

# Using Social Media Data Analytics to Determine Customers' Attitudes toward Green Initiatives

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**Abstract**—Today, by adopting environmental laws and regulations and expanding public attention to protect the environment, organizations and manufacturers are performing supply chain environmental management to enforce these laws and implement their social responsibility. In addition to meeting regulatory requirements and limitations, green management will create positive public images of manufacturers and companies and increase customer satisfaction. In order to reduce the environmental impact on the production cycle, manufacturers face many challenges that lead them to innovate in solving these challenges. Therefore, organizations' and businesses' awareness of target individuals and communities' knowledge and attitudes towards green initiatives and practices are important to organizations wanting to improve green collaboration with customers and gain social acceptance. Today, social media is an integral part of people's everyday lives and the communication channel for expressing their opinions, attitudes and complaints. Therefore, social networks are often seen as the most important source of information for organizations. Finding information and determining the types of attitudes people express on these social networks could help manufacturers make future decisions. In this study, we will examine the attitudes of Twitter social network users towards the activities and initiatives of Toyota in response to the company's environmental challenges.

**Index Terms**—green supply chain, green initiatives, sentiment analysis, twitter analytics

## I. INTRODUCTION

Evidence shows that the global ecosystem is exposed to an intense challenge to its economic subsystem because of diminished energy resources and dwindling waste disposal capabilities [1]. Although numerous factors—including household use, manufacturing operations, defense factors, and a lack of an appropriate consumption culture in some societies—have caused this challenge, manufacturing operations are the main reason for this damage to the ecosystem. Thus, numerous laws

and regulations have come into force to monitor these manufacturing operations and the resulting products [1]

Due to strict provisions and increased societal and consumer expectations, manufacturers need to consider the environmental issues related to their usual activities and their strategic planning agendas. As a result, the integration of environmental practices with supply chain management has become of great importance for manufacturers hoping to achieve a competitive advantage [2]. The integration of environmental practices into supply chain management activities is known as Green Supply Chain Management (GSCM).

GSCM has emerged as a significant part of business activities to help organizations develop “win-win” strategies that gain profits and achieve market share objectives by decreasing environmental risk and impacts while also enhancing ecological efficiency [3]. This is evaluated based on decreases in air emissions, effluent waste, and solid garbage, as well as the use of toxic materials [4]. Success in considering environmental impacts can create new opportunities for competition and new methods that can add value to core business programs [5]. These environmental activities can also improve customer satisfaction and meet social needs. They encourage stakeholders to champion environmental protection, to create a better image for suppliers and producers, and to provide a sense of improved quality of life for customers, thus resulting in a better reputation.

According to the literature, one of the significant GSCM practices is environmental collaboration with customers. This kind of collaboration requires companies to work with customers to design cleaner production processes that produce eco-friendly products with green packaging (Abdel-Baset et al., 2019). Thus, due to increasing customer demand for green products and the effect of customers' views on producers' environmental programs, analyzing customers' attitudes towards products and surveying and evaluating customers' views of the environmental activities of factories are very important to manufacturers. It makes them more proactive in implementing GSCM practices and encourages them to continue to maintain good

relationships with their customers. Since most consumers do not post comments on CRMs for reasons such as a lack of time or negligence, and because most complaints and criticisms of products or after-sales services are posted on these portals, investigations regarding the environmental activities of these CRMs are very limited. However, today's social networks are an integral part of people's lives through which customers express their views and opinions. Social media data are relatively inexpensive and can be very useful in collecting the views of vast and various audiences [6].

In this study, we extracted and analyzed the views of consumers and social networking users of Twitter on the environmental practices of Toyota as an example of a large manufacturer that set several extensive environmental protection goals. Toyota adopted its green principles in 1992 to provide clean and safe products and enhance the quality of life of everyone through their environmental practices. Since 1992, Toyota has implemented green production practices, environmental action plans, hybrid vehicles, environmental campaigns, and other effective activities [7].

## II. LITERATURE REVIEW

Twitter is rapidly growing as the most favorite social network services. Latter statistics indicate that more than 550 million users produce more than 300 million tweets per day. This leads to massive amount of data that can be made readily accessible. (Karidi, 2018). Largely because of their ready availability, academic community has more attention to twitter analysis and twitter become as a valuable data source for assessment popular opinions and tendencies.. (Lansley & Longley, 2016) To do so, researches have offered the extraction of related aspects from the textual content [8].

Zho et al. (2013) conducted a pioneer empirical study of emotion analysis on Twitter data to discover consumers' view toward mobile phones. They categorized different features and determined the positive and negative opinions about each feature by performing steps of preparing and analyzing data on mobile phones produced by eight different brands. To validate the research results, three experts in the mobile phone industry confirmed the majority of the results [9] examined the relationship between corporate social responsibility and their use and penetration in social networks. To do so, they collected information from about 500 companies on Twitter and tested that information in terms of the acceptance speed, number of their followers and the speed at which their number increased for each company. The results showed that organizations with higher social responsibility rates began to operate faster than other organizations in social networks, had higher numbers of followers, and higher influence growth rate. Finally, they argued that the firms' positive social orientation creates a strategic fit with the inherent nature of social media, and the firm can turn this ethical capital into a basis for its economic value by consolidating social support.

He proposed an analytical approach based on big data that analyzes the Twitter data to identify problems of supply chain management in the food industry. Content analysis based on the exploration of emotions and trends, SVM (Support Vector Machine), and HCA (Hierarchical Cluster Analysis) was proposed to investigate positive and negative consumer attitudes toward food products. Reviewing and categorizing the tweets determined consumers' taste about different meat products and the causes of demand shortages, thereby identifying the increase in waste of some products based on which, suggestions were made to address this issue.

Zhong et al. (2019) examined consumer's purchasing behavior in different cultural environments by extracting consumer opinion from different countries. This research helps international producers identify consumer attitudes with different cultural backgrounds about products and apply that insight to product innovation and technology advancement [9].

The review of studies indicates that despite the variety of text mining research on Twitter data, there has been little research on the social network users' attitude towards the green supply chain and environmental issues [10]. To address this issue, this study investigates Twitter users' attitudes about the green activities of a car company. Since in the automotive industry, carbon and pollutants' emission will cause environmental damage in the course of production as well as during the products' life cycle, the implementation of green supply chain management is a vital issue. Therefore, this study attempts to evaluate the type of attitude and attention of Twitter users towards the green activities of Toyota Automotive Company as one of the pioneers of the automotive industry in the environmental issues [11].

## III. RESEARCH METHOD

In this research, it was necessary to look at all tweets recorded since 2015 (the Toyota Environmental Plan Implementation Period) for a case study by Toyota Automotive Company; however, Twitter's official API prevents access to tweets older than a week. While other tools provide access to older tweets, most do so for a cost. Jefferson Henrique has analyzed how Twitter searching works within a browser and established an understanding of its flow [12]. Essentially, when a user accesses a Twitter page, a scroll loader starts. By scrolling down, the user is able to see more and more tweets through calls to a JSON provider [13]. By mimicking this, we can take advantage of the functionality of a Twitter search within a browser and gain access to the older historical tweets. We used Jefferson's solution to collect old tweets using Python programs [14].

## IV. RESULT

The results of the analysis showed a dominant positive attitude in all environmental areas (Toyota challenges). However, interestingly, the overall recorded tweet is not

significant in challenges such as carbon reduction in production and product life cycles and water usage, and few comments are recorded on these sections [15]. A significant portion of the comments—including news tweets—were neutral. This confirms previous

conclusions that users in these sections had fewer positive and negative comments due to a lack of awareness, expertise, or understanding. The number and ratio of positive, negative, and neutral tweets in terms of Toyota Green Challenges are shown in Table I and Fig. 1.

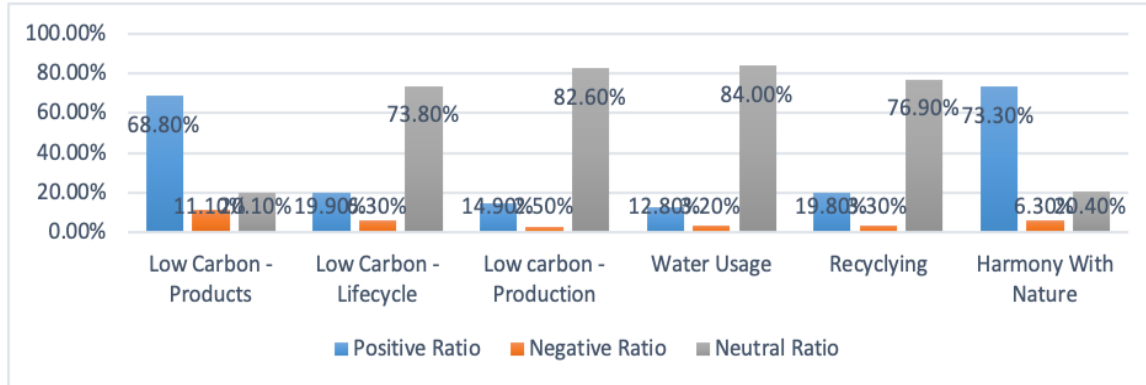


Figure 1. Sentiment analysis results for each challenge

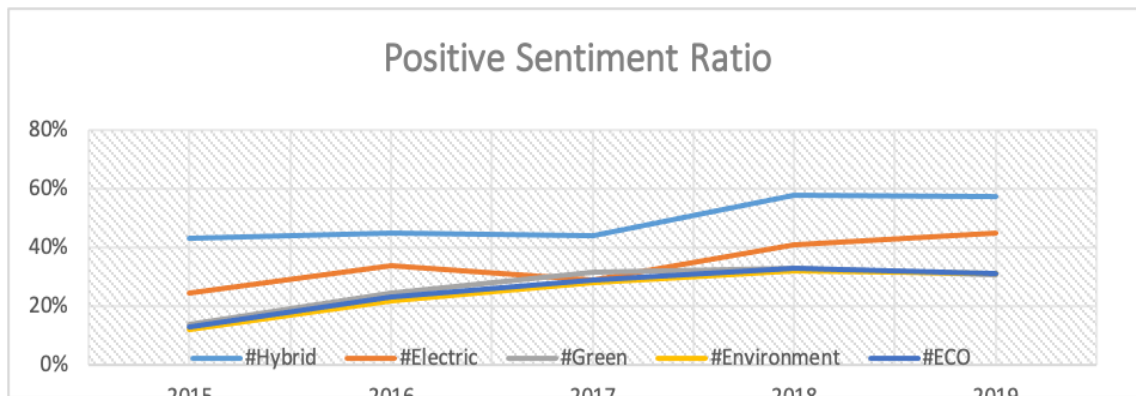


Figure 2. Positive sentiment ratio between 2015 and 2019

Because overall sentiment estimation was positive for all challenges, changes in this positive attitude were considered over the lifespan of the environmental program. The change in the trend of positive sentiments from 2015-2019 is illustrated in Fig. 2 based on frequent hashtags and on environmental challenges, respectively.

TABLE I. TWITTER DATA FROM 2015 TO 2019

Green Challenge	No. of Tweets	Positive Sentiment	Neutral Sentiment	Negative Sentiment	Overall sentiment
Low Carbon - Products	46214	31795(68.8%)	9289(20.1%)	5130(11.1%)	Positive
Low Carbon-Lifecycle	700	139(19.9%)	517(73.8%)	44(6.3%)	Positive
Low Carbon-Production	1424	212(14.9%)	1176(82.6%)	36(2.5%)	Positive
Water Usage	1084	139(12.8%)	911(84%)	34(3.2%)	Positive
Recycling	1004	199(19.8%)	772(76.9%)	33(3.3%)	Positive
Harmony with Nature	5258	3854(73.3%)	1073(20.4%)	331(6.3%)	Positive

## V. CONCLUSION

The attitudes and feelings of users of the Twitter social network were examined in relation to the environmental activities of Toyota—one of the largest automotive companies in the world. To examine Toyota's green activities, the challenges posed by Toyota itself in its long-term environmental plan were taken into consideration; the number of related tweets was recorded, and users' sentiments about each of Toyota's challenges were estimated. The results showed that Twitter users paid the most attention to Toyota's environmental products. Also, they had much less commentary on other Toyota environmental challenges related to manufacturing and recycling processes. This was justifiable, given the specialty of these areas. The results also showed a positive overall attitude towards all of the mentioned areas, with a more dominant positive attitude in the field of products—likely due to the direct relationship of users with this issue. There was also a positive attitude toward the challenge of adaptation to nature, as expected. However, in other areas, most tweets expressed a neutral tone, resulting in lower positive sentiment. User sentiment trends were examined from

2015 to 2019 (i.e., since the initiation of Toyota's long-term environmental program) and showed that people's familiarity increased in relatively more specialized areas in 2016 to 2018, which is not significant. In the final phase of this study, environmental attention to Toyota's activities was examined and compared in England, Japan, India, and the United States. The results showed that in Japan—given its good performance in terms of green activities and given that Toyota is a Japanese company—the attention is focused on green activities. India, which has not yet made significant progress in environmental considerations, pays the least attention to green activities.

#### CONFLICT OF INTEREST

The Authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

#### AUTHOR CONTRIBUTIONS

Conducted the research: Sajjad Shokouhyar; analyzed the data: Hamed Ghanadpour, Sajjad Shokouhyar, Omid Roosta; wrote the paper: Hamed Ghanadpour, Sina Shokouhyar, Omid Roosta; all authors had approved the final version.

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