human beings and nature without exploiting natural resources until they are exhausted. Hence, sustainable development constitutes an extremely critical issue for a sustainable economy, for the environment and for society, and to provide a livable world that can meet the requirements of future generations. Several policies have been developed to achieve sustainable economic development. Big data, big data analysis tools, and social network analysis, which are products of technology in the 21st century, have acquired new and significant roles as tools for achieving sustainable economic development.

The emergence of big data analysis capabilities has further increased the value of big data that is generated by social networks and has led to the concept of big social networking. The fact that billions of people can instantly share content including sports, economy, politics, and environment is extremely crucial in terms of the comprehensiveness of information. These data groups, which indicate the trends of large groups of people, can be analyzed through big data facilities. The results of this analysis can be used as a new tool to develop effective sustainable investment policies and policies and strategies in areas such as environment, health, and women's rights. The world economy has been growing since the Industrial Revolution. Its influence on environment and nature became more visible by the end of the 20th century. The inability of the world's resources to respond to this growth is the reason for the increase in poverty, inequalities, and conflicts. Hence, sustainable development has become critical in this context. It is significant in the economic sense and in terms of social norms to provide a fair and controllable approach, and model to meet the requirements of future generations. Widespread communication in social networks and all of these dimensions with big data analysis tools makes understanding billions of people's ideas and reactions easier. Thus, it is possible to create policies to meet these requirements, and this will help consumption to be more sustainable. In particular, this study can significantly contribute to sustainable development being discussed in the context of the 2030 sustainable development objectives [2], which the United Nations (UN) has set as global objectives.

Big data is a popular phenomenon aimed at providing alternatives to conventional solutions based on databases and data analysis. In addition to providing data storage and data access, big data aims to perform analysis to produce required solutions, comprehend data, and realize its value. Big data refers to data sets with sizes of the order of terabytes, petabytes, and even exabytes. As these data sets are so large, efficiently storing, managing, and analyzing them is beyond the capabilities of average database software tools [3]. New technologies have resulted in a high-level increase in current data volume and types, and have created unprecedented possibilities for informing and transforming society, and for protecting the environment. States, corporations, researchers, and citizens are attempting to become familiar with the new data world via experiences and innovations. This change is referred to as the data revolution [4]. Prior to the great data revolution, companies could not store all of their archives for long periods of time and effectively manage large data sets. Conventional technologies have limited storage capacities and inflexible management tools, which are considerably expensive. Their lack of scalability, flexibility, and performance has been resolved through new technologies in the context of big data [5].

The effect of social networks on sustainable development has been demonstrated by a few studies. However, the concepts of big data and facilities have not been discussed in these studies.

Willard Terri presented the impact of social networks on managing sustainable development. In general, the discussion included how individuals interested in sustainable development would use social networks, how communities and groups would benefit from social networks during their decision-making processes, and how the capabilities of social networks would be developed in sustainable development processes [6].

Herry and Vollan [7] conducted a study regarding sustainability science literature and discussed social networks. They proved that shortcomings still exist with regard to social networks and sustainability. The conclusions of their study are as follows:

1. Social relationships (and therefore social networks) are important in numerous sustainability issues, such as transfer of knowledge, cooperation and management of shared resources, and the creation of policies aimed at influencing behavior.
2. Concepts of networks emerge in relation to the following three difficulties in sustainability: associating knowledge with action, developing collective action, and encouraging social learning. Practical strategies can be developed to better understand the structure and dynamics of networks and to solve or manage these problems.

3. Networks can be conceptualized as structural limitations that make interactions (such as participating in shared spaces) or social processes (such as cooperating in or coordinating shared activities, sharing resources, or influencing the comprehension or behaviors of network members) possible.

The methods employed to solve various social network analysis issues can be used to handle extremely big social network data to realize the objective of sustainable development. Thus, the purpose of this study is to analyze big social network data using popular big data analysis tools and to demonstrate the effects of data on sustainable development.

The rest of the article is organized as follows: In Section 2, sustainable economic development is described with general dimensions. In the Section 3, general information about social networks is provided. In addition, online social networks, which are the focus of this study, are discussed in detail. The Section 4 discusses big data. Section 5 discusses the potential effects of big social network data on sustainable development. Section 6 presents the conclusions obtained from the study and the direction of future work.

2. Sustainable Economic Development

The concept of sustainable development has been proposed as an alternative to economic process, which began with the Industrial Revolution and continues today, that prevents long-term environmental and social development, and only based on the economic benefit obtained while processing raw materials into finished products. The concept began to be accepted when it was discussed in a number of international meetings, since the 1970s and 1980s. The concept was first introduced by the Limits of Growth report. This report was the first to demonstrate the contradiction between unlimited and uncontrolled growth and the world's limited resources, and it highlighted the options for society to create a sustainable development process that would be consistent with environmental constraints [8]. The second step that led to the development of the concepts of sustainability and sustainable development was the United Nations Conference on the Human Environment held in Stockholm, United Nations, in June 1972. The concerns about the protection and improvement of the ecological environment inhabited by humans and the transferability of the environment to the next generations were on the agenda. Thus, they constituted a basis for the development of the concepts of sustainability and sustainable development [9]. The concepts of "sustainability of the world system in a balanced manner" and "eco-development", which were introduced to the agenda by Dennis and Donella Meadows, were included for the first time in an official conceptual framework in the "Our Common Future" report, which was published in 1987 by the World Commission on Environment and Development (also known as the Brundtland Commission) [1]. Thus, all of the international organizations that manage the political and economic processes of the world have begun using the concept of sustainable development. The United Nations Conference on Environment and Development (also known as the Earth Summit), which was held in Rio de Janeiro in June 1992, used the conceptual framework of Brundtland Commission's report for sustainability and sustainable development. The Earth Summit is significant because an agreement consisting of five points with international consensus on the concepts of sustainability and sustainable development was declared [10]. Since the Rio summit [11], where sustainable development gained international importance, sustainable development has become a significant global phenomenon. Today, the 2030 sustainable development goals [2] constitute the most updated targets of sustainable development. Even though these goals include various topics, they include the following three dimensions that are generally accepted since the world started discussing and using sustainable development [12]:

- Economical: An economically sustainable system should be able to produce goods and services based on ongoing principles; the economy should manage the government and foreign debts and prevent imbalances between the sectors that would damage agricultural and industrial production.

- Environmental: An environmentally sustainable system should consume resources that are sufficiently stable so that the base of the resources remains, prevent exploitation of renewable resource systems or environmental investment functions, and use only nonrenewable resources if the resources are renewed through investments. In addition, this process should include the conservation of biodiversity, atmospheric balance, and other ecosystem functions that are not classified as economic resources.
- Social: A socially sustainable system should ensure an equal distribution of health, education, gender equality, political responsibility, participation, and the sufficient delivery of social services.

These three dimensions are related to each other and constantly affect each other. Hence, the concept of sustainable economic development does not require only economic success. It is necessary to simultaneously consider the "economic", "social", and "environmental" components for sustainable development. It was at the United Nations meeting in 2015 that the goals outlined in these dimensions of sustainable development were set as new and updated targets for the world. At the most recent UN Sustainable Development Summit held on 25–27 September 2015, the goals of sustainable development for 2030 were accepted with the signatures of 193 countries [2]. Sustainable development should be evaluated in the context of the following goals, and policies should be produced in the direction of these goals:

2030 Sustainable Development Goals

- Goal 1. Ending all kinds of poverty, no matter where they are.
- Goal 2. Ending hunger, providing food safety, developing nutritional resources, and supporting sustainable agriculture.
- Goal 3. Ensuring a healthy life for all people and prosperity for everybody, at every age.
- Goal 4. Providing everybody equally quality education and the possibility of life-long education.
- Goal 5. Providing gender equality in society and strengthening the social status of women and girls.
- Goal 6. Ensuring the availability and sustainable management of water and sanitation for all.
- Goal 7. Providing accessible, reliable, sustainable, and modern energy to everyone.
- Goal 8. Ensuring sustainable and inclusive economic development and ensuring full and productive employment and decent jobs for human dignity.
- Goal 9. Constructing durable infrastructure and encouraging sustainable and inclusive industrialization and new inventions.
- Goal 10. Reducing inequalities in and between countries.
- Goal 11. Making cities and human settlements strong, secure, and sustainable.
- Goal 12. Providing sustainable consumption and production.
- Goal 13. Taking emergent steps to address climate change and its impacts.
- Goal 14. Protecting oceans, seas, and marine resources for sustainable development and using them in a sustainable manner.
- Goal 15. Preserving and restoring terrestrial ecosystems, ensuring their sustainable use, and addressing desertification.
- Goal 16. Encouraging peaceful and embracing communities for sustainable development, ensuring access to justice for everyone, and establishing effective, accountable, and embracing institutions at every level.
- Goal 17. Strengthening the application tools of global partnership for sustainable development and reviving global partnership.

3. Social Networks

Towards the end of the 20th century, approximately between 1997 and 2000, the internet became highly widespread and revolutionized a considerable part of our economic and social life [13]. This change had a significant impact on online social networks. This was because the internet provides

important communication means. This communication opportunity created social networks, which are a part of the internet revolution, and made them extremely influential. In a general sense, a social network is a social structure composed of individuals and organizations [14]. Any community or social interaction unit can be defined as a social network in a particular manner. Theoretically, a social network is defined as an (*N*, *R*) graph, where *N* is the node cluster that represents individuals (persons, organizations, countries, etc.) and *R* is the cluster of edges (or connections) that constitutes relations [15]. In other words, a social network is a social structure that is composed of nodes (generally individuals or institutions) that are connected to each other with one or more than one type of dependency, such as values, visions, ideas, financial change, friendship, kinship, being unloved, conflict, or trade [6]. Figure 1 shows the diagram of a simple social network.
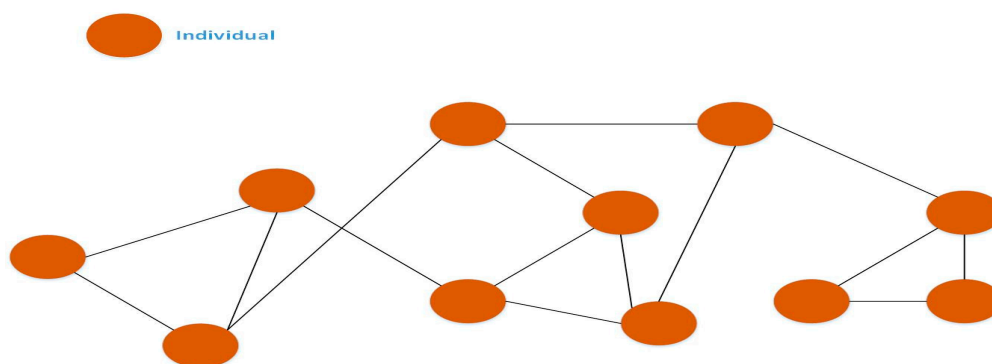

Figure 1. Social network diagram [16].

In this study, we use online social sites and a new concept of social networks, which have emerged through technology, instead of a definition. These social networks are a type of social media and involve social networking sites. They enable internet users to connect with people and create knowledge [17]. The collective adoption of online social network sites has changed the manner in which people convey and share knowledge, how establishments activate and compete, and how politicians make policy [18]. By virtue of these social networks, it is currently possible to analyze revealing confidential information, such as who would be the new crime focus, observing the spread of any disease, and what are the important political views [15]. Various applications have emerged along with the widespread utilization of social network data. Moreover, online social networks produce a vast amount of text and multimedia content that express a large number of views [18].

Social media analysis refers to the analysis of structural and nonstructural data obtained via various social media channels, and obtaining various results. Social media can be classified as follows: social networks (Facebook, LinkedIn), blogs (BlogSpot, WordPress), microblogs (Twitter, Tumblr), social news (Digg, Reddit), social bookmarks (Delicious, StumbleUpon), media sharing (Instagram, YouTube), Wiki (Wikipedia, Wikihow), question & answer sites (Yahoo! Answers, Ask.com), and comment sites (Yelp, TripAdvisor) [19,20]. Several of these sites either directly or indirectly refer to a social network.

Social networking sites have reached incredible amounts of users. For example, according to Twitter statistics, Twitter has 310 million users and 40% of these users are technical people [21]. In addition, according to 2017 data, YouTube has more than one billion users globally, and it has more viewers than any TV network in the United States of America in the age group of 18–34 years. YouTube is localized in 88 countries, and it is accessible in 76 different languages. Videos are being watched for 1 billion hours per day [22].

Figure 2 shows the number of active users of popular social networks throughout the world, according to a statistics report produced in August 2017. Market leader Facebook became the first social network to exceed 1 billion registered accounts, and it currently has 2.047 billion active users per month. The seventh-ranked photo sharing application, Instagram, has 700 million active accounts per month, and blogging service Tumblr has more than 357 million active blog users.
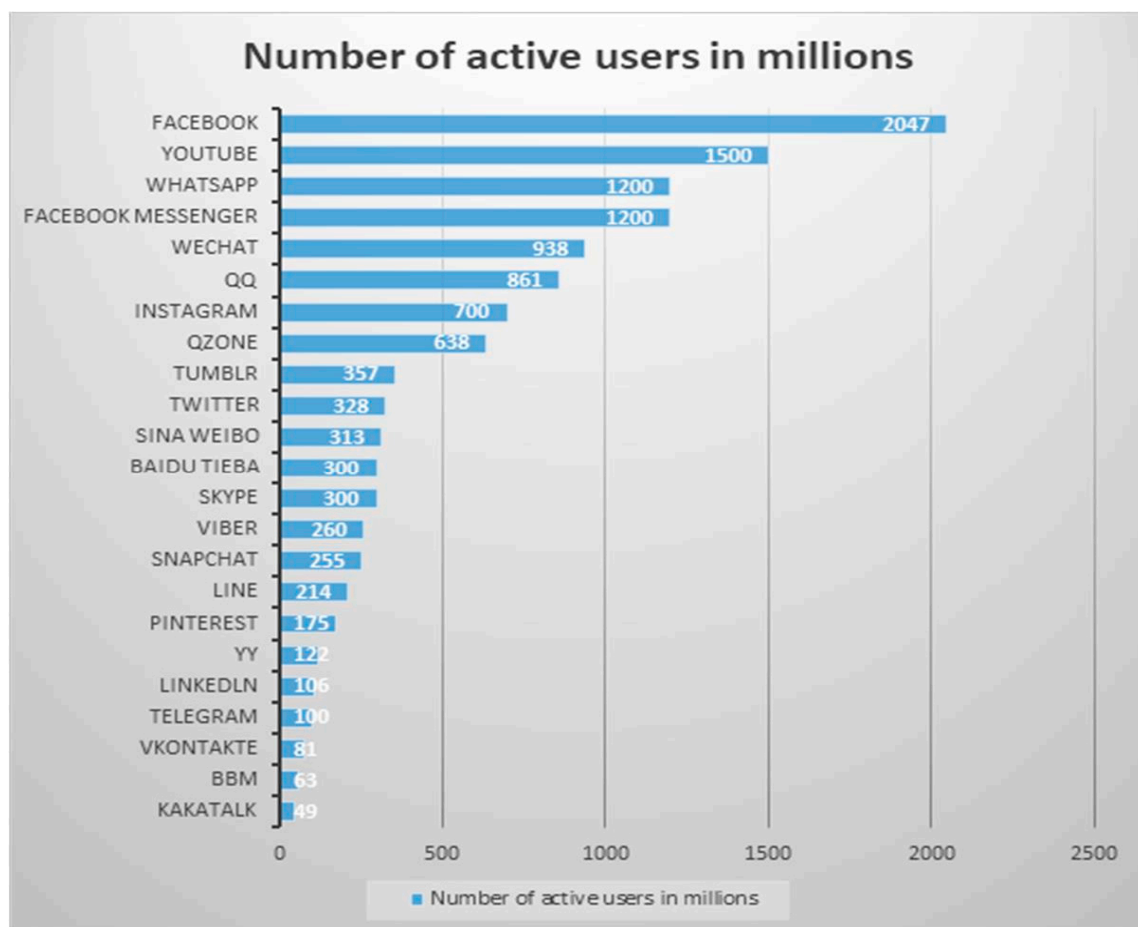
Figure 2. Number of active users of social network sites (August 2017) [23].

The figures stated in above graph are important as they show the dimensions of social networks established by social network platforms worldwide. The number of individuals interacting via these platforms is extremely high, and this number is increasing daily.

4. What Is Big Data?

Data collection and benefiting from this data has been one of the important fields throughout the history of humanity. In the beginning, the scarcity of data relatively facilitated obtaining knowledge from data. The slow data collection process underwent a significant change in the 21st century, owing to the digital revolution, and almost had a revolution within itself. Computers have allowed for data production in extremely short periods and for the storage of large amounts of data. Such data would normally be produced in tens of years. The size of collected data considerably increased again in the 21st century as a result of technological development. This initiated the big data era referred to as the petabyte era.

The concept of big data was first introduced by Francis X. Diabold in 2000 [24]. Subsequently, the developments in the internet made big data extremely important. The rapid development of sensors, wireless communication and network communication technology, cloud data processing, and smart mobile devices and the affordability of these devices enabled them to become more widespread. Thus, a large amount of data is accumulated almost in all fields of our lives. Moreover, data volume rapidly continues to increase via more complex structures and forms [3,25]. Large amounts of data are being produced by all devices that can connect to a network, such as social networks, financial markets, and connections with web servers, smart phones, tablets, credit cards, trains, and planes. While 100 GB

of data were generated per day in 1992, this increased to 100 GB per hour in 1997 and 28.875 GB per second in 2013. It is presumed that this amount will increase to 50.000 GB per second in 2018 [26].

In parallel with the increasing amount of data, establishments all around the world began recognizing that the skills required to analyze and use big and complex datasets would be the most important source of competitive advantage in the 21st century. Big data has the potential of offering a better customer experience, increasing internal productivity, and consequently, improving the profitability and competitive advantage of establishments in all industries. Organizations can use big data to become smarter and more innovative through methods that were not possible prior to the "zettabyte era" [27].

According to data obtained from IBM, more than 50% of the population of the US owns smartphones, and the total number is expected to be 10 billion in 2020. Two hundred and ninety four billion emails are sent per day, and more than 1 billion searches are performed on Google every day. The size of the data produced by users on Facebook is more than 30 petabytes per day. There are more than 230 million tweets per day on Twitter. However, only 23% organizations use big data strategies [28].

According to another study, the amount of data produced in 2020 will be exactly 44 times of the amount that was produced in 2009 [29]. Every hour, the operations of Wal-Mart customers provide approximately 2.5 petabytes of data to the company, and Wal-Mart is mentioned in social networks approximately 300,000 times per week [30].

Owing to the interesting information obtained from big data, numerous actors in different countries have initiated important projects. The USA was one of the first leading countries to realize the benefits of big data. In March 2012, the Obama administration commenced big data research and development, with a budget of 200 million dollars [31]. In Japan, big data development became an important element of the technological strategy in July 2012 [32]. Furthermore, the United Nations published a paper titled "Big Data for Development: Challenges and Opportunities". This paper aims at outlining the main concerns regarding big data and improving the discussion on how big data would serve international development [33].

4.1. Big Data and 4V's

Big data was initially explained by 3V's, i.e., volume, velocity, and variety. Subsequently, the "value" dimension was added to the concept of big data. Thus, big data is currently explained by 4V's. Figure 3 shows the volume, velocity, variety, and value dimensions. These dimensions are discussed below.
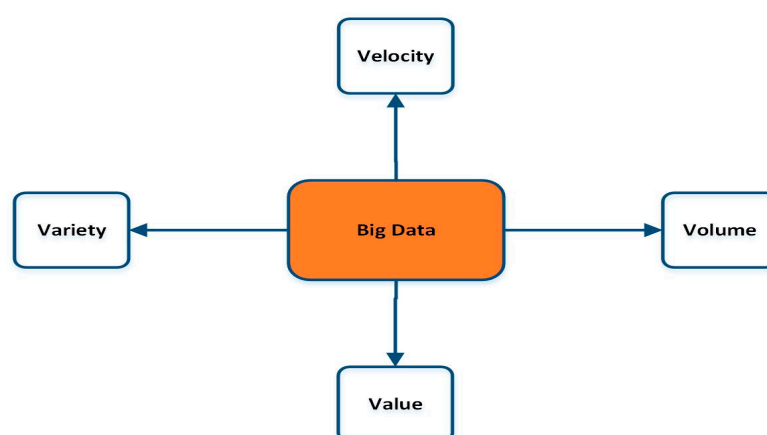

Figure 3. Big data and 4V's.

4.1.1. Volume

Volume refers to the data collected and/or produced by an organization or individual. Big data requires the processing of social network data, clicks on a web page, web traffic, and the high-volume and low-intensity data obtained by sensors that capture the data at the speed of light, the value of which is unknown [34]. While the current threshold for big data is 1 terabyte, the minimum size that would be qualified as big data can be defined as a function of technological development. One terabyte of data refers to an area where approximately 16 million Facebook pictures can be stored, and this refers to the data that would fit into 1500 CDs or 220 DVDs [35].

4.1.2. Velocity

Data are obtained at a certain velocity. High-velocity data typically flow in memory instead of being saved to a disk. The Internet of Things applications consist of health and security sub-applications that require real-time evaluation and processing. In addition, other smart products that can access the internet are managed in real time or close to real time. For example, e-commerce consumer applications merge the locations of mobile devices with consumer preferences and aim at providing offers when required. Operationally, mobile application experiences have broad user masses, increasing network traffic, and instant response expectation [34]. For example, Wal-Mart (an international discount retail chain) produces more than 2.5 petabytes of data per hour via the transactions of its customers. YouTube is a good example that shows the velocity of big data [5].

4.1.3. Variety

Variety refers to new unstructured data types. Unstructured or semi-structured data types, such as text, voice, and video necessitate additional processing to obtain meaning and supportive metadata. If unstructured data are comprehended once, they satisfy most of the requirements of structural data, such as summarization, ancestry, controllability, and confidentiality. The data obtained from a known source become more complex when altered without prior notification. Frequent or real-time schema changes create a huge burden for processing and analytical environments [34]. Big data is composed of more than one form of various sources (e.g., videos, documents, comments, and journals). Big data sets are composed of public or private, local or distant, shared or confidential, completed or missing, and structured or unstructured data [5].

4.1.4. Value

Data have value; however, this value must be discovered. Several research techniques are used to obtain value from data. Technological developments have led to an incremental decrease in data storage and computing expenses, and thus provided abundant data related to statistical sampling and other techniques to derive meaning. However, finding value requires new discovery processes that involve smart analysts, users from the business world, and administrators. The real big data challenge implies asking the right questions, recognizing patterns, making conscious assumptions, and predicting behaviors [34].

4.2. Big Data Analysis Tools

Big data comprises large amounts of multidimensional unstructured, semistructured, and structured data. Big data has become a production factor, and this amount of data cannot be processed using classic methods anymore. The most popular technology used to analyze and process big data today is Hadoop [36], an open source software. The biggest advantages of Hadoop are its ability to process big data rapidly and the fact that it is free. Many distributors, such as Cloudera [37] and Hortonworks [38] provide big data platform services by using the Hadoop framework. These distributors provide a simplified Hadoop experience to users by combining various Hadoop components together.

The Hadoop project contains many separate subprojects. Big data can be processed easily under these different projects, and various conclusions can be drawn.

The Hadoop project involves the following main modules:

- Hadoop Common: Common tools that support other Hadoop modules [36].
- Hadoop Distributed File System (HDFS): A distributed file system providing high-efficiency access to application data [36,39].
- Hadoop YARN: A framework for business planning and cluster source management [36].
- Hadoop MapReduce: A YARN-based parallel processing and programming model used for processing big data sets and producing information from them [36,40].

Other Hadoop projects:

- Ambari: A web-based tool containing support for Hadoop HDFS, Hadoop MapReduce, Hive, HCatalog, HBase, ZooKeeper, Oozie, Pig, and Sqoop projects and for enabling one to monitor and manage Apache Hadoop clusters. Ambari also provides a dashboard to monitor heat maps and applications like MapReduce, Pig, and Hive and to display the cluster efficiency [36].
- Avro: A data serialization system [36].
- Cassandra: A distributed, open source, unrelated, column-oriented database that was developed by Facebook to store a vast amount of structured data [41].
- Chukwa: A data collection system used for managing big distributed systems [36].
- HBase: A scalable and distributed database supporting structural data storage for big tables. Google's BigTable is an important Apache-Hadoop-based project that was developed recently and modelled using HBase. Hbase adds a fault-tolerant scalable database that is installed and distributed on an HDFS file system and that has random real-time read/write access [36,42].
- Hive: A data warehouse built on Hadoop that enables summarizing, querying, and analyzing big data clusters stored in Hadoop files. It is not designed to offer real-time queries; however, it may support text files and queue files [43].
- Mahout: A scalable machine learning and data mining library. Mahout currently focuses on algorithms for clustering, classification, data mining (frequent item set), and evolutionary programming [36,44].
- Pig: Provides a high-level parallel mechanism to execute MapReduce works on Hadoop clusters. It uses a command file language called Pig Latin; the data streaming language is collaterally directed to data processing [43].
- Spark: A fast and general calculation engine for Hadoop data. It provides a simple and effective programming model that supports a wide range of applications such as Spark, ETL, machine learning, stream processing, and graph calculation [36].
- TEZ: A generalized data stream programming framework installed on Hadoop YARN that provides a powerful and flexible engine to execute the directed acyclic gap (DAG) of tasks to process data for collective and interactive usage [36,45].
- ZooKeeper: Provides a high-performance coordination service for distributed applications [36].

Figure 4 [34] shows general details about the information management platforms.

Big data comprises unstructured, semistructured, and structured data. Big data mainly consists of unstructured data of types such as text, image, video, and audio. Semistructured data are produced by machines. Structured data mainly include transaction data.

As shown in Figure 4, when various types of data are obtained from many sources, they can be directly (in real time) written to memory processes or to disk as messages, files, or database processes. After obtaining the data, more than one option is available to keep them. They can be written to a file system or to distributed cluster systems, such as traditional RDBMS, NoSQL, and HDFS. The basic techniques used to rapidly evaluate unstructured data include Running Map

Reduce (Hadoop) and Memory Map Reduce (Spark). Additional evaluation options are available for real-time data streams. The integration layer in the middle is (while being organized) comprehensive and provides an open import, data store, data warehouse, and analytical architecture. The data can be analyzed using various tools. The business intelligence layer (under decision) contains interactive, real-time, and data modelling tools. These tools can leave a vast amount of data in their place and query, report, and model data. Along with traditional components, such as reports, dashboards, warnings, and queries, these tools also include advanced analytics, statistical analysis of a database or reservoir, and advanced visualization [34].

Big data management tools and analysis methods are greatly important today because they enable the analysis of data that is otherwise impossible to handle owing to its various dimensions. These tools and methods can be used to obtain new results from such data.
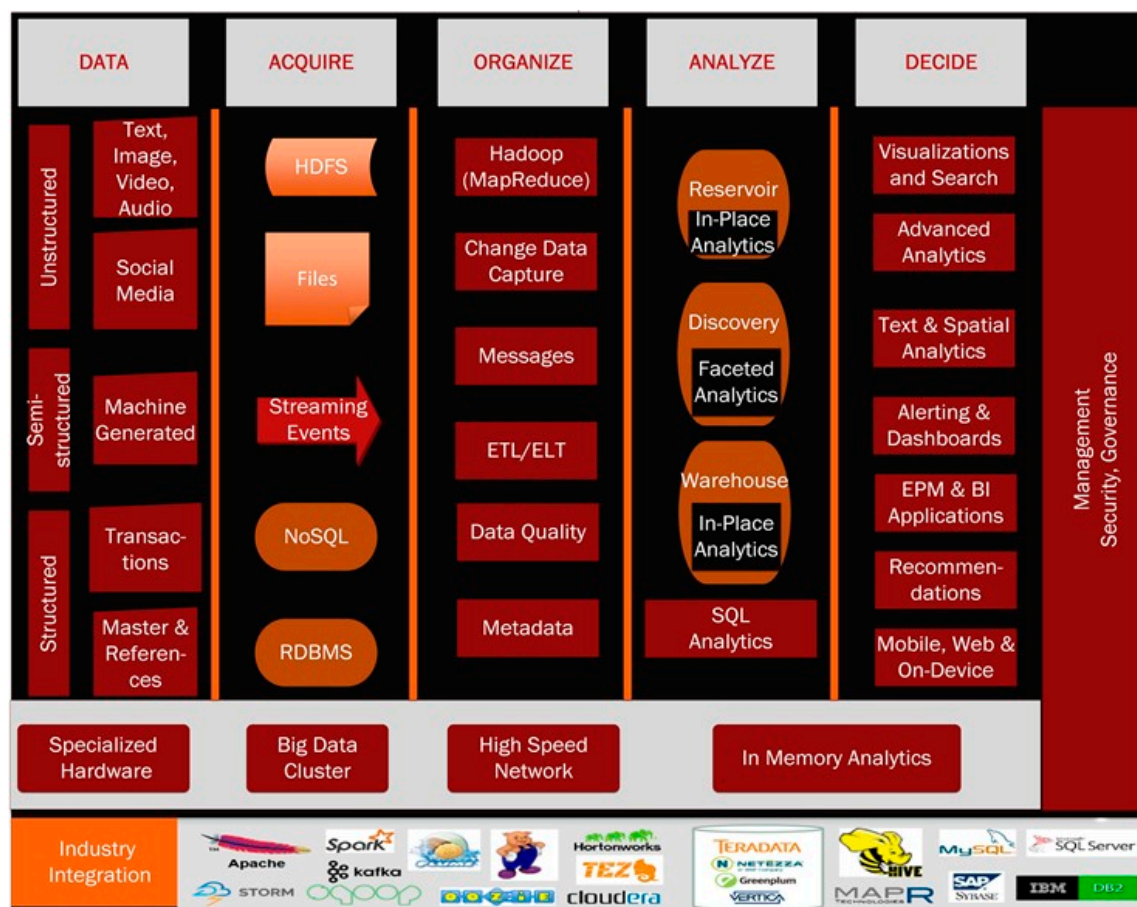

Figure 4. Big data and consolidated information management [34].

5. Big Social Network Data and Sustainable Development

Sustainable development has emerged as an important issue worldwide with industrialization and technological developments. Therefore, it is imperative to discuss this concept from different viewpoints and to develop it in parallel with new technological developments. One of the most important new technological developments was the widespread use of the internet at the turn of the century. Later, online social networks were developed; these can greatly influence sustainable development and are also responsible for producing big data, which is an important economic parameter. This study focuses on the large amounts of data (i.e., big data) produced on social networks, how new technological resources can be used to gauge the vast majority's opinions, and how this would affect sustainable development. Big data can provide very valuable information once it is

analyzed. In fact, in 2012, attendees of the World Economic Forum held in Davos, Switzerland, declared big data to be a strategic economic resource, which is as important as money and gold [25,46].

In the most recent report prepared by the Independent Expert Advisory Group (IEAG) [4] under the UN Secretary General, the data revolution for sustainable development was defined as producing more detailed and high-quality information to encourage and monitor sustainable development by combining the data that was obtained from new technologies with traditional data. It clearly reemphasized the importance of big data by declaring that access to data should be improved to produce better policies and decisions to obtain better results for humans and our planet and to provide more participation, accountability, and transparency.

5.1. Effect of Big Social Network Data on Developmental Goals

The concept of big social data is very important because it affords possibilities, such as involving billions of people worldwide, providing a communication network between them, rapidly revealing real-time solutions by evaluating immediate data streams with big data analysis tools, and making suggestions and predictions by using these results to determine sustainable development policies, generate new policies, and dynamically shape them when needed. Big social network data may play an important role in generating a clearer and more up-to-date picture of the world, planning required policies and programs together, monitoring and assessing these programs, and evaluating the processes of sharing resources that could affect people's lives and influence political decision-making [4]. Social networks are quite important in many sustainability issues, such as information transfer, cooperation on management of shared resources, and the formulation of policies aimed at influencing various behaviors [7].

Many social network analysis methods can be used for this purpose. These methods, although still very new, are already very popular. Methods used for network analyses, such as anomaly detection [47], discrimination discovery [48], opinion leaders detection [49], event detection [50], role mining [51], rumor propagation detection system [52], conflict detection [53], and topic detection [54], can also greatly contribute in the field of sustainable development.

5.1.1. Helping Companies Invest in Accordance with Sustainable Development Policies

Big social networking data can contribute to the promotion of investments because they may enable companies to invest or encourage investing in accordance with sustainable economic objectives by using social network analysis facilities. In addition, these data may contribute to the prevention or rehabilitation of investments that are unsuitable for this objective. This means that investments that can permanently damage natural resources can be prevented; therefore, this will influence the efficient use of economic resources and the sustainability of existing investments. Nowadays, large numbers of people can directly influence companies and their image and investments through social media. In other words, social media has become a preferred and inexpensive marketing tool that encourages communication among companies and consumers, thus liberating communication to a hitherto unseen extent. Customers have made social media a marketing tool by expressing their views about the community and their reactions. Social media has become a channel that allows for companies to address its customer's concerns and questions and to interact with its customers. When it is used effectively, it can contribute to brand building [55]. Brand building on social media may be oriented toward sustainable development. Therefore, companies can enjoy great opportunities for customer interaction when formulating sustainable policies.

Today, communicating with customers via social media has become an integral part of functions, such as marketing, public relations, and customer services [56]. Companies consider social sharing networks as the perfect tool for spreading marketing information, attracting new customers, or merely obtaining valuable feedback from dissatisfied customers [57].

Technological developments in big data infrastructures, analytics, and services have allowed for companies to transform themselves into data-driven entities. Owing to its great potential, big data

has been portrayed as a factor that has changed the rules of the game, and therefore, companies have improved their capacity to use big data to compete in the market [58]. All social networking and big data facilities help companies to be updated in terms of sustainable policies and to generate dynamic economic policies.

Similarly, states, related institutions, and nongovernmental organizations that are striving to produce sustainable development policies can also contribute to the formulation of policies and sustainable investments by using big social network data and analysis opportunities. Big data analysis allows for large quantities of data to be analyzed both retrospectively and instantly, and to reveal undiscovered information and even unknown parameters. For example, thousands of tweets from various accounts over a certain period can be analyzed rather than 50,000 tweets on a topic per day. In addition, big social network analysis is related to many different social network challenges that are unique to them. For example, the rumor propagation detection system [52] usually addresses the problem of finding an expansion of false information in social networks. As the number of social media tools increases, the amount of information and its spread is increasing, and therefore, information is increasingly exposed to modification and deterioration [59]. It is possible to quickly find information that supports investments that are unsuitable for sustainable development policies or that aim to produce such policies. After defining wrong policies, we can produce campaigns and policies against them. This approach may provide serious opportunities for the adoption of sustainable development policies by society.

Many companies actively use social network platforms. Figure 5 shows the importance of and usage ratio of these platforms by marketers.

The statistical graph in Figure 5 presents worldwide data about social media platforms used by marketers as of January 2017.
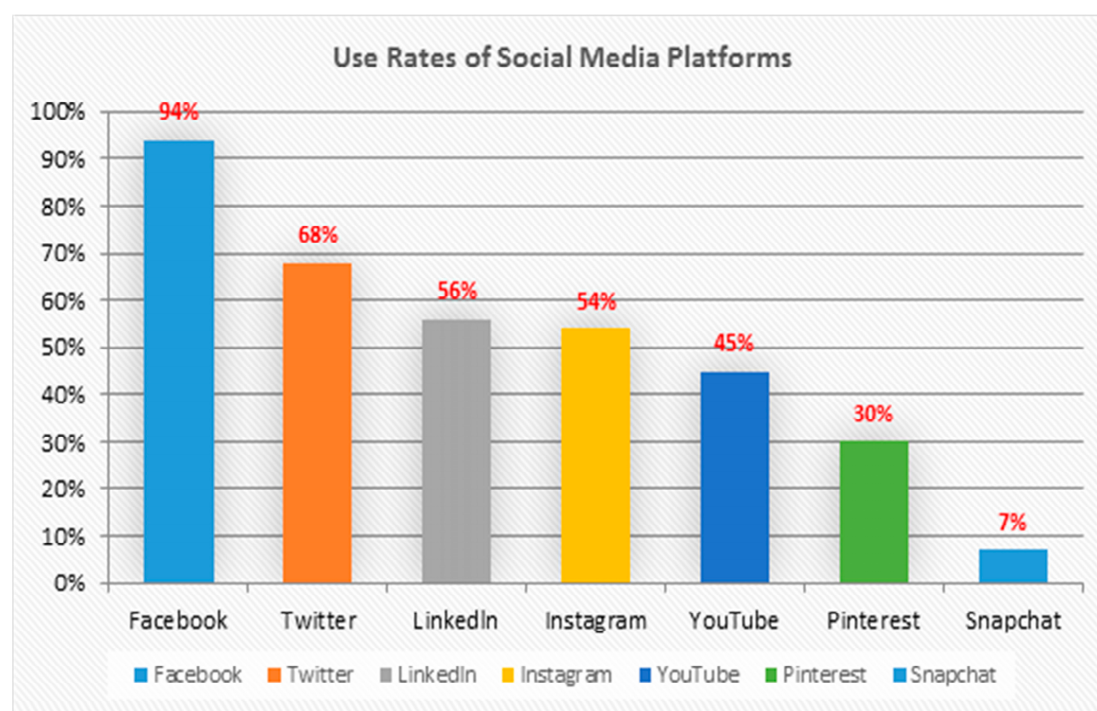

Figure 5. January 2017, usage ratio of social platforms by marketers worldwide.

As of January 2017, 94%, 56%, and 30% of respondents stated that Facebook, LinkedIn, and Pinterest, respectively, were the most important social platform for their establishments [60]. These data show the importance and comprehensiveness of the social platforms and the big data they produce as they enable establishments to rapidly reach more than 2 billion people.

The fact that companies and large numbers of people can reach each other through social networks may lead to the use of more efficient technologies that are suitable for sustainable development in many sectors. When considering the investment size and economic share of the private sector worldwide, private companies clearly have significant influence. For example, the construction sector is on its way to becoming the world's largest energy consumer; it uses 40% of global energy and causes one-third of global greenhouse gas emissions. Thus, campaigns that encourage a sustainable construction industry can be created through social networks, because energy efficiency has increasingly become one of the biggest concerns for a sustainable society [3]. The impact of social networks is huge and can lead the sector in this direction.

For example, Yazdanifard and Yee studied the effects of social network sites on the hospitality and tourism industries. They found that the establishment of a broad communication network through social networks is an important way to rapidly spread knowledge worldwide and to build a brand image. It also becomes easier to reach potential customers who are members of social networks. Finally, they stated that social networks enable people to express their views on companies. All of the above factors affect the hospitality and tourism sectors, making social networks an appropriate tool. Social networks can help make industries, such as tourism, more productive [17], as well as more efficient in terms of sustainable development.

The effective use of social network data would increase productivity in many sectors and contribute to sustainable development. This can have a great impact on economic productivity. This means that the effective use of big social network data might affect and support developmental goals 7–10 specified in the sustainable goals for 2030.

5.1.2. Helping States Formulate Sustainable Policies

Social networks and big data have led to the addition of digital data to the paradigm of the state organization. Big social network data have led to a great revolution and currently have great potential for state structures, which remain awkward, slow to react, and slow in formulating real-time policies that can meet society's needs to renew itself and stay up-to-date. Policy-making is now being actualized in an ever-prospering environment that brings new promises and creates difficulties for policy-makers. Social network data offers the chance to make and implement policies by considering the needs, preferences, and real public service experiences of citizens, and to be citizen-oriented. When citizens express their political views on social network sites like Twitter and Facebook, by rating the service they receive at state institutions or by debating issues on the sites of various social institutions and NGOs, they generate a series of data that state institutions can use to better themselves. Policy-makers can access a wide range of information about citizens' actual behaviors when they interact with government institutions or undertake a number of citizenship commitments, such as signing a petition [61].

These data obtained from social media or via administrative operations also provide new data that can enable government institutions to monitor and improve their own performances by way of daily usage data of their electronic existence or recorded internal transactions. Governments can learn what people say about the government; understand which policies, services, or contractors are subject to negative views and complaints; identify unsuccessful institutions such as schools, hospitals, or contractors; and, use social media data to make automatic improvements. They can obtain such data by using the data on their own sites or that on social networks. They can find out what people worry about or what people are searching for through Google Search APIs that save most users' search terms [62].

These new opportunities that have emerged with technological developments can transform the relationship between the state and the society into a new paradigm. In light of this transformation, if big social network data and analysis opportunities are used for achieving sustainable development objectives, they may lead states to the creation of economically sustainable policies, more equitable education policies, gender equality in government institutions, new policies for protecting the ecosystem, etc. This role of big social networks has begun to be discussed in international institutions, such as the UN. In turn, this has led to the production of related policies. For example,

on 23 September 2016, Twitter and the UN Global Pulse announced a partnership that would provide access to Twitter data tools to support the efforts of the UN to reach the Sustainable Development Goals that were adopted by world leaders last year. Robert Kirkpatrick, the Director of UN Global Pulse, said that "The Sustainable Development Goals are first and foremost about people, and Twitter's unique data stream can help us truly take a real-time pulse on priorities and concerns—particularly in regions where social media use is common—to strengthen decision-making. Strong public-private partnerships like this show the vast potential of big data to serve the public good" [63].

Public institutions can partner with social networks and exploit their capabilities to become more effective and to create more sustainable policies in any field in which government institutions are active. These dynamic policies signify a direct positive contribution to many sustainable development objectives that governments are influencing. These emerging new opportunities carry great hope in terms of government policies.

5.1.3. Contributing to the Protection of Women's Rights

One of the objectives of sustainable development is to strengthen the role of women and girls in social life by ensuring gender equality. This objective includes goals, such as ensuring equal right to education, access to health services, and a safe work environment [64]. Big social network data and its analysis can contribute greatly toward achieving this objective. Current and past communications about women can be collected from social media platforms to help create an image of women's social and economic situation, education and working conditions, and harassment. This information can help in achieving social equality by offering valuable benefits to many institutions that work to strengthen the position of women in society.

For example, the ILO (International Labour Organization) used social media as a tool to monitor workplace discrimination faced by women in the Asia-Pacific region, where gender-based discrimination remains widespread. Female labor participation in this region has increased greatly over the last two decades. This increase has brought along not only sexual and ethnic discrimination, but also sexual harassment. For example, Indonesian women have limited access to employment, face a 35% wage difference, and enjoy unequal employment and education possibilities, as well as professional responsibilities. In the last decade, women's labor participation rate was 50–53%, whereas that of men was 80–83% [65].

Big data provides new and important opportunities to extract real-time information from community behaviors. In Indonesia, social media data mining, especially of tweets, is a good alternative to expensive traditional data collection methods in long-term studies for obtaining new information about workplace discrimination. Together with the Indonesian Government and the ILO, the UN Global Pulse Laboratory in Jakarta tested whether social media supervision would provide indications regarding real-time workplace discrimination against women. They analyzed tweets in the Bahasa language between 2010 and 2013 and found tens of thousands of tweets about work permits, job suitability, workload of working women, and employment discrimination [65].

Because women fear highlighting the injustices at workplaces or institutions where they are working, they may use social media platforms instead, making these platforms the place where accurate information is available. Such projects can provide governments with accurate information on women's working conditions, as well as gender equality.

5.1.4. Contributing to Sustainable Environment Policies

Sustainable environment policies are one of the main elements of sustainable development. It is necessary to leave a healthy environment to live in for future generations. It is very important for environmental policies to be implemented and adopted by the community today as healthy environmental conditions are gradually disappearing. In particular, global warming and climate change are alarming for human life. Big social network platforms have a key role in the implementation

and expansion of these policies, and to measure the community's reaction to them in terms of the number of people reached.

For example, the Asia-Pacific region is one of the most important areas from the viewpoint of climate change. Even though climate change is not a regional priority, to deal with it in regions where it has greater effect, the awareness of people in these regions should be increased. However, sufficient data cannot be obtained using traditional data collection tools to increase the awareness and participation of people to solve the problem of climate change. Global Pulse and the Secretary General's Climate Change Support Team created a tool to monitor real-time social media interactions before and after the 2014 Climate Summit. Daily tweets on climate change and related issues in English, French, and Spanish were examined. These tweets helped to measure the pulse of the community and to produce new policies [66].

Nwagbara's work considered the position of the Niger Delta, which has strategic importance in the socioeconomic and political development of Nigeria in the supply of global energy. He stated that environmental sustainability in this region should be urgently monitored, social media tools should be used effectively for this purpose, and sufficient efforts should be made in the struggle against climate change for a more sustainable future. This study mentions criticisms against sustainability commitments by the shareholders of multinational companies in shaping corporate social responsibility (CSR) policies and lays the emphasis on the role of communication in the formation of immaterial assets, such as corporate reputations. Owing to corporate pressures along with climate change and the pressure of social media technology, this article suggests that communication on social media should be used to advance the CSR obligations of multinational companies toward a more sustainable future in the Niger Delta in Nigeria [67].

5.1.5. Contributing toward Sustainable Development Goals in Healthcare

Another goal of sustainable economic development is to ensure that people live a healthy life and that people of all ages prosper [68]. In 1992, the World Health Organization defined development as "the process to improve the quality of life for humans"; furthermore, attainable standard of health was defined as "one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" [69,70]. The 2030 targets for sustainable development objectives include, reducing child mortality, protecting maternal health, and combating diseases such as malaria, tuberculosis, polio, and HIV/AIDS. In this context, big social networking platforms allow for people to access platforms on health without making any distinction on economic or social condition. Thus, big social data may contribute toward achieving sustainable development objectives in health and other areas. Because people share their experiences about health problems through social networks, these networks can play a significant role in informing the masses. In addition, by increasing awareness about protective health measures, which is an important factor in the prevention of diseases, the possibility of infection may be reduced. The analysis of social media communications about diseases, such as malaria, tuberculosis, polio, and HIV/AIDS, may help to take effective decisions regarding sustainable objectives. In addition, it is conduct a social-media-based campaign against these diseases. These measures will contribute greatly to the health policies stated in the sustainable development objectives.

Google used big data analysis to measure the spread of flu and claimed that current public services could warn people about flu epidemics two weeks in advance. They detected a direct proportion between the searches that were made on relevant search engines by millions of people, and the occurrence of illness. If the public and the authorities can be warned in advance, it would provide a great advantage in preventing the potential increase of flu incidents [71]. In today's highly connected world, social media provides a data point on people searching about a flu epidemic by monitoring how people search about symptoms. In fact, social media, mobile phones, and other means of communication have provided a portal for providing information to the public by opening a two-way road in healthcare investigations and also enabled people to express their concerns, locations,

and physical movements [72]. A study conducted by ICF Macro consulting company on behalf of the Toxic Substances and Illnesses Organization Agency in China regarding two environmental health issues, perchlorates found in baby food and mold on dry walls, determined that the obtained results matched blogs, Facebook posts, and published official reports on the same topics [73]. In another study, Twitter data were used to try to detect flu trends in real time. Early diagnosis is very important to fight against epidemics. The traditional approach used by the Centers for Disease Control and Prevention (CDC) involves collecting influenza-like illnesses' (ILI) activity data from medical practices. This introduces a delay of 1–2 weeks between a patient's diagnosis and the entry of this information into reports. In this study, a framework to monitor the flu epidemic and make relevant guesses is recommended by examining tweets under the name of Social Network Enabled Flu Trends (SNEFT). The comparisons showed that tweets and illness ratios in the reports agreed with each other [74].

If early disease detection is possible using social network analysis, early protective measures can be taken to save the millions of dollars that are otherwise spent on these diseases, and these resources can instead be spent on improving human health. In addition, policies that are consistent with sustainable development goals can be organized by analyzing big social network data.

6. Conclusions

In this study, by discussing the concept of social networks and big data together, the contribution of new data analysis opportunities that have emerged with recent technological developments to the 2030 sustainable development objectives is discussed. Unlike previous studies, in addition to the topics of sustainable development and social networks, the issue of big data, which has become significant today, is also discussed. The concept of big social data is evaluated as a parameter that may influence sustainable development. The prominence of big social networking data in sustainable development is revealed by explaining companies' investment policies and the dynamism of state policies through examples such as women's rights, sustainable environment, and health.

Moreover, it is proved that the use of solutions that have been used for resolving various social network analysis problems for achieving sustainable development objectives and handling big social data will contribute directly or indirectly to every sustainable development objective. It is now essential to analyze social network platforms using big data analysis tools to obtain effective results. However, few studies and analyses have focused on big social network data for sustainable development objectives. In the future, many disciplines have to analyze social network data using big data tools to better understand the discipline and make correct predictions in a given field. Such analyses can also provide real-time results that measure the community's pulse as never before. This advantage of big social networks will be a significant factor in the establishment of a sustainable world economy.

Author Contributions: The research was conceived and designed by Umit Can and Bilal Alatas. Bilal Alatas studied social networks and big data and contributed to the related sections. Umit Can contributed to the introduction and the sections on big social network data and sustainable development.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. UN Documents, Report of the World Commission on Environment and Development: Our Common Future. Available online: http://www.un-documents.net/wced-ocf.htm (accessed on 25 September 2017).
2. Sustainable Development Knowledge Platform, Transforming Our World: The 2030 Agenda for Sustainable Development. Available online: https://sustainabledevelopment.un.org/post2015/transformingourworld (accessed on 5 September 2017).
3. Koseleva, N.; Ropaite, G. Big Data in Building Energy Efficiency: Understanding of Big Data and Main Challenges. *Procedia Eng.* **2017**, *172*, 544–549. [CrossRef]
4. A World that Counts: Mobilizing a Data Revolution for Sustainable Development. Available online: http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf (accessed on 20 September 2017).

5. Oussous, A.; Benjelloun, F.Z.; Lahcen, A.A.; Belfkih, S. Big Data Technologies: A Survey. *J. King Saud Univ. Comput. Inf. Sci.* **2017**, in press. [CrossRef]

6. Willard, T. *Social Networking and Governance for Sustainable Development*; International Institute for Sustainable Development: Winnipeg, MB, Canada, 2009; pp. 1–34.

7. Henry, A.D.; Vollan, B. Networks and the challenge of sustainable development. *Annu. Rev. Environ. Resour.* **2014**, *39*, 583–610. [CrossRef]

8. Meadows, D.H.; Meadows, D.L.; Randers, J.; Behrens, W.W. *The Limits to Growth*, 5th ed.; Universe Books: New York, NY, USA, 1972, ISBN 0-87663-165-0.

9. Declaration of the United Conference on the Human Environment. Available online: http://www.un-documents.net/aconf48-14r1.pdf (accessed on 25 September 2017).

10. The Rio Declaration on Environment and Development. Available online: http://www.unesco.org/education/pdf/RIO_W.PDF (accessed on 26 September 2017).

11. Wheeler, S.M.; Beatley, T. *The Sustainable Urban Development Reader*, 3rd ed.; Routledge: New York, NY, USA, 2014; pp. 79–87, ISBN 978-0-415-70775-6.

12. Harris, J.M. Basic principles of sustainable development. In *Dimensions of Sustainable Development*; Seidler, R., Bawa, K.S., Eds.; Eolss Publishers Co. Ltd.: Oxford, UK, 2009; Volume 1, pp. 21–41, ISBN 978-1-84826-207-2.

13. Milano, R.; Baggio, R.; Piattelli, R. The effects of online social media on tourism websites. In Proceedings of the 18th International Conference on Information Technology and Travel & Tourism, Innsbruck, Austria, 26–28 January 2011.

14. Ozkan-Canbolat, E.; Beraha, A. Evolutionary knowledge games in social networks. *J. Bus. Res.* **2016**, *69*, 1807–1811. [CrossRef]

15. Brandão, M.A.; Moro, M.M. Social professional networks: A survey and taxonomy. *Comput. Commun.* **2016**, *100*, 20–31. [CrossRef]

16. File:Social-network.svg. Available online: http://en.wikipedia.org/wiki/Image:Social-network.svg (accessed on 14 September 2017).

17. Yazdanifard, R.; Yee, L.T. Impact of social networking sites on hospitality and tourism industries. *Glob. J. Hum. Soc. Sci. Econ.* **2014**, *14*. Available online: https://globaljournals.org/GJHSS_Volume14/1-Impact-of-Social-Networking.pdf (accessed on 5 November 2017).

18. Sapountzi, A.; Psannis, K.E. Social networking data analysis tools & challenges. *Future Gener. Comput. Syst.* **2016**, in press.

19. Özköse, H.; Arı, E.S.; Gencer, C. Yesterday, today and tomorrow of big data. *Procedia Soc. Behav. Sci.* **2015**, *195*, 1042–1050. [CrossRef]

20. Li, H.; Lu, K.; Meng, S. Big Provision: A Provisioning Framework for Big Data Analytics. *IEEE Netw.* **2015**, *29*, 50–56. [CrossRef]

21. About. Available online: https://about.twitter.com/company (accessed on 17 September 2017).

22. YouTube for Press. Available online: https://www.youtube.com/yt/about/press/ (accessed on 3 September 2017).

23. The Statistics Portal, Most Famous Social Network Sites Worldwide as of August 2017, Ranked by Number of Active Users (in Millions). Available online: https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/ (accessed on 28 September 2017).

24. Diebold, F.X. *"Big Data" Dynamic Factor Models for Macroeconomic Measurement and Forecasting, Advances in Economics and Econometrics, Eighth World Congress of the Econometric Society*; Cambridge University Press: Cambridge, UK, 2003; pp. 115–122, ISBN-10: 052152413X.

25. Alharthi, A.; Krotov, V.; Bowman, M. Addressing barriers to big data. *Bus. Horiz.* **2017**, *60*, 285–292. [CrossRef]

26. Every Day Big Data Statistics—2.5 Quintillion Bytes of Data Created Daily. Available online: http://www.vcloudnews.com/every-day-big-data-statistics-2--5-quintillion-bytes-of-data-created-daily/ (accessed on 5 April 2015).

27. LaValle, S.; Lesser, E.; Shockley, R.; Hopkins, M.S.; Kruschwitz, N. Big data, analytics and the path from insights to value. *MIT Sloan Manag. Rev.* **2011**, *52*, 21.

28. Quick Facts and Stats on Big Data. Available online: http://www.ibmbigdatahub.com/gallery/quick-facts-and-stats-big-data (accessed on 16 September 2017).

29. Big Data Statistics & Facts for 2017. Available online: https://www.waterfordtechnologies.com/big-data-interesting-facts/ (accessed on 16 September 2017).

30. How Big Data Analysis helped increase Walmarts Sales Turnover? Available online: https://www.dezyre.com/article/how-big-data-analysis-helped-increase-walmarts-sales-turnover/109 (accessed on 9 September 2017).

31. The White House. Obama Administration Unveils Big Data Initiative: Announces 200 Million in New R&D Investments. Available online: https://obamawhitehouse.archives.gov/the-press-office/2015/11/19/release-obama-administration-unveils-big-data-initiative-announces-200 (accessed on 18 September 2017).

32. Chen, M.; Mao, S.; Zhang, Y.; Leung, V.C.M. *Big Data: Related Technologies, Challenges and Future Prospects*; Springer: New York, NY, USA, 2014; pp. 2–9, ISBN 978-3-319-06245-7. (online).

33. United Nations Global Pulse. White Paper: Big Data For Development: Opportunities & Challenges. 2012. Available online: https://www.unglobalpulse.org/projects/BigDataforDevelopment (accessed on 2 September 2017).

34. An Enterprise Architect's Guide to Big Data, Oracle. Available online: http://www.oracle.com/technetwork/topics/entarch/articles/oea-big-data-guide-1522052.pdf (accessed on 15 September 2017).

35. Gandomi, A.; Haider, M. Beyond the hype: Big data concepts, methods, and analytics. *Int. J. Inf. Manag.* **2015**, *35*, 137–144. [CrossRef]

36. Apache Hadoop. What Is Apache Hadoop? Available online: http://hadoop.apache.org/ (accessed on 13 September 2017).

37. Cloudera. Available online: https://www.cloudera.com/ (accessed on 14 September 2017).

38. Hortonworks. Available online: https://hortonworks.com/ (accessed on 14 September 2017).

39. Shvachko, K.; Kuang, H.; Radia, S.; Chansler, R. The hadoop distributed file system. In Proceedings of the 2010 IEEE 26th Symposium on Mass Storage Systems and Technologies (MSST), Incline Village, NV, USA, 3–7 May 2010.

40. Dean, J.; Ghemawat, S. MapReduce: A flexible data processing tool. *Commun. ACM* **2010**, *53*, 72–77. [CrossRef]

41. Lakshman, A.; Malik, P. Cassandra: Structured storage system on a p2p network. In Proceedings of the 28th ACM symposium on Principles of distributed computing, Calgary, AB, Canada, 10–12 August 2009.

42. Chang, F.; Dean, J.; Ghemawat, S.; Hsieh, W.C.; Wallach, D.A.; Burrows, M.; Chandra, T.; Fikes, A.; Gruber, R.E. Bigtable: A distributed storage system for structured data. *ACM Trans. Comput. Syst. (TOCS)* **2008**, *26*, 4. [CrossRef]

43. Kulkarni, A.P.; Khandewal, M. Survey on Hadoop and Introduction to YARN. *Int. J. Emerg. Technol. Adv. Eng.* **2014**, *4*, 82–87.

44. Taylor, R.C. An overview of the Hadoop/MapReduce/HBase framework and its current applications in bioinformatics. *BMC Bioinform.* **2010**, *11*, S1. [CrossRef] [PubMed]

45. Saha, B.; Shah, H.; Seth, S.; Vijayaraghavan, G.; Murthy, A.; Curino, C. Apache tez: A unifying framework for modeling and building data processing applications. In Proceedings of the 2015 ACM SIGMOD International Conference on Management of Data, Melbourne, Australia, 31 May–4 June 2015.

46. Johnson, J.E. Big data + big analytics = big opportunity: Big data is dominating the strategy discussion for many financial executives. As these market dynamics continue to evolve, expectations will continue to shift about what should be disclosed, when and to whom. *Financ. Executive* **2012**, *28*, 50–54.

47. Chandola, V.; Banerjee, A.; Kumar, V. Anomaly Detection: A Survey. *ACM Comput. Surv.* **2009**, *41*, 1–72. [CrossRef]

48. Ruggieri, S.; Pedreschi, D.; Turini, F. Data mining for discrimination discovery. *ACM Trans. Knowl. Discov. Data (TKDD)* **2010**, *4*, 9. [CrossRef]

49. Cho, Y.; Hwang, J.; Lee, D. Identification of effective opinion leaders in the diffusion of technological innovation: A social network approach. *Technol. Forecast. Soc. Chang.* **2012**, *79*, 97–106. [CrossRef]

50. Zhou, X.; Chen, L. Event detection over twitter social media streams. *VLDB J.* **2014**, *23*, 381–400. [CrossRef]

51. Rossi, R.A.; Ahmed, N.K. Role discovery in networks. *IEEE Trans. Knowl. Data Eng.* **2015**, *27*, 1112–1131. [CrossRef]

52. Zhang, Q.; Zhang, S.; Dong, J.; Xiong, J.; Cheng, X. Automatic detection of rumor on social network. In *Natural Language Processing and Chinese Computing*; Springer: Cham, Germany, 2015; Volume 9362, pp. 113–122.

53. Gürses, S.; Berendt, B. The social web and privacy: Practices, reciprocity and conflict detection in social networks. In *Privacy-Aware Knowledge Discover: Novel Applications and New Techniques*, 1st ed.; Bonchi, F., Ferrari, E., Eds.; Chapman and Hall/CRC: New York, NY, USA, 2010; pp. 395–432, ISBN 978-1-4398-0366-0.

54. Cataldi, M.; Di Caro, L.; Schifanella, C. Emerging topic detection on twitter based on temporal and social terms evaluation. In Proceedings of the Tenth International Workshop on Multimedia Data Mining, New York, NY, USA, 25 July 2010.

55. Carraher, S.M.; Buchanan, J.K.; Puia, G. Entrepreneurial need for achievement in China, Latvia, and the USA. *Balt. J. Manag.* **2010**, *5*, 378–396. [CrossRef]

56. Berkowitch, A. What does success look like for your company: Social media starting points with measurable returns. *People Strateg.* **2010**, *33*, 10.

57. Ioanid, A.; Scarlat, C. Factors Influencing Social Networks Use for Business: Twitter and YouTube Analysis. *Procedia Eng.* **2017**, *181*, 977–983. [CrossRef]

58. Lee, I. Big data: Dimensions, evolution, impacts, and challenges. *Bus. Horiz.* **2017**, *60*, 293–303. [CrossRef]

59. Nel, F.; Lesot, M.J.; Capet, P.; Delavallade, T. Rumour detection and monitoring in open source intelligence: Understanding publishing behaviours as a prerequisite. In Proceedings of the Terrorism and New Media Conference, Dublin, UK, 8–9 September 2010.

60. Which Social Media Platform(s) Do You Use to Market Your Business? Available online: https://www.statista.com/statistics/259379/social-media-platforms-used-by-marketers-worldwide (accessed on 25 September 2017).

61. Marsh, D.; Stoker, G. *Theory and Methods in Political Science*, 3rd ed.; Palgrave Macmillan: New York, NY, USA, 2010; pp. 1–34, ISBN 978-0-230-57626-1.

62. Margetts, H. The Promises and Threats of Big Data for Public Policy-Making. Available online: http://blogs.oii.ox.ac.uk/policy/promises-threats-big-data-for-public-policy-making/ (accessed on 17 September 2017).

63. Twitter and UN Global Pulse Announce Data Partnership. Available online: http://www.unglobalpulse.org/news/twitter-and-un-global-pulse-announce-data-partnership (accessed on 17 September 2017).

64. Goal 5: Achieve Gender Equality and Empower All Women and Girls. Available online: www.un.org/sustainabledevelopment/gender-equality (accessed on 24 September 2017).

65. United Nations Global Pulse. Feasibility Study: Identifying Trends in Discrimination against Women in the Workplace in Social Media (2014). Available online: https://www.unglobalpulse.org/projects/indonesia-women-employment (accessed on 16 September 2017).

66. United Nations Global Pulse. Using Twitter to Measure Global Engagement on Climate Change. Available online: https://www.unglobalpulse.org/projects/Twitter-Climate-Change (accessed on 24 September 2017).

67. Nwagbara, U. The effects of social media on environmental sustainability activities of oil and gas multinationals in Nigeria. *Thunderbird Int. Bus. Rev.* **2013**, *55*, 689–697. [CrossRef]

68. Goal 3: Ensure Healthy Lives and Promote Well-Being for All at All Ages. Available online: https://www.un.org/sustainabledevelopment/health/ (accessed on 24 September 2017).

69. Our Planet, Our Health. Report of the WHO Comission on Health and Environment. Available online: http://apps.who.int/iris/handle/10665/37933 (accessed on 25 September 2017).

70. WHO. *Basic Documents*, 48th ed.; WHO: Geneva, Switzerland, 2014; Available online: http://apps.who.int/gb/bd/PDF/bd48/basic-documents-48th-edition-en.pdf (accessed on 26 September 2017).

71. Google Predicts Spread of Flu Using Huge Search Data. Available online: https://www.theguardian.com/technology/2008/nov/13/google-internet (accessed on 10 September 2017).

72. Schmidt, C.W. Trending now: Using social media to predict and track disease outbreaks. *Environ. Health Perspect.* **2012**, *120*, a30. [CrossRef] [PubMed]

73. Vincent, N. Social Media and Environmental Health Crises: An Examination of Public Response to Imported Drywall and Perchlorate Health Risks. Presented at American Public Health Association Annual Meeting and Exposition, Washington, DC, USA, 31 October 2011.

74. Achrekar, H.; Gandhe, A.; Lazarus, R.; Yu, S.H.; Liu, B. Predicting flu trends using twitter data. In Proceedings of the 2011 IEEE Conference, Computer Communications Workshops (INFOCOM WKSHPS), Shanghai, China, 10–15 April 2011.